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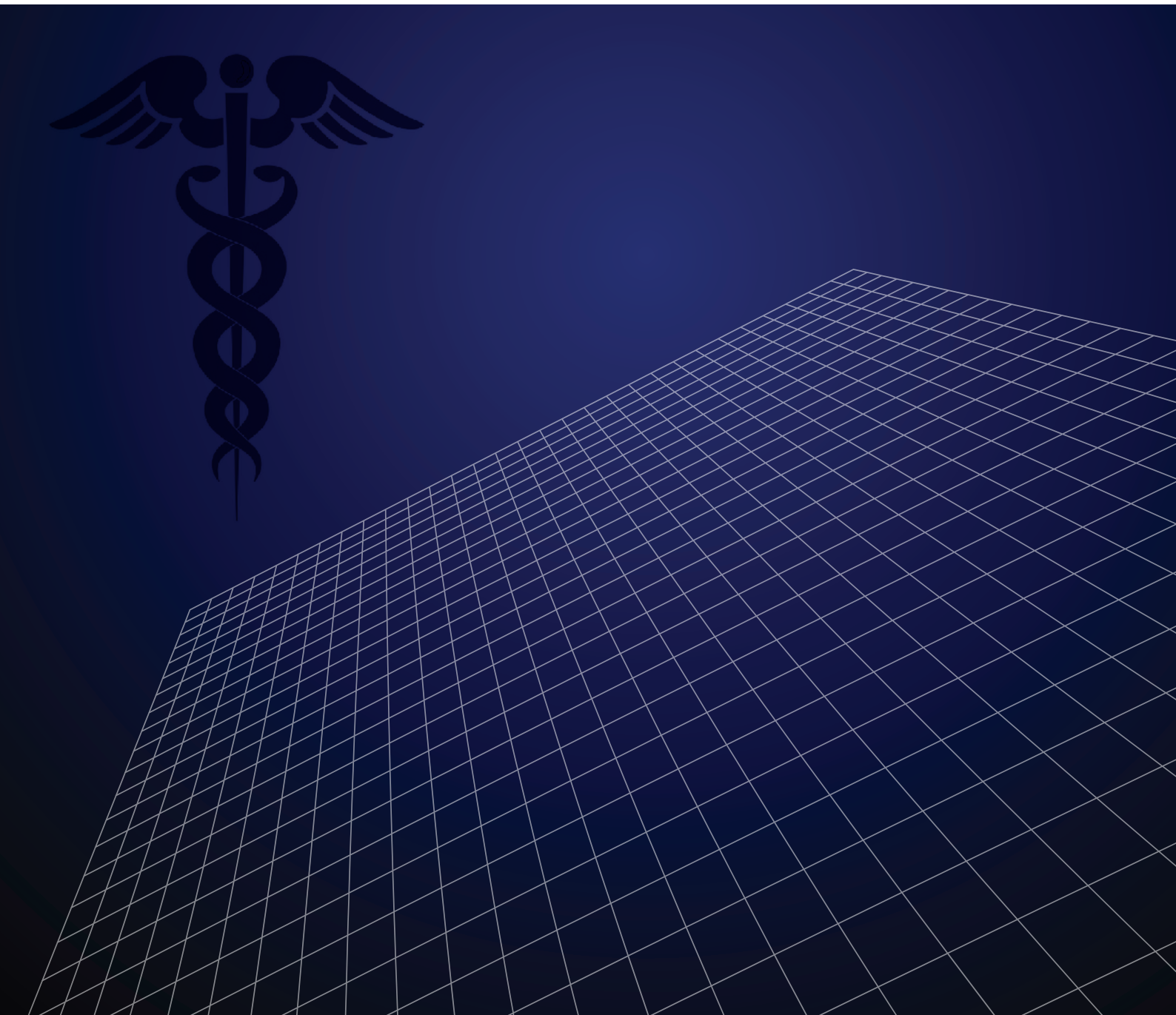

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Research Article

Distribution of hepatitis C virus genotypes in Ordu province

Ordu ilinde hepatit C virüsü genotiplerinin dağılımı

Hacer Ozlem Kalayci[1]*, Mustafa Kerem Calgin[1], Huseyin Erdal[2], Ahmet Burak Gurpinar[3]

[1]Department of Medical Microbiology, Ordu University, Faculty of Medicine, Ordu, Turkey
[2]Department of Medical Genetics, Aksaray University, Faculty of Medicine, Aksaray, Turkey
[3]Department of Medical Biochemistry, Tokat Gaziosmanpaşa University, Faculty of Medicine, Tokat, Turkey.

Abstract

Aim: Hepatitis C virus (HCV) infection is a major health problem worldwide and leads to chronic liver disease, cirrhosis, and hepatocellular carcinoma. Genotype 1, the most common genotype worldwide, usually requires longer and more complex treatment regimens compared to other genotypes. HCV infection is closely associated with changes in liver enzyme levels, especially alanine aminotransferase (ALT). This study aims to determine the distribution of HCV genotypes in chronic HCV patients and to investigate the relationship between HCV genotype and serum ALT levels.

Material and Methods: In this retrospective study, the outcomes of patients diagnosed with chronic liver disease due to HCV at Ordu University Medical Faculty, Education and Research Hospital between May 2021 and October 2023 were analyzed. HCV genotyping was performed using the Bosphore HCV Genotyping Kit v5 (Anatolia Geneworks, Türkiye) according to the manufacturer's instructions. Serum ALT levels were measured using the electrochemiluminescence immunoassay method (Cobas e 601, Roche, Germany).

Results: A total of 219 HCV-RNA positive patients were included in the study. Of all patients, 125 (57.1%) were female and 94 (42.9%) were male. When genotype distribution was examined, it was seen that 200 patients (91.3%) had genotype 1b, 9 patients (4.1%) had genotype 1a, 7 patients (3.2%) had genotype 3, 2 patients (0.9%) had genotype 1, and 1 patient (0.5%) had genotype 4. A total of 9 patients had serum ALT levels above 40 IU/L.

Conclusion: Genotype 1b remains the most frequently detected genotype among our patients, while the prevalence of Genotype 3 has changed over the years. No significant differences were found in serum ALT levels, mean age, and gender distribution between patients infected with Genotype 1 and other genotypes.

Keywords: Hepatitis C Virus, HCV genotype, HCV-RNA, ALT

Corresponding Author*: Hacer Ozlem Kalayci, Deparment of Medical Microbiology, Faculty of Medicine, Ordu University, Ordu, Turkey.
E-mail: kalayciozlem55@gmail.com
Orcid: 0000-0003-2358-6764
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Öz

Amaç: Hepatit C virüsü (HCV) enfeksiyonu dünya çapında büyük bir sağlık sorunudur ve kronik karaciğer hastalığı, siroz ve hepatoselüler karsinomaya yol açar. Dünya çapında en yaygın genotip olan genotip 1, genellikle diğer genotiplere kıyasla daha uzun ve daha karmaşık tedavi rejimleri gerektirir. HCV enfeksiyonu, özellikle alanin aminotransferaz (ALT) olmak üzere karaciğer enzim seviyelerindeki değişikliklerle yakından ilişkilidir. Bu çalışma, kronik HCV hastalarında HCV genotiplerinin dağılımını belirlemeyi ve HCV genotipi ile serum ALT seviyeleri arasındaki ilişkiyi araştırmayı amaçlamaktadır.

Gereç ve Yöntemler: Bu retrospektif çalışmada, Ordu Üniversitesi Tıp Fakültesi Eğitim ve Araştırma Hastanesinde Mayıs 2021 ile Ekim 2023 tarihleri arasında HCV'ye bağlı kronik karaciğer hastalığı tanısı konulan hastaların sonuçları analiz edildi. HCV genotipleme, üreticinin talimatları doğrultusunda Bosphore HCV Genotyping Kit v5 (Anatolia Geneworks, Türkiye) kullanılarak gerçekleştirildi. Serum ALT düzeyleri elektrokemilüminesans immünoassay yöntemi (Cobas e 601, Roche, Almanya) kullanılarak ölçüldü.

Bulgular: Çalışmaya toplam 219 HCV-RNA pozitif hasta dahil edildi. Tüm hastaların 125'i (%57,1) kadın, 94'ü (%42,9) erkekti. Genotip dağılımına bakıldığında 200 hastanın (%91,3) genotip 1b, 9 hastanın (%4,1) genotip 1a, 7 hastanın (%3,2) genotip 3, 2 hastanın (%0,9) genotip 1 ve 1 hastanın (%0,5) genotip 4 olduğu görüldü. Toplam 9 hastanın serum ALT seviyesi 40 IU/L'nin üzerindeydi.

Sonuç: Genotip 1b hastalarımız arasında en sık tespit edilen genotip olmaya devam etmekte olup, Genotip 3'ün yaygınlığı yıllar içinde değişmiştir. Genotip 1 ile enfekte olan hastalar ile diğer genotipler arasında serum ALT düzeyleri, ortalama yaş ve cinsiyet dağılımı açısından anlamlı bir fark bulunmamıştır.

Anahtar Kelimeler: Hepatit C Virüsü, HCV genotip, HCV-RNA, ALT

Introduction

Hepatitis C virus (HCV) infection is a major health concern worlwide, affecting an estimated 58 million people worldwide and leading to chronic liver disease, cirrhosis, and hepatocellular carcinoma [1]. First identified in 1989, HCV is an enveloped, single-stranded RNA virus belonging to the Flaviviridae family. The virus primarily targets hepatocytes, leading to inflammation, fibrosis, and, in severe cases, cirrhosis and hepatocellular carcinoma (HCC). Globally, it is estimated that approximately 60 million people live with chronic HCV infection, with around 1.5 million new infections occurring annually. A defining feature of HCV is its genetic diversity. Understanding the genetic diversity of HCV is crucial for effective diagnosis, treatment, and epidemiological surveillance [2]. The virus is classified into seven major genotypes (1-7), with multiple subtypes within each genotype [3]. This genetic variation has important implications for the clinical management of HCV, as different genotypes exhibit varying responses to antiviral therapies. Genotype 1, the most prevalent genotype globally, often requires longer and more complex treatment regimens compared to other genotypes. The identification of HCV genotype in infected individuals is therefore critical for guiding appropriate treatment strategies [4]. HCV is a complex and evolving global health issue. Understanding its virology, epidemiology, and clinical management is essential for developing effective strategies to reduce the burden of disease and achieve the goal of HCV elimination.

HCV infection is closely associated with alterations in liver enzyme levels, particularly alanine aminotransferase (ALT) [5]. ALT is an enzyme found predominantly in the liver, and its levels in the bloodstream are commonly used as a biomarker for liver health [6]. When liver cells are damaged or inflamed, as occurs during HCV infection, ALT is released into the bloodstream, leading to elevated serum ALT levels [7]. Elevated serum ALT levels are frequently observed in HCV-infected individuals, indicating hepatocellular damage. The relationship between HCV genotype and ALT levels can provide insights into the pathogenicity and clinical progression of the infection [8]. Certain genotypes may be associated with more severe liver damage and higher ALT levels, reflecting a more aggressive disease course.

This study aims to determine the distribution of HCV genotypes in a specific population and to investigate the relationship between HCV genotype and serum ALT levels. By elucidating these associations, we can enhance our understanding of HCV pathogenesis and improve the management strategies for patients with chronic HCV infection.

Material and Methods

In this retrospective study, the results of blood samples sent for HCV genotyping from HCV-RNA positive patients diagnosed with chronic liver disease due to HCV, between May 2021 and October 2023, at the Molecular Microbiology Laboratory of Ordu University Faculty of Medicine Education and Research Hospital were analyzed. Demographic data of the patients, such as age and

gender, along with alanine transaminase (ALT) levels, and HCV genotypes, were recorded from the hospital information system.

HCV-RNA levels were measured using real-time PCR (Cobas TaqMan HCV, Roche Diagnostics, Germany) for viral load determination. The dynamic range of the test was 15 IU/ml, with a linear range of 15-1x10^8 IU/ml. HCV genotyping was performed using the Bosphore HCV Genotyping Kit v5 (Anatolia Geneworks, Türkiye) following the manufacturer's instructions. This kit is capable of detecting genotypes 1, 1a, 1b, 2, 3, 4, 5, and 6 individually and targets the NS5B region of the HCV genome with specific primers. Serum ALT and Anti-HCV levels were measured using the electrochemiluminescence immunoassay (ECLIA) method (Cobas e 601, Roche Diagnostics, Mannheim, Germany). Samples with Anti-HCV levels ≥ 1 (S/CO) were considered reactive. The normal reference range for ALT was defined as 10-40 IU/L.

Statistical Analysis

Statistical analyses were performed using the MedCalc (version 20.009; Ostend, Belgium) statistical package program. In the statistical description of the data, numerical data were expressed as number (n), percentage, arithmetic mean (mean) and standard deviation (SD).

Results

A total of 219 HCV-RNA positive patients were included in the present study. ALT values were available for 84 of these patients. Among all patients, 125 (57.1%) were female and 94 (42.9%) were male. The mean age of the patients was 64 years (age range 20-90), and 193 patients (88.1%) were over the age of 50. Genotype distribution revealed that 200 patients (91.3%) had genotype 1b, 9 patients (4.1%) had genotype 1a, 7 patients (3.2%) had genotype 3, 2 patients (0.9%) had genotype 1c-k, and 1 patient (0.5%) had genotype 4. Both of the two foreign patients were found to have genotype 1b. Among genotype 1b patients, 59.5% were female; in genotype 1a, 66.7% were male; in genotype 3, 71.4% were male; in genotype 1c-k, 50% were male; and in genotype 4, all patients were male (Table 1).

The mean ALT level was 26.5 IU/L in female patients and 29.6 IU/L in male patients. A total of 9 patients had serum ALT levels above 40 IU/L. The mean age of patients with genotype 1b was 65.6 ± 11.4 years, genotype 1a patients 48.2 ± 19.2 years, genotype 3 patients 46.3 ± 13.3 years, genotype 1c-k patients 56.5 ± 31.8 years, and the genotype 4 patient 54 years.

Table 1. Age and gender distribution according to genotypes.

Genotype	n	%	Age		Gender			
			Mean	SD	Male		Female	
						%	n	%
HCV Genotype 1a	9	4.1%	48.2	19.2	6	66.7%	3	33.3%
HCV Genotype 1b	200	91.3%	65.6	11.4	81	40.5%	119	59.5%
HCV Genotype 1c-k	2	0.9%	56.5	31.8	1	50.0%	1	50.0%
HCV Genotype 3	7	3.2%	46.3	13.3	5	71.4%	2	28.6%
HCV Genotype 4	1	0.5%	54,.0		1	100.0%	0	0.0%

The average age of patients with genotype 1 was higher compared to other genotypes. The mean ALT level was 27.8 IU/L in genotype 1b patients, 31 IU/L in genotype 1a patients, and 32.2 IU/L in genotype 3 patients (Table 2).

Table 2. Evaluation of ALT levels according to genotypes.

Genotype	n	%	ALT	
			Mean	SD
HCV Genotype 1a	4	4.8%	31.0	21.0
HCV Genotype 1b	73	86.9%	27.8	27.6
HCV Genotype 1c-k	1	1.2%	11.0	
HCV Genotype 3	5	6.0%	32.2	27.0
HCV Genotype 4	1	1.2%	34.0	

Discussion

Hepatitis C virus (HCV) remains a global public health issue due to its high chronicity rate, potential to lead to cirrhosis and hepatocellular carcinoma, and the absence of an effective vaccine. HCV genotypes are distinguished by variations in nucleotide and amino acid sequences in different regions of the virus genome resulting from mutations [9]. The distribution of HCV genotypes and subtypes varies by geographic region [10]. Determining the HCV genotype is essential for guiding the selection of treatment, determining the duration of therapy, and monitoring treatment response in patients with chronic hepatitis C. Cases infected with HCV genotypes 1 and 4 respond less favorably to interferon therapy and require longer treatment durations compared to those infected with genotypes 2 and 3. Additionally, the risk of developing hepatocellular carcinoma is reported to be higher in genotype 1b cases. Therefore, identifying HCV genotypes not only informs treatment but also provides prognostic insights [11]. Given that epidemiological data are influenced by human activities such as war, migration, and tourism, regularly updating regional data is crucial. This study aims to determine the distribution of HCV genotypes, which are pivotal in shaping treatment and prognosis, and to

evaluate changes in genotype distribution over the past three years, contributing to the epidemiological data of our region.

As seen globally and in our country, the most common genotype in our hospital in Ordu province is type 1b (91.3%). Genotype 1a ranks second (4.1%), followed by genotype 3 (3.2%). Genotype 4 was detected in only one patient. One of the main findings of our study is the lack of significant correlation between genotype variation and serum ALT levels in chronic HCV patients. However, larger-scale studies are required for more conclusive results. Similar to global genotype distribution, genotype 1 is also the most prevalent in our country [12]. Genotypes 2, 3, and 4 are reported less frequently in Türkiye, although their frequency may vary by region. For instance, in a study conducted in Nevşehir, the most common genotype was genotype 1 (45.1%), followed by genotype 2 (14.5%) [13]. In studies by Bulut and Sayar, genotype 1b was also found to be the most common type, consistent with the findings of our study [14,15]. In a study involving 119 patients in Adana, 71.4% were infected with genotype 1 (12.6% genotype 1a, 58.8% genotype 1b), 16.8% with genotype 3, 7.6% with genotype 2, and 3.4% with genotype 4 [16]. Similarly, a study from Gaziantep involving 160 patients reported that 98% of patients had genotype 1b, with only one patient having genotype 2 and two having genotype 3 [17]. In a study from Konya involving 480 patients, 396 (82.6%) had genotype 1b, 17 (3.5%) had genotype 1a, and 15 (3.1%) had genotype 3a [18]. In Giresun, the most frequently detected genotypes were 1b, followed by 1a, 3, and 2, with no detections of genotypes 4, 5, or 6 [19]. Consistent with these findings, genotype 1b was the most frequently identified genotype in 91.3% of our study group.

The frequency of genotype 3 in Türkiye has been reported to range between 6.7% and 14%, often ranking as the second most common genotype [20–24]. Due to its prevalence in neighboring countries (especially Syria), its resistance, and its longer treatment duration, monitoring genotype 4 is important [14]. Recent studies in Türkiye indicate that genotype 4 is more commonly observed in regions with high populations of Middle Eastern immigrants, particularly due to migration [25–27]. In our study, the frequencies of genotypes 3 and 4 were 3.2% and 0.5%, respectively. In a study from our region conducted in 2019, the frequencies of genotype 3 and genotype 4 were 2.5% and 0.5%, respectively [28].

Several studies have also shown that HCV genotype ratios differ by gender. In one study, genotypes 1a and 1b were found to be more common in female patients, while another study reported that genotype 1b was more prevalent in females, with genotypes 1a and 3 more common in males [29–31]. However, Arici et al. found no significant difference in genotype distribution between genders [21]. Bulut and Sayar also observed a similar distribution of genotypes between men and women [15]. In our study, genotypes 1a, 3, and 4 were more common in male patients, while genotype 1b was more frequently observed in female patients. In a study involving 160 patients, Harman and colleagues reported a mean age of 56 years, with 25% of patients in the 18-50 age group and 75% over 50 years of age [17]. In Izmir, the mean age of patients infected with genotype 1b was higher than those infected with genotypes 1a, 3, and 4 [32]. Similarly, in Giresun, the mean age of genotype 1b patients was significantly higher than those with genotypes 1a and 3 [19]. In our study, the mean age was 64, and 85.8% of patients were over the age of 50. Consistent with the literature, the mean age of patients infected with genotype 1b was higher than that of patients with genotypes 1a and 3. Borcak et al. found ALT levels to be between 13-352 UI/ml in patients with Genotype 1 and 4, and 18-218 IU/ml in patients with Genotype 2 and 3 [13]. Çizmeci also found serum ALT levels to be 68.02±43.6 IU/L in genotype 1b patients and 49.5±39.51 IU/L in genotype 1a patients [29]. This study found no significant association between different genotypes and ALT levels, which is consistent with previous findings [13,21,29]. However, Kirişçi et al. found that ALT values ranged between 10-215 UI/ml in Genotype 1 patients and 11-1085 IU/ml in genotype 3 patients. Kirişçi and colleagues reported a statistically significant relationship between genotypes and serum ALT levels in their study [33]. In their study, Tezcan et al. determined the median value of ALT levels in patients identified as Genotype 1b as 46.14 IU/L in women and 63.9 IU/L in men, and found the difference to be statistically significant [31]. Studies suggest that serum ALT levels are a significant indicator of liver fibrosis and can guide treatment decisions in patients with chronic hepatitis C [34].

In conclusion, based on initial data from our hospital, genotype 1b remains the most frequently detected genotype among our patients, maintaining its leading position. According to the study conducted by Çalgın and Çetinkol in Ordu province, the prevalence of Genotype 3 has changed over the years [28]. No significant difference was found between patients infected with genotype 1 and other genotypes regarding serum ALT levels, average age, and gender distribution.

Ethical Approval

This study is approved by Ordu University Institution's Clinical Research Ethics Committee (270/10.11.2023).

Conflict of Interest

The authors have no conflict of interest to declare.

Financial Disclosure

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Araştırma Makalesi

Önlenebilir bir yaralanma nedeni: bisiklet kazaları ile çocuk acile getirilen olguların değerlendirilmesi

A preventable cause of injury: evaluation of cases brought to the pediatric emergency department due to bicycle accidents

Gamze Gökulu[1]*, Hayri Levent Yılmaz[2], Sevcan Bilen[2], Pınar Çay[3], Yaşar Sertdemir[4], Ceren Efe Saygın[5]

[1]Mersin Şehir Eğitim ve Araştırma Hastanesi, Çocuk Sağlığı ve Hastalıkları Anabilim Dalı, Çocuk Acil Servisi, Mersin, Türkiye

[2]Çukurova Üniversitesi Tıp Fakültesi, Çocuk Sağlığı ve Hastalıkları Anabilim Dalı, Çocuk Acil Bilim Dalı, Adana, Türkiye

[3]Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Çocuk Sağlığı ve Hastalıkları Anabilim Dalı, Çocuk Acil Servisi, Muğla, Türkiye

[4]Çukurova Üniversitesi Tıp Fakültesi, Bioistatistik Anabilim Dalı, Adana, Türkiye

[5]Sütçü İmam Üniversitesi Tıp Fakültesi, Bioistatistik ve tıbbi Bilişim Anabilim Dalı, Kahramanmaraş, Türkiye

Öz

Amaç: Dünya genelinde, bisiklet kazaları önlenebilir çocuk yaralanmalarında önemli bir yer tutmaktadır. Çocuklarda yaralanmalara neden olan risk faktörlerinin bilinmesi etkin önlemlerin alınması için gereklidir.

Gereç ve Yöntemler: Ocak-Aralık 2018 tarihleri arasında bisiklet kazası nedeni ile Çukurova Üniversitesi Tıp Fakültesi Hastanesi, çocuk acil servisine getirilen 2-18 yaş arasındaki bisiklet sürücüleri geriye dönük olarak değerlendirildi. Tıbbi kayıtlar incelenerek demografik veriler, yaralanma durumları, aldıkları tanılar ve uygulanan tedaviler araştırıldı. Motorlu taşıt karışan ve karışmayan olgular karşılaştırıldı.

Bulgular: Bisiklet kazası nedeniyle getirilen 158 hastanın yer alan hastaların yaş ortancası 9 (Aralık 2-17) yıl idi. Hastaların %68,4'si erkek ve %31,6'sı kadındı. Başvuru nedenlerinin en sık olanları sırası ile üst ekstremite ağrısı/yaralanması (%32,3), alt ekstremitede ağrı/yaralanma (%29,1) ve yüz bölgesinde ağrı/ yaralanma (%27,8) idi. Bisiklet kazalarından 17 (%10,8) tanesine motorlu bir taşıt karışmıştı. Motorlu taşıtın karışmış olduğu bisiklet kazaları ayrı bir grup olarak değerlendirildi ve bu kazalarda hem maksillofasiyal kırık hem de baş-boyun yaralanması tanısı alan hastaların daha yüksek sıklıkta olduğu görüldü. Bu olgulardaki cerrahi bölümlerden konsültasyon istenme oranları ve cerrahi müdahale gereksinimleri motorlu taşıtın karışmadığı bisiklet kazalarına göre anlamlı olarak yüksek bulundu ($p < 0,05$). Hastaların hiçbirinde kask kullanımı mevcut değildi. Ölen hasta yoktu. Çocuk yoğun bakım ihtiyacı olan 3 hastanın kafa travması mevcuttu.

Sonuç: Bisiklet kazalarında hayatı tehdit eden en büyük sorun kafa travmalarıdır. Çalışmamızın sonuçları önceki çalışmalar ile uyumludur. Kask, uyarı işaretleri ve diğer güvenlik araçlarının bilinçli kullanımı ile bisiklet kazalarının vereceği zarar azaltılabilir. Acillerdeki sağlık personeli bu önemli hasta grubunda karşılaşılacak sorunlar ile ilgili bilgi sahibi olmalıdır.

Anahtar Kelimeler: bisiklet kazası, kafa travması, çocuk acil

Sorumlu Yazar*: Gamze Gökulu, Mersin Şehir Eğitim ve Araştırma Hastanesi, Çocuk Sağlığı ve Hastalıkları Anabilim Dalı, Çocuk Acil Servisi, Mersin, Türkiye.
E-posta: drgamzegokulu@gmail.com
Orcid: 0000-0001-8380-4140
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Abstract

Aim: Bicycle accidents are a prominent contributor to avoidable kid injuries on a global scale. Understanding the risk variables that contribute to childhood injuries is essential for implementing effective preventive measures.

Material and Methods: A retrospective evaluation was conducted on bicycle riders aged 2-18 years who were referred to the pediatric emergency department owing to cycling incidents occurring between January and December 2018. Analyzed medical information to explore demographic data, injury status, diagnosis, and treatments. A comparison was made between cases involving motor vehicles and not involving motor vehicles

Results: The median age of 158 patients admitted for bicycle accidents was 9 years, with an age range of 2 to 17 years. The male patients accounted for 68.4% of the total, while the female patients accounted for 31.6%. The primary causes for presentation were upper limb pain/injury (32.3%), lower limb pain/injury (29.1%), and facial pain/injury (27.8%). A motorized vehicle was a factor in 17 (10.8%) of the bicycle accidents. Motor vehicle-related bicycle accidents were analyzed as a distinct category, revealing a higher incidence of mandibular fractures and head and neck injuries. The incidence of seeking medical advice from surgical departments and the necessity for surgical intervention were notably greater in these instances as compared to bicycle accidents that did not include any motor vehicle ($p<0.05$). None of the patients were wearing helmets. There were no fatalities among the patients. Three patients requiring pediatric intensive care exhibited head trauma.

Conclusion: The biggest life-threatening problem in cycling accidents is head trauma. The results of our study are consistent with previous studies. The damage caused by bicycle accidents can be reduced with the conscious use of helmets, warning signs and other safety devices. Health personnel in emergency departments should be informed about the problems to be encountered in this important patient group.

Keywords: bicycle accident, head injury, pediatric emergency

Giriş

Bisiklet kullanımı günümüzde kullanımı giderek artan çevre dostu bir ulaşım şekli aynı zamanda oldukça faydalı bir fiziksel etkinliktir [1,2]. Ancak kullanımı sırasında yeterli önlemlerin alınmaması nedeniyle dünya genelinde çocuk yaralanmalarının önemli nedenlerinden biridir [3]. Bisiklet kazaları dünya genelinde önemli bir sağlık sorunudur. Kanada gibi kullanımının yaygın olduğu bir ülkede, bisiklet kazaları 0–14 yaş arası çocukların kasıtsız yaralanma nedeniyle hastane yatışlarının ilk 3 nedeni arasında yer almaktadır [3]. Amerika Birleşik Devletleri'nde (ABD) acil servis başvurularına bakıldığında çocuklardaki en yaygın yaralanma nedeni olan spor futboldur. Bisiklet kullanımı ise ikinci sırada yer almaktadır [4]. Bu sorunun ülkemizde sıklığı net olarak bilinmemekle birlikte, özellikle çocuklarda bununla ilgili çok az çalışma yapılmıştır. Çalışmamızda, bir yıllık çocuk acil başvuruları incelenmiş ve 3168 adli olgunun 158'inin (%4,9) bisiklet kazası nedeniyle gerçekleştiği görülmüştür.

Bisiklet kazaları hayati tehdit taşımayan hafif yaralanmalardan, kalıcı hasar hatta ölüme neden olabilen ciddi travmalara kadar farklı tablolara neden olabilir. Kazaya motorlu bir aracın karışıp karışmaması, oluş mekanizması ve kazanın yeri yaralanmanın ciddiyetini belirleyen faktörlerdendir. Bisikletler için ayrılmış yolların, uyarı işaretlerin ve özellikle kask gibi güvenlik araçlarının bilinçli kullanımına göre kazaların vereceği zarar azaltılabilir [5-8]. Gelişmekte olan ülkelerde bisiklet kazaları sonucundaki ciddi yaralanma sıklıklarının daha yüksek oranda olduğu gösterilmiştir. Bu durumun farklı nedenleri mevcuttur. Kullanılan güvenli alanların ve bisiklet yollarının kısıtlı olması, kişisel koruyucu önlemlerin (kask, dizlik veya dirseklik kullanımı gibi) önemsenmemesi ve trafik kurallarına yeterince özen gösterilmemesi gibi durumlar hayatı tehdit eden yaralanmalara sebep olmaktadır [9-12]. Bugüne kadar farklı ülkelerde bisiklet kazası ile ilgili birçok farklı çalışma yapılmıştır [13]. Bizim ülkemizde ise bisiklet kazaları ile ilgili yeterli çalışma bulunmamaktadır. Oysaki her geçen gün birçok ilimizde bisiklet kullanımı artmaktadır. Bu durum bisiklet kazalarının daha sık görülmesine neden olmaktadır. Bisiklet kazası ile ilgili ülkemizde daha önce yapılmış az sayıdaki çalışmada bisiklet kazası sonucu zarar görmüş tüm hastalar değerlendirmiştir. Çalışmamızda ise sadece bisiklet sürücüsü olarak gelen hastaların özellikleri araştırılmıştır. Bisiklet sürücülerinin kazaya bağlı yaralanmalarında hangi sistem ve/veya organlarının etkilediğinin bilinmesi önemlidir. Bu tür kaza sonucu müdahale edecek sağlık personelinin kendini hangi konularda geliştirmesi

konusunda farkındalık sağlamaya yarar. Aynı zamanda yaralanmaların ciddiyetinin azaltılmasına yönelik korunma önerileri sunulmasını kolaylaştıracaktır. Bisiklet kazası nedeni ile çocuk acil servisine getirilen bisiklet sürücüleri geriye dönük değerlendirilmiştir. Hastaların demografik özellikleri, yaralanma durumları, izlemlerinde istenilen konsültasyonlar ve uygulanan tedavilerin araştırılması planlanmıştır. Çalışmamızın çocuk acil servislerde sayısı her geçen gün artan ve birçoğu engellenebilir özellikte olan bu tür yaralanmalara karşı alınacak önlemlerde yol gösterici olması öngörülmüştür.

Gereç ve Yöntemler

Çalışma geriye dönük, tek merkezli olarak planlandı ve Çukurova Üniversitesi Tıp Fakültesi Etik kurul onayı alındı (6 Mart 2020, No: 97). Bu çalışma, Çukurova Üniversitesi Tıp Fakültesi Hastanesi, Çocuk Acil Servis'te gerçekleştirildi. Ocak-Aralık 2018 tarihleri arasındaki hasta başvuruları incelendi. Bisiklet kullanırken kaza yapan ve bunun sonucunca oluşan yaralanma ile başvuran, 2-18 yaş arasındaki hastalar çalışmaya dahil edildi. Sürücü olmayan ancak bisiklet kazasından etkilenmiş hastalar çalışmaya dahil edilmedi. Olguların dosya ve elektronik veri tabanı verileri incelendi. Hastalara ait demografik veriler (cinsiyet, yaş, başvuru şekli (ilk başvuru yeri veya başka bir merkezden sevk alınmış hasta), hastaneye getirilme şekli (kendi imkanı ile veya ambulans ile) motorlu bir aracın kazaya karışması durumu, başvuru şikayetleri, aldıkları tanılar, konsültasyonlar, uygulanan tedaviler ve hastaların acilden çıkış durumları (taburcu, servis yatışı, yoğun bakım yatışı, izinsiz terk) kayıt altına alındı. Bisiklet kazasına motorlu taşıtın dahil olduğu olgular ayrı olarak da değerlendirildi. Bu olguların yukarıdaki özellikleri ayrıca incelendi ve motorlu taşıtın karışmadığı olgular arasındaki ilişki araştırıldı.

Verilerin istatistiksel analizinde IBM SPSS Statistics Versiyon 20.0 paket programı kullanıldı. Kategorik ölçümler sayı ve yüzde olarak, sayısal ölçümlerse ortalama ve standart sapma (gerekli yerlerde ortanca ve minimum- maksimum) olarak özetlendi. Kategorik ölçümlerin gruplar arasında karşılaştırılmasındaki Kare test istatistiği kullanıldı. Tüm testlerde istatistiksel önem düzeyi 0,05 olarak alındı.

Bulgular

Çocuk acil servisimize gelen 3168 adli olgu incelendi. Bisiklet kazası nedeniyle getirilen 158 hasta çalışmaya dahil edildi. Olguların yaşları 2 ila 17 arasında değişkenlik göstermekte ve yaş ortalaması 10.39 ± 4,314 bulundu. Erkek cinsiyette 108 hasta (%68,4 ve kadın cinsiyette 50 hasta (%31,6) mevcut idi. Motorlu taşıtın dahil olduğu 17 (%10,8) bisiklet kazası mevcuttu. Bu motorlu taşıtlar; otomobil (n=13, %8,2), motosiklet (n=3, %1,9) ve otobüs (n=1, %0,6) idi. Yirmi altı hasta (%15,4) ambulans ile getirilmişti. Başka merkezden sevk edilmiş 12 hasta (%7,6) hastanemize yönlendirilmişti (Tablo 1).

Tablo 1. Bisiklet kazaları ile getirilen çocukların demografik verileri.

Cinsiyet ve yaş özellikleri	n (%)	yaş/ yıl ortanca (min maks)
Kadın	50 (31,6)	10,5 (2-177)
Erkek	108 (68,4)	6,5 (2-17)
Toplam	158 (100)	9 (2-17)
		n (%)
Yaş grubuna göre hasta dağılımı		
Oyun çağı (2-6 yaş)		45 (28,4)
Okul çağı (7-11 yaş)		63 (40,0)
Ergenlik çağı (12-18 yaş)		50 (31,6)
Mevsimlere göre hasta dağılımı		
İlkbahar		28 (17,7)
Yaz		44 (27,8)
Sonbahar		66 (41,8)
Kış		20 (12,7)
Çocuk acil servise başvuru şekli		
İlk merkez		146 (92,4)
Başka merkezden sevk		12 (7,6)
Hastaneye getirilme		
Kendi imkanları ile		132 (84,6)
Ambulans		26 (15,4)
Acil servisten ayrılma durumları		
Taburcu		126 (79,7)
Servis Yatışı		17 (10,8)
Yoğun Bakım Yatışı		3 (1,9)
İzinsiz/kendi isteği ile terk		12 (7,6)

Çalışmaya dahil edilen olgulardaki en sık başvuru nedenleri sırası ile üst ekstremite ağrısı/yaralanması (n=51, %32,3) ve alt ekstremitede ağrı/yaralanması (n=46, %29,1) idi. Bu şikayetleri üçüncü sırada yüz bölgesinde ağrı/ yaralanma (n=44, %27,8) takip etmekte idi. Hastaların diğer başvuru yakınmaları Tablo 2'de gösterilmiştir. Hastalar için hangi bölümlerden konsültasyon istendiğine bakıldı. Bisiklet kazası ile gelen 52 olgu (%32,9) için çocuk cerrahisi, 47 olgu (%29,7) için ortopedi ve travmatoloji, 29 olgu (%18,4) için de beyin ve sinir cerrahisi bölümünden konsültasyon istenmiş idi. Hastaların birincil, ikincil ve üçüncül değerlendirmeleri tamamlandıktan sonra aldıkları tanılar Tablo 2'de gösterilmiştir. En sık görülen tanı yumuşak doku hasarıydı ve 118 hastada (%74,7) mevcuttu. Yüz yirmi sekiz hastaya (%81,0) medikal tedavi verilmiş, 52 hastaya (%32,9) yara pansumanı ve 51 hastaya (%32,3) primer sütürasyon uygulanmıştı. Hastaların %5,1'ine (n=8) cerrahi operasyon uygulanmıştı.

Tablo 2. Bisiklet kazaları ile getirilen çocukların özellikleri.

		Motorlu taşıt karışmış mı?		
	Toplam	Evet	Hayır	
	n (%)	n (%)	n (%)	*p
	158 (100)	17(10,77)	141(89,2)	<0,001
Başvuru yakınmaları ve yaralanma alanları				
Üst ekstremite	51 (32,3)	9 (52,9)	42 (29,8)	0,096
Alt ekstremite	46 (29,1)	6 (35,3)	40 (28,4)	0,577
Yüz bölgesi	44 (27,8)	6 (35,3)	38 (27,0)	0,576
Baş-boyun bölgesi	39 (24,7)	9 (52,9)	30 (21,3)	0,014
Torakal bölge	18 (11,4)	6 (35,3)	12 (8,5)	0,005
Abdominal bölge	14 (8,9)	3 (17,6)	11 (7,8)	0,178
Pelvik alan	13 (8,2)	1(5,9)	12 (8,5)	>0.999
Vertebra alanı	6 (3,8)	1 (5,9)	5 (3,5)	0,501
Konsültasyonlar				
Çocuk cerrahisi	52(32,9)	14(82,4)	38 (27,0)	<0,001
Ortopedi	47(29,7)	14(82,4)	33 (23,4)	<0,001
Beyin cerrahisi	29(18,4)	12(70,6)	17(12,1)	<0,001
Plastik cerrahisi	19(12,0)	3(17,6)	16(11,3)	0,434
Kulak burun boğaz	4(2,5)	3(17,6)	1(0,7)	0,004
Göz hastalıkları	4(2,5)	1(5,9)	3(2,1)	0,369
Tanılar				
Yumuşak doku hasarı	118 (74,7)	15(88,2)	103(73,0)	0,242
Laserasyon	78 (49,4)	9(52,9)	69 (48,9)	0,802
Üst ekstremite kırığı	13 (8,2)	2(11,8)	11(7,8)	0,634
Kafa travması	10 (6,3)	5(29,4)	5(3,5)	0,001
Maksillofasiyal kırık	10 (6,3)	5(29,4)	5(3,5)	0,001
Alt ekstremite kırığı	7 (4,4)	1(5,9)	6(4,3)	0,557
Batın içi organ hasarı	6 (3,8)	1(5,9)	5(3,5)	0,501
Tedaviler				
Medikal tedavi	128 (81,0)	16(94,1)	112(79,4)	0,199
Yara pansumanı	52 (32,9)	12(70,6)	40(28,4)	0,001
Primer sütürasyon	51 (32,3)	7(41,2)	44 (31,2)	0,420
Atel/ bandaj	10 (6,3)	6(35,3)	4(2,8)	<0,001
Cerrahi operasyon	8 (5,1)	3(17,6)	5(3,5)	0,042
Alçı	5 (3,2)	0(0,0)	5(3,5)	>0,999
Konservatif tedavi	3 (1,9)	0(0,0)	3(2,1)	>0,999
Boyunluk	1 (0,6)	0(0,0)	1(0,7)	>0,999

Motorlu taşıtların bisiklet kazasına karıştığı olgular ayrı olarak değerlendirildi. Motorlu taşıtın kazaya karıştığı olguların (n=17) başvuru nedenleri incelendiğinde baş boyun yaralanma/ ağrılarının (n=9, %52,9), üst ekstremite yaralanma/ ağrıları (n=9, %52,9) kadar sık bir neden olduğu görüldü. Motorlu taşıt kazası ile getirilen olgularda en çok konsültasyon istenen bölümler sırası ile yine benzer şekilde çocuk cerrahisi (n=14, %83,4), ortopedi ve travmatoloji (n=14, %83,4) ve beyin cerrahisi (n=12, %70,6) idi. Bu vakalarda konsültasyon istenme oranları motorlu taşıt karışmayan bisiklet kazalarına göre anlamlı olarak yüksekti (p<0,001). Hastaların birincil, ikincil ve üçüncül değerlendirmeleri tamamlandıktan sonra aldıkları tanılara bakıldığında en sık görülen tanı yumuşak doku hasarıydı (n=15, %88,2). Kafa travmaları ve maksillofasiyal kırıklar motorlu aracın karıştığı kazalarda anlamlı olarak daha yüksek sıklıkta görülmekteydi (p=0,001). En sık uygulanan tedavi medikal tedavi olmakla birlikte (n=16, %94,1); bu hastalara uygulanan yara pansumanı, atel/bandaj uygulaması ve cerrahi operasyon motorlu taşıt karışmayan olgulara göre anlamlı olarak yüksekti (p<0,05).

Tartışma

Daha önce farklı ülkelerde yapılan birçok çalışmada bisiklet kazalarının daha yüksek sıklıkta erkek cinsiyette saptandığı gözlenmiştir [14-16]. Bazı çalışmalar erkek cinsiyetini bir risk faktörü olarak kabul etse de yapılan sistematik bir derlemede 14 çalışmaya ait sonuçlar dahil edilmiş ve çalışmanın sonucunda hasta sayısı daha fazla olsa da erkek cinsiyette

olmanın bir risk faktörü olduğu gösterilememiştir [17]. Yapmış olduğumuz çalışmada önceki çalışmalara benzer şekilde erkek cinsiyet oranı kadın cinsiyetine göre yüksek saptanmıştır.

Farklı ülkelerdeki çalışmalarda yaş gruplarına göre dağılımına bakıldığında Belçika'da bisiklet kazası ile gelen hastaların en sık 11- 20 yaş grubunda olduğu, İngiltere' de ise hastaların %65'inin 15 yaş altında olduğu görülmüştür [18,19]. İzmir' de tüm yaş gruplarını değerlendiren bir çalışmada bisiklet kazası geçirenlerin büyük çoğunluğunun 19 yaş altında ve en sık olarak 0-9 yaş grubunda olduğu bildirilmiştir [20]. Bisiklet kazalarında yaş grubunun risk faktörü olduğuna dair bir kanıt bulunamamıştır [17]. Çalışmamıza 18 yaş altı çocuk hastalar dahil edilmiş ve bu grubun içinde en sık 7-11 yaş aralığındaki okul çağı çocuklarının çocuk acil servisimize getirilmiş olduğu görülmüştür.

Başvuruların mevsimlere göre dağılımına bakıldığında yaz aylarında diğer mevsimlere göre daha yüksek, kış aylarında ise en düşük oranda görüldüğü bildirilmiştir [21,22]. Çalışmamızda diğer çalışmalar ile benzer şekilde kış aylarında en düşük oranda başvuru olduğu görülmüştür. Ancak en yüksek oranda başvuru yaz değil, son bahar ayında olduğu saptanmıştır. Bu durumun Adana ilimizde yaz mevsiminin çok sıcak geçmesine, bisiklet kullanımı gibi dış mekanlarda geçekleştirilecek oyun veya spor aktivitelerini daha az tercih etmelerine bağlı olduğunu düşünmekteyiz.

Bisiklet kazası geçiren çocuklarda sıklıkla birden fazla organ veya sistemde yaralanma mevcut olabileceği bilinmektedir. Farklı çalışmalarda hastaların en sık yüz yaralanması veya ekstremite veya baş-boyun yaralanması ile hastaneye götürüldüğü gösterilmiştir [15,19,22-24]. Çalışmamızın sonuçlarına göre hastalar en sık üst ekstremite yaralanması/ağrısı yakınması (%32,3) ve alt ekstremite yaralanması/ağrı yakınması (%29,1) nedeni ile çocuk acil servise getirilmiştir. Yüz yaralanması (%27,8) ve baş-boyun yaralanması (%24,7) da sık görülen nedenlerdendir. Toraks, abdominal ve pelvik alan gibi gövde yaralanmaları bizim çalışmamızda da diğer çalışmalardaki gibi daha düşük sıklıkta görülmüştür. Gövde yaralanmalarının daha düşük sıklıkta görüldüğü bisiklet kazalarında kafa travması en önemli ölüm nedenidir. Benzer oranların gösterildiği birçok çalışma mevcuttur. Kafa travmasını ve neden olduğu ölümü önlemenin en etkin yolununun kask kullanımı olduğu pek çok çalışma ile kanıtlanmıştır. 23-28 Bizim çalışmamıza dahil ettiğimiz hastalarda ölüm vakası olmamıştır. Ancak kafa travması olan 10 hastamız (%6,3) vardır. Kafa travması olan 2 hastada epidural kanamanın eşlik ettiği deplese fraktür, 1 hastada ise subdural kanama ve yanında deplese fraktür tespit edilmiştir. Çocuk yoğun bakım ihtiyacı olan hastalarımızın tümünde kafa travması mevcuttur. Maalesef çalışmamıza dahil edilen hiçbir hastada kask kullanımı yoktur.

Literatür incelendiğinde motorlu taşıtın dahil olduğu bisiklet kazalarında hastaların daha ciddi travmalar ve ağır yaralanmalar ile getirildiği gösterilmiştir [27-30]. Bizim çalışmamızın bulguları da bu çalışmalar ile benzer bulunmuştur. Motorlu taşıtın karışmış olduğu bisiklet kazaları sonucunda hayati risk taşıyan baş-boyun yaralanmaları ve de maksillofasiyal kırıklar gibi sorunların daha yüksek sıklıkta görüldüğü saptanmıştır. Beklenildiği üzere bu hasta grubunda konsültasyon istenme oranları ve de cerrahi müdahale gereksinimleri diğer gruba göre anlamlı olarak yüksek bulunmuştur.

Sonuç

Çalışmamızda ülkemizde kullanımının yaygınlaşması ile acil servislerde başvuru sayısı her geçen gün artmakta olan bisiklet kazalarının bölgemizdeki özellikleri araştırılmıştır. Kalıcı hasar veya ölüme sebep olabilecek bisiklet kazalarının çoğu önlenebilir veya vereceği hasarlar azaltılabilir özelliktedir. Kolaylaştırıcı nedenlerin ve risk altındaki çocukların belirlenmesi, koruyucu yöntemlerin geliştirilmesinde yararlı olacaktır. Ülkemizde bisiklet kazaları ile ilgili yeterli sayıda çalışma bulunmamaktadır. Çalışmamız mevcut çalışmalardan farklı olarak sadece bisiklet sürücülerini değerlendirmiştir. Kazalarda sadece sürücülerin yaşayacağı sorunlara odaklanmanın sürücülerin alması gereken önlemlerin tespitinde yol gösterici olacağı düşünülmüştür. Ülkemizin farklı bölgelerinin katılacağı daha kapsamlı çalışmalar gerekmektedir.

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Araştırma Makalesi

Evde trakeostomi bakımı için Youtube videolarının eğitim içeriği açısından değerlendirilmesi

Evaluation of Youtube videos in terms of educational content for tracheostomy care at home

Mehmet Nurullah Arıkan[1]*, Mahmut Semih Akdağ[2]

[1]Özel Mardin Park Hastanesi, Anesteziyoloji ve Reanimasyon Bölümü, Mardin, Türkiye
[2]Beyhekim Eğitim Araştırma Hastanesi, Anesteziyoloji ve Reanimasyon Bölümü, Konya, Türkiye

Öz

Amaç: YouTube, tıbbi videolar sunan bir eğitim kaynağı olarak hizmet verse de, sıkı düzenlemelerin eksikliği, yanıltıcı bilgilerin yayılmasına yol açarak hem sağlık çalışanları hem de hastalar için risk oluşturabilir. Evde trakeostomi bakımıyla ilgili İngilizce videoları değerlendiren çalışmaların sınırlı olması nedeniyle, bu çalışma standart trakeostomi bakımı ile ilgili YouTube videolarının içerik ve kalitesini analiz etmeyi amaçlamaktadır.

Gereç ve Yöntemler: YouTube'da evde trakeostomi bakımı ile ilgili videoları değerlendirmek amacıyla "caring for your tracheostomy," "home care tracheostomy patient," ve "tracheostomy care at home" anahtar kelimeleri kullanılarak arama yapılmıştır. Her bir anahtar kelime için arama sonuçlarının ilk 10 sayfasındaki videolar analiz edilmiştir. Bu videolar, uygunluk, yükleme kaynağı ve içerik güncelliği ile doğruluğu açısından değerlendirilmiştir

Bulgular: Video uzunlukları (415 (256-542) saniye- 321 (168-539) saniye), içerik kapsamlılık skor yüzdesi (80 (80-100)-40 (20-60)) ve trakeostomi bakımına yönelik videoların alabileceği maksimum puan 16 olup çalışmamızda videoların toplam puanları (15,00 (15,00-16,00)-8,00 (4,00-11,00)) faydalı videolar lehine yanıltıcı videolara göre istatistiksel olarak anlamlı derecede yüksek bulunmuştur (sırasıyla p=0,043, p<0,001 ve p<0,001).

Sonuçlar: Bu çalışmada, trakeostomi bakımına yönelik sosyal medya videolarının bilimsel yeterliliği incelenmiştir. Analiz edilen 98 videodan %29,6'sının (29 video) bilgilendirici, %70,4'ünün (69 video) ise yanıltıcı olduğu tespit edilmiştir. Bu sonuç, sosyal medyada paylaşılan videoların büyük bir kısmının yetersiz içerik sunduğunu ve trakeostomi bakımı gibi hassas konularda bilginin doğruluğunu sağlama ihtiyacını ortaya koymaktadır.

Anahtar Kelimeler: trakeostomi bakımı, evde trakeostomi bakımı, youtube videoları

Sorumlu Yazar*: Mehmet Nurullah Arıkan, Özel Mardin Park Hastanesi, Anesteziyoloji ve Reanimasyon Bölümü, Artuklu, Mardin, Türkiye.
E-posta: znarikan_87@hotmail.com
Orcid: 0000-0001-6763-0662
Doi: 10.18663/tjcl.1572809
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Abstract

Aim: While YouTube serves as an educational resource offering medical videos, the lack of strict regulations may lead to the dissemination of misleading information, posing risks for both healthcare providers and patients. Given the limited studies evaluating English-language videos on home tracheostomy care, this study aims to analyze the content and quality of available YouTube videos on standard tracheostomy care.

Material and Methods: A search was conducted on YouTube using the keywords "caring for your tracheostomy," "home care tracheostomy patient," and "tracheostomy care at home" to evaluate videos related to home tracheostomy care. Videos from the first 10 pages of search results for each keyword were analyzed. These videos were assessed in terms of relevance, source of upload, and content accuracy and currency.

Results: The video durations (415 [256-542] seconds vs. 321 [168-539] seconds), comprehensive score percentages (80 [80-100]% vs. 40 [20-60]%), and the maximum achievable score for tracheostomy care videos (16 points) were found to be statistically significantly higher in favor of useful videos compared to misleading videos in our study. The total scores of the videos (15.00 [15.00-16.00] vs. 8.00 [4.00-11.00]) were also significantly higher for useful videos ($p=0.043$, $p<0.001$, and $p<0.001$, respectively).

Conclusion: This study evaluated the scientific adequacy of social media videos related to tracheostomy care. Among the 98 videos analyzed, 29.6% (29 videos) were found to be informative, while 70.4% (69 videos) were categorized as misleading. These findings highlight the significant inadequacy of content in a majority of social media videos and underscore the critical need to ensure the accuracy of information on sensitive topics such as tracheostomy care.

Keywords: tracheostomy care; tracheostomy care at home; youtube videos

Giriş

Dünya genelinde sağlık hizmetlerinin ulaşılabilirliği ve kalitesi arttıkça, evde trakeostomi ile takip edilen hasta sayısı da artmaktadır. Noninvaziv ventilatörleri tolere edemeyen, sekresyon kontrolü ve yutma refleksi bozuk olan hastalar için trakeostomi gerekli hale gelir. Trakeostomi, bu tür hastalarda havayolu açıklığını koruma, solunum işlevini destekleme, sekresyonların etkin yönetimini sağlama ve yaşam kalitesini artırma gibi avantajlar nedeniyle tercih edilmektedir. Uzun süreli hastane yatışları; enfeksiyon riski, elektrolit bozuklukları, depresyon ve malnütrisyon gibi sorunların artmasına yol açar. Bu da sağlık hizmeti maliyetlerini yükseltmekte ve özellikle yoğun bakıma ihtiyaç duyan hastaların bu hizmete erişimini zorlaştırmaktadır. Ancak, trakeostomi açılan hastaların çoğu taburcu olmadan önce palyatif servislerde değerlendirilmekte ve gerekli eğitim ve bakım planları yapıldıktan sonra evde bakım sürecine geçmektedir [1]. Çalışmalarda, uzun dönem trakeostomili hastaların rehabilitasyonunda evde bakımın düşük maliyet, sosyal destek ve yaşam kalitesinde artış açısından önemi vurgulanmıştır [2-4]. Evde trakeostomi bakımı, hastaların yaşam kalitesini artırmada önemli bir rol oynar; ancak, bakım verenlerin yeterli eğitim almaması durumunda ciddi komplikasyonlar ortaya çıkabilir. Eğitim eksikliği, trakeostomi kanülünün tıkanması, enfeksiyonlar ve yanlış aspirasyon teknikleri komplikasyon riskini artırır. Evde bakımda karşılaşılan sorunların başında hava yolu enfeksiyonları ve mekanik ventilatör sorunları gelmektedir [5,6].

YouTube, sağlık çalışanları ve hastalar için çeşitli tıbbi işlemlere yönelik eğitici videolar sunarak, görsel bir rehber görevi görmektedir [7-9]. Bilimsel olarak doğru, iyi tasarlanmış ve yeterli düzeyde sunulan YouTube eğitim videoları, teori ve uygulama arasında faydalı kavramsal bağlantılar sağlayarak tıbbi eğitim materyallerinin kalitesini artırabilir. Ancak, YouTube'da videoların eğitimsel yönlerine dair katı düzenlemeler veya standartlar bulunmamaktadır; bu da yanıltıcı bilgilere rastlanma olasılığını artırarak, hem sağlık çalışanları hem de hastalar için risk oluşturabilir [9,10]. YouTube'daki evde trakeostomi bakımı ile ilgili, özellikle İngilizce hazırlanmış videoları değerlendiren akademik çalışmaların sayısı oldukça sınırlıdır.

Bu doğrultuda, YouTube'da ulaşılabilen standart trakeostomi bakımı videolarının içerik ve kalite analizini değerlendirmeyi amaçladık.

Gereç ve Yöntemler

11 Nisan 2023 tarihinde YouTube (https://www.youtube.com; YouTube, LLC, San Bruno, CA, USA) üzerinde "caring for your tracheostomy", "home care tracheostomy patient" ve "tracheostomy care at home" anahtar kelimeleri kullanılarak arama yapılmıştır. Her bir anahtar kelime için arama sonuçlarının ilk 10 sayfasındaki videolar, bağımsız iki anestezi hekimi tarafından incelenmiştir. Analiz, ilk 10 sayfa ile sınırlandırılmıştır; çünkü bu noktadan sonra alakasız videoların daha fazla gösterildiği ve önceki çalışmalarda izleyicilerin genellikle arama sonuçlarının en üst sıralarında çıkan videoları izlediklerinin gösterildiği belirlenmiştir [11,12]. Bu çalışmada insan veya hayvan denekleri kullanılmadığından, etik kurul onamı gerekmemektedir.

Çalışma Dışı Bırakılma Kriterleri

Çalışma dışı bırakılma kriterleri aşağıdaki şekilde belirlenmiştir: İlgisiz içerik, İngilizce dışında bir dilde hazırlanmış videolar, ses veya performans içermeyen videolar, pediatrik hastalara yönelik videolar, akademik içerik, reklam içeren videolar, tıbbi içerik taşımayan videolar, tekrarlanan videolar.

Videoların Uygunluk Değerlendirmesi

Videoların eğitici nitelikte olup olmadıkları, Azer SA tarafından tanımlanan kriterlerin modifiye edilmesiyle belirlenmiştir (Tablo 1). Bu kriterler, video içeriğinin doğruluğu, verilen mesajın netliği, uzman görüşünün bulunması, eğiticilik ve teknik tasarıma dayalı 5 majör ve 6 minör ölçütten oluşmaktadır. Söz konusu kriterler daha önce birçok çalışmada kullanıldığı için tercih edilmiştir (Tablo 1) [11,13,14]. Her bir majör kriterin karşılanması durumunda 2 puan, minör kriterlerin karşılanması durumunda ise 1 puan verilmiştir. Majör kriterlerin tamamının sağlandığı ve toplamda 13 puan alan videolar "faydalı" olarak değerlendirilmiştir [13,14].

Tablo 1. Videoların değerlendirilmesinde kullanılan kriterler [9,11,12].

Ana Kriterler
1. Trakeostomi bakımı ile ilgili içerik bilimsel olarak doğrudur.
2. Görüntüler nettir.
3. Yaratıcı/organizasyon belirtilmiştir.
4. Konu açık bir şekilde sunulmuştur.
5. Sesler net ve arka plan gürültüsüzdür.
Alt Kriterler
1. Video başlıkta belirtilen konuyu kapsamaktadır.
2. Lisans düzeyinde tıp öğrencileri için tasarlanmıştır.
3. İndirme süresi makuldür.
4. Yaratıcı hakkında bilgiler günceldir.
5. Eğitim hedefleri belirtilmiştir.
6. Trakeostomi bakım prosedürünün insan üzerinde gösterimi yapılmaktadır.

Veri Toplama

Her bir video için aşağıdaki veriler kaydedilmiştir: Toplam izlenme sayısı, YouTube'da bulunma süresi (ay), günlük izlenme sayısı, video uzunluğu (saniye), videoların beğenilme/beğenilmeme oranları, video yükleme kaynağı. Videolara rağbet edilme. Video Güç İndeksi (VPI) kullanılarak hesaplanmıştır (Tablo 2).

Tablo 2. Video Güç İndeksi Hesaplaması

Parametre	Hesaplama Formülü
VPI	Beğenilme Derecesi x İzlenme Derecesi / 100
Beğenilme Derecesi	(Beğenme Sayısı x 100) / (Beğenilme + Beğenilmeme Sayısı)
İzlenme Derecesi	İzlenme Sayısı / Gün

VPI; Video güç indeksi.

Video Yükleme Kaynağı

Videoların yüklenme kaynaklarına göre sınıflandırılması şu şekilde yapılmıştır: "Doktor veya hemşire", "Hastane veya laboratuvar", "Sağlık kuruluşu" ve "Birey".

Videoların İçerik Güncelliği ve Doğruluğunun Değerlendirilmesi

Her bir videonun içeriğinin değerlendirilmesi, trakeostomi bakım prosedürlerini standartlaştırmak ve değerlendirme sürecine rehberlik etmek amacıyla referans yayınlar kullanılarak gerçekleştirilmiştir [15]. Trakeostomi bakım videolarında dikkate alınan parametreler Tablo 3'de sunulmuştur.

Tablo 3. Trakeostomi Bakım Video İçerik Kriterleri

Trakeostomi prosedürünün ve trakeostomi bakım malzemelerinin tanıtımı
Aspirasyon açıklanıyor mu?
İç kanül temizliği açıklanıyor mu?
Stoma temizliği açıklanıyor mu?
Nemlendirme açıklanıyor mu?

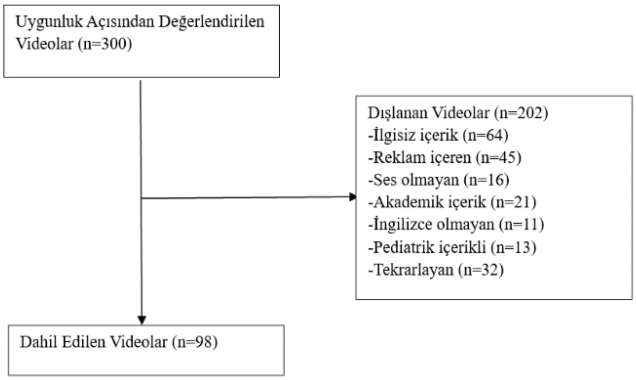
İstatistiksel Analiz

Bu çalışmada elde edilen verilerin analizi IBM SPSS Statistics 26.0 (IBM-SPSS Inc., Şikago, IL, ABD) programı kullanılarak gerçekleştirildi. Verilerin normal dağılıma uygunluğu Shapiro–Wilk veya Kolmogorov–Smirnov testleri ile değerlendirildi. Sürekli değişkenler, dağılım durumlarına bağlı olarak ortanca (25. ve 75. persentil) şeklinde, kategorik değişkenler ise sayı ve yüzde olarak ifade edildi. Sürekli değişkenlerin analizinde, parametrik test varsayımlarının karşılanmadığı durumlarda Mann-Whitney U testi veya Kruskal-Wallis testi kullanıldı. Kategorik değişkenler ise Ki-kare testi ile analiz edildi. Toplam video puanı ile temel video özellikleri arasındaki

ilişki Spearman korelasyonu ile incelendi. Kişiler arası uyum Cohen'in kappa katsayısı ile belirlendi. İstatistiksel anlamlılık düzeyi p<0,05 olarak kabul edildi.

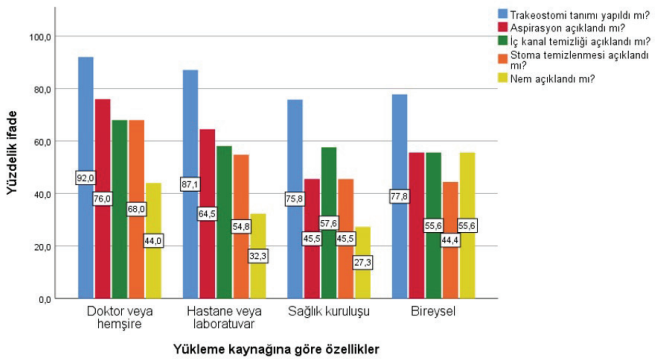
Bulgular

YouTube platformunda "caring for your tracheostomy," "home care tracheostomy patient," ve "tracheostomy care at home" anahtar kelimeleri kullanılarak, ilk on sayfada çıkan sonuçlar incelenmiş ve her bir anahtar kelimeden 100 video olmak üzere toplam 300 video değerlendirilmiştir. Çalışma dışlama kriterlerine göre 202 video dışlanmıştır. Bunların 64'ü ilgisiz içerik, 45'i reklam içeren, 16'sı ses veya performans içermeyen, 21'i akademik içerik, 11'i İngilizce dışında bir dilde, 13'ü çocuk hastalar için bilgi içeren ve 32'si yinelenen videolardı. Sonuç olarak, çalışmaya 98 video dahil edilmiş olup, bu videolardan %29,6 (29 video)'sı bilgilendirici, %70,4 (69 video)'ü ise yanıltıcı olarak değerlendirilmiştir (Şekil 1).



Şekil 1. Uygunluk Kriterlerine Göre Değerlendirilen, Dahil Edilen ve Dışlanan Videoların Akış Şeması

Çalışmaya dahil edilen videoların ortanca izlenme sayısı 19.750 (3.600-115.000), video uzunluğu 342 (183-542) saniye, YouTube'da bulunma süresi 36 ay (12-59), günlük ortalama izlenme sayısı 16,54 (3,57-85,00) ve Video Power Index (VPI) değeri 16,54 (3,57-85,00) olarak tespit edilmiştir. Eğitim amaçlı faydalı bilgilere sahip videoların yanıltıcı olanlara kıyasla toplam izlenme sayısı (19.500 (6.300-116.000)-20.000 (2.900-107.000)), YouTube'da bulunma süreleri (36 (12-59)-36 (12-49) ay), günlük izlenme sayıları (15,28 (6,67-195,83)-19,44 (3,06-79,17)) ve VPI skorları (15,28 (6,67-195,83)-19,44 (3,06-79,17)) daha yüksek olmasına rağmen, bu farklılıklar istatistiksel olarak anlamlı bulunmamıştır (p>0,05). Ancak video uzunlukları (415 (256-542) saniye-321 (168-539) saniye), içerik kapsamlılık skor yüzdesi (80 (80-100)-40 (20-60)) ve trakeostomi bakımına yönelik videoların yaralılık (UK) toplam puanlarının (15,00 (15,00-16,00)-8,00 (4,00-11,00)) faydalı videolar lehine istatistiksel olarak anlamlı derecede yüksek bulunmuştur (sırasıyla p=0,043, p<0,001 ve p<0,001) (Tablo 4). Videolar yükleme kaynaklarına göre değerlendirildiğinde; "Doktor veya hemşire", "Hastane veya laboratuvar", "Sağlık kuruluşu" ve "Birey." kategorileri arasında "YouTube'da bulunma süresi,""günlük izlenme sayısı,""VPI değeri," "içerik kapsamlılık skor" ve "UK toplam puan" açısından anlamlı bir fark bulunmamıştır (p>0,05). Ancak, "videoların izlenme sayısı" parametresi "Hastane veya laboratuvar" kategorisinde diğer gruplara kıyasla daha düşük olup, bu farklılık istatistiksel olarak anlamlıdır (p<0,05). Ayrıca, video uzunlukları açısından "Hastane veya laboratuvar", "Sağlık kuruluşu" gruplarına ait videolar daha kısa süreli olup, bu fark da istatistiksel olarak anlamlı bulunmuştur (p<0,05) (Tablo 5). Video içeriklerinin yükleme kaynaklarına göre değerlendirilmesinde, "Trakeostomi prosedürü ve bakım materyallerinin tanıtımı," "Aspirasyonun açıklanıp açıklanmadığı," "İç kanül temizliğinin anlatılıp anlatılmadığı," "Stoma temizliğinin açıklanıp açıklanmadığı" ve "Nemlendirme işleminin açıklanıp açıklanmadığı" gibi içerik açısından gruplar arasında istatistiksel olarak anlamlı bir fark bulunmamıştır (p>0,05) (Şekil 2).



Şekil 2. Yükleme kaynağına göre video içerik özelliklerinin değerlendirilmesi

Toplam video skoru ile toplam izlenme sayısı, video uzunluğu, YouTube'da bulunma süresi, günlük izlenme sayısı ve VPI değerleri arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır (p>0,05). Buna ek olarak, toplam video skoru ile İçerik kapsamlılık skor yüzdesi arasında pozitif ve anlamlı bir korelasyon saptanmıştır (sırasıyla r=0,609, p<0,001) (Tablo 6). UK toplam puanlarının gözlemciler arası uyumu kappa istatistiği ile değerlendirilmiş ve yüksek düzeyde uyum tespit edilmiştir (0,986, %95 CI: 0,978–0,991).

Tablo 4. Trakeostomi Bakım Videolarının Video Karakteristik Özellikleri ve Bilgi Türüne Göre Değerlendirilmesi.

Özellikler	Tüm Videolar (n=98)	Faydalı Bilgi (n=29)	Yanıltıcı Bilgi (n=69)	p değeri
Toplam izlenme	19.750 (3.600-115.000)	19.500 (6.300-116.000)	20.000 (2.900-107.000)	0,840
Video uzunluğu (saniye)	342 (183-542)	415 (256-542)	321 (168-539)	0,043
YouTube'da bulunma süresi (ay)	36 (12-59)	36 (12-59)	36 (12-48)	0,715
Günlük izlenme sayısı	16,54 (3,57-85,00)	15,28 (6,67-195,83)	19,44 (3,06-79,17)	0,709
VPI	16,54 (3,57-85,00)	15,28 (6,67-195,83)	19,44 (3,06-79,17)	0,709
Kapsamlılık skoru (%)	60,00 (40,00-80,00)	80,00 (80,00-100,00)	40,00 (20,00-60,00)	<0,001
UK toplam puanı	12,00 (8,00-14,00)	15,00 (15,00-15,00)	10,00 (6,00-12,00)	<0,001

VPI, Video güç indeksi; UK, Video yararlılık.

Tablo 5. Trakeostomi Bakım Videolarının Video Karakteristik Özellikleri ve Yükleme Kaynağına Göre Değerlendirilmesi.

Özellikler	Doktor veya hemşire (n=25)	Hastane veya laboratuvar (n=31)	Sağlık kuruluşu (n=23)	Birey (n=9)	p değeri
Toplam izlenme	14.000 (2.900-122.000)	40.000 (10.000-168.000)	14.000 (1.700-86.000)	14.000 (802-41.000)	0,009
Video uzunluğu (saniye)	528 (415-701)	300 (219-469)	212 (128-342)	461 (168-1.253)	0,005
YouTube'da bulunma süresi (ay)	12 (12-36)	38 (36-48)	48 (12-60)	24 (24-48)	0,205
Günlük izlenme sayısı	25,0 (5,10-198,41)	27,78 (9,26-188,89)	7,78 (1,40-62,22)	15,28 (2,21-28,47)	0,086
VPI	25,00 (5,10-198,41)	27,78 (9,26-188,89)	7,78 (1,40-62,22)	15,28 (2,21-28,47)	0,086
Kapsamlılık skoru (%)	80,00 (40,00-100,00)	80,00 (40,00-80,00)	60,00 (20,00-80,00)	60,00 (40,00-80,00)	0,160
UK toplam puanı	12,00 (7,00-14,00)	13,00 (10,00-15,00)	11,00 (9,00-13,00)	8,00 (3,00-10,00)	0,088
Faydalılık	Faydalı, n (%) 7 (%21)	14 (%45,2)	7 (%21,2)	1 (%11,1)	0,101
	Yanıltıcı, n (%) 18 (%72)	17 (%54,8)	26 (%78,8)	8 (%88,9)	

VPI, Video güç indeksi; UK, Video yararlılık.

Tablo 6. Toplam Video Puanı ile Video Karakteristik Özellikleri Arasındaki İlişki.

Özellikler	R değeri	p değeri
Toplam izlenme	0,045	0,658
Video uzunluğu (saniye)	0,152	0,134
YouTube'da bulunma süresi (ay)	0,029	0,780
Günlük izlenme sayısı	0,101	0,323
VPI	0,101	0,323
Kapsamlılık skoru	0,609	<0,001

VPI; Video güç indeksi

Tartışma

Bu çalışma, YouTube'da trakeostomi bakımıyla ilgili videoların genel kalitesini değerlendirerek, bilgilendirici içerikleri yanıltıcı içeriklerden ayırmada önemli bilgiler sunmaktadır. Çalışmamızda, dahil edilen videoların büyük bir kısmının yanıltıcı içerik kategorisinde yer alması, hastaların ve bakıcıların doğru bilgiye erişim konusunda karşılaştıkları zorlukları ve bu durumun potansiyel risklerini ortaya koymaktadır.

Trakeostomi, kritik hastalar arasında yaygın bir prosedürdür ve son 20 yılda bu müdahaleyle yaşayan hasta sayısında bir artış gözlenmiştir [16]. Özellikle 2019'da başlayan COVID-19 pandemisi sırasında, yoğun bakım ünitesine kabul edilen hasta sayısında belirgin bir artış olmuş ve birçok hasta solunum yetmezliği nedeniyle mekanik ventilasyona ihtiyaç duymuştur [17,18]. Trakeostomi ile ilişkili komplikasyonlar arasında tüp dekanülasyonu, tüp tıkanıklığı ve kanama gibi acil durumlar bulunmaktadır. Bu komplikasyonlar acil servis müdahalesini gerektirmektedir. Öte yandan, tıkanmış veya yerinden çıkmış tüpler, oksijen düşüşü, konuşma valfi sorunları ve tüp değişimi gibi daha az acil durumlar genellikle birincil bakım sağlayıcıları tarafından yönetilmektedir [16,19,20]. Trakeostomili hastalara en iyi şekilde bakım sağlanabilmesi için tüm sağlık hizmeti sunucularının trakeostomi bakımı konusunda temel düzeyde bilgiye sahip olması gerekmektedir. Trakeostomi gibi karmaşık bakım prosedürlerinin klinik öncesi dönemde tanıtılması, bu tür hastalarla karşılaşıldığında sağlık çalışanlarının bilgi düzeyini ve güvenini artırmak için önemlidir. Yapılan araştırmalar, videoların hem hastaların hem de evde bakım sağlayıcıların eğitimi için etkili bir yöntem olduğunu göstermiştir [21,22]. Bizim çalışmamızda video skoru ile içerik kapsamlılık skor yüzdesi arasında pozitif bir

korelasyonun tespit edilmesi, daha detaylı bilgi sunan videoların daha yüksek değerlendirme puanı aldığını ortaya koymakta ve bu tür içeriklerin kullanıcılar için daha yararlı olduğunu ima etmektedir. Trakeostomi sonrasında taburcu edilen hastaların video kaynaklarına erişimi, yaşam kalitesi puanlarının artmasına katkıda bulunmuştur. Hastalar, acil olmayan soruları veya endişeleri olduğunda çevrimiçi videolara başvurabilmekte ve bu durum, sağlıkları üzerinde daha fazla kontrol hissetmelerini sağlamaktadır. Benzer şekilde, bakım sağlayıcılar için uygulanan trakeostomi eğitim programlarının da etkili olduğu belirlenmiştir [20,23]. Çalışmamızda içerik analizi sonuçları, videoların belirli trakeostomi bakım prosedürlerini açıklayıp açıklamadığına dair önemli bulgular sunmuştur; ancak bu içeriklerin yükleme kaynaklarına göre anlamlı bir farklılık göstermemesi, trakeostomi bakımına ilişkin temel bilgilerin farklı kaynaklar tarafından benzer şekilde ele alındığını göstermektedir.

Bununla birlikte, literatürde yapılan diğer çalışmalar, YouTube'daki sağlıkla ilgili videoların çoğunlukla eğitim kalitesi açısından yetersiz olduğunu vurgulamış ve bu videoların sağlık profesyonelleri tarafından ayrıntılı bir şekilde incelenmesi gerektiğini belirtmiştir [8,9,24-26]. Çalışmamızın bulguları, yanıltıcı içeriklerin bilgilendirici içeriklerle karşılaştırıldığında YouTube'da bulunma süresi, izlenme sayısı ve VPI değeri gibi parametrelerde istatistiksel olarak anlamlı bir farklılık göstermediğini ortaya koymuştur. Bu durum, yanıltıcı içeriklerin kullanıcılar tarafından geniş ölçüde tüketildiğini ve bu nedenle bilgi kirliliğine neden olabileceğini göstermektedir. Videoların yükleme kaynakları açısından değerlendirildiğinde, "hastane veya laboratuvar" kategorisindeki videoların diğer kategorilere göre daha düşük izlenme sayısına sahip olması, bu tür kurumların içeriklerini geniş kitlelere ulaştırmada yeterince etkili olamadığını düşündürmektedir. Ayrıca, "hastane veya laboratuvar" ve "sağlık kuruluşu" gruplarına ait videoların diğer kaynaklara kıyasla daha kısa olması, bu grupların içerik üretiminde süreyi daha kısıtlı tutma eğiliminde olduğunu göstermektedir. Bu, bilgilendirici içeriklerin kısa sürede özlü bilgiler sunması gerektiği, ancak bu sürenin izleyicilere yeterli bilgi sağlamak açısından sınırlayıcı olabileceği gerçeğini ortaya koymaktadır.

Çalışmanın Kısıtlılıkları: Bu çalışmada, sınırlı sayıda video incelenebilmiştir. Spesifik olarak, evde trakeostomi bakımı konusundaki videolar ele alınmış ve çoğu video dahil edilme kriterlerini karşılamadığı için analiz dışı bırakılmıştır. Ayrıca, inceleme yalnızca YouTube platformundaki videolarla sınırlı tutulmuştur. Oysaki YouTube dışında da eğitim amaçlı videoların yer aldığı başka video paylaşım platformlarının mevcut olduğu bilinmektedir.

Sonuç

Bu çalışmada, trakeostomi bakımına yönelik sosyal medya videolarının bilimsel yeterliliği incelenmiştir. Analiz edilen 98 videodan %29,6'sının (29 video) bilgilendirici, %70,4'ünün (69 video) ise yanıltıcı olduğu tespit edilmiştir. Bu sonuç, sosyal medyada paylaşılan videoların büyük bir kısmının yetersiz içerik sunduğunu ve trakeostomi bakımı gibi hassas konularda bilginin doğruluğunu sağlama ihtiyacını ortaya koymaktadır. Sağlık profesyonellerinin ve yetkili platformların, sosyal medyada doğru ve bilgilendirici içeriklerin yaygınlaştırılması için daha fazla çaba göstermesi gerekmektedir.

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Research Article

Lactate levels as a predictor of mortality in patients with diabetic ketoacidosis in the emergency department

Acil serviste diyabetik ketoasidozda mortalite prediktörü olarak laktat düzeyleri

Ömerul Faruk Aydın*, Tahir Talat Yurttaş

Department of Emergency Medicine, Faculty of Medicine, Istanbul Yeni Yüzyıl University, Istanbul, Turkey

Abstract

Aim: Diabetic ketoacidosis (DKA) is a life-threatening metabolic disorder commonly seen in patients with diabetes, particularly in emergency departments. Early identification of high-risk patients is crucial for reducing mortality. Lactate, a marker of tissue hypoxia, may have prognostic value in predicting outcomes in DKA patients.

Material and Methods: This retrospective study included patients diagnosed with DKA in the emergency department of a tertiary healthcare center between January 1, 2019, and January 1, 2024. Patients were identified using the hospital's electronic medical records system. Data collected included demographic characteristics, clinical parameters, laboratory results, and patient outcomes. The diagnosis of DKA was based on established clinical and laboratory criteria, including hyperglycemia, metabolic acidosis, and ketonemia or ketonuria. The primary outcome was in-hospital mortality.

Results: A total of 85 patients were included in the study, with a mean age of 54 years (IQR: 35–70). Of the study population, 44.7% were female. The overall mortality rate was 15.3%, with 72 patients surviving (84.7%) and 13 patients not surviving (15.3%). The median age of non-survivors was significantly higher than that of survivors (66 years vs. 51 years, $p = 0.049$). Additionally, lactate levels were significantly higher in non-survivors than in survivors, indicating a potential prognostic role of lactate in predicting outcomes in DKA patients.

Conclusion: Elevated lactate levels at admission are strongly associated with increased mortality in patients with diabetic ketoacidosis. Monitoring lactate levels in the emergency department could be a useful prognostic tool for identifying high-risk patients and guiding early interventions.

Keywords: Diabetic ketoacidosis, lactate, mortality

Corresponding Author*: Ömerul Faruk Aydın, Department of Emergency Medicine, Faculty Of Medicine, Istanbul Yeni Yüzyıl University, Istanbul, Turkey,
E-mail: omerulfaruk.aydin@yeniyuzyil.edu.tr
Orcid: 0000-0002-4279-297X
Doi: 10.18663/tjcl.1581961
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Öz

Amaç: Diyabetik ketoasidoz (DKA), özellikle acil servislerde diyabet hastalarında yaygın olarak görülen, hayatı tehdit eden metabolik bir bozukluktur. Yüksek riskli hastaların erken tespiti, mortalitenin azaltılması açısından kritik öneme sahiptir. Doku hipoksisinin bir belirteci olan laktat, DKA hastalarında sonuçları öngörmede prognostik değere sahip olabilir.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, 1 Ocak 2019 - 1 Ocak 2024 tarihleri arasında üçüncü basamak bir sağlık merkezinin acil servisinde DKA tanısı alan hastalar dahil edilmiştir. Hastalar, hastanenin elektronik tıbbi kayıt sistemi kullanılarak belirlenmiştir. Toplanan veriler arasında demografik özellikler, klinik parametreler, laboratuvar sonuçları ve hasta sonuçları yer almıştır. DKA tanısı, hiperglisemi, metabolik asidoz ve ketonemi veya ketonüriyi içeren yerleşik klinik ve laboratuvar kriterlere dayanarak konulmuştur. Birincil sonuç ölçütü hastane içi mortalite olarak belirlenmiştir.

Bulgular: Çalışmaya toplam 85 hasta dahil edilmiştir ve hastaların ortalama yaşı 54 yıl (IQR: 35–70) olarak bulunmuştur. Çalışma popülasyonunun %44,7'si kadındı. Genel mortalite oranı %15,3 olup, 72 hasta (%84,7) sağ kalırken, 13 hasta (%15,3) hayatını kaybetmiştir. Hayatta kalamayan hastaların medyan yaşı, sağ kalanlara kıyasla anlamlı derecede daha yüksekti (66 yıl vs. 51 yıl, p = 0,049). Ayrıca, laktat seviyeleri hayatta kalamayan hastalarda sağ kalanlara kıyasla anlamlı derecede daha yüksekti ve bu durum, laktatın DKA hastalarındaki sonuçları öngörmede potansiyel bir prognostik role sahip olabileceğini göstermektedir.

Sonuç: Başvuru anındaki yüksek laktat seviyeleri, diyabetik ketoasidoz hastalarında artmış mortalite ile güçlü bir şekilde ilişkilidir. Acil serviste laktat seviyelerinin izlenmesi, yüksek riskli hastaların belirlenmesi ve erken müdahalelerin yönlendirilmesi için faydalı bir prognostik araç olabilir.

Anahtar Kelimeler: Diyabetik ketoasidoz, laktat, mortalite.

Introduction

Diabetic ketoacidosis (DKA) is a serious metabolic complication characterized by hyperglycemia, ketosis, and metabolic acidosis, commonly seen in patients with type 1 diabetes (1-3). This condition develops due to insulin deficiency and the effects of increased counter-regulatory hormones (glucagon, cortisol, adrenaline). Frequently encountered in emergency departments, DKA can lead to increased mortality and morbidity rates if not treated promptly and appropriately (4,5). Given the severity and potential complications of DKA, timely recognition and management in emergency settings are of critical importance.

Early diagnosis and rapid intervention in DKA significantly impact both short- and long-term outcomes. Early identification reduces the need for intensive care and helps prevent complications. It is crucial for emergency physicians to quickly recognize DKA and initiate appropriate treatment, as this directly affects patient prognosis and the efficiency of healthcare delivery. Since the symptomatology of DKA can sometimes be nonspecific, there is a need for rapid diagnostic tools. In this context, the evaluation of biochemical parameters plays a vital role, particularly in the early stages of clinical management (6,7).

Lactate levels are used as a prognostic marker in various acute clinical conditions and play a crucial role in assessing the severity of metabolic acidosis. In DKA, elevated lactate levels are considered an indicator of hypoperfusion and tissue hypoxia. There is increasing evidence in the literature that lactate has a significant impact on the prognosis of DKA. Studies have reported higher mortality rates in patients with elevated lactate levels (8,9). Therefore, lactate is thought to be a valuable prognostic marker for risk assessment in DKA patients in the emergency department.

The aim of this study is to examine the relationship between lactate levels and mortality in patients diagnosed with DKA in the emergency department.

Material and Methods

This study was conducted with the approval of the Taksim Education and Research Hosptial's Ethics Committee (Date: 30.10.2024, Decision No: 13). The study adhered to the ethical principles outlined in the Declaration of Helsinki. This retrospective study was carried out on patients diagnosed with DKA in the emergency department of a tertiary healthcare facility between January 1, 2019, and January 1, 2024. Due to the retrospective nature of the study, informed consent was not obtained from the patients, and exemption was granted by the ethics committee.

All patients aged 18 and over who were diagnosed with DKA were included in the study. Patients who received diagnoses other than DKA upon admission, those whose DKA diagnosis could not be confirmed due to incomplete data, and patients with other serious clinical conditions such as renal failure or sepsis were excluded from the study.

The following data were collected by reviewing the patients' medical records: age, gender, blood pressure (systolic and diastolic), pulse, respiratory rate, Glasgow Coma Scale (GCS) score, oxygen saturation (SPO2), blood glucose, creatinine, blood urea nitrogen (BUN), albumin, C-reactive protein (CRP), pH, partial pressure of carbon dioxide (pCO2), bicarbonate (HCO3), and lactate levels. Additionally, hospital length of stay and in-hospital mortality were recorded. Blood gas laboratory values were measured using the ABL800 FLEX blood gas analyzer (Radiometer).

The diagnosis of DKA was based on the patient's clinical findings and laboratory results. Diagnostic criteria included hyperglycemia (blood glucose level >250 mg/dL), metabolic acidosis (pH <7.3), low serum bicarbonate levels (<15 mmol/L), and either ketonuria or ketonemia (10). The primary outcome of the study was in-hospital mortality.

Statistical Analysis

All statistical analyses were conducted using IBM SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, NY, USA) and MedCalc version 20.104 (MedCalc Software Ltd., Ostend, Belgium). Descriptive statistics were calculated for each variable, with continuous variables presented as medians with interquartile ranges (IQR) or means ± standard deviation (SD), based on normality testing. Categorical variables were summarized using frequencies and percentages. Data normality was assessed through histograms and the Shapiro-Wilk test. Group comparisons were made using the Student's t-test for continuous variables with normal distribution and the Mann-Whitney U test for non-normal distributions. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate.

The diagnostic accuracy of lactate levels for predicting in-hospital mortality was evaluated using receiver operating characteristic (ROC) curve analysis, with the area under the ROC curve (AUROC) computed. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated at the optimal cutoff identified by Youden's Index (11). A p-value of <0.05 was considered statistically significant.

Results

A total of 85 patients with diabetic ketoacidosis were included in the study. Of these, 72 (84.7%) survived, while 13 (15.3%) did not survive. Female patients comprised 44.7% of the total population, with no statistically significant difference in the proportion of females between survivors (41.7%, n=30) and non-survivors (61.5%, n=8) (p = 0.185). The median age was significantly higher among non-survivors [66 years, IQR 49 - 81] than survivors [51 years, IQR 33.5 - 67.5] (p = 0.049).

Systolic blood pressure (BP) was lower in non-survivors [111±30.3 mmHg] compared to survivors [124±24.3 mmHg], but this difference was not statistically significant (p = 0.087). Similarly, diastolic BP was lower in non-survivors [66.4±16.8 mmHg] than in survivors [74.8±16.6 mmHg], without a significant difference (p = 0.096). The heart rate was higher in non-survivors [107±24.7 bpm] than in survivors [98.8±19.2 bpm], though this difference was also not statistically significant (p = 0.199).

The respiratory rate was higher among non-survivors [22 breaths/min, IQR 16 - 32] compared to survivors [19 breaths/min, IQR 15 - 25], but this difference did not reach statistical significance (p = 0.163). Non-survivors had significantly lower Glasgow Coma Scale (GCS) scores [14, IQR 12 - 15] compared to survivors who had a median score of 15 (p = 0.002). Oxygen saturation (SPO2) levels were significantly lower among non-survivors [95%, IQR 90 - 96] compared to survivors [98%, IQR 96 - 99] (p = 0.016).

Glucose levels did not differ significantly between non-survivors [634±263 mg/dL] and survivors [595±188 mg/dL] (p = 0.518). Creatinine levels were higher in non-survivors [1.69 mg/dL, IQR 1.12 - 2.05] compared to survivors [1.27 mg/dL, IQR 1.00 - 1.74], although this difference was not statistically significant (p = 0.269). Blood urea nitrogen (BUN) levels were also elevated among non-survivors [50 mg/dL, IQR 22 - 68] compared to survivors [25 mg/dL, IQR 17 - 47], with no statistically significant difference (p = 0.166).

Albumin levels were lower in non-survivors [34.5±13.7 g/dL] than in survivors [40±8.58 g/dL], but the difference was not statistically significant (p = 0.058). C-Reactive Protein (CRP) levels were higher among non-survivors [115 mg/L, IQR 31 - 171] compared to survivors [25 mg/L, IQR 4.8 - 129], though this difference did not reach statistical significance (p = 0.092).

The pH level did not differ significantly between survivors and non-survivors (p = 0.893). Levels of partial pressure of carbon dioxide (pCO2) were similar between the two groups (p = 0.881). Bicarbonate (HCO3) levels were lower in non-survivors [11.8 mmol/L, IQR 8.4 - 17.5] compared to survivors [12.6 mmol/L, IQR 9.38 - 16.7], but this difference was not statistically significant (p = 0.826).

Lactate levels were significantly higher among non-survivors [5.25±0.88 mmol/L] compared to survivors [2.95±1.47 mmol/L], with a mean difference of 2.3 mmol/L (95% CI: 1.46 - 3.14, p < 0.001).

When comparing patients with low lactate (≤ 3.5 mmol/L, n=25) to those with high lactate (> 3.5 mmol/L, n=60), older age was observed in the high lactate group [59.5 years, IQR 41.8 - 73] versus the low lactate group [37 years, IQR 30 - 56] (p = 0.007). Heart rate was higher in the high lactate group [103±20.5 bpm] than in the low lactate group [92.1±17.4 bpm] (p = 0.02). Respiratory rates were significantly higher in patients with elevated lactate [20.5 breaths/min, IQR 16 - 29.3] compared to those with low lactate [16 breaths/min, IQR 14 - 20] (p = 0.013). (Tables 1 2,3).

The mortality rate was significantly higher in patients with high lactate levels (21.7%) compared to those with low lactate levels (0%) (p = 0.009).

The diagnostic performance of lactate levels for predicting in-hospital mortality in patients with DKA yielded an Area Under the Receiver Operating Characteristic Curve (AUROC) of 0.91 (95% CI: 0.85 - 0.96) (Figure 1). Using a lactate cutoff of > 3.5 mmol/L, the sensitivity was 87% (95% CI: 70% - 96%) and specificity was 85% (95% CI: 76% - 92%), with a positive predictive value (PPV) of 67% (95% CI: 54% - 78%) and a negative predictive value (NPV) of 95% (95% CI: 88% - 98%).

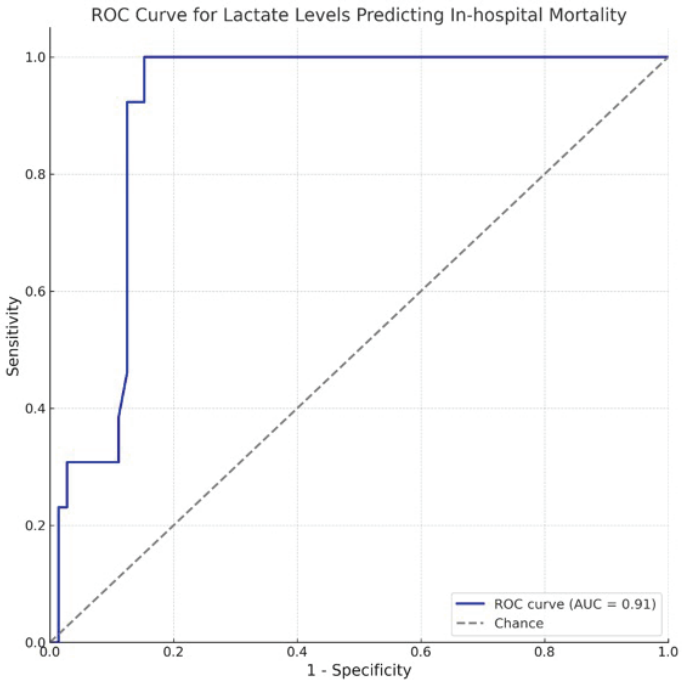

Figure 1. Receiver Operating Characteristic Curve for Lactate Levels in Predicting In-hospital Mortality in Patients with Diabetic Ketoacidosis

Table 1. Baseline Characteristics and Outcomes of Patients with Diabetic Ketoacidosis by Survival Status.

Variable	All (n=85)	Survivor (n=72)	Deceased (n=13)	p	Mean Difference (95% CI)
Sex (Female)	38 (44.7%)	30 (41.7%)	8 (61.5%)	0.185	-
Age (years)	54 (35 - 70)	51 (33.5 - 67.5)	66 (49 - 81)	0.049	-
Systolic BP (mmHg)	122±25.5	124±24.3	111±30.3	0.087	-
Diastolic BP (mmHg)	73.5±16.8	74.8±16.6	66.4±16.8	0.096	-
Heart Rate (bpm)	100±20.2	98.8±19.2	107±24.7	0.199	-
Respiratory Rate (/min)	20 (15 - 28)	19 (15 - 25)	22 (16 - 32)	0.163	-
GCS,	15 (15 - 15)	15 (15 - 15)	14 (12 - 15)	0.002	-
SPO2 (%)	97 (95 - 99)	98 (96 - 99)	95 (90 - 96)	0.016	-
Glucose (mg/dL)	601±200	595±188	634±263	0.518	-
Creatinine (mg/dL)	1.29 (1.00 - 1.81)	1.27 (1.00 - 1.74)	1.69 (1.12 - 2.05)	0.269	-
BUN (mg/dL)	26 (17 - 50)	25 (17 - 47)	50 (22 - 68)	0.166	-
Albumin (g/dL)	39.2±9.64	40±8.58	34.5±13.7	0.058	-
CRP (mg/L)	36 (5 - 131)	25 (4.8 - 129)	115 (31 - 171)	0.092	-
pH	7.18 (7.09 - 7.29)	7.19 (7.11 - 7.29)	7.17 (7.07 - 7.30)	0.893	-
pCO2 (mmHg)	31.8±9.69	31.9±9.95	31.4±8.43	0.881	-
HCO3 (mmol/L)	12.4 (9.3 - 17.1)	12.6 (9.38 - 16.7)	11.8 (8.4 - 17.5)	0.826	-
Lactate (mmol/L)	3.3±1.62	2.95±1.47	5.25±0.88	<0.001	2.3 (1.46 - 3.14)

Abbrev. : BP: Blood Pressure;bpm: Beats per Minute; GCS: Glasgow Coma Scale; SPO2: Oxygen Saturation; BUN: Blood Urea Nitrogen; CRP: C-Reactive Protein; pCO2: Partial Pressure of Carbon Dioxide; HCO3: Bicarbonate.

Table 2. Comparison of Baseline Characteristics and Outcomes in Patients with Low vs. High Lactate Levels.

Variable	Low Lactate (n=25)	High Lactate (n=60)	p	Mean Difference (95% CI)
Sex(Female)	11 (44%)	27 (45%)	0.933	-
Age (years)	37 (30 - 56)	59.5 (41.8 - 73)	0.007	-
Systolic BP (mmHg)	121±19.9	122±27.7	0.950	-
Diastolic BP (mmHg)	72.3±12.1	74±18.5	0.661	-
Heart Rate (bpm)	92.1±17.4	103±20.5	0.02	11.1 (1.81 - 20.4)
Respiratory Rate (/min)	16 (14 - 20)	20.5 (16 - 29.3)	0.013	-
GCS,	15 (15 - 15)	15 (14 - 15)	0.012	-
SPO2 (%)	98 (96 - 99)	97 (93.8 - 99)	0.243	-
Glucose (mg/dL)	558±150	619±216	0.205	-
Creatinine (mg/dL)	1.07 (0.9 - 1.47)	1.35 (1.04 - 1.81)	0.171	-
BUN (mg/dL)	21 (16 - 32)	28 (20 - 50.3)	0.137	-
Albumin (g/dL)	39.2±9.73	39.2±9.68	0.975	-
CRP (mg/L)	23 (5 - 102)	39.4 (5.75 - 147)	0.461	-
pH	7.26 (7.17 - 7.30)	7.17 (7.08 - 7.28)	0.053	-
pCO2 (mmHg)	31.5±9.55	31.9±9.82	0.841	-
HCO3 (mmol/L)	14 (10 - 18.3)	11.3 (9.25 - 16.6)	0.201	-
Mortality	0 (0%)	13 (21.7%)	0.009	-

Abbrev.: BP: Blood Pressure; bpm: Beats per Minute; GCS: Glasgow Coma Scale ;SPO2: Oxygen Saturation; BUN: Blood Urea Nitrogen; CRP: C-Reactive Protein; pCO2: Partial Pressure of Carbon Dioxide; HCO3: Bicarbonate.

Table 3. Diagnostic Performance of Lactate Levels for Predicting In-hospital Mortality in Patients with Diabetic Ketoacidosis.

Parameter	AUROC (95% CI)	p	Youden's Index (J)	Criterion	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Lactate Level	0.91 (0.85 - 0.96)	< 0.001	0.75	> 3.5 mmol/L	87% (70% - 96%)	85% (76% - 92%)	67% (54% - 78%)	95% (88% - 98%)

Abbrev.: AUROC: Area Under the Receiver Operating Characteristic Curve; CI: Confidence Interval; PPV: Positive Predictive Value; NPV: Negative Predictive Value; J: Youden's Index

Discussion

The main finding of this study is that lactate levels at the time of admission are significantly associated with in-hospital mortality in DKA patients. Mortality rates were considerably higher in patients with lactate levels above 3.5 mmol/L compared to those with lower levels. This finding suggests that lactate is a valuable marker for predicting clinical prognosis in DKA patients.

DKA is a common condition encountered in emergency departments and, if not treated promptly, can lead to severe outcomes. Initiating appropriate treatment quickly in patients diagnosed with DKA plays a crucial role in reducing both mortality and morbidity (12-14). Early recognition of the condition and timely initiation of treatment by emergency physicians significantly improve patient survival and shorten hospital stays. The clinical spectrum of DKA ranges from mild symptoms to severe complications, such as loss of consciousness and multiple organ failure, making the timely and effective use of diagnostic tools critically important (15). In this context, carefully evaluating the biochemical parameters of patients upon admission is essential to initiating a rapid intervention process.

Lactate plays a significant role in the pathophysiology of DKA, and the results of this study support its importance as a critical marker in the progression of the disease. In DKA, insulin deficiency and the effects of counter-regulatory hormones increase gluconeogenesis and lipolysis, leading to elevated free fatty acids and the production of ketone bodies. While the accumulation of ketone bodies causes metabolic acidosis, hypoperfusion and tissue hypoxia contribute to the accumulation of lactate. Elevated lactate levels indicate a deficiency in tissue oxygenation and the activation of anaerobic metabolism (16). Therefore, elevated lactate is associated with poor prognosis in DKA patients and correlates with higher mortality rates.

In this study, high lactate levels at the time of admission were found to be associated with in-hospital mortality in DKA patients. Similarly, in the prospective cohort study by Suwarto et al., lactate levels of ≥4 mmol/L were identified as an independent predictor of five-day mortality (17). Likewise, Siregar et al. demonstrated in their 72-hour mortality prediction model that the risk of mortality increased fivefold in patients with lactate levels above 4 mmol/L (9). However, Cully et al., who examined pediatric DKA patients, found that while lactic acidosis was common in this patient group, it was not significantly associated with mortality (18). These findings support the prognostic value of lactate in adult DKA patients, although this relationship may not always apply to pediatric populations due to differing physiological responses.

Lactate elevation in DKA reflects underlying metabolic stress, which is often influenced by a variety of precipitating factors that may also affect patient outcomes. Precipitating factors for DKA, such as infections, acute coronary syndromes, and arrhythmias, are known to significantly impact clinical outcomes and are closely associated with both lactate elevation and mortality. These conditions exacerbate metabolic stress and hypoxia, contributing to the pathophysiological complexity of DKA. Previous studies have highlighted that infections, in particular, are a major contributor to lactic acidosis in critically ill patients, further underlining their relevance in this context (19). A more detailed exploration of these factors in future studies could provide valuable insights into their interplay with lactate levels and patient outcomes in DKA.

Lastly, current clinical guidelines for the management of diabetic ketoacidosis emphasize the importance of rapid assessment and correction of metabolic disturbances but do not consistently address the prognostic role of lactate levels. While lactate monitoring is well-established in other critical care settings, such as sepsis management, its routine use in DKA has not yet been widely adopted. The findings of this study suggest that elevated lactate levels at admission could serve as a valuable prognostic tool in DKA, aiding in the early identification of high-risk patients. By highlighting the prognostic significance of lactate, this study contributes to the growing body of evidence supporting its integration into clinical practice and may inform future updates to DKA management guidelines.

Limitations of the Study

This study has several limitations. First, its retrospective design limits the ability to establish a causal relationship between elevated lactate levels and mortality in diabetic ketoacidosis (DKA). Second, the study was conducted at a single tertiary healthcare center, which may reduce the generalizability of the findings to other populations and settings. Additionally, certain confounding factors, such as the presence of comorbid conditions or the variability in treatment approaches, may have influenced the outcomes. Moreover the absence of a control group, such as patients without lactate elevation but with other factors contributing to mortality, limits the generalizability of our findings. Future prospective studies incorporating control groups are needed to enhance the robustness and comparability of results. Lastly, the sample size, particularly in the non-survivor group, was relatively small, which could affect the statistical power of the study.

In conclusion, elevated lactate levels at the time of admission are significantly associated with increased in-hospital mortality in patients presenting with diabetic ketoacidosis in the emergency department. Monitoring lactate levels may serve as a valuable prognostic tool in the early identification of high-risk patients, enabling prompt and appropriate interventions.

Ethical Approval

This study was approved by the Taksim Education and Research Hosptial's ethics committee (ethics committee ruling number: 13, date: 30.10.2024).

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Conflicts of Interest

Authors declare that they have no conflicts of interest.

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Research Article

The Diagnostic Value of Virtual Colonoscopy in Colonic Diseases

Kolon Hastalıklarında Sanal Kolonoskopinin Tanısal Değeri

Ihsaniye Suer Dogan*[1], Esin Cakmakci[2], Yildiran Songur[3], Baki Hekimoglu[4]

[1]Ministry of Health Etlik City Hospital, Department of Radiology, Ankara, Turkey
[2]Kansas City VA Medical Center Department of Radiology, USA
[3]Nyclinic, Gastroenterology Antalya, Turkey
[4]Dışkapı Yıldırım Beyazıt Mevki Hospital Department of Radiology, Ankara, Turkey

Abstract

Aim: This study aims to assess the diagnostic accuracy of multi-slice computed tomography (CT) colonography in detecting colorectal lesions.

Material and Methods: 22 patients with confirmed or clinically suspected colorectal pathology underwent multi-slice CT colonography followed by conventional colonoscopy on the same day. The diagnostic findings of multi-slice CT colonography were compared with those obtained from conventional colonoscopy.

Results: Of 22 patients who underwent CT colonography, 10 (45%) were evaluated as normal. Bowel wall thickening was observed in 4 patients (18%), while polypoid lesions were detected in 8 (36%). Among the 9 polypoid lesions identified through conventional colonoscopy, 8 were also detected by CT colonography. The overall sensitivity of CT colonography for polypoid lesions, regardless of size, was 89%. Sensitivity was 50% for lesions smaller than 1 cm and 100% for lesions larger than 1 cm. When polypoid lesions were evaluated according to their histology, the sensitivity of CT Colonography was found to be 50% in tubular adenoma, 100% in tubulovillous adenoma, and 100% in adenocarcinoma.

Conclusion: The sensitivity of CT colonography for detecting colorectal polypoid lesions was found to be 89%. These results indicate that CT colonography is a valuable diagnostic modality for comprehensive evaluation of the colon. CT colonography represents a viable alternative to traditional colorectal cancer screening methods due to its high sensitivity for detecting colorectal lesions, coupled with its relatively safe and minimally invasive nature.

Keywords: Computed Tomography Colonography, Colonoscopy, Colonic Polyp, Colorectal Neoplasms

Corresponding Author*: Ihsaniye Suer Dogan, Ministry of Health Etlik City Hospital, Department of Radiology, Ankara, Turkey,
E-mail: dr.ihsaniye@gmail.com
Orcid: 0000 0002 7586 0537
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Öz

Amaç: Çok kesitli bilgisayarlı tomografi (BT) kolonografinin kolorektal lezyonların görülmesindeki ve ek bulguların araştırılmasındaki etkinliğini değerlendirmektir.

Gereç ve Yöntemler: Kolorektal patolojisi olan veya klinik olarak şüphelenilen 22 hastaya aynı gün BT kolonografi sonra konvansiyonel kolonoskopi incelemesi yapıldı. Çok kesitli BT kolonografi, konvansiyonel kolonoskopi sonuçları karşılaştırıldı.

Bulgular: BT kolonografi de 22 hastanın 10 tanesi (%45) normal olarak değerlendirildi. Dört hastada (%18) barsak duvarında kalınlaşma, 8 hastada (%36) polipoid lezyon saptandı. Konvansiyonel kolonoskopi de saptanan 9 polipoid lezyonun 8 tanesi BT kolonografi de saptandı. Boyut farkı gözetmeksizin tüm polipoid lezyonlarda BT kolonografinin duyarlılığı %89, 1 cm'den küçük polipoid lezyonlarda %50, 1 cm'den büyük polipoid lezyonlarda %100 bulundu.

Sonuç: BT kolonografisinin kolorektal polipoid lezyonları tespit etme duyarlılığı %89 olarak bulundu. Bu sonuçlar BT kolonografisinin kolonun kapsamlı değerlendirilmesi için değerli bir tanı yöntemi olduğunu göstermektedir. BT kolonografisi, kolorektal lezyonları tespit etmedeki yüksek duyarlılığı ve nispeten güvenli ve minimal invaziv yapısı nedeniyle geleneksel kolorektal kanser tarama yöntemlerine uygulanabilir bir alternatif sunmaktadır.

Anahtar Kelimeler: Bilgisayarlı Tomografi Kolonografi, Kolonoskopi, Kolon Polip, Kolorektal Neoplazmalar

Introduction

In developed nations, colorectal cancer (CRC) stands as one of the principal causes of cancer-related mortality [1]. The prevalence of CRC is also on the rise in our country. On a global scale, CRC is the third most commonly diagnosed malignancy and the second leading cause of cancer-related deaths.

The precise etiology of CRC remains elusive. Despite the potential for early diagnosis to markedly enhance prognosis, CRC frequently presents without distinct clinical symptoms or only vague, non-specific signs during its early stages, resulting in a low rate of early detection [2]. Given the well-documented progression of colorectal polyps to carcinoma over time, the early identification of premalignant lesions, such as polyps, is critical for improving patient outcomes [3]. Early detection and subsequent removal of these polyps can significantly reduce the likelihood of CRC development.

Colonoscopy remains the gold standard for the detection of CRC; however, it is both financially demanding and resource-intensive, requiring skilled endoscopists and strong patient compliance. Furthermore, it is an invasive procedure, carrying inherent risks such as bowel perforation and bleeding [4,5]. For a comprehensive examination, complete visualization of the entire colon is also essential.

Computed tomography (CT) colonography, by contrast, is a rapid, non-invasive imaging modality for colorectal evaluation. It utilizes computed tomography to detect polyps and malignancies. Standard protocols typically involve bowel preparation, oral contrast administration, and colon insufflation, but do not necessitate sedation [6].

This study aims to assess the diagnostic accuracy of multi-slice CT colonography in detecting colorectal lesions and evaluating additional findings.

Material and Methods

Between December 2002 and July 2003, a total of 22 patients with confirmed or clinically suspected colorectal pathology underwent CT colonography at the Radiology Department of Social Security Institution Dışkapı Ankara Training Hospital. The study was studied prospectively within the Declaration of Helsinki Principles guidelines. This thesis study was conducted with the permission of the Radiology Department of Social Security Institution Dışkapı Ankara Training Hospital (ethical approval date: 18.07.2022 no: 08)

The findings were correlated with conventional colonoscopy and histopathological results. Positive and false-negative cases were identified to evaluate the diagnostic performance of CT colonography in detecting colorectal pathologies.

Patients included in the study were those with positive faecal occult blood tests, rectal bleeding, a history of adenomatous polyps, previous surgical intervention for colorectal carcinoma, or confirmed/suspected inflammatory bowel disease. Patients under the age of 18 were excluded from the study.

Before the examination, patients were instructed to follow a liquid diet for three days. On the day before the procedure, bowel cleansing was achieved using either Fleet Phospho-Soda solution (monobasic sodium phosphate 2.4 g + dibasic sodium phosphate 0.9 g/5 mL) or X-M solution (Sennoside A+B Ca 150 mg). All CT colonography examinations were conducted on the same day as conventional colonoscopy. To reduce smooth muscle spasms

and peristalsis, 2 mL of intravenous hyoscine butylbromide was administered immediately before the procedure. Following the placement of a 16F Foley catheter into the rectum, room air was insufflated manually using a hand pump until adequate colonic distension was achieved, as tolerated by the patient. Air insufflation was halted upon the patient reporting abdominal distension or discomfort. A scout image of the abdomen and pelvis was then obtained with the patient in the supine position.

CT colonography examinations were performed using a multi-slice computed tomography scanner (Marconi MX 8000). Axial images of the abdomen, extending from the dome of the diaphragm to the symphysis pubis, were obtained with a slice thickness of 3.2 mm, a reconstruction interval of 1.6 mm, a pitch of 1.75, and a 512x512 matrix. The scans were completed within 10–15 seconds during a single breath-hold.

Following the initial scan, with the patient in the prone position, 90–100 mL of intravenous contrast material was administered at a rate of 3.5 mL/second using an automatic injector. A delayed scan was performed 70 seconds post-contrast administration. The acquired images were transferred to a secondary workstation (MX View) capable of 3D reconstruction.

Axial 2D images, multiplanar reformatted (MPR) images, and 3D endoluminal views (virtual colonoscopy) were independently evaluated by two radiologists. Final decisions were made by consensus for each patient. Axial CT images were reviewed using a window width of +1000 HU and a window level of -500 HU. In cases of uncertainty, 2D MPR and 3D endoluminal images were utilised for further assessment.

Conventional colonoscopy was performed by an experienced gastroenterologist (YS) using a standard endoscope, without prior knowledge of the CT colonography findings. The procedure documented which segments of the colon were adequately visualised, and any detected lesions were reported based on their location and size.

The findings from conventional colonoscopy and CT colonography were compared on a lesion-by-lesion basis. Conventional colonoscopy was regarded as the gold standard. For a lesion detected by CT colonography to be considered a true positive, its location and size had to match the corresponding findings from conventional colonoscopy.

Statistical Analysis

Descriptive statistics for continuous variables included calculating mean values, standard deviations, medians, and ranges (minimum and maximum). For categorical variables, frequencies and percentages were presented. The McNemar test was employed to assess statistical significance. Data analysis was performed using IBM SPSS for Windows (SPSS Inc., Chicago, IL), with a p-value of <0.05 considered indicative of statistical significance.

Results

The ages of the patients ranged from 22 to 80 years, with a mean age of 56.5 years. Of the 22 patients, 13 were male (59%).

CT colonography identified 10 patients (45%) as having normal findings. Bowel wall thickening was observed in 4 patients (18%), and polypoid lesions were detected in 8 (36%). Among the 10 patients deemed normal on CT colonography, 8 were also assessed as normal by conventional colonoscopy (Figure 1).

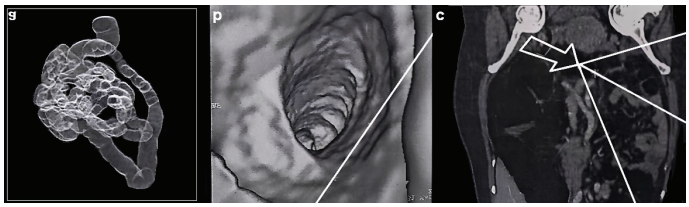

Figure 1. Normal computed tomography colonography (a), virtual endoluminal image (b) and coronal multiplanar reformatted image (c).

Histopathological analysis of lesions identified through conventional colonoscopy revealed the following: inflammatory bowel disease in 6 cases (26%), tubular adenoma in 2 cases (8.7%), tubulovillous adenoma in 1 case (4.3%), and adenocarcinoma in 3 (%13) cases. Of the 9 polypoid lesions examined histopathologically, 1 (11%) was associated with inflammatory bowel disease, 2 (22%) with tubular adenoma, 1 (11%) with tubulovillous adenoma, and 3 (33%) with adenocarcinoma (Table 1).

The overall sensitivity of CT colonography for polypoid lesions, regardless of size, was 89%. Sensitivity was 50% for lesions smaller than 1 cm and 100% for lesions larger than 1 cm (Table 2).

When polypoid lesions were evaluated according to their histology, the sensitivity of CT Colonography was found to be 50% in tubular adenoma, 100% in tubulovillous adenoma, and 100% in adenocarcinoma (Table 3) (Figure 2) (Figure 3).

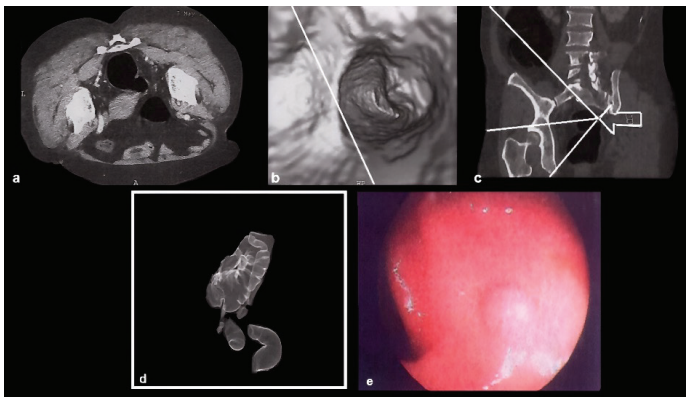

Figure 2. 0.5 mm polyp in rectum, 2D axial section (a), virtual endoluminal image (b) coronal multiplanar reformatted image (c) Polyp in virtual colonoscopy (d) conventional colonoscopy (e).

Table 1. Classification of polypoid masses detected by conventional colonoscopy based on size and histology.					
Size	Tubular Adenoma	Tubulovillous Adenoma	Adenocarcinoma	Inflammatory Bowel Disease	Total
Less than 1 cm (<1cm)	2 (22%)				2
Equal and greater than 1 cm (≥1cm)		1 (11%)	3 (33%)	1 (11%)	5
Total	2 (22%)	1 (11%)	3 (33%)	1 (11%)	7

Table 2. Sensitivity of computed tomography colonography in detecting polypoid lesions based on size.				
Category	Total	True Positive	False Negative	Sensitivity
All polypoid lesions	9	8	1	89%
Less than 1 cm (<1cm)	2	1	1	50%
Equal and greater than 1 cm (≥1cm)	7	7	0	100%

Table 3. Sensitivity of computed tomography colonography in detecting polypoid lesions based on histology.				
Histology	Total	True Positive	False Negative	Sensitivity
Tubular Adenoma	2	1	1	50%
Tubulovillous Adenoma	1	1	0	100%
Adenocarcinoma	3	3	0	100%

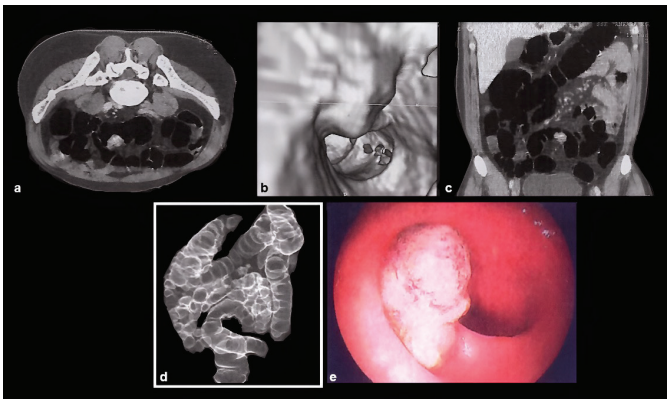

Figure 3. 3 cm polyp in sigmoid colon , 2D axial section (a), virtual endoluminal image (b), coronal multiplanar reformatted image (c), Polyp in virtual colonoscopy (d) and conventional colonoscopy (e).

Discussion

CRC is a significant public health issue, leading to substantial morbidity and mortality. Common diagnostic methods for colorectal cancer include the faecal occult blood test, flexible sigmoidoscopy, double-contrast barium enema, and colonoscopy.

Colonoscopy is considered the gold standard for colorectal evaluation as it provides direct visualisation of the mucosa and serves both diagnostic and therapeutic purposes. While numerous techniques are available for imaging the colon, each has its limitations. A critical aspect of colorectal examination is achieving complete visualisation of the entire colon.

CT colonography has emerged as the most effective radiological procedure for diagnosing colorectal neoplasms and is the leading non-invasive modality for this purpose. Consequently, it is recommended as the preferred radiological examination for the clinical evaluation of colorectal neoplasms [7]. CT colonography exposes patients to minimal radiation while eliminating the risks associated with intubation and sedation. It is particularly suitable for patients who are unable or unwilling to undergo traditional colonoscopy or sedation [8].

In one of the earliest studies on CT colonography, Hara et al. evaluated 30 endoscopically confirmed polyps. They reported a sensitivity of 100% for polyps larger than 1 cm, 71% for polyps measuring 0.5–0.9 cm, and 28% for polyps smaller than 0.5 cm [9]. In a separate study involving 70 patients, the sensitivity of CT colonography was found to be 75% for lesions larger than 1 cm, 66% for adenomatous polyps measuring 5–10 mm, and 45% for polyps smaller than 5 mm [10]. Fletcher et al., in their study of 180 patients, reported a patient-based sensitivity of 85% and specificity of 93% for polyps 1 cm or larger, with a polyp-based sensitivity of 75% [11]. In another study conducted by Hara et al. involving 237 high-risk patients, the patient-based sensitivity was 100%, specificity was 90%, and polyp-based sensitivity for polyps 1 cm or larger was 89% [12]. Yee et al., in a study with 300 patients, found a patient-based sensitivity of 100% and a polyp-based sensitivity of 93% for polyps 1 cm or larger [13]. Additionally, Mulhall et al. conducted a meta-analysis involving 6,393 patients across 33 trials, further reinforcing the diagnostic utility of CT colonography. The sensitivity of CT colonography varies depending on polyp size, with higher sensitivity observed

for larger polyps. For polyps smaller than 6 mm, sensitivity was reported at 48% (95% CI: 25%–70%), increasing to 70% (95% CI: 55%–84%) for polyps measuring 6–9 mm, and 85% (95% CI: 79%–91%) for polyps larger than 9 mm [14]. In a study by Sato et al., CT colonography accurately identified 86 out of 87 central colon tumours. By utilising CT colonography and excising one minor lesion, they successfully detected all 87 tumours. The authors suggest that clipping could be further explored as a technique for diagnosing small tumours, particularly those less than 10 mm in diameter [15]. Weinberg et al. found that CT colonography demonstrated a sensitivity of 44.0% (95% CI: 30.2%–57.8%) and a specificity of 93.4% (95% CI: 89.7%–97.0%) for polyps smaller than 6 mm. For polyps smaller than 10 mm, the sensitivity was 76.9% (95% CI: 54.0%–99.8%) and the specificity was 89.0% (95% CI: 84.8%–93.1%) [16]. In a study conducted by Royster et al. involving 20 patients with suspected colorectal cancer, all lesions measuring 2 cm or larger were successfully detected, yielding a sensitivity of 100% [17]. In our study, 8 out of 9 polypoid lesions identified through conventional colonoscopy were also detected by CT colonography. The overall sensitivity of CT colonography for detecting polypoid lesions, irrespective of size, was determined to be 89%.

In our study, CT colonography demonstrated a sensitivity of 100% for detecting colorectal cancers. One of its significant advantages is the ability to evaluate both intraluminal and extraluminal regions by combining 3D endoluminal views (virtual colonoscopy) with 2D multiplanar MPR images. This capability allows for precise localization of lesions in relation to extraluminal structures. Additionally, CT colonography provides a bidirectional endoscopic view of the colon, enabling the detection of polyps hidden behind haustral folds, which may be missed during conventional colonoscopy. It also offers several other advantages, including the assessment of bowel wall thickening, evaluation of extracolonic structures and pathologies, and simultaneous screening for recurrence and metastasis in patients who have undergone surgery for colorectal cancer. Moreover, in cases of obstructive carcinoma, CT colonography can assess the proximal colon and detect synchronous tumors, offering a critical diagnostic advantage. This technique is particularly valuable when structural abnormalities, such as colonic obstruction, preclude the complete evaluation of the colon. Identifying proximal lesions can significantly impact surgical planning, as undiagnosed lesions may necessitate additional surgeries or compromise the effectiveness of radical treatment [18]. Fenlon et al., in a study of 34 patients with occlusive distal colon cancer identified via endoscopy, reported additional cancers in the proximal colon in 17 patients. In another study involving 29 patients, CT colonography successfully detected all 29 cases of occlusive cancer, along with 24 polyps and two proximal colon cancers. In our study, no additional cancers were identified. Conventional colonoscopy carries a small but significant risk of serious complications. The perforation rate during screening colonoscopy without polypectomy is approximately 0.056%, increasing to 0.062%–0.082% for colonoscopies overall [19-21]. In one case within our study, massive bleeding occurred as a complication during polypectomy. This underscores the potential of CT colonography as a safer alternative to conventional colonoscopy, particularly for patients at higher risk of complications. In our cohort, complete visualization of the colon was not achieved in 18% of patients using conventional colonoscopy. However, CT colonography successfully provided full colonic imaging in these cases. One of the major advantages of CT colonography is its ability to simultaneously evaluate extracolonic organs within the pelvis and abdomen, offering additional diagnostic value beyond the colon itself.

The primary disadvantages of CT colonography include the necessity for thorough bowel preparation, as residual stool and fluid can obscure colorectal pathology. Another limitation is the occasional insufficient distension of the rectosigmoid region, which can hinder adequate evaluation. Inadequate distension or collapse of colonic segments complicates the interpretation of the images. Additionally, CT colonography may exhibit lower sensitivity for detecting flat polyps, such as sessile serrated adenomas, compared to conventional polypoid lesions.

Limitations of the Study

This study has several noteworthy limitations. The most significant is the relatively small sample size, which may reduce the applicability of the results to a broader population. Moreover, the study did not include any cases of occlusive tumours, limiting the evaluation of CT colonography's performance in such critical conditions. CT colonography also has inherent drawbacks. One concern is the cumulative radiation exposure associated with repeated scans, which poses a potential long-term risk. Additionally, the detection of incidental findings may lead to unnecessary follow-up investigations, increasing healthcare costs and patient anxiety. The technique's utility is further constrained by the limited number of specialized radiologists and imaging facilities capable of offering the procedure.

Another major limitation of CT colonography is its inability to assess mucosal texture and colour changes, which are crucial in identifying certain pathologies. Virtual colononoscopy can be false positives due to artifacts such as pseudopolyps from fecal residue and segmental spasms.

In conclusion, unlike conventional colonoscopy, CT colonography does not allow for biopsy or therapeutic interventions, making the former a superior choice for both diagnostic and treatment purposes when direct mucosal assessment is required. This study demonstrates that CT colonography has a sensitivity of 89% for detecting colorectal polypoid lesions, underscoring its reliability in identifying significant pathologies. As a non-invasive and relatively safe imaging modality, CT colonography offers several advantages over traditional screening methods, including complete colonic visualization and the detection of extracolonic findings. Its high diagnostic accuracy and safety profile make CT colonography a valuable alternative for colorectal cancer screening, particularly in patients who are unable or unwilling to undergo conventional colonoscopy. Furthermore, its ability to detect polyps and early-stage cancers in a selected patient population highlights its potential as a key tool in the early detection and management of colorectal neoplasms.

Ethics Committee Approval

This thesis study was conducted with the permission of the Radiology Department of Social Security Institution Dışkapı Ankara Training Hospital (ethical approval date: 18.07.2022 no: 08)

Conflict of interest statement

The authors declared no conflicts of interest for the authorship and/or publication of this article.

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Research Article

Admission Complaints and Results of Patients with Solid Organ Malignancy Who Were Applied to the Emergency Internal Medicine Department

Acil Dahiliye Polikliniğine Başvuran Katı Organ Maligniteli Hastaların Başvuru Şikayetleri ve Sonuçları

Serdar Ata*[1], Isil Bavunoglu[2]

[1]Afyonkarahisar State Hospital, Medical Oncology, Afyonkarahisar, Turkey

[2]Cerrahpasa School of Medicine, Istanbul University-Cerrahpasa, Department of Internal Medicine, İstanbul, Turkey

Abstract

Aim: In parallel with the increase in the prevalence of cancer, it is inevitable that the frequency of cancer patients presenting to the emergency department will also increase. The aim of this study was to analyze the primary diagnoses, treatments and outcomes of patients with solid organ malignancy admitted to the emergency internal medicine polyclinic.

Material and Methods: Patients with solid organ malignancy who were admitted to Cerrahpaşa Emergency Internal Medicine Polyclinic between 01.06.2009-31.05.2010 and whose examinations were completed and a conclusion was reached were included in this prospective observational study.

Results: There were a total of 1316 admissions of 930 patients. Among the patients 353(26.8%) were followed up for lung cancer, 161(12.2%) for breast cancer, and 124(11.9%) for colorectal cancer. 511(38.8%), 369(28%) and 266(20.2%) of the admissions were due to shortness of breath, fatigue and fever, respectively. Treatment of 596(45.2%) patients evaluated in emergency polyclinic and discharged; 348(26.4%) were referred to medical oncology polyclinic; 186(14.1%) were hospitalized; 123(9.3%) were admitted to intensive care unit; 30(2.2%) left the emergency department voluntarily during their treatment; 22(1.6%) were transferred to the emergency surgery polyclinic and 3(0.2%) died in the emergency internal medicine polyclinic during their treatment.

Conclusion: Increasing emergency admissions in cancer patients with increasing life expectancy necessitates training of healthcare personnel and re-organization of emergency units in this direction. In addition, the creation of separate units with appropriate equipment and space for the care and treatment of these patients for both acute problems and end-stage care may improve the service provided.

Keywords: Oncological Emergencies, Emergency Department, Cancer

Corresponding Author*: Serdar Ata, Afyonkarahisar State Hospital, Medical Oncology, Afyonkarahisar, Turkey.
E-mail: drserdarata@gmail.com
Orcid: 0000-0002-8269-9884
Doi: 10.18663/tjcl.1603399
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Öz

Amaç: Kanser prevalansındaki artışa paralel olarak acil servise başvuran kanser hastalarının sıklığının da artması kaçınılmazdır. Bu çalışmanın amacı acil dahiliye polikliniğine solid organ malignitesi nedeniyle başvuran hastaların primer tanılarını, tedavilerini ve sonuçlarını analiz etmektir.

Gereç ve Yöntemler: Kesinleşmiş solid organ malignitesi olan ve 01.06.2009-31.05.2010 tarihleri arasında Cerrahpaşa Acil Dahiliye Polikliniğine başvuran ve tetkikleri tamamlanıp sonuca varılan hastalar prospektif gözlemsel çalışmaya dahil edildi.

Bulgular: Toplam 930 hastaya ait 1316 yatış vardı. Hastaların 353'ü (%26,8) akciğer kanseri, 161'i (%12,2) meme kanseri ve 124'ü (%11,9) kolorektal kanser tanısı mevcuttu. Başvuruların 511'i (%38,8) nefes darlığı, 369'u (%28) yorgunluk ve 266'sı (%20,2) ateş nedeniyle yapılmıştı. Acil polikliniğinde değerlendirilen ve taburcu edilen 596 (%45,2) hastanın tedavisi yapılarak taburcu edilmiş, 348 (%26,4) hasta tıbbi onkoloji polikliniğine yönlendirilmişti, 186 (%14,1) hasta hastaneye yatırılmıştı; 123 (%9,3) hasta yoğun bakıma alınmıştı; 30 (%2,2) hasta tedavileri devam ederken acil servisten kendi isteğiyle ayrılmıştı; 22 (%1,6) hasta acil cerrahi polikliniğine transfer edilmişti ve 3 (%0,2) hasta tedavileri sırasında acil dahiliye polikliniğinde hayatını kaybetmişti.

Sonuç: Yaşam beklentisinin artmasıyla birlikte kanser hastalarında acil başvuruların artması, sağlık personelinin eğitilmesini ve acil ünitelerin bu yönde yeniden düzenlenmesini gerektirmektedir. Birçok sebeple tekrarlayan acil servis başvurusu olan bu hastaların hem akut sorunları hem de son dönem bakımı için uygun donanım ve mekâna sahip ayrı ünitelerin oluşturulması verilen hizmetin kalitesini artıracaktır.

Anahtar kelimeler: Onkolojik acil, acil servis, kanser

Introduction

While the incidence of cancer is increasing, it is gradually being included in the scope of chronic diseases with the new treatments developed and the life expectancy of patients is prolonged. As this period increases, the incidence of side effects related to the cancer itself or the treatments given also increases. In cancer disease, which requires a coordinated approach between patients and physicians, patients are likely to consult the emergency department with various complaints. These admissions may be oncological emergencies, as well as treatment-related complications and other chronic factors [1]. While some oncological emergencies take months to develop, others develop within hours and may lead to death [2].

Frequent oncological emergencies have been classified into 4 categories: metabolic (tumor lysis syndrome, hypercalcemia, irregular antidiuretic hormone release), hematological (febrile neutropenia, hyperviscosity syndrome), structural (superior vena cava syndrome, pericardial effusion, spinal cord compression) and treatment-related [3]. All these conditions are reversible with timely diagnosis and appropriate treatment.

The aim of this study was to investigate the reasons and outcomes of emergency department admissions of patients with a diagnosis of cancer.

Material and Methods

Patients over 18 years of age who were admitted to Cerrahpaşa Emergency Internal Medicine Polyclinic between 01.06.2009 and 31.05.2010 and who were diagnosed with solid organ malignancy according to the biopsy results before admission were prospectively included in the study. Approval for this study was obtained from the ethics committee of Istanbul University Cerrahpasa School of Medicine with the number 21451. Informed consent form was obtained from the patients. As a result of the analyses and examinations, the diagnoses of the patients in the emergency department and the follow-up of the patients were evaluated. The study has been conducted in accordance with the Declaration of Helsinki. All people included in the study signed the informed consent form.

Patients whose primary disease diagnosis was unknown at the time of admission, who were referred for malignancy examination from an external center or who presented with non-specific complaints and were referred to internal medicine polyclinics for further examination with a preliminary diagnosis of malignancy, patients who were evaluated in the emergency department and left the emergency department without a definitive diagnosis, and non-solid organ hematological malignancies were not included in the study.

Statistical Analysis

Data were analyzed with SPSS 21.0 for Windows statistical package program. Normally distributed numerical data were expressed as mean ±SDS, non-normally distributed numerical data were expressed as median (minimum-maximum).

Results

During the 12-months study period, there were 12609 admissions to Cerrahpaşa Emergency Internal Medicine polyclinic and 4068 (32.2%) of these admissions were hospitalized for observation, examination and treatment. In the analyses performed, 1316 admissions of 930 patients with a diagnosis of solid organ malignancy were included in the study. This number constituted 10.4% of all admissions and 32% of observation hospitalizations. Another 523 patients with hematological malignancy were not included in the study. Of the patients included in the study, 481 (51.8%) were male and 449 (48.2%) were female (Table 1).

When the primary diagnoses of 1316 patients with solid organ malignancy were analyzed, 353 were lung cancer (26.8%), 161 were breast cancer (12.2%), 124 were colon cancer (9.4%), 102 were gastric cancer (7.7%) and 576 were other (43.9%) (Table 2). Some of the patients admitted to the emergency department had more than one complaint. When the reasons of admission of the patients who applied to the emergency department for one or more reasons were analyzed, at least 2 or more complaints were present in 1010 applications. When the complaints were analyzed individually, 511 patients presented with shortness of breath (38.8%), 369 patients with fatigue (28.0%), 266 patients with fever (20.2%), 210 patients with abdominal pain (15.9%), 198 patients with nausea and vomiting (15.0%) (Table 3). While 50.8% of the patients presenting with dyspnea had a diagnosis of lung cancer, 49.2% had other cancers. Among patients presenting with cough, 43.3% had a diagnosis of lung cancer and 56.7% had other cancers.

It was found that 442 (33.5%) of the total patient admissions were due to complaints related to primary malignancy and its metastasis. As a result of other admissions, 182 pneumonia (6 of which were aspiration pneumonia) (13.8%), 151 hypercalcemia (11.4%), 96 urinary tract infection (7.2%), 91 anemia (6.9%), 90 sepsis (6.8%), 70 hyperpotassemia (5.3%), 54 febrile neutropenia (4.1%) and 140 (11%) other diagnoses have been detected.

Of the 58 patients who were referred from the Medical Oncology polyclinic and admitted to the emergency department; 28 with erythrocyte suspension replacement (48.2%), 9 with platelet suspension replacement (15.5%), 7 with electrolyte disorders (12.0%) [4 with hypercalcemia (6.8%), 3 with hyperpotassemia (5.2%)], 4 with dyspnea (6.8%), 3 were referred for unconsciousness (5.1%), 2 for abdominal pain (3.4%), 2 for ascites drainage (3.4%), 1 for hypoglycemia (1.7%), 1 for headache (1.7%) and 1 for urgent CT scan (1.7%).

Of the total admissions, 596 (45.2%) were treated in the emergency polyclinic and discharged, 348 (26.4%) were referred to the medical oncology polyclinic, 186 (14.1%) were admitted to the service, 123 (9.3%) were admitted to the intensive care unit, 3 (0.2%) died in the emergency internal medicine polyclinic during their treatment and 60 (4.8%) patients were admitted to other services.

Table 1. Clinical and demographic findings of the patients.

Age (years)	Median, (min.-max)	(min.-max)
	58, 24-83	24-83
Gender	N	%
Male	682	51.8
Woman	634	48.2
Emergency service admissions/year	N	%
One	758	81.5
>1	172	18.5
Results	N	%
Hospitalization	369	28
Treated and discharged	944	71.8
Death	3	0.2

Table 2. Cancer localization.

Localization	%(n)
Lung	26.8% (353)
Breast	12.2% (161)
Gastrointestinal	
Colon	9.4% (124)
Stomach	7.7% (102)
Pancreas	4.7% (63)
Liver	2.9% (39)
Rectum	2.5% (33)
Bile ducts	0.9% (13)
Esophagus	0.8% (11)
Genitourinary	
Bladder	4.2% (56)
Prostate	4.0% (53)
Kidney	2.3% (31)
Testis	0.5% (7)
Gynecological	
Over	4.1% (54)
Cervix	2.2% (30)
Uterus	1.5% (20)
Head-neck	3.2% (43)
Central nervous system	2.7% (36)
Soft tissue sarcoma	1.5% (21)
Bone	1.5% (20)
Mesothelioma	0.7% (10)
Malignant melanoma	0.6% (8)
Thyroid	0.5% (7)
Primary unknown	1.5% (21)

Table 3. Admission complaints.	
	% (n)
Shortness of breath	38.8% (511)
Weakness	28.0% (369)
Fever	20.2% (266)
Stomach-ache	15.9% (210)
Nausea/vomiting	15.0% (198)
Dysuria	7.3% (97)

Discussion

The proportion of oncology patients with urgent problems among patients admitted to all emergency polyclinics, especially to the emergency polyclinics of training research and university hospitals with oncology centers where malignancy patients are treated, is increasing day by day.

As reported in the studies conducted by Bozdemir et al. [4] at Akdeniz University and Yaylacı et al. [5] at Dokuz Eylül University, emergency admissions may be related to the progression of terminal disease, easier accessibility of emergency service compared to polyclinic service, and admissions of patients whose hospitalization was postponed due to bed occupancy. In these two studies, the frequency of oncological patients in all emergency admissions was given (174 patients (0.65%); 324 patients (1.30%), respectively). Our study, however, only included the frequency of solid organ malignancies among emergency internal medicine emergency department admissions. Since the frequency of malignancies admitted to other emergency polyclinics within our hospital is not known, we could not comment on the total rate of patients with malignancies admitted to the emergency department. However, when compared on the basis of the number of admissions, the number of patients with solid organ malignancies in our study is much higher, although there are emergency polyclinics with similar density.

In our study, 51.8% of the patients were male and the median age was 58 (24-83) years. In two studies from Turkey; Yaylacı et al. [5] had a male patient ratio of 55.7% and a median age of 58 years; Bozdemir et al. [4] had a male patient ratio of 49.7% and a median age of 60 years, with mean age and gender distributions similar to our study. In the study by Kerrouault et al [6], 65% of the patients were male and the mean age was 62 years. When evaluated together with other studies conducted in Turkey, we think that the mean age of the patients may be different due to the different ages of cancer diagnosis, due to effective screening policies in different countries or because access to treatment and supportive therapies vary between countries.

Oncological patients have recurrent emergency admissions. The reason for this may be explained by the fact that patients can reach emergency departments more easily and emergency departments provide 24-hour uninterrupted service and out-of-hours patients apply to emergency departments because they cannot reach their primary physician. In our study, the median number of admissions per patient in a one-year period was 1 (1-6). In the study by Muallaoğlu et al. [7] the median number of emergency admissions was 2. The reason for this difference may be related to the fact that patients can reach their primary physicians and find a solution to their emergency problems in this way.

When the distribution according to the diagnosis at presentation was analyzed, it was found that lung cancer ranked first, followed by breast and colorectal cancers. Similar distribution of cancer diagnoses was found in the study by Ferrer et al [8]. The reason for this is that there is a harmonious distribution between the frequency of cancer diagnosis and the cancer diagnoses of patients presenting to the emergency department. The only cancer type that draws attention here is prostate cancer. Although it ranked high in terms of frequency, it was ranked eighth among the patients admitted to the emergency department. We believe that the frequency of application is low because the complaints related to prostate cancer are mostly chronic and these complaints can be solved in polyclinic conditions.

The most common symptoms are general symptoms such as increasing breathlessness, progressive weakness, pain and fever [9]. These symptoms usually become prominent in the later stages of the disease and may be indicators of terminal illness. In the studies by Ferrer A. et al. [8] and Swenson et al. [10] the two most common complaints of patients presenting to the emergency department were fever and shortness of breath, respectively. In our study, shortness of breath ranked first among the complaints, while fever ranked second. The change in the ranking may be explained by the high rate of lung cancer in the patients in our study. In addition, since hematological cancers were not included in our study, patients with febrile neutropenia, which occurs with a frequency of 33% per chemotherapy in this group, were excluded from the study [11]. In the study conducted by Bozdemir et al. [4] 23% of cancer patients admitted to Akdeniz University Faculty of Medicine Emergency Polyclinic were gastrointestinal system cancer, 22% were lung cancer and 18% were breast cancer. Among the patients, 24% presented with pain, 17% with dyspnea and 14% with nausea and vomiting. As seen in

this study, the complaint of shortness of breath is in parallel with the rate of patients with lung cancer. Furthermore, it is important to remember that dyspnea is not always seen in patients with primary lung cancer; it may also occur due to lung or pleural metastases of other cancers.

When the reasons for referral of the patients from the Medical Oncology polyclinic were analyzed, it has been determined that most of the patients (37 patients) were referred for replacement (erythrocyte suspension and thrombopheresis) treatments. It was thought that this may be due to the fact that the procurement of the necessary blood products for the patients for whom replacement was decided during the polyclinic control was delayed until after working hours. It was concluded that referring this group of patients to the emergency polyclinic only when urgent replacement is required with adequate information may be effective in reducing the patient density in the emergency department. In other studies, emergency polyclinic referrals for this reason were not found [4,8-10].

Barrett et al. [9] reported that 23% of patients with lung cancer have been hospitalized. In our study, this rate was 26% (92 patients) and was similar to other studies. Among the patients, 48 were hospitalized in the oncology service, 42 in the adult intensive care unit and 2 in the coronary intensive care unit. Patients admitted to intensive care unit were terminal malignancy patients with respiratory failure and/or infection. Three patients died while they were being treated in the emergency internal medicine polyclinic.

In conclusion, cancer patients are admitted to emergency clinics with more and more complex problems due to the increase in the number of cancer patients, prolonged survival with new treatment protocols and receiving more line treatment. This situation necessitates the training of healthcare personnel and the re-organization of both emergency units and the services and polyclinics serving these patients in this direction. In addition, we think that the creation of separate units with appropriate equipment and space for the care and treatment of these patients for both acute problems and end-stage care may improve the service provided.

Ethical Approval

Approval for this study was obtained from the ethics committee of Istanbul University Cerrahpasa School of Medicine with the number 21451.

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Conflict of interest

None declared.

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Research Article

Demographic and clinical characteristics in disability assessment of sleep disorder patients

Uyku bozukluğu hastalarının engellilik değerlendirmesinde demografik ve klinik özellikler

Sule Deveci*, Ulku Dubus Hos

Department of Neurology, Başakşehir Çam and Sakura City Hospital, Istanbul, Turkey

Abstract

Aim: This study aimed to investigate the impact of demographic and clinical characteristics in the disability assessment of patients with sleep disorders.

Material and Methods: A retrospective analysis was conducted on 122 patients referred for disability evaluations related to sleep disorders. Demographic data, clinical parameters, and disability outcomes were analyzed. Key parameters such as the Epworth Sleepiness Scale (ESS), Apnea-Hypopnea Index (AHI), and the presence of other sleep disorders were assessed across patient subgroups.

Results: Patients applying for military service eligibility assessments had a mean age of 25.3 ± 8.7 years and a median ESS score of 7. Obstructive sleep apnea syndrome (OSAS) was present in 37.5% of cases. Fifty percent of these patients were deemed unfit for military service. Patients applying for health reports for driver's licenses had a mean age of 47.6 ± 5.6 years and a mean body mass index (BMI) of 35.3 ± 8.6 kg/m^2. Severe OSAS was diagnosed in most cases, and eligibility for driver's licenses was confirmed for all patients. Patients applying for disability reports had a mean age of 47.7 ± 9.2 years, a mean BMI of 34.4 ± 6.8 kg/m^2, and a median AHI of 40. Severe OSAS was diagnosed in 79.5% of those granted disability retirement. Excessive daytime sleepiness was significantly less common in this group compared to other disability subgroups.

Conclusions: Severe OSAS plays a prominent role in functional impairment and disability assessments, particularly in high-risk occupational settings. Other sleep disorders and sleep duration variations also influence disability outcomes, underlining the need for comprehensive sleep evaluations in disability determinations.

Keywords: sleep disorders, obstructive sleep apnea, disability evaluation, military service, driver's licenses, excessive daytime sleepiness

Corresponding Author*: Sule Deveci, Department of Neurology, Başakşehir Çam and Sakura City Hospital, Istanbul, Turkey.
E-mail: suledeveci75@gmail.com
Orcid:0000-0002-3863-9171
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Öz

Amaç: Bu çalışma, uyku bozukluğu olan hastaların engellilik değerlendirmelerinde demografik ve klinik özelliklerin etkisini araştırmayı amaçlamıştır.

Gereç ve Yöntemler: Uyku bozukluklarıyla ilgili engellilik değerlendirmelerine yönlendirilen 122 hasta üzerinde retrospektif bir analiz yapılmıştır. Demografik veriler, klinik parametreler ve engellilik sonuçları analiz edilmiştir. Epworth Uykululuk Ölçeği (EUÖ), Apne-Hipopne İndeksi (AHİ) ve diğer uyku bozukluklarının varlığı gibi temel parametreler hasta alt grupları arasında değerlendirilmiştir.

Bulgular: Askerlik hizmeti uygunluk değerlendirmeleri için başvuran hastaların ortalama yaşı 25,3 ± 8,7 yıl ve ortanca EUÖ puanı 7 idi. Obstrüktif uyku apne sendromu (OUAS) vakaların %37,5'inde mevcuttu. Bu hastaların %50'si askerlik hizmeti için uygun görülmedi. Bu hastaların yarısı askerlik için uygun bulunmamıştır. Sürücü belgesi sağlık raporu için başvuran hastaların ortalama yaşı 47,6 ± 5,6 yıl, ortalama vücut kitle indeksi (VKİ) 35,3 ± 8,6 kg/m^2 olarak saptandı. Vakaların çoğunda şiddetli OUAS teşhis edilmiş ve tüm hastalar için sürücü belgesi uygunluk raporu verilmiştir. Engellilik raporu için başvuran hastaların ortalama yaşı 47,7 ± 9,2 yıl, ortalama VKİ değeri 34,4 ± 6,8 kg/m^2 ve median AHİ değeri 40 olarak bulundu. Engellilik nedeniyle emeklilik hakkı tanınan hastaların %79,5'inde şiddetli OUAS teşhis edilmiştir. Aşırı gündüz uykululuğu bu grupta diğer engellilik alt gruplarına göre belirgin şekilde daha az yaygın bulunmuştur.

Sonuçlar: Şiddetli OUAS, işlevsel bozulma ve engellilik değerlendirmelerinde önemli bir rol oynamaktadır, özellikle yüksek riskli meslek gruplarında daha belirgindir. Diğer uyku bozuklukları ve uyku süresindeki değişiklikler de engellilik sonuçlarını etkilemektedir. Bu durum, engellilik belirlemelerinde kapsamlı uyku değerlendirmelerinin önemini vurgulamaktadır.

Anahtar Kelimeler: uyku bozuklukları, obstrüktif uyku apnesi, engellilik değerlendirmesi, askerlik hizmeti, ehliyetler, aşırı gündüz uykululuğu

Introduction

Sleep disturbances involve a broad spectrum of conditions, including insomnia and obstructive sleep apnea (OSA) to hypersomnia and parasomnias, all of which can substantially disrupt physical, mental, and emotional functioning [1]. These conditions are widespread across the globe, with current estimates indicating that as many as one in three adults will encounter sleep disorder symptoms at some stage in their lives [2].

The functional limitations resulting from sleep disorders can substantially diminish individuals' performance in social, occupational, and personal spheres [3,4]. Patients diagnosed with OSA syndrome (OSAS) or chronic insomnia often experience impairments in attention, memory, executive functions, psychomotor skills, and mood regulation [5,6]. Such impairments can lead to increased risk of work-related accidents, productivity losses, higher employee turnover, and escalating healthcare costs [7-9]. Hence, the association between sleep disorders and disability continues to continues to be a significant focus of research. Patients with sleep disorders may face challenges in employment, social interactions, and self-care activities, necessitating formal disability assessments [10,11]. However, the complexity of these disorders, compounded by patient variations in demographic characteristics and clinical factors, makes the evaluation process particularly challenging for clinicians.

Demographic and clinical characteristics can play a key role in understanding the disability status of patients with sleep disorders. Factors such as age, gender, obesity, the type of sleep disorder, the frequency of symptoms, and associated mental health issues can significantly influence the severity of the disorder, its impact on daily life, and the degree of disability [12-14]. Despite this, the integration of such characteristics into standardized disability assessment protocols remains inconsistent, highlighting a critical gap in the literature. Therefore, this study aimed to investigate the impact of demographic and clinical characteristics in the disability assessment of patients with sleep disorders.

Material and Methods

This retrospective study was conducted on patients diagnosed with a sleep disorder at the Neurology Clinic of Başakşehir Çam and Sakura City Hospital between August 2020 and April 2023. The study was approved by the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (Date: 19.04.2023, Decision No: 154), and was carried out in accordance with the relevant ethical guidelines and the Helsinki Declaration (2013 Brazil revision).

During the study period, 127 patients diagnosed with a sleep disorder were retrospectively reviewed. Inclusion criteria consisted of patients over 18 years of age who had both a sleep disorder diagnosis and an assigned disability score. Patients under 18 years of age, those without a sleep disorder, and those who did not receive a disability score were excluded from the study. The hospital's electronic information system and patient files were used to gather demographic and clinical data.

Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) was administered face-to-face at the time of patients' hospital visits, and the data were collected retrospectively. This questionnaire consists of eight questions, each asking when and under what circumstances the patient tends to doze off during the day. Each question is scored from 0 to 3, where 0 indicates "no chance of dozing," 1 indicates "slight chance of dozing," 2 indicates "moderate chance of dozing," and 3 indicates "high chance of dozing." Total scores span from 0 to 24, and a higher score correlates with increased daytime sleepiness. An ESS score of 11 or more was categorized as excessive daytime sleepiness, with mild severity assigned to scores between 11 and 12, moderate severity for 13–15, and severe for 16–24 [15].

Polysomnography evaluation

All patients' polysomnography examinations, which were previously requested for snoring and various reasons, were taken in rooms suitable for sleep at night and recorded sleep data were scored manually according to standard criteria based on the American Academy of Sleep Medicine (AASM) Manual for the Scoring of Sleep and Associated Events, Version 2.6, released in 2020. In the recording montage, 3-channel electroencephalography (F4-M1, C4-M1, O4-M1), two-channel electrooculography, one-channel submental electromyography, right and left tibialis anterior electromyography, body position, oro-nasal thermal sensor, nasal pressure sensor, thoracic and abdominal respiratory movements, electrocardiography, respiratory sound recording, oxygen (O2) saturation and synchronous video recording were used to record abnormal respiratory events related to sleep. The polysomnography data of the patients were retrospectively examined according to the patients' polysomnography monitoring results. AHI, average oxygen saturation (A-SPO2) and minimum oxygen saturation (M-SPO2) data were recorded in the scoring. Apnea events were defined as a ≥90% decrease in respiratory amplitude lasting at least 10 seconds. Hypopneas were defined as a ≥30% decrease in airflow compared to baseline and a ≥3% oxygen desaturation from pre-event baseline or the event associated with an arousal for 10 seconds with an electroencephalography stimulus. The average number of apnea and hypopnea episodes per hour of sleep is measured as AHI [16]. Patients will be divided into 4 groups according to their AHI scores: those with AHI < 5 simple type snoring, mild OSAS (5 ≤ AHI < 15), moderate OSAS (15 ≤ AHI < 30) and severe OSAS (AHI ≥30) [17].

Rapid eye movement (REM) without atonia sleep was defined as increased tonic or phasic muscle activity during REM sleep. Bruxism was described as repetitive masticatory muscle activity characterized by clenching or grinding of the teeth. Periodic limb movement (PLM) disorder (PLMD) was defined as stereotypical, repetitive, non-epileptiform movements of the lower extremities, typically occurring during non-REM sleep. Narcolepsy was defined as a rapid-onset REM sleep disorder characterized by excessive daytime sleepiness, frequent uncontrollable sleep attacks, and sleep fragmentation [16, 18].

Assessment of disability status

In accordance with the disability assessment procedures regulation issued in 2013, Disability scoring was calculated using the Baltazar formula. Under these guidelines, the insomnia group receives a maximum of 10 disability points. For those with sleep-disordered breathing, disability points are determined by the apnea-hypopnea index: 5 points for mild cases, 10 points for moderate cases, and 35 points for severe cases. A maximum of 35 disability points is given to the hypersomnia group, which includes narcolepsy and idiopathic hypersomnia. Circadian rhythm disorders, sleep movement disorders (including bruxism), and parasomnias are assigned a maximum of 10 disability points. For cases of REM sleep behavior disorder parasomnia, 35 disability points are allocated. If the total disability score is less than 40%, it is considered "no disability." Scores ranging from 40% to 60% are categorized as "workforce loss" whereas scores over 60% are classified as "disability (retirement)" [19].

Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA) software. The normal distribution of numerical variables was assessed using the Kolmogorov-Smirnov test. Data exhibiting a normal distribution were presented as mean ± standard deviation, and comparisons between groups were made using the Student's T-test. Non-normally distributed data were displayed as median (interquartile range (IQR): 25-75 percentiles) and comparisons between groups were conducted using the Mann-Whitney U test. Value of $P < 0.05$ were considered statistically significant.

Results

Study population

This study involved 122 patients with sleep disorders, including 99 evaluated for disability reports, 8 for military service eligibility reports, and 15 for health reports for driver's licenses. The mean age of patients was 46.2 ± 10.4 years (range: 19–72). The majority were male (91%) and obese (73.0%). Among all patients, the median ESS score was 11 (range: 0–24), and excessive daytime sleepiness was observed in 45.9% of cases. The median AHI score was 38.5 (range: 0–141), with OSAS diagnosed in 94.3% of the patients.

Patients applying for eligibility for military service

The mean age of patients applying for military service eligibility

assessments was 25.3 ± 8.7 years, with a mean body mass index (BMI) of 26.1 ± 3.1 kg/m^2. Their median ESS score was 7 (IQR: 4.5–11.0), and excessive daytime sleepiness was observed in 12.5%. Sleep disorders were distributed as follows: 37.5% with OSAS, 50% with parasomnias, and 12.5% with REM without atonia. Half of the patients received a report indicating that they were unsuitable for military service (Table 1). These patients had parasomnias, with only one patient diagnosed with OSAS.

Patients applying for health reports for driver's licenses

The mean age of patients applying for health reports for driver's licenses assessments was 47.6 ± 5.6 years, with a mean BMI of 35.3 ± 8.6 kg/m^2. Their median ESS score was 2 (IQR: 0–4), and excessive daytime sleepiness was observed in 13.3%. All patients were diagnosed with OSAS, most of whom had severe OSAS. PLMD was observed in 20% of cases, while 6.7% had bruxism. Reports confirming eligibility for a driver's license were issued for all patients (Table 2).

Patients applying for disability reports

The mean age of patients applying for disability reports assessments was 47.7 ± 9.2 years, with a mean BMI of 34.4 ± 6.8 kg/m^2. Their median ESS score was 12 (IQR: 7 - 17), and excessive daytime sleepiness was observed in 53.5%. In these patients, the median AHI score was 40 (IQR: 27-77), with OSAS diagnosed in 98.0% of the patients. Other sleep disorders were distributed as follows: 17.2% with PLMD, 5.1% with REM without atonia, 4% with central sleep apnea syndromes, 4% with bruxism, 3% with hypoxemic syndromes, 1% with parasomnias, 1% with hypersomnias, and 1% with narcolepsy. The median sleep-related disability score was 30 (IQR: 25 - 35), with a total disability score of 57 (IQR: 47 - 76). Of the patients, 13.1% were determined not to have a disability, 42.4% were assessed as having workforce loss, and 44.4% were granted disability (retirement) reports (Table 3).

Based on disability status, the mean age was significantly higher in the disability (retirement) group compared to the no disability and workforce loss groups ((No disability: 42.6 ± 9.0 years vs. Workforce loss: 44.8 ± 6.1 years vs. Disability: 51.9 ± 10.1 years, $p < 0.001$). The disability (retirement) group demonstrated both lower ESS scores (No disability: 16 vs. Workforce loss: 13 vs. Disability: 11, $p < 0.001$) and a lower rate of excessive daytime sleepiness compared to the other groups (No disability: 84.6% vs. Workforce loss: 61% vs. Disability: 36.4%, $p = 0.011$). The median AHI levels were lowest in the no disability group and highest in the disability group. The median PLM index did not differ significantly between the disability groups. In the workforce loss and disability (retirement) groups, 100% of patients were diagnosed with OSAS, while OSAS was identified in 84.6% of the no disability group. Severe OSAS was significantly more prevalent in the disability (retirement) group than in the no disability and workforce loss groups (No disability: 30.8% vs. Workforce loss: 69.0% vs. Disability: 79.5%, $p = 0.003$). Although PLMD was observed more frequently in the disability (retirement) group, the difference was not statistically significant (No disability: 22.7% vs. Workforce loss: 11.9% vs. Disability: 15.9%, $p = 0.429$). There were no statistically significant differences in the rate of other sleep disorders between the groups (Table 4).

Table 1. Demographic and clinical characteristics of patients applying for eligibility for military service.

Variables	Results n = 8
Age, years	25.3 ± 8.7
Gender, n (%)	
Female	-
Male	8 (100)
BMI, kg/m2	26.1 ± 3.1
Obesity, n (%)	1 (12.5)
Neck circumference, cm	38.9 ± 2.9
Epworth sleepiness scale	7 (4.5 - 11)
Excessive daytime sleepiness, n (%)	1 (12.5)
Mild	-
Moderate	1 (12.5)
Severe	-
Spo2, %	
Awake	95.4 ± 0.5
Sleep	94.8 ± 0.9
Minimum	81.4 ± 11.3
Sleep efficiency, %	74.3 ± 18.5
AHI	5 (4 - 21.5)
PLMI	5 (3.5 - 10)
Sleep disorders, n (%)	
OSAS	3 (37.5)
Mild	1 (12.5)
Moderate	-
Severe	2 (25.0)
Parasomnias	4 (50.0)
REM without atonia	1 (12.5)
PLMD	-
Central sleep apnea syndromes	-
Hypoxemic syndromes	-
Bruxism	-
Hypersomnias	-
Narcolepsy	-
Suitability for military service, n (%)	
Suitable	4 (50.0)
Not suitable	4 (50.0)

The data are expressed as the mean ± SD, median (IQR), or number (%). AHI, apnea-hypopnea index; BMI, body mass index; PLMD; periodic limb movement disorder, PLMI, periodic limb movement index, Spo2; blood oxygen saturation.

Table 2. Demographic and clinical characteristics of patients applying for health reports for driver's licenses.

Variables	Results n = 15
Age, years	47.6 ± 5.6
Gender, n (%)	
Female	1 (6.7)
Male	14 (93.3)
BMI, kg/m2	35.3 ± 8.6
Obesity, n (%)	11 (73.3)
Neck circumference, cm	43.2 ± 3.8
Epworth sleepiness scale	2 (0 - 4)
Excessive daytime sleepiness, n (%)	2 (13.3)
Mild	1 (6.7)
Moderate	-
Severe	1 (6.7)
Spo2, %	
Awake	92.8 ± 2
Sleep	91.9 ± 2
Minimum	80.2 ± 6.2
Sleep efficiency, %	80.0 ± 11.6
AHI	32 (26 - 56)
PLMI	1 (0 - 10)
Sleep disorders, n (%)	
OSAS	15 (100.0)
Mild	1 (6.7)
Moderate	4 (26.7)
Severe	10 (66.7)
PLMD	3 (20.0)
Bruxism	1 (6.7)
Central sleep apnea syndromes	-
Parasomnias	-
Hypoxemic syndromes	-
REM without atonia	-
Hypersomnias	-
Narcolepsy	-
Driving license eligibility, n (%)	
Suitable	15 (100.0)
Not suitable	-

The data are expressed as the mean ± SD, median (IQR), or number (%). AHI, apnea-hypopnea index; BMI, body mass index; PLMD; periodic limb movement disorder, PLMI, periodic limb movement index, Spo2; blood oxygen saturation.

Table 3. Demographic and clinical characteristics of patients applying for disability reports.

Variables	Results n = 99
Age, years	47.7 ± 9.2
Gender, n (%)	
Female	10 (10.1)
Male	89 (89.9)
BMI, kg/m2	34.4 ± 6.8
Obesity, n (%)	77 (77.8)
Neck circumference, cm	43.6 ± 4.7
Epworth sleepiness scale	12 (7 - 17)
Excessive daytime sleepiness, n (%)	53 (53.5)
Mild	10 (10.1)
Moderate	15 (15.1)
Severe	28 (28.3)
Spo2, %	
Awake	92.5 ± 2.3
Sleep	91.3 ± 3.7
Minimum	78.1 ± 9.1
Sleep efficiency, %	73.4 ± 14.5
AHI	40 (27 - 77)
PLMI	3 (1 - 10)
Sleep disorders, n (%)	
OSAS	97 (98.0)
Mild	12 (12.1)
Moderate	17 (17.2)
Severe	68 (68.7)
PLMD	17 (17.2)
REM without atonia	5 (5.1)
Central sleep apnea syndromes	4 (4.0)
Bruxism	4 (4.0)
Hypoxemic syndromes	3 (3.0)
Parasomnias	1 (1.0)
Hypersomnias	1 (1.0)
Narcolepsy	1 (1.0)
Sleep disability score, %	30 (25 - 35)
Total disability score, %	57 (47 - 76)
Disability status, n (%)	
No disability	13 (13.1)
Workforce loss	42 (42.4)
Disability	44 (44.4)

The data are expressed as the mean ± SD, median (IQR), or number (%). AHI, apnea-hypopnea index; BMI, body mass index; PLMD; periodic limb movement disorder, PLMI, periodic limb movement index, Spo2; blood oxygen saturation.

Table 4. Demographic and clinical characteristics by disability of patients.				
Variables	No disability n = 13	Workforce loss n = 42	Disability n = 44	P - value
Age, years	42.6 ± 9.0	44.8 ± 6.1	51.9 ± 10.1	<0.001*
Gender, n (%)				
Female	2 (15.4)	3 (7.1)	5 (11.4)	0.659
Male	11 (84.6)	39 (92.9)	39 (88.6)	
BMI, kg/m2	30.8 ± 5.4	34.6 ± 6.0	35.3 ± 7.7	0.106
Obesity, n (%)	8 (61,5)	37 (88,1)	32 (72,7)	0.061
Neck circumference, cm	42.2 ± 4.6	44.1 ± 4.8	43.5 ± 4.5	0.468
Epworth sleepiness scale	16 (12 - 21)	13 (9 - 17)	11 (5 - 15)	0.011*
Excessive daytime sleepiness, n (%)	11 (84.6)	25 (61.0)	16 (36.4)	0.003*
Mild	3 (23.1)	4 (9.8)	2 (4.5)	0.013*
Moderate	1 (7.7)	8 (19.5)	6 (13.6)	
Severe	7 (53.8)	13 (31.7)	8 (18.2)	
Spo2				
Awake	93.6 ± 2	92.7 ± 1.8	92.0 ± 2.7	0.068
Sleep	93.2 ± 3.2	91.1 ± 2.7	90.2 ± 4.4	0.022*
Minimum	83.3 ± 8.9	78.5 ± 7.6	75.8 ± 9.9	0.025*
Sleep efficiency, %	80.5 ± 10.7	73.7 ± 15.3	71.0 ± 14.3	0.112
AHI	27 (12 - 66)	38 (25 - 76)	48 (33 - 83)	0.037*
PLMI	2 (1 - 10)	3 (1 - 7)	4 (1 - 11)	0.589
Sleep disorders, n (%)				
OSAS	11 (84.6)	42 (100.0)	44 (100.0)	0.018*
Mild	4 (30.8)	6 (14.3)	2 (4.5)	0.003*
Moderate	3 (23.1)	7 (16.7)	7 (15.9)	
Severe	4 (30.8)	29 (69.0)	35 (79.5)	
PLMD	2 (15.4)	5 (11.9)	10 (22.7)	0.429
REM without atonia	2 (15.4)	1 (2.4)	2 (4.5)	0.197
Central sleep apnea syndromes	-	2 (4.8)	2 (4.5)	0.999
Bruxism	1 (7.7)	3 (7.1)	-	0.183
Hypoxemic syndromes	-	1 (2.4)	2 (4.5)	0.999
Parasomnias	-	-	1 (2.3)	0.999
Hypersomnias	1 (7.7)	-	-	0.132
Narcolepsy	1 (7.7)	-	-	0.132
Sleep disability score, %	20 (10 - 35)	30 (19 - 35)	35 (30 - 35)	0.004*
The data are expressed as the mean ± SD, median (IQR), or number (%). AHI, apnea-hypopnea index; BMI, body mass index; PLMD; periodic limb movement disorder, PLMI, periodic limb movement index, Spo2; blood oxygen saturation.				

Discussion

This study provides a comprehensive evaluation of the demographic and clinical characteristics of patients diagnosed with sleep disorders who were assessed for various purposes such as military service eligibility, driver's license, and disability reports. The results indicate that OSAS is the most commonly diagnosed sleep disorder in this population, with a significant proportion of patients presenting with obesity and symptoms of excessive daytime sleepiness. Furthermore, the variability in clinical presentations and outcomes across different evaluation groups highlights the diverse impacts of sleep disorders on health and occupational abilities.

Evaluation of Findings Regarding Military Service Eligibility

Among the study groups, patients evaluated for military service were the youngest, showing a relatively lower frequency of OSAS and a higher prevalence of parasomnias. These findings

are consistent with the existing literature, which indicates that the prevalence of OSAS increases with age and BMI [20]. Additionally, 50% of these patients were deemed unfit for military service, which may predominantly be attributed to parasomnias and the severity of OSAS. The presence of parasomnias and sleep behavior disorders, especially among young adults, could be significant factors influencing suitability for military service. In the United States, sleep disorders that disqualify individuals from military recruitment are addressed in the "DoD Instruction 6130.03 Manual," which provides guidelines for Medical Standards for Appointment, Enlistment, or Induction [21]. Based on these guidelines, chronic insomnia, the use of medications or substances to promote sleep 15 or more times within the last 12 months, sleep-related breathing disorders (including sleep apnea) not definitively treated through surgery, a history of narcolepsy, cataplexy, or other hypersomnia disorders, and circadian rhythm disorders requiring treatment or special arrangements, parasomnias, and sleep-related movement disorders are major disqualifying conditions for military recruitment [21]. The current study found that four patients diagnosed with parasomnias were considered unsuitable for military service, with only one of them also being diagnosed with OSAS. Poor nighttime sleep quality, especially when it results in excessive daytime fatigue and impaired concentration, can adversely impact the capacity to fulfill military duties [22]. Most of the current literature examines sleep disorders in either active-duty military personnel or veteran/retired military populations, with reported prevalence rates around 30% to 94% [23-27]. These findings imply that people with sleep disorders before enlisting may develop more severe sleep-related problems after their military duty. Therefore, individuals suspected of having sleep disorders during military examinations should undergo a comprehensive evaluation, with early diagnosis and treatment approaches considered.

Evaluation of Findings Regarding Driver's License Eligibility

The patients assessed for driver's license eligibility in our study had a higher average age and stood out due to all being diagnosed with OSAS, most of whom were categorized as having severe OSAS. The notable obesity burden and elevated BMI levels in this group could serve as key contributors to the pathophysiological mechanisms of OSAS [28]. Previous studies have emphasized the need for meticulous screening of individuals applying for a driver's license for sleep disorders, noting that untreated OSAS increases the risk of traffic accidents [29]. Our findings revealed that all patients seeking a driver's license were granted "eligibility"; however, the detection of severe OSAS in the majority underscores the significance of ensuring treatment compliance and regular follow-up in these individuals. Uncontrolled OSAS can result in excessive daytime sleepiness and attention deficits, posing significant risks to traffic safety [30, 31]. The European Sleep Research Society and comparable organizations do not restrict patients undergoing consistent continuous positive airway pressure therapy from obtaining a driver's license, provided that treatment continuity is closely supervised [32]. The existing literature reports that approximately half of patients with OSAS experience daytime sleepiness [33]. This indicates that these patients tend to downplay their daytime functional deficits, potentially increasing the risk of traffic accidents [34]. Interestingly, all patients in this group were considered eligible to drive. To enhance road safety for this population, the development of objective sleep evaluations and more stringent regulations could be essential.

Evaluation of Findings Regarding Disability Eligibility

Those applying for disability reports had the highest mean age and obesity prevalence among all groups in this study. Additionally, the much higher incidence of OSAS in this group is a key indicator of how severely OSAS can affect overall health and productivity. Studies suggest that severe OSAS is commonly accompanied by comorbidities, particularly cardiovascular diseases, metabolic syndrome, and diabetes, which can significantly elevate disability severity [35, 36]. According to the findings of our study, the retirement (disability) group demonstrated a higher mean age, lower ESS scores, and a reduced incidence of excessive daytime sleepiness compared to other groups. The discrepancy between low ESS scores and the high OSAS prevalence in the disability group indicates that older patients might be less inclined to report daytime sleepiness or could present with alternative clinical symptoms.

In patients with severe OSAS, the risk of performance impairment and susceptibility to accidents rises in occupations requiring sustained focus and vigilance [37]. Therefore, it is crucial to systematically evaluate the work capacity of patients with OSAS and implement protective or preventive measures when necessary. On the other hand, PLMD during sleep and OSAS frequently occur together as overlapping sleep disorders [38]. However, other sleep disorders, such as PLMD and REM sleep without atonia, did not show significant differences among the disability groups. Non-OSA sleep disorders also make a

significant contribution to disability evaluations in a subset of patients. A study conducted in China found that sleep durations of less than 7 hours and more than 7 hours were associated with a higher risk of functional disability in adults aged 65 and older [13]. The results demonstrate a U-shaped correlation between sleep duration and functional impairment.

Research from the United States reported that the relative risks of short and long sleep durations for participants with work disabilities were 1.4 and 1.5 times greater than those with moderate sleep durations [39]. A study involving Finnish twins found that sleep quality and changes in sleep quality served as early indicators of disability pensions due to lower back conditions, independent of other influencing factors [10]. These findings underscore the critical role of comprehensive sleep assessments in disability evaluations, highlighting the multifaceted impact of both sleep duration and quality on functional impairment and workforce participation.

In conclusion, this study highlights the significant role of sleep disorders, particularly severe OSAS, in contributing to functional impairment and disability. The findings emphasize the necessity of systematic evaluations to assess work capacity and implement appropriate interventions, especially for individuals in high-risk occupations. While OSAS remains the most prevalent and impactful disorder, the role of other conditions, such as PLMD and REM sleep without atonia, should not be overlooked in disability assessments. Furthermore, evidence linking both short and long sleep durations to increased functional disability underscores the importance of promoting optimal sleep patterns for maintaining overall health and workforce participation. Future research should focus on tailored interventions and long-term outcomes to mitigate the societal and individual burdens of sleep-related disabilities.

Ethics Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (Date: 19.04.2023, Decision No: 154).

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Conflicts of Interest

The authors declare they have no conflicts of interest.

Authors' contribution

Concept – Ş.D., Design – Ş.D. and U.D.H., Supervision – Ş.D., Data collection and/or processing – Ş.D. and U.D.H., Analysis and/or interpretation – Ş.D. and U.D.H., Writing – Ş.D., Critical review- U.D.H.

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Araştırma Makalesi

Hemşirelik fakültesi eğitim sürecinin öğrencilerin mikrobeslenme ve periodontal durumları üzerine etkisi

The effect of nursing faculty education process on micronutrition and periodontal status of students

Selcen Özcan Bulut*[1], Nihan Özel Ercel[2]

[1]Niğde Ömer Halisdemir Üniversitesi, Diş Hekimliği Fakültesi, Periodontoloji Anabilim Dalı, Niğde, Türkiye
[2]Mersin Üniversitesi, Biyoistatistik Anabilim dalı, Mersin, Türkiye

Öz

Amaç: Hemşirelik Fakültesi eğitim sürecinin öğrencilerin mikrobeslenme ve periodontal durumları üzerine etkisini araştırmaktır.

Gereç ve Yöntemler: Hemşirelik Fakültesi Eğitim sürecinde olan 109 öğrenci çalışmaya dahil edilmiştir. Çalışmaya dahil edilen öğrencilere demografik veriler, sosyo-ekonomik veriler, ağız diş sağlığı veriler ve Wilhom indeksini (Wİ) içeren anket uygulaması yapılmıştır. Wi puanı 65-75 arası "Ne yediğinin ve nasıl besleneceğinin farkında", 40-64 puan "bu konuda dikkatli" ve 40'tan az puan " beslenmesi kötü" olarak sınıflandırılmıştır. 2017 Periodontal hastalık ve durumlar sınıflamasına göre periodontal muayeneleri yapılıp teşhis konulmuştur. Kan parametreleri (Hemoglobin, HemoglobinA1c, D vitamini, B12 vitamini, Demir ve ferritin seviyeleri) ile tüm veriler istatistiksel olarak analiz edilmiştir.

Bulgular: 3. Ve 4. Sınıfta diş ağrısı ve dişeti kanaması olduğunu belirten öğrenci sayısı 1. sınıftan daha fazladır. ($p<0,05$). Anketteki ağız ve diş sağlığı alışkanlıkları benzer olduğu belirtilmiş olmasına rağmen, klinikte evre 1 periodontitis görülen öğrenci sayının da 4. Sınıfta daha fazla olduğu saptanmıştır. Sınıf düzeyine göre Wİ'de farklılık yokken vücut kitle indeksinde ve vitamin B12 de istatistiksel olarak anlamlı bir farklılık vardır. ($p<0,05$) Wi ile Periodontal durum ilişkili bulunmuştur.

Sonuçlar: Hemşirelik fakültesi eğitim düzeyi mikrobeslenme ve periodontal sağlık/hastalık üzerine etkili olabilir. Ağız ve diş sağlığı ve sağlıklı beslenme konusunda eğitim programları genişletilmeli öğrencilerin farkındalığı arttırılmalıdır.

Anahtar Kelimeler: Ağız ve Diş sağlığı, Beslenme, Hemşirelik Eğitimi, Periodontal hastalık

Sorumlu Yazar*: Selcen Özcan Bulut, Niğde Ömer Halisdemir Üniversitesi, Diş Hekimliği Fakültesi, Periodontoloji Anabilim Dalı, Niğde, Türkiye.
E-mail: selcen_ozcan@hotmail.com
Orcid: 0000-0003-4984-9817
Doi: 10.18663/tjcl.1611979
Geliş Tarihi: 02.01.2025 Kabul Tarihi: 20.01.2025

Abstract

Aim: To investigate the effect of the Faculty of Nursing education process on the micronutrition and periodontal status of the students.

Material and Methods: 109 students who are in the Faculty of Nursing education process were included in the study. A questionnaire including demographic data, socioeconomic data, oral and dental health data and Wilhom index (WI) was applied to the students included in the study. A Wi score between 65-75 was classified as "aware of what you eat and how to eat", 40-64 points as "careful in this regard" and less than 40 points as "poor nutrition". Periodontal examinations were performed and diagnoses were made according to the 2017 Periodontal diseases and conditions classification. Blood tests were obtained from the hospital archives and Hemoglobin, HemoglobinA1c, Vitamin D, Vitamin B12, Iron and ferritin levels were obtained and all data were analyzed statistically.

Results: The number of students reporting toothache and gum bleeding in the 3rd and 4th grades is higher than in the 1st grade. ($p<0.05$). Although the oral and dental health habits in the survey were stated to be similar, it was determined that the number of students with stage 1 periodontitis in the examination was higher in the 4th grade. While there was no difference in WI according to the grade level, there was a statistically significant difference in body mass index and vitamin B12. ($p<0.05$)

Conclusions: The level of education in the nursing faculty may have an effect on micronutrition and periodontal health/disease. Students' awareness should be increased with education programs.

Keywords: Nutrition, Nursing Education, Oral and Dental Health, Periodontal Disease

Giriş

Beslenme, ihtiyaç duyulan enerjinin besinlerden alınması olarak tanımlanmaktadır [1]. Bireyin beslenme alışkanlıkları vücudun genel sağlığı üzerinde önemli bir etkendir. Ağız sağlığı ile beslenme karşılıklı etkileşim içindedir [2, 3]. Beslenme yetersizliği ağız içi bir durumla ilişkili olabileceği gibi (örneğin ağrıyan veya eksik diş varlığı), beslenme yetersizliğine bağlı ağız içi hastalıklar (aftlar, periodontal hastalıklar gibi) görülebilmektedir [2, 3].

Periodontal destek dokularda dişetinin kronik iltihabıyla karakterize, alveol kemik ve ataçman kaybı görülmeden renk değişimi, ödem, sondlamada kanama ve dişetinde form bozukluğu gibi klinik bulgular veren dişeti hastalığına gingivitis denilmektedir [4]. Gingivitis, dişeti kenarında mikrobiyal dental plak birikimiyle meydana gelir ve geri dönüşümlüdür [4-6]. Periodontitis ise spesifik mikroorganizmaların sebep olduğu, periodontal ligament ve alveol kemiğinin kaybının olduğu, klinik olarak periodontal cep ve dişeti çekilmesi oluşumu ile karakterizedir ve periodontal dokularının enflamatuvar bir hastalığıdır [4-6]. Periodontal hastalıklar genel olarak yavaş ilerleyen bir hastalık olarak kabul edilmektedir. Dental plaktaki mikroorganizmalara karşı konak cevabını değiştiren diabet, sigara kullanımı, stress ve genetik ya da beslenme alışkanlıkları-vitamin eksikliği gibi sistemik ve çevresel faktörlerin varlığında hastalığın prognozu daha şiddetli de olabilmektedir [2, 4, 7, 8].

Beslenmedeki sorunlar vücutta başlıca vitamin- mineral ve protein eksikliğine, glikoz direncine, diabete, obeziteye, büyüme gelişme problemlerine, zeka geriliğine dental ve periodontal hastalıklara hatta kansere bile sebep olabilmektedir [1, 2, 9, 10].

Vitaminler vücutta antioksidan olarak görev alıp antioksidan-oksidan dengesinden sorumludurlar ayrıca birçok metabolik olayın sağlıklı gerçekleşmesi için de yeterli seviyede vücutta bulunması gerekmektedir [11-14]. Protein, glikoz ve yağın vücuda dengeli şekilde alınması gerekir. Enerji kaynağı olarak kullanılmasının yanında dokuların hücrelerin yapı taşı olarak oluşmasında ve büyümesi-gelişmesinde gereklidirler [11, 12, 14]. Fazla alımında obezite, diabet, kardiovasküler problemlere, inflamatuar hastalıklara (periodontal hastalık gibi) vs sebep olabilmektedirler. Eksikliğinde ise büyüme gelişmede gerilik söz konusu olabilmektedir [11-14].

Beslenme alışkanlıkları bireyin yaşadığı çevreden, yaşadığı ülkenin kültüründen etkilenmektedir [15]. Örneğin aile ile beraber yaşamanın bir rutin sağladığı ve kötü beslenmeden koruduğu görülmektedir [16]. Bununla birlikte bireyin sağlıkla ilgili bilgi sahibi olması ve sağlıkla eğitim görmesi de davranışları şekillendirebilir [10, 17]. Litvanya'da yapılan bir çalışmada aktif olarak ağız diş sağlığı eğitimi almış diş hekimliği öğrencilerinin tıp öğrencilerinden bu alandaki farkındalığının yüksek olduğu görülmüştür [17]. Öğrencilerin katılımıyla yapılan literatürdeki başka çalışmada diş hekimliği fakültesi eğitim seviyesi ve diş fırçalama sıklığı arasında anlamlı bir ilişki olduğu saptanmıştır [10].

Literatüre bakıldığında ülkemizdeki çalışmaların çoğu öğrencilerin beslenme alışkanlığını anketle ölçmektedir ve yine bazı çalışmalarda ağız içi durum da sadece anketler ile ortaya konmuştur [10, 18-20]. Bu durumdaki çalışmalar verilerin sadece öğrencilerin kendi verdikleri bilgiye bağlı olmasını limitasyon olarak göstermişlerdir [10]. Eğitim, öğrencilerin düşünce yapılarını tutum ve davranışlarını değiştirebilen aktif bir süreçtir. Çalışmamızda araştırma grubu olarak, ağız sağlığı ve beslenme dersi alan ve ağız diş sağlığının korunmasında ve tedavisinde aktif rol alacak meslek grubunu yetiştiren bir fakülte olan hemşirelik fakültesinin öğrencileri seçilmiştir [21]. Mevcut çalışmamızda Hemşirelik Fakültesi eğitim sürecinin öğrencilerin mikrobeslenme ve periodontal durumları üzerine etkisini, beslenme ve oral hijyen alışkanlıkları anketleri, kan parametreleri ve periodontal durumları incelenerek araştırmak amaçlanmıştır.

Gereç ve Yöntemler

Çalışma Dizayın ve Dahil Edilme, Dışlanma Kriterleri

Çalışmamıza Niğde Ömer Halisdemir Üniversitesi Hemşirelik Fakültesi eğitim sürecinde olan ve çalışmaya katılmaya gönüllü olan son 3 ay içinde aşağıdaki kan parametrelerine bakılmış olan 109 öğrenci dahil edilmiştir. Çalışmaya dahil edilen öğrencilere Niğde Ömer Halisdemir Üniversitesi Hemşirelik Fakültesinde anket uygulaması yapılmıştır. Öğrencilerin klinik muayeneleri Niğde Ömer Halisdemir Üniversitesi Diş Hekimliği Fakültesi Periodontoloji kliniğinde gerçekleştirilmiştir. Aşağıda belirtilen kan parametrelerine Niğde Ömer Halisdemir Üniversitesi Eğitim ve Araştırma Hastanesi arşivinden ulaşılmıştır.

Dahil edilmeme kriteri

-Ankete katılmayan

-Belirtilen kan parametreleri eksik olan

-Periodontal muayene verisi olmayan

-Çalışmaya katılmak istemeyen öğrenciler çalışma dışı bırakılmıştır.

Anket uygulaması

-Demoğrafik Veriler

Kaçıncı sınıf olduğu (eğitim düzeyi), Yaş, cinsiyet, kilo, boy, sosyokültürel ve sosyoekonomik durum ile ilgili sorular içermektedir.

-Beslenme Alışkanlıkları verileri- Wilhom indeksi(Wİ) anketinden yararlanılmıştır.

Hangi besinleri ne sıklıkta tükettiklerine dair sorular içermektedir. Wilhom indeks anketinde sorulara verilen cevaplar puanlanır ve toplam puan değerlendirilir.Wi puanı 65-75 arası olanlar "Ne yediğinin ve nasıl besleneceğinin farkında", 40-64 puan arası "bu konuda dikkatli" ve 40'tan az puan " beslenmesi kötü" olarak sınıflandırılmaktadır [10].

-Ağız Hijyen Alışkanlıları

Günlük ağız bakımında ne yaptıkları-yapmadıklarına (diş fırçalama, diş ipi, gargara vs) dair sorular bulunmaktadır [10].

Klinik ve Radyolojik Parametreler (Periodontal Muayene)

Çalışmaya gönüllü olan öğrencilerin Niğde Ömer Halisdemir Üniversitesi Diş Hekimliği Fakültesi Periodontoloji kliniğinde tek uzman doktor tarafından (S.Ozcan Bulut) periodontal muayeneleri gerçekleştirilmiştir. Klinik ve radyolojik muayeneleri yapılan öğrencilerin periodontal teşhisi 2017 periodontal hastalık sınıflamasına göre yapılmıştır. Klinik olarak periodontal cep derinlikleri, sondlamada kanama, gingival indeks ve plak indeksi değerlendirilmiştir. Ortopantografide interdental kemik kayıp dereceleri belirlemiş olup interdental kemik kayıp yüzdelerine göre periodontitis evreleri belirlenmiştir. Öğrencilerin periodontal durumu aşağıdaki gibi skorlanmıştır.

Skor 0 : Periodontal Sağlık

Skor 1 : Gingivitis

Skor 2 : %0-15 interdental kemik kaybı durumunda, Evre 1 Periodontitis- hafif periodontitis

Skor 3: %15-33 interdental kemik kaybı durumunda, Evre 2 Periodontitis- orta periodontitis

Skor 4: %33'den fazla interdental kemik kaybı ve diş kaybı durumunda, Evre 3 Periodontitis- şiddetli periodontitis

Skor 5: %33'den fazla interdental kemik kaybı ve dentisyon kaybı durumunda, Evre 4 Periodontitis- ilerlemiş periodontitis

Kan Parametreleri

Son 3 ay içinde herhangi bir sebeple Eğitim ve Araştırma hastanesinde kan tahlili bulunan ve Vitamin D, Vitamin B12, Demir, ferritin, Hemoglobin A1c, Hemoglobin parametreleri olan öğrenciler çalışmaya dahil edilmiştir.

Kan örneklerindeki Serum Demir, Serum Ferritin ve 25-hidroksi-vitamin D değerleri hastanenin biyokimya laboratuvarında bir analiz cihazı kullanılarak analiz edilmektedir.(Roche Cobas E 601 (Roche Diagnostics))

İstatistiksel Analiz

Veri analizi IBM SPSS Statistics Version 26 paket programı ile gerçekleştirilmiştir. Verilerin normal dağılıma uygunluğu Kolmogorov Smirnov normallik testti ile test edilmiştir. Sınıf düzeyine göre cinsiyet, gelir, anne-baba eğitim vs. sosyo-demografik ve diş sağlığı ile ilgili özelliklerin karşılaştırılmasında

Ki Kare testi kullanılmıştır. Yaş, VKI, Wilhom beslenme puanı, vitamin D, vitamin B12, Demir, Ferritin gibi ölçüm ortalamalarının sınıf düzeyi ve klinik teşhis grupları arasındaki karşılaştırmalar için tek yönlü varyans analizi (ANOVA) veya Kruskal Wallis testi kullanılmıştır. Yaş, VKI, Wilhom beslenme puanı, D, Demir gibi ölçümler arasındaki ilişkinin tespiti için Spearman korelasyon testi kullanılmıştır. Elde edilen tüm sonuçlar p<0.05 durumunda istatistiksel olarak anlamlı kabul edilmiştir.

Bulgular

Çalışmaya 109 öğrenci dahil edilmiştir. Sınıf düzeyi ile cinsiyet arasında, sınıf düzeyi ve anne eğitim seviyesi arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur (p=0,046). Diğer verilerde istatistiksel anlamlı bir fark yoktur. (Tablo 1. Farklı Eğitim düzeyinde demografik verilerin ve sosyo-ekonomik verilerin karşılaştırılması)

Tablo 1. Farklı Eğitim düzeyinde demografik verilerin karşılaştırılması

	1. sınıf (N=43)	2. sınıf (N=27)	3. sınıf (N=18)	4. sınıf (N=21)	Toplam	P*
Cinsiyet						
Kız	38 (88,4)	27 (100) [3, 4]	15 (83,3)	17 (81)	97 (89)	0,046
Erkek	5 (11,6)	0 (0) [3, 4]	3 (16,7)	4 (19)	12 (11)	
Aile gelir						
1-17.000TL altı	19 (44,2)	9 (33,3)	4 (22,2)	7 (33,3)	39 (35,8)	0,132
2-17.000-34.000TL	18 (41,9)	15 (55,6)	11 (61,1)	6 (28,6)	50 (45,9)	
3-34.000TL üstü	6 (14)	3 (11,1)	3 (16,7)	8 (38,1)	20 (18,3)	
Kalınan yer						
1-Aile ile beraber	5 (11,6)	9 (33,3)	1 (5,6)	3 (14,3)	18 (16,5)	0,095
2-Yurtta	36 (83,7)	17 (63)	14 (77,8)	16 (76,2)	83 (76,1)	
3-Tek başına kendi evinde	1 (2,3)	0 (0)	3 (16,7)	1 (4,8)	5 (4,6)	
4-Arkadaşla beraber öğrenci evinde	1 (2,3)	1 (3,7)	0 (0)	1 (4,8)	3 (2,8)	
Anne eğitim						
1-ilkokul	16 (37,2)	10 (37) [4]	10 (55,6)	15 (71,4)	51 (46,8)	0,038
2-ortaokul	16 (37,2) [4]	8 (29,6)	6 (33,3)	2 (9,5)	32 (29,4)	
3-lise	10 (23,3)	4 (14,8)	1 (5,6)	2 (9,5)	17 (15,6)	
4-üniversite	1 (2,3) [2]	5 (18,5)	1 (5,6)	2 (9,5)	9 (8,3)	
Baba eğitim						
1-ilkokul	15 (34,9)	6 (22,2)	5 (27,8)	11 (52,4)	37 (33,9)	0,500
2-ortaokul	12 (27,9)	8 (29,6)	8 (44,4)	5 (23,8)	33 (30,3)	
3-lise	10 (23,3)	6 (22,2)	3 (16,7)	2 (9,5)	21 (19,3)	
4-üniversite	6 (14)	7 (25,9)	2 (11,1)	3 (14,3)	18 (16,5)	

*:Ki Kare testi, p<0.05 istatistiksel olarak anlamlı fark.

Sınıf düzeyi ile diş ağrısı oranı arasında istatistiksel olarak anlamlı bir ilişki vardır (p=0,001). Diş ağrısı olmayan 3. ve 4. Sınıf öğrencilerin oranı, 1 ve 2. Sınıftaki öğrencilerin oranından anlamlı derecede düşüktür (p<0,05). Diş ağrısı olan 3. ve 4. Sınıf öğrencilerin oranı ise 1 ve 2. Sınıftaki öğrencilerin oranından anlamlı derecede yüksektir (p<0,05).(Tablo 2. Farklı eğitim düzeyinde ağız sağlığı anketi ve periodontal teşhis verilerinin karşılaştırılması)

Sınıf düzeyi ile diş eti kanaması oranı arasında istatistiksel olarak anlamlı bir ilişki vardır (p=0,001). Diş eti kanaması olmayan 3. ve 4. Sınıf öğrencilerin oranı, 1 ve 2. Sınıftaki öğrencilerin oranından anlamlı derecede düşüktür (p<0,05). Diş eti kanaması olan 3. ve 4. Sınıf öğrencilerin oranı ise 1 ve 2. Sınıftaki öğrencilerin oranından anlamlı derecede yüksektir (p<0,05). Sınıf düzeyi ile diş hekimi ziyaret sıklığı arasında istatistiksel olarak anlamlı bir ilişki vardır (p=0,018). Diş hekimi ziyaret sıklığı "2" olan 4. Sınıf öğrenci oranının 1, 2 ve 3. Sınıf öğrencilerin oranından anlamlı derecede yüksek olduğu görülmüştür (p<0,05). (Tablo 2)

Sınıf düzeyi ile klinik teşhis arasında istatistiksel olarak anlamlı bir ilişki vardır (p=0,012). Klinik teşhisi periodontal sağlık (skor 0) olan 2. Sınıf öğrenci oranının 1. Sınıf öğrenci oranından anlamlı derecede yüksek olduğu görülmüştür (p<0,05). Klinik teşhisi gingivitis (skor 1) olan 2. Ve 4. Sınıf öğrenci oranının ise 1. Sınıf öğrenci oranından anlamlı derecede düşük olduğu görülmüştür (p<0,05). Klinik teşhisi evre 1 periodontitis (teşhis skor 2) olan 4. Sınıf öğrenci oranının ise 1 ve 3. Sınıf öğrenci oranından anlamlı derecede yüksek olduğu görülmüştür (p<0,05). (Tablo 2)

Tablo 2. Farklı eğitim düzeyinde ağız sağlığı anketi ve periodontal teşhis verilerinin karşılaştırılması						
Diş fırçalama sıklığı						
	1. sınıf (N=43)	2. sınıf (N=27)	3. sınıf (N=18)	4.sınıf (N=21)	Toplam	P*
1-günde 1	25(58,1)	16(59,3)	9(50)	18(85,7)	68(62,4)	0,138
2-günde 2	13(30,2)	9(33,3)	8(44,4)	3(14,3)	33(30,3)	
3-günde 3	5(11,6)	2(7,4)	1(5,6)	0(0)	8(7,3)	
Diş fırçası						
Manuel	40(93)	26(96,3)	17(94,4)	19(90,5)	102(93,6)	0,866
Elektronik	3(7)	1(3,7)	1(5,6)	2(9,5)	7(6,4)	
Gargara kullanımı						
0-yok	33(76,7)	15(55,6)	9(50)	12(57,1)	69(63,3)	0,124
1-var	10(23,3)	12(44,4)	9(50)	9(42,9)	40(36,7)	
Diş ipi kullanımı						
0-yok	37(86)	19(70,4)	11(61,1)	13(61,9)	80(73,4)	0,080
1-var	6(14)	8(29,6)	7(38,9)	8(38,1)	29(26,6)	
Ara yüz fırçası kullanımı						
0-yok	38(88,4)	23(85,2)	16(88,9)	18(85,7)	95(87,2)	0,972
1-var	5(11,6)	4(14,8)	2(11,1)	3(14,3)	14(12,8)	
Diş macunu kullanımı						
0-yok	0(0)	0(0)	1(5,6)	1(4,8)	2(1,8)	0,242
1-var	43(100)	27(100)	17(94,4)	20(95,2)	107(98,2)	
Ağız sağlığı değerlendirme						
0-çok kötü	1(2,3)	0(0)	0(0)	2(9,5)	3(2,8)	0,058
1-kötü	3(7)	8(29,6)	3(16,7)	2(9,5)	16(14,7)	
2-orta	21(48,8)	10(37)	6(33,3)	11(52,4)	48(44)	
3-iyi	17(39,5)	9(33,3)	6(33,3)	6(28,6)	38(34,9)	
4-çok iyi	1(2,3)	0(0)	3(16,7)	0(0)	4(3,7)	
Diş ağrısı						
0-yok	31(72,1) [3,4]	22(81,5) [3,4]	6(33,3)	8(38,1)	67(61,5)	0,001
1-var	12(27,9) [3,4]	5(18,5) [3,4]	12(66,7)	13(61,9)	42(38,5)	
Diş eti ağrısı						
0-yok	31(72,1)	19(70,4)	10(55,6)	9(42,9)	69(63,3)	0,100
1-var	12(27,9)	8(29,6)	8(44,4)	12(57,1)	40(36,7)	
Diş eti kanaması						
0-yok	27(62,8) [3,4]	21(77,8) [3,4]	6(33,3)	6(28,6)	60(55)	0,001
1-var	16(37,2) [3,4]	6(22,2) [3,4]	12(66,7)	15(71,4)	49(45)	
Diş hekimi ziyareti						
0-Hiç	11(25,6)	6(22,2)	4(22,2)	5(23,8)	26(23,9)	0,018
1 -yılda 1	32(74,4)	20(74,1)	14(77,8)	11(52,4)	77(70,6)	
2- yılda 1'den fazla	0(0)	1(3,7)	0(0)	5(23,8) [1,2,3]	6(5,5)	
Klinik teşhis						
0-Periodontal sağlık	1(2,3)2	7(25,9)	2(11,1)	2(9,5)	12(11)	0,012
1-Gingivitis	34(79,1)[2, 4]	12(44,4)	13(72,2)	10(47,6)	69(63,3)	
2-Evre 1 periodontitis	8(18,6)[4]	8(29,6)	3(16,7)[4]	9(42,9)	28(25,7)	
P<0,05 istatistiksel olarak anlamlı fark vardır.						

Tablo 3. Farklı eğitim düzeyinde yaş, VKİ, Wİ ve kan parametrelerinin karşılaştırılması

	1. sınıf (N=43)	2. sınıf (N=27)	3. sınıf (N=18)	4. sınıf (N=21)	
	X ±SS	X ±SS	X ±SS	X ±SS	p
Yaş	19,14±0,71	20,44±0,51	22,33±0,91	24±0,89	<0,001
VKI	22,38±3,65	21,88±3,18[4]	22,59±2,78	24,66±3,03	0,019
WI	48,74±7,25	50,96±8,21	52,5±7,88	52,67±8,59	0,183
D vitamini	28,35±8,07	26,93±8,2	25,01±6,95	23,27±4,28	0,061
Demir	75,66±24,31	74,34±18,44	77,52±23,3	74,82±15,37	0,966
Hemoglobin	13,52±1,35	13,37±1,09	13,79±1,44	13,94±1,39	0,627
Ferritin	52,64±24,13	45,83±16,83	69,6±30,2	52,37±24,33	0,051
Vitamin B12	413,44±139,5	386,89±183,24[3,4]	564,67±254,88	516,1±255,09	0,025
HbA1c	5,36±0,46	5,36±0,43	5,46±0,45	5,68±0,61	0,112

Sınıf düzeyine göre VKİ ortalamaları arasında istatistiksel olarak anlamlı bir farklılık olup (p=0,019), bu farklılık 4. Sınıf öğrencilerinin VKİ ortalamalarının 2. Sınıf öğrenci ortalamasından anlamlı derecede yüksek olmasından kaynaklanmaktadır (p<0,05).

Sınıf düzeyine göre vitamin B12 ortalamaları arasında istatistiksel olarak anlamlı bir farklılık olup (p=0,025), bu farklılık 3 ve 4. Sınıf öğrencilerinin vitamin B12 ortalamalarının 2. Sınıf öğrenci ortalamasından anlamlı derecede yüksek olmasından kaynaklanmaktadır (p<0,05). (Tablo 3. Farklı eğitim düzeyinde yaş, VKİ, Wİ ve kan parametrelerinin karşılaştırılması)

Wilhom beslenme puanı ile yaş ve D vitamini arasında zayıf düzeyde, pozitif yönlü ve istatistiksel olarak anlamlı bir korelasyon vardır (p=0,047 ve p=0,016). Yaş ile VKI, B12, HbA1c arasında zayıf düzeyde, pozitif yönlü ve istatistiksel olarak anlamlı bir korelasyon mevcutken (p=0,011, p=0,007, p=0,012) yaş ile D vitamini arasında zayıf düzeyde, negatif yönlü istatistiksel olarak anlamlı bir korelasyon vardır (p=0,001).VKI ile hemoglobin, B12 arasında zayıf, VKI ile HbA1c arasında yüksek düzeyde, pozitif yönlü istatistiksel olarak anlamlı bir korelasyon bulunmuştur (p<0,001, p<0,001, p<0,001). (Tablo 4. Wİ, VKİ, yaş ve kan parametrelerinde korelasyon)

Klinik teşhise göre yaş, VKI, Ferritin, vitamin B12 ve HbA1c ölçüm ortalamaları bakımından istatistiksel olarak anlamlı bir farklılık bulunmamıştır (p>0,05). Klinik teşhise göre Wilhom beslenme puan ortalamaları arasında istatistiksel olarak anlamlı bir farklılık olduğu görülmüştür (p<0,001). Bu farklılık klinik teşhisi skor 1 ve 2 olanların beslenme puanlarının klinik teşhisi skor 0 olanlara göre anlamlı derecede düşük olmasından ve klinik teşhisi skor 2 olanların beslenme puanlarının klinik teşhisi skor 1 olanlara göre anlamlı derecede düşük kaynaklanmaktadır (p<0,05)Klinik teşhise göre hemoglobin ortalamaları arasında istatistiksel olarak anlamı bir farklılık olup (p=0,029), bu farklılık klinik teşhisi skor 1 ve 2 olanların hemoglobin düzeylerinin klinik teşhisi skor 0 olanlara göre anlamlı derecede yüksek olmasından kaynaklanmaktadır (p<0,05).Klinik teşhise göre D vitamini ortalamaları arasında istatistiksel olarak anlamı bir farklılık vardır (p<0,001). Bu farklılık klinik teşhisi skor 1 ve 2 olanların D vitamini düzeylerinin klinik teşhisi 0 olanlara göre anlamlı derecede yüksek olmasından ve klinik teşhisi skor 2 olanların D vitamini düzeylerinin klinik teşhisi skor 1 olanlara göre anlamlı derecede düşük olmasından kaynaklanmaktadır (p<0,05).Klinik teşhise göre Demir ortalamaları arasında istatistiksel olarak anlamı bir farklılık vardır (p<0,001). Bu farklılık klinik teşhisi skor 1 ve 2 olanların Demir düzeylerinin klinik teşhisi skor 0 olanlara göre anlamlı derecede yüksek olmasından ve klinik teşhisi skor 2 olanların Demir düzeylerinin klinik teşhisi skor 1 olanlara göre anlamlı derecede düşük olmasından kaynaklanmaktadır (p<0,05). (Tablo 5. Periodontal Hastalık teşhisinde göre Wİ, yaş, VKİ ve kan parametreleri karşılaştırılması)

Tablo 4. Wİ, VKİ, yaş ve kan parametrelerinde korelasyon

	Wilhom	Yaş	VKİ	Hemoglobin	D vitamini	Demir	Ferritin	Vit B12	HbA1c	
Wilhom	r	1	0,191*	0,089	0,045	0,231*	0,059	0,050	0,176	0,069
	p	-	0,047	0,357	0,644	0,016	0,540	0,605	0,067	0,476
Yaş	r	0,191*	1	0,243*	0,177	-0,301**	0,003	0,104	0,257**	0,240*
	p	0,047	-	0,011	0,066	0,001	0,974	0,284	0,007	0,012
VKİ	r	0,089	0,243*	1	0,461**	-0,079	0,054	-0,018	0,375**	0,820**
	p	0,357	0,011	-	<0,001	0,413	0,580	0,855	<0,001	<0,001

*: p<0,05, **: p<0,01

Tablo 5. Periodontal Hastalık teşhisinde göre Wİ, yaş, VKİ ve kan parametreleri karşılaştırılması)

	Klinik teşhis 0 (N=12)	Klinik teşhis 1 (N=69)	Klinik teşhis 2 (N=28)	
	X ±SS	X ±SS	X ±SS	p
Wİ	58,58±5,05 [1, 2]	51,36±7,44 [2]	45,57±6,77	<0,001
Yaş	21,17±1,59	20,68±2,03	21,43±2,06	0,162
VKİ	21,58±3,34	22,7±3,5	23,28±3,11	0,338
Hemoglobin	12,75±1,01[1, 2]	13,63±1,2	13,91±1,56	0,029
D vitamini	33,92±7,96[1, 2]	28,5±5,33[2]	18,26±4,81	<0,001
Demir	66,83±22,53	79,9±21,4[2]	68,28±16,46	0,014
Ferritin	57,63±21,92	55,45±25,7	47,7±22,66	0,331
Vitamin B12	429,08±238,51	456,46±192,41	449,32±230,79	0,501
HbA1c	5,23±0,53	5,44±0,48	5,53±0,49	0,115

Tartışma

Protein-enerjiyetersizbeslenmesivemikrobesineksikliklerinden oluşan yetersiz beslenme, gelişmekte olan ülkelerde önemli bir sağlık sorunu olmaya devam etmektedir [22]. Gelişen endüstri ile işlenmiş gıdanın artması doğal gıdaların sebze ve meyve tüketiminin yerini alması, karbonhidrat tüketiminde artış son yıllarda dünya da obezite hastalığının armasına sebep olmuştur [14, 22]. Glikoz vücutta gerekenden fazla alındığında depolanması- birikmesi inflamasyonu tetiklemektedir [23]. Fazla glikoza bağlı nötrofil fonksiyon bozuklukları, kollajen bozuklukları gibi dejenerasyonlar meydana gelmekte bu da obezitenin dışında diabet, romatoid artrit, periodontitis – periodontal gibi birçok inflamatuar hastalık oluşabilmektedir [8, 9, 23, 24]. Tüm bunların ışığında beslenme bozukluklarının periodontal hastalıklar için risk oluşturduğu görülmektedir [9]. Mevcut çalışmamızda hemşirelik fakültesinde eğitim gören öğrencilerde beslenme ve ağız sağlığı anketi uygulaması, klinik periodontal muayene ve kan taraması yapılmıştır. Farklı eğitim derecesinde Wİ açısından anlamlı fark görülmemişken, eğitim seviyesine göre beslenme ile ilişkili olan VKİ de ve vitamin B12 seviyelerinde fark olduğu saptanmıştır. Eğitim seviyesi ve ağız sağlığı alışkanlıkları anketi arasında anlamlı bir fark yokken, eğitim seviyesine göre klinik teşhislerde fark olduğu görülmüştür. Bu bulgular daha önceki çalışmaları destekler şekilde olup beslemenin ve ağız sağlığının eğitim seviyesiyle ilgili olabileceğini göstermektedir. Ayrıca bir çok faktörden etkilendiği gibi beslenmeyi araştırmak için Wi indeksinin -anket uygulamasının- da tek başına yetersiz olabileceği konusunu düşündürmektedir ki önceki çalışmalarda limitasyon olarak düşünülmüştür [10]. Ilave olarak çalışmamızda Wİ ile yaş ve D vitamini arasında anlamlı ilişki görülmüşken diğer kan parametreleri ile anlamlı bir ilişki saptanamamıştır. Ancak sınıf seviyesi arttıkça Wİ'de anlamlı değişiklik olmazken, D vitamini seviyesinde anlamlı olmasa da azalma, hemoglobin A1c de artma görülmüş ve VKİ de ve B12 seviyelerinde anlamlı değişiklik olduğu saptanmıştır. Bu da eğitim düzeyi arttıkça öğrenci bilinçlense de Wİ indeksi "dikkatli beslenme" olduğunu gösterse de çevresel koşulların değişmesinin beslenmeyi olumsuz etkileyebildiğini düşündürmektedir. Kıvrak ve ark. yaptıkları çalışmada dönem 5 diş hekimliği fakültesi öğrencilerinin daha yoğun, klinik ağırlıklı eğitime geçmesiyle dönem 1'e göre ara öğüne vakit bulamadıklarını bildirmişlerdir [25]. Değirmenci'nin çalışmasında da diş hekimliği 4 ve 5 sınıfta Wi anketiyle beslenmenin daha kötü olduğu ve sigara alışkanlığının da arttığı bildirilmiştir [10]. Zemzemoğlu ve ark'nın Sağlık Bilimleri Fakültesinde yaptıkları çalışmada öğrencilerde ana öğün atlama durumunun ve atıştırmalık tüketiminin yüksek olduğu bulunmuştur [19]. Yine bir başka çalışma da da Hemşirelik lisans öğrencilerinde yeme alışkanlıklarının düzensiz olduğu ve yeme bağımlılığı oranının yüksek olduğu belirlenmiştir [18]. Sağlıklı beslenme tüm vücut sağlığı için elzemdir ve on sekiz-yirmi dört yaş dönemi, sağlığın korunması, geliştirilmesi ayrıca hastalıkların önlenmesi açısından önemli bir yaş dönemi olarak kabul edilmektedir [26]. ve bu nedenledir ki bizim çalışmamızda dahil bir çok çalışmada örneklemi bu yaş grubu oluşturmaktadır [10, 19, 25]. Öğrencilerin öncelikle kendi sağlıklarını sonra da birer sağlık çalışanı adayı olarak toplum sağlığını koruma çalışmalarında bilinç kazanmaları oldukça önemlidir [18]. Mevcut çalışmamızda dahil literatürde beslenme ile ilgili bazı çalışmalar sağlıkla ilgili eğitim verilen üniversitelerde sağlıklı beslenme ile ilgili eğitim programlarının oluşturulması gerektiğini savunmaktadır [18, 19]. Ilave olarak sağlıklı beslenmeyi sağlamak için beslenmeyi etkileyen değiştirilebilecek çevresel faktörlerinde değiştirilmesi gerekmektedir, yurt şartlarının değiştirilmesi gibi [19, 26, 27].

Beslenmenin periodontal hastalıkla ilişkili olduğu, başka bir

deyişle yetersiz-dengesiz beslenmenin periodontal hastalıkta risk faktörü olduğu bilinmektedir [8, 9, 11, 25]. Mevcut çalışmamızda da literatürü destekler sonuçlar bulunmuş olup Wi, D vitamini, demir ve hemoglobin ile periodontal teşhis arasında anlamlı bir ilişki saptanmıştır. Çalışmamızda ağız sağlığı anketinde hemşirelik dönem 1 öğrencilerinin %27,9 unda diş ağrısı %37,2 sinde dişeti kanaması olduğu belirtilmişken dönem 4 te %61,9 unda diş ağrısı ve %71,4 ünde dişeti kanaması olduğu belirtilmiştir. (p=0,001). Ayrıca 4. Sınıfta diş hekimi ziyareti sıklığıda anlamlı şekilde yüksek bulunmuştur. 2. Sınıfta 1.sınıfa göre periodontal sağlıklı öğrenci yüzdesi artmış olarak bulunmuş ve gingivitisli öğrenci sayısı da dönem 4 e kadar azalmış gözükse de dönem 4 te periodontitis daha fazla saptanmıştır. Periodontal hastalığın doğası ile uyumlu bir bulgudur gingivitis tedavi edilirse (oral hijyene sağlanırsa) periodontal sağlık tekrardan sağlanabilir ama tedavi edilmezse zamanla alveolar kemik yıkımı başlar ve periodontitis oluşur [4, 6, 8]. Ilave olarak, bu sonuçlar öğrencilerin yaşam tarzlarının değişmesine, eğitim durumunu yoğunlaşmasına, öğrencinin aile ortamındaki düzenden uzaklaşmasına ve kümülatif olarak biriken plağa-diştaşına ve zaman geçtikçe ilerleyen dişeti problem ve çürük durumu ile ilgili olabilmektedir. Ayrıca anketteki ağız sağlığı alışkanlıkları benzer olsa da eğitim düzeyi arttıkça diş hekimi ziyaretinin artması, diş ağrısında ve dişeti kanamasında farkındalığın artması eğitim düzeyi ile öğrenci farkındalığının artmasıyla da ilgili olabilir. Bu da literartürdeki farkındalık çalışmalarıyla uyumludur [28].

Çalışmamızda kullanılan Wİ anketi kişinin beslenmesi ile ilgili genel bilgi sunmaktadır ancak detaylı bilgi bu indeksten elde edilememektedir [10]. Ancak bizim çalışmamıza beslenme ile ilgili bazı kan parametreleri dahil edilerek objetif veriler ile çalışmamız detaylandırılmıştır. Bu kapsamada çalışmamızın önceki çalışmaları biraz daha aydınlattığını düşünebiliriz. Çalışmamızda anketi cevaplayan ama muayene edilemeyen veya kan sonucu olmayan öğrenciler çalışma dışı bırakılmıştır bu sebeple öğrenci sayısı bazı sınıflarda azdır. Bir başka limitasyon olarak çalışmada kullanılan kan parametreleri periodontal teşhis ve anketle aynı anda alınmış olan kan testinden elde edilmemiştir. Araştırmaya daha çok öğrenci katılımı sağlanarak ve öğrencilerin 4 yıl boyunca takibi yapılarak planlanan çalışmalarda daha doğru sonuçlar alınabilinir. Ayrıca anket uygulamasının objektif bulgularla desteklenmesi önerilebilir.

Sonuç

Farklı eğitim düzeylerinde Wilhom beslenme indeksinde anlamlı fark görülmemiştir. Ancak beslenme ile ilişkili kan parametrelerinde farklılıklar olduğu saptanmıştır. Vitamin B12 seviyesi ve VKİ'nin dönem 4 öğrencilerinde diğer dönemlere göre yüksek olarak görülmüştür. Farklı eğitim düzeylerinde ağız sağlığı alışkanlıkları anketlerinin benzer sonuçları olduğu görülse de klinik bulguların, diş ağrısı ve dişeti kanamasının ve evre 1 periodontitis durumunun 4. sınıf öğrencilerinde diğer öğrencilerinden daha fazla olduğu saptanmıştır. Anket uygulamalarının objektif bulgularla desteklenmesi çalışmaları daha anlamlı hale getirebilir. Mevcut hemşirelik eğitimi süreci öğrencilerin beslenmesi ve periodontal sağlığını etkileyebilir.

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Research Article

The role of the triglyceride-glucose index (TyG Index) in predicting disease severity, ICU admission, and total hospital stay in patients with myocarditis

Miyokarditli hastalarda hastalık şiddetini, YBÜ'ye yatışı ve toplam hastanede kalış süresini tahmin etmede trigliserit-glikoz indeksinin (TyG indeksi) rolü

Hatice Eyiol*[1], Azmi Eyiol[2], Ahmet Taha Sahin[2]

[1]Beyhekim Training and Research Hospital, Department of Anesthesiology, Konya, Turkey
[2]Beyhekim Training and Research Hospital, Department of Cardiology, Konya, Turkey

Abstract

Aim: Myocarditis is characterized by myocardial inflammation, with varying etiologies, including infectious and autoimmune causes, and presents with a broad range of clinical severity. Identifying prognostic markers is essential to tailor treatment and optimize outcomes. This study aims to evaluate the Triglyceride-Glucose (TyG) Index as a potential marker for disease severity, ICU admission, and hospital length of stay in patients with acute myocarditis.

Material and Methods: In this retrospective study, 326 patients diagnosed with acute myocarditis between January 2015 and December 2023 were analyzed. Clinical and laboratory data, including demographics, disease severity markers, and TyG Index values, were collected. Statistical analyses evaluated associations between TyG Index and key clinical outcomes, such as ICU admission and total hospital stay.

Results: Patients with higher TyG Index values had significantly increased ICU admission rates, prolonged hospital stays, and higher levels of inflammatory markers, including CRP and ferritin. The TyG Index also correlated with markers of myocardial injury, such as elevated troponin and D-dimer levels, and was notably higher in patients with comorbidities like hypertension, diabetes, and hyperlipidemia.

Conclusion: The TyG Index appears to be a valuable biomarker for assessing myocarditis severity and predicting clinical outcomes. Given its accessibility, the TyG Index could be a practical tool for risk stratification in clinical settings. Prospective studies are needed to confirm these findings and further clarify its role in the pathophysiology of myocarditis.

Keywords: Myocarditis, TyG Index, ICU admission, Disease severity

Corresponding Author*: Hatice Eyiol, Beyhekim Training and Research Hospital, Department of Anesthesiology, Konya, Turkey.
E-mail: haticerkan42@hotmail.com
Orcid: 0000-0001-6558-9344
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Öz

Amaç: Myokardit, enfeksiyöz ve otoimmün nedenler dahil olmak üzere çeşitli etiyolojilere sahip miyokardiyal inflamasyon ile karakterizedir ve geniş bir klinik şiddet aralığında seyredebilir. Prognostik belirteçlerin belirlenmesi, tedavinin bireyselleştirilmesi ve klinik sonuçların iyileştirilmesi açısından önemlidir. Bu çalışmada, Trigliserid-Glukoz (TyG) İndeksi'nin akut myokarditli hastalarda hastalık şiddeti, yoğun bakım ihtiyacı ve hastanede yatış süresi ile ilişkisini değerlendirmek amaçlanmıştır.

Gereç ve Yöntemler: Bu retrospektif çalışmada, Ocak 2015 - Aralık 2023 tarihleri arasında akut myokardit tanısı alan 326 hasta analiz edilmiştir. Demografik veriler, hastalık şiddeti belirteçleri ve TyG İndeksi değerleri dahil olmak üzere klinik ve laboratuvar verileri toplanmıştır. İstatistiksel analizlerle TyG İndeksi'nin yoğun bakım yatışı ve toplam hastanede kalış süresi gibi klinik sonuçlarla ilişkisi değerlendirilmiştir.

Bulgular: Yüksek TyG İndeksi değerine sahip hastalarda yoğun bakım yatış oranları belirgin şekilde artmış, hastanede kalış süresi uzamış ve CRP, ferritin gibi inflamatuar belirteçler daha yüksek bulunmuştur. Ayrıca, TyG İndeksi miyokard hasarı belirteçleri olan troponin ve D-dimer seviyeleri ile de korelasyon göstermiştir. Hipertansiyon, diyabet ve hiperlipidemi gibi ek hastalıkları olan bireylerde TyG İndeksi daha yüksek bulunmuştur.

Sonuç: TyG İndeksi, myokardit şiddetini değerlendirmede ve klinik sonuçları öngörmede değerli bir biyobelirteç olabilir. Kolay erişilebilirliği sayesinde, klinik pratiğe yönelik risk sınıflandırmasında pratik bir araç olarak kullanılabilir. Bulguların doğrulanması ve myokardit patofizyolojisindeki rolünün daha iyi anlaşılması için ileriye dönük çalışmalar gereklidir.

Anahtar Kelimeler: Myokardit, TyG İndeksi, Yoğun bakım yatışı, Hastalık şiddeti

Introduction

Myocarditis is a condition characterized by inflammation of the myocardium. Various etiologies, including viral or bacterial infections and autoimmune reactions, can contribute to this clinical presentation (1). The prevalence of myocarditis varies depending on the population and diagnostic criteria used, but it is estimated to affect 10 to 22 individuals per 100,000 persons annually (2). Common symptoms include chest pain, which may mimic myocardial infarction, as well as fatigue, dyspnea, and palpitations (3,4). Diagnostic methods for myocarditis encompass electrocardiography (ECG), echocardiography, cardiac magnetic resonance imaging (MRI), and endomyocardial biopsy (4,5). These tools are essential for identifying inflammation and structural changes in the heart, which are critical for confirming the diagnosis.

The length of hospital stay for patients with myocarditis can vary widely depending on numerous factors (6). These factors include the patient's clinical condition, treatment response, presence of complications, and post-discharge care needs (7). For instance, patients exhibiting symptoms of heart failure or arrhythmias may require prolonged observation in the hospital. Conversely, patients with mild symptoms and no complications may be suitable for outpatient management with short-term follow-up (8).

Treatment for myocarditis largely depends on the severity of the disease, which can range from a self-limiting condition to a life-threatening state (9). Therapeutic strategies vary accordingly and may include supportive care, immunosuppressive therapy, and, in severe cases, mechanical circulatory support or heart transplantation (10,11). Identifying the factors that determine disease severity is crucial for tailoring treatment plans and improving patient outcomes. Traditional biomarkers, such as troponins and natriuretic peptides, have been used to assess myocardial injury and stress, yet there remains a need for additional biomarkers that could offer more comprehensive insights into disease activity and prognosis (12).

Elevated triglyceride-glucose (TyG) index values are associated with insulin resistance and an increased risk of metabolic syndrome (13). Recent studies have shown that the TyG index is an independent predictor of prognosis, demonstrating potential clinical utility in predicting cardiovascular risk among both diabetic and non-diabetic patients with cardiovascular disease (14). Inflammatory diseases like myocarditis involve a complex interplay between metabolic and inflammatory

processes. Therefore, further investigation is warranted to elucidate the role of the TyG index in myocarditis and its relationship with triglycerides and glucose. Understanding the role of the TyG index in myocardial pathophysiology may provide insights into disease mechanisms and contribute to the development of improved therapeutic approaches.

Material and Methods

Compliance with Ethical Standards

The study was reviewed and approved by the institutional research ethics board in accordance with the principles of the Declaration of Helsinki. Artificial intelligence-supported technologies were not used in the study. We received ethics committee approval from the Konya Necmettin Erbakan University Ethics Board. The ethics committee approval of the study was obtained by the decision of the university board meeting dated 17/05/2024 and numbered 2024/4975.

Study Design

This retrospective study was conducted to assess the use of the Triglyceride-Glucose (TyG) Index as a biomarker for determining disease severity and predicting ICU admission and total hospital stay duration in patients with acute myocarditis. Patients diagnosed with acute myocarditis at our institution between January 2015 and December 2023 were included in the study. A total of 326 patients were enrolled, comprising 177 males and 149 females. Patients presenting with resistant chest pain, hypotension, pericardial effusion, ejection fraction (EF) reduction, and those unresponsive to medical and symptomatic treatment were classified as having severe disease. Diagnosis was based on clinical assessment, cardiac biomarkers, and cardiac imaging, with coronary angiography or coronary CT angiography performed to exclude atherosclerotic heart disease. Although cardiac MRI is considered the gold standard for noninvasive myocarditis diagnosis, it was not routinely performed in our study due to its unavailability at our institution. Triglyceride-Glucose index was calculated with the formula TyG = ln(fasting triglyceride mg/dL × fasting glucose mg/dL/2).

Data on demographic information, clinical presentation, laboratory findings, imaging results, treatment, and outcomes were collected from medical records. Patients were eligible for inclusion if they were aged 18 years or older and had a confirmed diagnosis of acute myocarditis. Exclusion criteria were as follows: chronic kidney disease, liver disease, malignancy, any types of diabetes mellitus, pancreatic diseases, patients with incomplete medical records; and those who had received glucose- or triglyceride-altering therapies prior to myocarditis diagnosis. This approach was implemented to ensure homogeneity within the study population and to prevent confounding of TyG Index measurements by underlying conditions.

Statistical Analysis

Statistical analyses were performed using SPSS 21.0 (IBM Inc, Chicago, IL, USA) program in the study. Kolmogrov-Smirnov test, histogram analyses, skewness/kurtosis data and Q-Q plots were used to assess the conformity of numerical variables to normal distribution. Descriptive statistics of numerical and categorical data obtained in the study were analyzed and expressed as IQR (median [minimum-maximum]) since quantitative parameters did not exhibit a normal distribution pattern. Relationships between the two groups were examined with Mann-Whitney U test. Correlation relationships between quantitative parameters were performed with Spearman correlation analysis. Type-I error rate was taken as 5% ($\alpha = 0.05$) throughout the study and $p<0.05$ level was accepted as the significant limit.

Results

Table 1 summarizes the distribution of quantitative parameters in patients with myocarditis. Patient ages ranged from 18 to 74 years, with a median age of 40 years. White blood cell (WBC) counts demonstrated a broad range, with a median of 10.24 $\times 10^3$/μL (IQR: 8.01–23.82), while neutrophil counts had a median of 7.48 $\times 10^3$/μL (IQR: 3.62–19.93). Troponin levels varied significantly, ranging from 48 to 50,000 ng/L, with a median of 456 ng/L. Other noteworthy parameters included C-reactive protein (CRP) levels with a median of 33 mg/L (IQR: 10–348) and D-dimer levels with a median of 560.5 ng/mL (IQR: 365–987).

Table 2 compares parameters between male and female myocarditis patients. The median age for males was 46 years (IQR: 38–59), while for females, it was 34 years (IQR: 29–41), with a significantly higher age in males ($p = 0.023$). Hemoglobin levels were significantly higher in males (mean: 15.1 ± 1.2 g/dL) compared to females (mean: 13.4 ± 1.1 g/dL, $p < 0.001$). WBC and neutrophil counts were significantly lower in males,

with median values of 9.92 $\times 10^3$/µL (IQR: 8.08–21.26) and 7.2 $\times 10^3$/µL (IQR: 3.62–18.28), respectively. Females had a higher mean platelet count (253.8 ± 49.6 $\times 10^3$/µL). CRP levels were significantly higher in females (median: 38 mg/L, IQR: 16–284) compared to males (median: 29 mg/L, IQR: 12–174, p = 0.001). Triglyceride levels were also significantly higher in females (median: 127 mg/dL, IQR: 94–186) than in males (median: 124 mg/dL, IQR: 91–173, p = 0.028).

Table 3 presents the assessment of the TyG index according to specific clinical conditions. Patients with pericardial effusion, those requiring inotropic support, IV steroids, and IV immunoglobulin (IVIG) had significantly higher TyG indices. Additionally, the TyG index was notably elevated in patients with hypertension (HT), diabetes mellitus (DM), hyperlipidemia (HPL), a family history of atherosclerotic coronary artery disease, prior tonsillitis, and recent gastroenteritis within the past 3–4 weeks. These findings suggest that a higher TyG index is associated with indicators of more severe disease, such as pericardial effusion and the need for inotropic support, IV steroids, and IVIG.

Table 4 shows that patients with a longer hospital stay (>2 days) had higher mean WBC, neutrophil, CRP, troponin, and ferritin levels compared to those with shorter stays. Importantly, patients with a hospital stay longer than two days had a significantly higher TyG index (p < 0.001).

Table 5 presents correlations between the TyG index and other clinical parameters, revealing significant associations with ICU stay duration, total hospital stay, and various hematological and biochemical markers. These findings suggest that the TyG index could serve as a useful indicator of disease severity and hospital outcomes in myocarditis patients. Strong positive correlations were observed between total hospital stay and elevated troponin, D-dimer, and fibrinogen levels. Additionally, there was a strong positive correlation between uric acid and the TyG index. A strong negative correlation was found between age and levels of ASO and CRP.

Table 1. Summary of the general distribution of quantitative parameters in myocarditis patients.

Parameters	Unit	Minimum	Maximum	Distribution †
Age	years	18	74	40 (18 – 74)
WBC	103/mL	8.01	23.82	10.24 (8.01 – 23.82)
Neutrophil	103/mL	3.62	19.93	7.48 (3.62 – 19.93)
Monocyte	%	0.04	1.82	0.67 (0.04 – 1.82)
Hemoglobin	g/dL	10.50	17.70	14.3±1.4
Lymphocyte	103/mL	0.40	4.78	2.15±0.69
Platelet	103/mL	146.0	366.0	245.4±49.1
RDW	%	11.2	17.7	13.4±1.1
Albumin	g/L	32.0	50.6	42.6±3
LDL	mg/dL	53.0	198.0	135.4±23.7
HDL	mg/dL	23.0	65.0	44.0±6.6
TRG	ng/dL	72.0	307.0	126 (72 – 307)
ASO	IU/mL	111.0	387.0	180 (111 – 387)
EF	%	30.0	65.0	60 (30 – 65)
Troponin	ng/L	48	50000	456 (48 – 50000)
CRP	mg/L	10.0	348.0	33 (10 – 348)
D-dimer	ng/mL	365.0	987.0	560.5 (365 – 987)
Ferritin	ng/mL	19.0	165.0	76 (19 – 165)
Fibrinogen	ng/dL	2.56	4.16	3.41 (2.56 – 4.16)
Uric Acid	mg/dL	3.60	6.20	4.4 (3.6 – 6.2)
Glucose	mg/dL	77.0	167.0	97 (77 – 167)
TyG index		8.17	9.92	8.70 (8.17 – 9.92)
ICU Time	Day	1	10	1 (1 – 10)
Total Hospitalization Time	Day	1	14	3 (1 – 14)

† Parameters are expressed as IQR (Interquartile Range) [median, min and max] or mean±SD.
WBC: White Blood Cell; RDW: Red Cell Distribution Width; ASO: Antistreptolysin O; EF: Ejection Fraction; CRP: C Reactive Protein; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TRG: Triglyceride; TyG Index: Triglyceride-Glucose Index; ICU: Intensive Care Unit

Table 2. Comparison of parameters according to gender in myocarditis patients

		Sex		p
		Male (n=177, %54,3)	Female (n=149, %45,7)	
Parameters	Unit	Distribution*		
Age	years	46 (18 – 74)	34 (18 – 65)	0.023
WBC	103/mL	9.92 (8.08 – 21.26)	11.29 (8.01 – 23.82)	<0.001
Neutrophil	103/mL	7.2 (3.62 – 18.28)	8.36 (4.66 – 19.93)	<0.001
Monocyte	%	0.66 (0.04 – 1.82)	0.68 (0.28 – 1.8)	0.106
Hemoglobin	g/dL	15.1±1.2	13.4±1.1	<0.001
Lymphocyte	103/mL	2.2±0.73	2.1±0.64	0.188
Platelet	103/mL	238.3±47.7	253.8±49.6	0.005
RDW	%	13.6±1	13.2±1.2	0.005
Albumin	g/L	43.3±2.6	41.7±3.3	<0.001
LDL	mg/dL	136.2±25	134.5±22	0.522
HDL	mg/dL	41.8±6.1	46.7±6.3	<0.001
TRG	ng/dL	124 (72 – 298)	127 (78 – 307)	0.028
ASO	IU/mL	182 (111 – 387)	178 (113 – 386)	0.364
EF	%	60 (30 – 65)	60 (45 – 65)	<0.001
Troponin	ng/L	560 (51 – 50000)	455 (48 – 38990)	0.406
CRP	mg/L	29 (10 – 348)	38 (11 – 256)	0.001
D-dimer	ng/mL	577 (367 – 987)	550 (365 – 790)	0.026
Ferritin	ng/mL	67 (19 – 165)	78 (24 – 144)	0.001
Fibrinogen	ng/dL	3.38 (2.56 – 4.16)	3.41 (2.66 – 4.01)	0.801
Uric Acid	mg/dL	4.4 (3.6 – 6.2)	4.4 (3.6 – 6.1)	0.597
Glucose	mg/dL	96 (78 – 132)	99 (77 – 167)	0.649
TyG index		8.68 (8.17 – 9.82)	8.73 (8.35 – 9.92)	0.110
ICU Time	Day	1 (1 – 10)	1 (1 – 7)	0.818
Total Hospitalization Time	Day	2 (1 – 14)	3 (2 – 14)	0.112

† Parameters are expressed as IQR (Interquartile Range) [median, min and max] or mean±SD.
WBC: White Blood Cell; RDW: Red Cell Distribution Width; ASO: Antistreptolysin O; EF: Ejection Fraction; CRP: C Reactive Protein; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TRG: Triglyceride; TyG Index: Triglyceride-Glucose Index; ICU: Intensive Care Unit

Discussion

This study aimed to evaluate the potential use of the TyG Index as a marker for assessing disease severity and predicting ICU and total hospital stay durations in patients with acute myocarditis. Previous studies have demonstrated that, in cases of acute myocarditis, persistent chest pain, increased pericardial effusion, cardiac tamponade, hypotension, reduced ejection fraction, low cardiac output, and sustained ventricular arrhythmias indicate a more severe, refractory, and rapidly progressing disease course (15). The Lombardy registry, a multicenter Italian study involving 443 hospitalized patients with confirmed myocarditis, identified severe hemodynamic compromise at admission as the highest risk factor for cardiac mortality (16-18). Similarly, another study from 16 tertiary care centers, including 220 patients with biopsy-confirmed myocarditis, found that hemodynamic compromise at presentation was the primary determinant of both short- and long-term prognosis (19-21). In fulminant myocarditis, symptoms typically appear rapidly, within 2 days to 2 weeks, leading to marked hemodynamic dysfunction and circulatory failure, often necessitating aggressive blood pressure management and vasopressors, with mechanical circulatory support devices required in advanced stages (22-24).

Our findings indicate that higher TyG Index values are significantly associated with increased severity of myocarditis, correlating with longer ICU and total hospital stays, greater need for inotropic support, IV steroids, IVIG, and elevated levels of inflammatory markers such as CRP and ferritin, as well as elevated troponin, fibrinogen, and D-dimer levels. These results align with prior research suggesting that oxidative stress and inflammation play central roles in the pathophysiology of myocarditis.

Table 3. Comparison of TyG index values according to the presence of specific conditions

Parameters		TyG index Medyan (min-max)	P*
Pericardial effusion	No (n=224)	8.62 (8.17-9.53)	<0.001
	Yes (n=102)	9.33 (9.04-9.92)	
Beta blocker use	No (n=191)	8.69 (8.17-9.79)	0.181
	Yes (n=135)	8.74 (8.19-9.92)	
ACEi use	No (n=191)	8.69 (8.17-9.79)	0.181
	Yes (n=135)	8.74 (8.19-9.92)	
Inotropic support	No (n=312)	8.69 (8.17-9.92)	<0.001
	Yes (n=14)	9.39 (9.14-9.68)	
IV steroid intake	No (n=308)	8.69 (8.17-9.92)	<0.001
	Yes (n=18)	9.39 (9.14-9.68)	
IVIG	No (n=318)	8.7 (8.17-9.92)	0.005
	Yes (n=8)	9.25 (9.14-9.44)	
Coronary angiography	No (n=85)	8.66 (8.17-9.4)	0.043
	Yes (n=241)	8.71 (8.19-9.92)	
Hypertension	No (n=190)	8.69 (8.17-9.71)	0.123
	Yes (n=136)	8.74 (8.19-9.92)	
Hyperlipidemia	No (n=247)	8.65 (8.17-9.68)	<0.001
	Yes (n=79)	8.87 (8.19-9.92)	
Diabetes Mellitus	No (n=269)	8.67 (8.17-9.71)	<0.001
	Yes (n=57)	8.84 (8.46-9.92)	
Smoking	No (n=147)	8.71 (8.19-9.79)	0.996
	Yes (n=179)	8.7 (8.17-9.92)	
Family History	No (n=244)	8.68 (8.17-9.79)	0.003
	Yes (n=82)	8.82 (8.19-9.92)	
Obesity	No (n=135)	8.71 (8.17-9.68)	0.603
	Yes (n=191)	8.7 (8.19-9.92)	
Flu in 4 weeks	No (n=121)	8.69 (8.17-9.54)	0.09
	Yes (n=205)	8.74 (8.19-9.92)	
Tonsillitis	No (n=200)	8.73 (8.19-9.92)	0.123
	Yes (n=126)	8.67 (8.17-9.71)	
Gastroenteritis within 4 weeks	No (n=263)	8.69 (8.17-9.92)	0.002
	Yes (n=63)	8.81 (8.33-9.82)	
Coronary CT Angiography	No (n=238)	8.71 (8.19-9.92)	0.055
	Yes (n=88)	8.68 (8.17-9.4)	

† Parameters are expressed as IQR (Interquartile Range) [median, min and max].
*Mann-Whitney U test.
IV: intravenous; IV: Intravenous Immunoglobulin; ECG: electrocardiography; CT: Computed Tomography; ACEI: ACE inhibitor

The relationship between TyG Index and disease severity, prognosis, ICU stay, and overall hospital stay in myocarditis is a complex issue requiring further detailed investigation. The Tehran Lipid and Glucose Study found a significant association between the TyG Index and increased cardiovascular and coronary heart disease risk in 7,521 Iranian men (25). The Kailuan Study reported that high initial and long-term TyG Index levels are associated with an increased risk of myocardial infarction (26). Research conducted in Korea demonstrated that an elevated TyG Index is a significant indicator of ischemic heart disease in a non-diabetic population (27). Additionally, the Atherosclerosis Risk in Communities (ARIC) Study identified a higher TyG Index as independently associated with an increased risk of peripheral artery disease (28). The cumulative exposure, variability, and progression of the TyG Index have been linked to higher cardiovascular disease rates over time (29-32).

Table 4. Comparison of quantitative parameters with total hospital stay groups

		Total Hospitalization Time		
		1-2 day (n=159, %48,8)	>2 day (n=167, %51,2)	P**
Parameters	Unit	Distribution*		
Age	year	43 (19 – 68)	32 (18 – 74)	0.011
WBC	103/mL	9.78 (8.01 – 23.82)	11.95 (8.23 – 22.71)	<0.001
Neutrophil	103/mL	6.72 (3.62 – 19.93)	8.66 (3.67 – 18.47)	<0.001
Monocyte	%	0.66 (0.04 – 1.37)	0.69 (0.2 – 1.82)	0.013
Hemoglobin	g/dL	14.5±1.4	14.1±1.5	0.030
Lynphocyte	103/mL	2.22±0.77	2.08±0.6	0.064
Platelet	103/mL	246.5±51	244.3±47.4	0.687
RDW	%	13.2±1.1	13.7±1	<0.001
Albumin	g/L	42.8±3.0	42.3±3.0	0.132
LDL	mg/dL	130.7±22.8	139.9±23.7	<0.001
HDL	mg/dL	44.6±6.9	43.5±6.4	0.131
TRG	ng/dL	118 (72 – 290)	132 (77 – 307)	<0.001
ASO	IU/mL	172 (111 – 387)	189 (121 – 386)	<0.001
EF	%	60 (45 – 65)	60 (30 – 65)	<0.001
Troponin	ng/L	228 (48 – 18511)	4246 (51 – 50000)	<0.001
CRP	mg/L	23 (10 – 203)	43 (10 – 348)	<0.001
D-dimer	ng/mL	506 (365 – 722)	598 (367 – 987)	<0.001
Ferritin	ng/mL	67 (19 – 165)	78 (22 – 165)	0.001
Fibrinogen	ng/dL	3.12 (2.56 – 3.87)	3.61 (2.88 – 4.16)	<0.001
Uric Acid	mg/dL	4.3 (3.6 – 6.1)	4.7 (3.6 – 6.2)	<0.001
Glucose	mg/dL	93 (78 – 167)	101 (77 – 145)	<0.001
TyG index		8.62 (8.19 – 9.72)	8.83 (8.17 – 9.92)	<0.001

† Parameters are expressed as IQR (Interquartile Range) [median, min and max] or mean±SD.
**Mann-Whitney U test.
WBC: White Blood Cell; RDW: Red Cell Distribution Width; ASO: Antistreptolysin O; EF: Ejection Fraction; CRP: C Reactive Protein; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TRG: Triglyceride; TyG Index: Triglyceride-Glucose Index.

Emerging evidence suggests that the TyG Index reflects underlying metabolic dysregulation, which may contribute to the pathophysiology of myocarditis through mechanisms involving oxidative stress, endothelial dysfunction, and systemic inflammation. Insulin resistance, a key component of TyG Index elevation, has been associated with increased pro-inflammatory cytokine release, mitochondrial dysfunction, and impaired myocardial energy metabolism, all of which may exacerbate myocardial injury in acute myocarditis. Additionally, hypertriglyceridemia promotes lipotoxicity and enhances the production of reactive oxygen species, leading to cardiomyocyte apoptosis and fibrosis. These processes may amplify the inflammatory cascade and perpetuate myocardial damage. Given the established role of oxidative stress and metabolic disturbances in myocarditis, the strong association between a high TyG Index and severe disease manifestations in our cohort supports the hypothesis that metabolic and inflammatory pathways are intertwined in myocardial injury.

In our study, patients with pericardial effusion, those requiring inotropic support, IV steroid, and IVIG treatments had significantly higher TyG Index values. These findings suggest that the TyG Index may be influenced by both the clinical presentation of myocarditis and the therapeutic interventions employed. A high TyG Index was also observed in patients with a history of tonsillitis or recent gastroenteritis (3–4 weeks prior to diagnosis), which may reflect infectious etiologies. Additionally, the association between an elevated TyG Index and comorbidities such as HT, DM, HPL, and a family history of atherosclerotic risk factors suggests that these comorbidities may enhance the inflammatory response.

Methodologically, the TyG Index can be easily calculated based on routine blood biochemistry tests, making it accessible for

Table 5. Examining the correlation relationships of quantitative parameters with age, ICU length of stay, total hospital length of stay and TyG index

		Age	ICU Time	Hospitalization Time	TyG index
Age	rho	–	-0,204	-0,155	0,114
	P	–	<0,001	0,005	0,039
ICU Time	rho	-0,204	–	0,475	0,331
	P	<0,001	–	<0,001	<0,001
Hospitalization Time	rho	-0,155	0,475	–	0,41
	P	0,005	<0,001	–	<0,001
TyG index	rho	0,114	0,331	0,41	–
	P	0,039	<0,001	<0,001	–
WBC	rho	-0,305	0,304	0,424	0,476
	P	<0,001	<0,001	<0,001	<0,001
Neutrophil	rho	-0,271	0,311	0,414	0,435
	P	<0,001	<0,001	<0,001	<0,001
Monocyte	rho	-0,29	0,224	0,244	0,073
	P	<0,001	<0,001	<0,001	0,186
Hemoglobin	rho	0,092	-0,209	-0,182	-0,356
	P	0,096	<0,001	0,001	<0,001
Lymphocyte	rho	0,003	-0,073	-0,052	0,175
	P	0,952	0,186	0,347	0,001
Platelet	rho	0,096	-0,071	-0,017	0,186
	P	0,084	0,204	0,754	0,001
RDW	rho	0,207	0,293	0,314	0,555
	P	<0,001	<0,001	<0,001	<0,001
Albumin	rho	0,068	-0,269	-0,186	-0,321
	P	0,219	<0,001	0,001	<0,001
LDL	rho	0,36	0,161	0,276	0,528
	P	<0,001	0,004	<0,001	<0,001
HDL	rho	-0,479	-0,101	-0,051	-0,273
	P	<0,001	0,068	0,36	<0,001
TRG	rho	-0,029	0,329	0,412	–
	P	0,606	<0,001	<0,001	–
ASO	rho	-0,696	0,106	0,143	-0,025
	P	<0,001	0,056	0,01	0,656
EF (%)	rho	-0,454	-0,121	-0,223	-0,22
	P	<0,001	0,029	<0,001	<0,001
Troponin	rho	-0,371	0,287	0,678	0,131
	P	<0,001	<0,001	<0,001	0,018
CRP	rho	-0,609	0,34	0,438	0,167
	P	<0,001	<0,001	<0,001	0,002
D-dimer	rho	-0,153	0,358	0,618	0,274
	P	0,006	<0,001	<0,001	<0,001
Ferritin	rho	-0,587	0,344	0,248	0,074
	P	<0,001	<0,001	<0,001	0,184
Fibrinogen	rho	-0,1	0,362	0,652	0,323
	P	0,07	<0,001	<0,001	<0,001
Uric Acid	rho	-0,11	0,351	0,353	0,673
	P	0,047	<0,001	<0,001	<0,001
Glucose	rho	0,191	0,255	0,298	–
		0,001	<0,001	<0,001	–

*Spearman correlation analysis.
WBC: White Blood Cell; RDW: Red Cell Distribution Width; ASO: Antistreptolysin O; EF: Ejection Fraction; CRP: C Reactive Protein; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TRG: Triglyceride; TyG Index: Triglyceride-Glucose Index.

clinical applications worldwide. This straightforward approach may provide valuable information regarding disease severity, prognosis, ICU, and total hospital stay durations in myocarditis patients. However, further studies are necessary to validate the clinical applicability of these parameters. Future research should also consider the potential influence of factors such as ethnicity, comorbidities, and follow-up duration on outcomes.

Limitations

This study has several limitations that should be acknowledged. First, the diagnosis of myocarditis in our cohort was based on clinical presentation and non-invasive tests rather than on endomyocardial biopsy or cardiac MRI, which are considered gold standards for definitive diagnosis. The absence of these diagnostic methods may have led to misclassification or underestimation of disease presence and severity. Second, we did not measure B-type natriuretic peptide (BNP) levels, a well-established biomarker in heart failure and myocarditis. BNP could have provided additional insights into the severity of myocardial dysfunction and patients' hemodynamic status. The lack of BNP data may limit a comprehensive assessment of cardiac function in our study population.

Additionally, this study's retrospective nature introduces the potential for selection and recall bias. Reliance on medical records for data collection may lead to missing or inaccurate information, potentially affecting study outcomes. Prospective studies are needed to validate our findings and provide more robust evidence. Another limitation involves potential confounding factors not accounted for in our analysis. Underlying comorbidities, medications, and lifestyle factors (e.g., diet, smoking) could influence glucose and triglyceride levels, thereby affecting the TyG Index. A more comprehensive analysis controlling for these variables would strengthen the validity of our results.

Conclusion

In conclusion, our study provides evidence supporting the use of TyG Index as a new marker for assessing disease severity, ICU and total hospital length of stay in patients with acute myocarditis. By integrating markers of oxidative stress and nutritional/inflammatory status, TyG Index provides a comprehensive tool for risk stratification and management in clinical practice. Future studies should aim to confirm these findings in larger, prospective cohorts and explore the mechanistic pathways linking TyG Index to myocarditis severity.

Ethics Committee Approval

This study complies with all relevant national regulations, institutional policies, and the principles of the Declaration of Helsinki and has been approved by the Ethics Committee of Konya Necmettin Erbakan University Faculty of Medicine (approval number: 2024/4975).

Informed Consent

All rights of the participants were protected and written informed consent was obtained before the procedures in accordance with the Declaration of Helsinki.

Author Contributions

Concept - A.E.; Design - A.T.S.; Supervision - H.E.; Resources - A.E.; Materials - A.E., H.E.; Data Collection and/or Processing - A.E.; Analysis and/or Interpretation - A.T.S.; Literature Review - A.E.; Writing the Article - H.E.; Critical Review - A.E., A.T.S.

Conflict of Interest

The authors have no conflict of interest to declare.

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Araştırma Makalesi

Sporcu elektrokardiyogramlarında hipertrofi kriterlerinin diyastolik disfonksiyon ilişkisi

Relatıonshıp between hypertrophy crıterıa and dıastolıc dysfunctıon ın athlete electrocardıograms

İdris Yakut*[1], Ömer Özkan[2]

[1]İstanbul Medipol Üniversitesi, Kardiyoloji Kliniği, İstanbul, Türkiye

[2]Ankara Gaziler Fizik Tedavi ve Rehabilitasyon Eğitim ve Araştırma Hastanesi, Spor Hekimi, Ankara, Türkiye

Öz

Amaç: Çalışmamız ile öncelikle Sokolow-Lyon kriterinin sol ventrikül hipertrofisi ve sol ventrikül diyastolik disfonksiyonu öngördürücülüğü araştırılacaktır ve diğer hipertrofi kriterleri ile karşılaştırılacaktır.

Gereç ve Yöntemler: Ocak 2023 ve Ocak 2024 tarihleri Ankara Gaziler Fizik Tedavi ve Rehabilitasyon Eğitim ve Araştırma Hastanesi'nden 121 profesyonel sporcu ile Bahçelievler Medipol Hastanesi'nden 31 sağlıklı gönüllü katılımcı olarak değerlendirilmiştir. Hastaların elektrokardiyografi ve ekokardiyografi tetkiklerinden veriler elde edilmiştir.

Bulgular: Sporcu grubunun yaş ortalaması 24,83 yıl ve kontrol grubu 28,81 yıl olarak hesaplandı. Sokolow-Lyon voltajı sporcularda anlamlı olarak daha yüksek bulundu. Sol ventrikül kitle indeksi sporcu grubunda 81,66 g/m2 ve kontrol grubunda 76,59 g/m2 olarak ölçüldü gruplar arasında anlamlı fark yoktu(p=0,09). Sol ventrikül geometri değişikliği ve diyastolik disfonksiyon açısından gruplar arasında fark saptanmadı. Sokolow-Lyon voltajının ≥35 mm olması normal dışı geometri, sol ventrikül kitlesi ve diyastolik disfonksiyon ile ilişkili bulunmadı.

Sonuç: Sokolow-Lyon kriterinin sporcularda hipertrofiyi öngörmedeki sınırlı duyarlılığı göz önünde bulundurularak, sporcu EKG'lerinin değerlendirilmesinde daha kapsamlı değerlendirmelerin dikkate alınması gerektiği vurgulanmıştır. Ayrıca, sol ventrikül geometrisinin değerlendirilmesi, patolojik durumların ayrımında önem taşımaktadır. Sporcularda görülen kalp değişikliklerinin büyük ölçüde fizyolojik adaptasyon olduğu sonucuna varılmıştır.

Anahtar kelimeler: Diyastolik disfonksiyon, Elektrokardiyografi, Sokolow-Lyon kriteri, Sporcu

Sorumlu Yazar*: İdris Yakut, İstanbul Medipol Üniversitesi, Kardiyoloji Kliniği, İstanbul, Türkiye,
E-mail: idrislive@windowslive.com
Orcid: 0000-0002-3038-3829
Doi: 10.18663/tjcl.1618159
Geliş Tarihi: 12.01.2025 Kabul Tarihi: 24.02.2025

Abstract

Aim: Our study aims to investigate the predictive power of the Sokolow-Lyon criterion for left ventricular hypertrophy and left ventricular diastolic dysfunction and to compare it with other hypertrophy criteria.

Material and Methods: Between January 2023 and January 2024, 121 professional athletes from Ankara Gaziler Physical Therapy and Rehabilitation Training and Research Hospital and 31 healthy volunteers from Bahçelievler Medipol Hospital were evaluated as participants. Data were obtained from electrocardiography and echocardiography examinations of the patients.

Results: The mean age of the athlete group was 24.83 years and the control group was 28.81 years. Sokolow-Lyon voltage was significantly higher in the athletes (p=0.00). Left ventricular mass index was 81.66 g/m2 in the athlete group and 76.59 g/m2 in the control group and there was no significant difference between the groups (p=0.09). There was no difference between the groups in terms of left ventricular geometry change and diastolic dysfunction. Sokolow-Lyon voltage of ≥35 mm was not associated with abnormal geometry, left ventricular mass and diastolic dysfunction.

Conclusion: Considering the limited sensitivity of the Sokolow-Lyon criterion in predicting hypertrophy in athletes, it is emphasized that more comprehensive evaluations should be considered in the evaluation of athlete ECGs. Furthermore, assessment of left ventricular geometry is important in differentiating pathologic conditions. Most of the cardiac changes seen in athletes

Keywords: Athlete, Diastolic dysfunction, Electrocardiography, Sokolow-Lyon criteria

Giriş

Düzenli ve uzun süreli yoğun fiziksel egzersiz, kalbin yapısal, işlevsel ve elektriksel olarak yeniden şekillenmesine yol açar. Bu fizyolojik değişiklikler atriyal ve ventriküler boyutları etkiler ve sporcu kalbi olarak tanımlanır. Bu durum hem erkeklerde hem de kadınlarda görülebilir. Morfolojik değişikliklerin derecesi yaş, vücut boyutu, etnik köken, cinsiyet ve spor aktivitesi ve yoğunluğu gibi faktörlere bağlıdır[1]. Elektrokardiyografi (EKG) ile tespit edilen sol ventrikül hipertrofisi(SVH), hipertansif hastalarda önemli bir kardiyovasküler risk faktörü ve organ hasarı belirtisi olarak kabul edilir. EKG'nin düşük maliyetli ve kolay uygulanabilir olması hipertrofi açısından avantaj iken tanımlanmış SVH kriterlerinin düşük duyarlılıkları ve yanlış negatif sonuçları dezavantaja neden olmaktadır. Yanlış negatif sonuçlar, SVH hastalarında baskın EKG bulgularıdır. Sokolow-Lyon kriterinin incelendiği çalışmada bile anatomik SVH'li hastaların yalnızca %32'si normal aralığın üst sınırını aşmıştır, başka bir deyişle %68 EKG bulgusu normal popülasyonla örtüşmektedir[2].

Sol ventrikül(SV) kitlesi indeksi ve rölatif duvar kalınlığı kullanılarak SV geometrisinin değerlendirilmesi, sporcunun kalbini hipertrofik kardiyomiyopati gibi patolojik sol ventrikül hipertrofisinden ayırt etmede giderek daha önemli bir bileşen haline gelmektedir[3].

Sporcular miyokardiyal diyastolik özelliklerde ve süpernormal SV diyastolik fonksiyonunda iyileşme göstermektedir. Bu durum çeşitli türdeki uygulanan sporların sonuçlarında farklı morfolojik kalp özelliklerine bağlı değişiklik göstermektedir. Sporcunun kardiyak fonksiyonuna ilişkin önceki ekokardiyografik çalışmalar, uzun süreli egzersizin diyastolik dolumda erken diyastolden geç diyastole doğru bir kaymaya, ventriküler boyutlarda ve hacimlerde bir değişikliğe, sistolik fonksiyonda bir azalmaya ve SV'de duvar hareket anormalliklerinin gelişimine eşlik ettiğini göstermiştir[4]. Çalışmamız ile öncelikle Sokolow-Lyon kriterinin sol ventrikül hipertrofisini ve SV diyastolik disfonksiyonu öngördürücülüğü araştırılacaktır ve diğer hipertrofi kriterleri ile karşılaştırılacaktır.

Gereç ve Yöntemler

Çalışma popülasyonu

Ocak 2023 ve Ocak 2024 tarihleri arasında Ankara Gaziler Fizik Tedavi ve Rehabilitasyon Eğitim ve Araştırma Hastanesi Spor hekimliği polikliniğine başvuran 121 düzenli antrenman yapan profesyonel sporcu ile Bahçelievler Medipol Hastanesi Kardiyoloji polikliniğinde atipik semptomlarla incelenen 31 sağlıklı gönüllüden oluşmaktadır. 18 yaşın altında, doğumsal kalp hastalığı, kardiyovasküler hastalığı olan, senkop veya aritmi öyküsü olan hastalar dışlanmıştır.

Çalışma protokolü İstanbul Medipol Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu'ndan onay almıştır (Tarih 29.02.2024, Karar no:233) ve araştırmamız Helsinki Bildirgesi ve onun beyanında belirtilen etik ilkelere uygun olarak yürütülmüştür.

Elektrokardiyogram

25 mm/s kâğıt hızında 12 derivasyonlu dinlenme EKG'si GE HEALTHCARE MAC 2.000 EKG sistemi kullanılarak kaydedildi. EKG kaydından önce, tüm katılımcılar 10 dakika boyunca loş ışıklı bir odada sırtüstü pozisyonda sessizce dinlendiler. EKG'nin iyi teknik kalitesi, tüm derivasyonlarda net EKG sinyalleri, kas titremesi artefaktları veya elektromanyetik girişim olmaması ve iyi elektrot teması ile sağlandı. Aşağıdaki EKG değişkenleri ölçüldü/not edildi.

• Kalp hızı

• PR interval süresi

• QRS süresi

• QT süresi

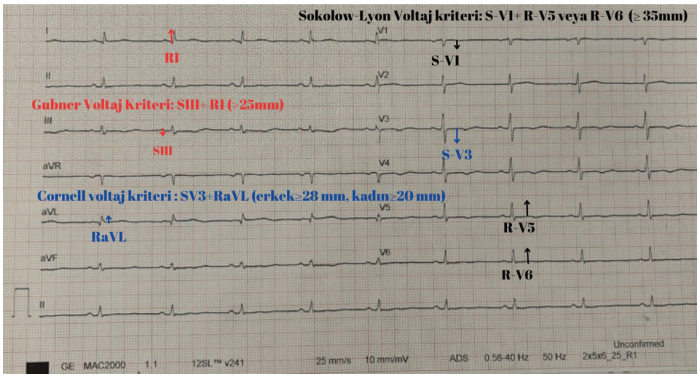
• Bazett'in formülüne göre QTc(düzeltilmiş) süresi

• Sol ventrikül hipertrofi kriterlerine göre voltaj ölçümleri (Şekil 1'de hesaplama görselleştirilmiştir.)

a) Sokolow-Lyon voltaj kriteri: V1S ile V5-6R amplütüdü toplamı

b) Cornell voltaj kriteri: aVLR ile V3S amplütüdü toplamı

c) Gubner voltaj kriteri: DIR ile DIIIS amplütüdü toplamı [5, 6].



Şekil-1: Sol ventrikül hipertrofi kriterleri hesaplama görseli

Ekokardiyografi

Transtorasik ekokardiyografi(TTE), her bir deneğin klinik özelliklerini bilmeyen kardiyolog tarafından 5S Problu GE Vivid S60 ekokardiyografi cihazı (GE, Boston, ABD) ile gerçekleştirildi. TTE incelemeleri sırasında, hastalar loş ışıkta göğüs ön duvarını açacak şekilde ve sol lateral dekübit pozisyonunda yattı. Aşağıdaki 2 boyutlu ve M-mod ekokardiyografik parametreler ölçüldü:

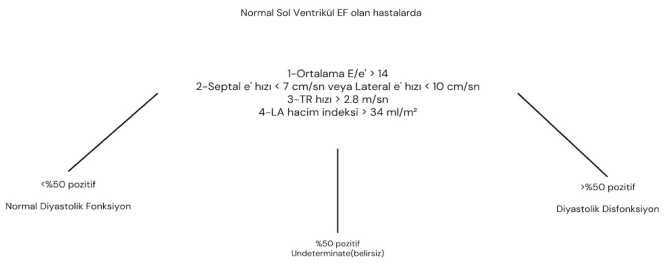
• Sol ventrikül diyastol sonu çapı: Edd, mm

• İnterventriküler septum kalınlığı: IVS, mm

• Posteriyor duvar kalınlığı: PWT, mm

Transmitral dalga doppler hızları, mitral kapak yaprakçığı seviyesine yerleştirilen bir doppler örneği ile apikal 4 odacıklı görünümden ölçüldü. Erken (E dalgası, m/sn) ve geç (A dalgası, m/sn) mitral akım hızları ölçüldü. Mitral annulus hareketinin doku doppler görüntülemesi lateral mitral annulus ve septal bazal bölgeden peak erken diyastolik (e', m/sn) hızları ölçüldü. Sol ventrikül ejeksiyon fraksiyonu, LVEF Simpson yöntemi kullanılarak hesaplandı. Her bir SV kitlesi hesaplandı ve vücut yüzey alanına göre indekslendi. Sol ventrikül kitlesi basit ve anatomik olarak doğrulanmış bir formül kullanılarak hesaplandı: LVM=0,8 × 1,04 (IVS+LVEDD+LVPW)3– LVEDD3]+0,6.

Rölatif Duvar Kalınlığı: RWT=2x(PWT/ LVEDd) olarak ölçüldü. Ekokardiyografik parametlerden E/e', septal veya lateral e' hızları, triküspit yetersizliği pik hızı ve sol atriyum hacim indeks değerlerini içeren 4 faktörden %50 den daha fazlası mevcut ise diyastolik disfonksiyon olarak tanımlandı(Şekil-2)[7]. Normal EF'si olan kontrol grupları ile sporcular incelendiğinde diyastolik fonksiyon parametreleri çeşitli çalışmalarda gruplar arasında farklılıklar göstermiştir. Güncel kılavuzlar ve algoritmalara ek olarak klinik öykü, fizik muayene ve ek testler ile diyastolik disfonksiyon desteklenmelidir [8].



Şekil-2: Diyastolik disfonksiyon varlığını belirleme algoritması

Çalışmaya dahil edilenler sol ventrikül geometrisine göre 4 ayrı gruba ayrıldı. 1- Normal geometri (Rölatif duvar kalınlığı (RWT) ≤ 0.42, sol ventrikül kitle indeksi(Lwmı) erkek≤115/kadın≤95 g/m2), 2-Konsantrik remodelling (RWT>0.42, Lwmı erkek≤115/kadın≤95 g/m2), 3- Konsantrik hipertrofi (RWT>0.42, Lwmı erkek>115/kadın>95 g/m2), 4-Ekzantrik hipertrofi (RWT≤ 0.42, Lwmı erkek>115/kadın>95 g/m2)[3].

İstatiksel Analiz

Elde edilen veriler bilgisayarda SPSS (statistical package for social sciences) for Windows 23.0 programına kaydedilerek analiz edilmiştir. Sürekli değişkenler ortalama ± standart sapma ya da medyan olarak tanımlandı ve kategorik değişkenler yüzde olarak ifade edildi. Verilerin analizinde ilk olarak hangi testlerin (parametrik/nonparametrik testler) uygulanacağına karar vermek için karşılanması gereken varsayımlar test edilmiştir. Dağılımın normalliğine karar vermek için Kolmogorov-Smirnov, normal dağılımın diğer varsayımları olan basıklık ve çarpıklık

değerlerinden yararlanılmıştır. Bağımsız iki grup karşılaştırmasında t-testi (Independent sample t-testi) ve kategorik değişkenler arası Ki-kare/ fisher's exact test ile bakılmıştır. Elde edilen değerlerin anlamlı olup olmadığının yorumlanmasında 0.05 anlamlılık düzeyi ölçüt olarak kullanılmıştır.

Sonuçlar

31 sağlıklı gönüllünün (kontrol grubu) ve 121 sporcunun incelendiği çalışmada kontrol grubunun %96,7(n:30) nin erkek olduğu sporucu grubunun ise %80,9(n:98) nun erkek olduğu tespit edilmiştir. Pearson Ki-kare testi sonuçlarına göre bu fark istatistiksel olarak anlamlı bulunmuştur (χ^2=4,62; p<0,05). Sporcu grubunun yaş ortalaması (24,83±7,37), kontrol grubunun yaş ortalamasından (28,81±6,67) anlamlı derecede düşük bulunmuştur (p<0,01).

VKİ (Vücut Kitle İndeksi): İki grup arasında VKİ değerlerinde anlamlı bir fark bulunmamıştır (p>0,05). Kreatinin, hemoglabin, Alt ve Ast düzeyleri gruplar arasında benzer bulunmuştur.

Sporcu grubunun LDL düzeyi (100,94±23,05), kontrol grubuna göre (115,68±28,21) anlamlı derecede daha düşüktür (p<0,01). Sporcu grubunun trigliserit düzeyi (95,30±38,59), kontrol grubuna göre (114,16±38,19) anlamlı derecede daha düşüktür (p<0,05). Troponin ve BNP düzeylerinde iki grup arasında anlamlı bir fark bulunmamıştır. Sporcu grubunun VYA (Vücut Yüzey Alanı) değeri (1,90±0,18), kontrol grubuna göre (2,01±0,14) anlamlı derecede daha düşüktür (p<0,01). Bu bulgular Tablo 1'de özetlenmiştir.

Tablo 1: Kontrol grubu ve Sporcuların demografik ve laboratuar özellikleri

Değişkenler	Kontrol(n:31) X±Ss	Sporcular(n:121) X±Ss	P değeri
Cinsiyet (erkek)	30(23,4)	98(76,6)	0,03Y
Cinsiyet (kadın)	1(4,2)	23(95,8)	
Yaş (yıl)	28,81±6,67	24,83±7,37	0,01†
Boy (cm)	179,90±4,95	175,50±6,65	0,00†
Kilo (kg)	81,90±12,10	74,67±15,33	0,02†
VKİ (kg/m2)	25,23±3,55	24,20±4,33	0,22†
VYA(m2)	2,01±0,14	1,90±0,18	0,00†
Kreatinin	0,89±0,10	0,88±0,11	0,94†
Hemoglabin (g/dl)	14,89±1,09	15,20±1,17	0,19†
Alt	29,03±17,50	27,37±13,10	0,56†
Ast	24,71±7,16	28,92±11,25	0,05†
Ldl	115,68±28,21	100,94±23,05	0,00†
Trigliserit	114,16±38,19	95,30±38,59	0,02†
Troponin	2,85±1,95	3,04±3,18	0,75†
BNP	12,21±6,84	11,63±4,70	0,58†

†: Bağımsız örneklem t test Y:Ki kare test
VKİ: Vücut kitle indeksi, VYA: Vücut yüzey alanı, Ldl: Düşük dansiteli lipoprotein-Kolesterol, BNP: Brain natriüretik peptit

Çalışmaya dahilen edilen grupların ekokardiyografi parametreleri incelendiğinde kontrol grubunun Edd değeri (46,87±4,33), sporcu grubunun Edd değerine (45,71±2,93) kıyasla daha yüksek bulunmuş ancak bu fark istatistiksel olarak anlamlı değildir (p>0,05).

Kontrol grubunda septum kalınlığı ve posterior duvar kalınlığı, sporcu grubuna kıyasla daha düşük bulunmuş, ancak bu fark istatistiksel olarak anlamlı değildir (p>0,05). Kontrol grubunun sol ventrikül kitlesi (154,39±31,76), sporcu grubuna (154,38±28,26) benzer bulunmuş olup istatistiksel olarak anlamlı fark bulunmamıştır(p>0,05). Sol ventrikül kitle indeksi açısından kontrol grubunun değeri (76,59±14,46), sporcu grubuna (81,66±14,65) kıyasla daha düşük bulunmuş, ancak bu fark da istatistiksel olarak anlamlı değildir (p>0,05).

Sporcu grubunun E dalga hızı (85,34±14,88), kontrol grubunun E dalga hızına (79,13±13,68) kıyasla anlamlı derecede daha yüksek bulunmuştur (p<0,05). Kontrol grubunun A dalga hızı (48,15±9,17), sporcu grubuna (50,51±9,03) kıyasla daha düşük bulunmuş, ancak bu fark istatistiksel olarak anlamlı değildir (p>0,05). Kontrol grubunun E/A oranı (1,67±0,30), sporcu grubuna (1,74±0,43) kıyasla daha düşük bulunmuş, ancak bu fark da istatistiksel olarak anlamlı değildir (p>0,05).

Diyastolik fonksiyona yönelik yapılan incelemede sporcu grubunun e' septal hızı (12,53±2,13), kontrol grubuna göre anlamlı derecede yüksektir (p<0,05), e' lateral hızı açısından fark anlamlı değildir (p>0,05). Kontrol grubunun triküspit yetersizliği pik velositesi ortalaması (2,17±0,19), sporcuların ortalamasından (2,50±0,19) düşük bulunmuş ve bu fark istatistiksel olarak anlamlıdır (p<0,01). Kontrol grubunun sol atriyum volüm indeksi ortalaması (23,06±3,71), sporcuların ortalamasından (28,59±2,51) düşük bulunmuş ve bu fark istatistiksel olarak anlamlıdır (p<0,01).

Sporcu grubunun kalp hızı (56,42±8,16), kontrol grubuna göre (61,74±9,69) anlamlı derecede daha düşüktür (p<0,01). Bu bulgular tablo2'de özetlenmiştir.

Kontrol grubunda normal sol ventrikül geometrisi %58,06(n=18) saptanırken sporcularda normal sol ventrikül geometrisi %41,32(n=50) saptanmıştır ve gruplar arasında anlamlı farklılık gözlemlenmemiştir(p=0,09). Konsantrik remodelling kontrol grubunda %42,94(n=13) saptanırken sporcu grubunda %53,71(n=65) saptanmaktadır ve yine istatistiksek farklılık gözlemlenmemiştir(p=0,24). Sporcu grubunda konsantrik hipertrofi %4,13(n=5), ekzantrik hipertrofi %0,82 (n=1) olarak saptanmıştır kontrol grubunda bu iki geometri tipine sahip hasta bulunmamaktadır ve gruplar arasında anlamlı fark elde edilmemiştir. Diyastolik disfonksiyon sadece sporcu grubunda 5 hastada görülürken istatistiksel anlamlılığa ulaşmamıştır (p=0,25). SV geometrisine ait bulgular ve diyastolik disfonksiyon verileri tablo 3'te gösterilmektedir.

Tablo 2: Kontrol grubu ve Sporcuların Ekokardiyografik ve Elektrokardiyografik özellikleri

Değişkenler	Kontrol(n:31)	Sporcular(n:121)	P değeri
	X±Ss	X±Ss	
Edd(mm)	46,87±4,33	45,71±2,93	0,08†
Septum(mm)	9,44±1,11	9,84±1,11	0,07†
Posterior duvar(mm)	9,55±0,96	9,77±1,07	0,31†
Lvm(g)	154,39±31,76	154,38±28,26	0,99†
Lvmi(g/m2)	76,59±14,46	81,66±14,65	0,09†
Rwt	0,41±0,05	0,43±0,05	0,08†
Lveddi	23,37±2,33	24,26±2,34	0,06†
EF	65,48±2,57	65,28±2,10	0,65†
E dalgası (m/sn)	79,13±13,68	85,34±14,88	0,04†
A dalgası (m/sn)	48,15±9,17	50,51±9,03	0,20†
E/A oranı	1,67±0,30	1,74±0,43	0,40†
e' septal (m/sn)	11,62±1,92	12,53±2,13	0,03†
e' lateral (m/sn)	15,78±2,77	15,62±2,92	0,77†
E/e'	6,92±1,35	6,94±1,47	0,92†
Deselarasyon zamanı(msn)	150,23±49,29	160,24±33,93	0,19†
Triküspit yetersizliği pik velositesi	2,17±0,19	2,50±0,19	0,01†
Sol atriyum volüm indeksi	23,06±3,71	28,59±2,51	0,01†
Kalp hızı(atım/dakika)	61,74±9,69	56,42±8,16	0,00†
Pr(msn)	157,32±16,38	155,93±19,39	0,71†
Qrs(msn)	92,84±7,62	92,93±6,80	0,95†
Qt(msn)	389,84±29,78	394,22±25,59	0,41†
Qtc(msn)	388,77±35,81	382,12±31,01	0,30†
Sokolow-Lyon voltaj (msn)	28,03±4,61	31,68±6,46	0,00†
Cornel voltaj(msn)	9,03±3,53	10,45±3,84	0,06†
Gubner voltaj(msn)	5,42±1,75	6,79±3,21	0,02†

†:Bağımsız örneklem t test
Edd:Diyastol sonu mesafe, Lvm: sol ventrikül kitlesi, Lvmi: sol ventrikül kitle indeksi, Rwt: Rölatif duvar kalınlığı, Lveddi: sol ventrikül diyastol sonu mesafe indeksi, EF: Ejeksiyon fraksiyonu

Tablo 3: Kontrol grubu ve Sporcularda Sol ventrikül geometrisi ve diyastolik disfonksiyonun karşılaştırılması

Değişken	Grup	Grup				P değeri
		Kontrol(n:31)		Sporcular(n:121)		
		n	%	n	%	
Normal geometri	Yok	13	15,48	71	84,52	0,09 Y
	Var	18	26,47	50	73,53	
Konsantrik remodeling	Yok	18	24,32	56	75,68	0,24 Y
	Var	13	16,67	65	83,33	
Konsantrik hipertrofi	Yok	31	21,09	116	78,91	0,25Y
	Var	0	0,00	5	100,00	
Ekzantrik hipertrofi	Yok	31	20,53	120	79,47	0,61 Y
	Var	0	0,00	1	100,00	
Diyastolik disfonksiyon	Yok	31	21,09	116	78,91	0,25 Y
		0	0,00	5	100,00	

Y :Ki kare test

Kontrol grubu ve sporcu grubu arasında 3 hipertrofi kriterinden sadece Sokolow-Lyon kriteri gruplar arasında anlamlı farklılık göstermiştir. Sokolow-Lyon voltajı 35 değerinin altı ve üstü olacak şekilde hastalar gruplandırılarak diyastolik disfonksiyon, SVH ve normal geometri dışı geometriler incelendiğinde Sokolow-Lyon voltaj kriterinin 35 ve üzerinde olması bu üç sonlanım açısından anlamlı bir farklılık göstermemiştir. Bu durumu gösteren bulgular tablo 4'te gösterilmektedir.

Tablo 4: Sokolow- Lyon voltaj kriterlerine göre kategorize edilen hasta gruplarında klinik- ekokardiyografik sonlanımlarının değerlendirilmesi

Değişken	Grup	Sokolow-Lyon				P değeri
		35<		35≥		
		n	%	n	%	
Diyastolik disfonksiyon	Yok	87	75,00	29	25,00	0,45 Y
	Var	3	60,00	2	40,00	
Sol ventrikül hipertrofisi	Yok	87	75,65	28	24,35	0,16 Y
	Var	3	50,00	3	50,00	
Normal geometri dışı	Yok	39	78,00	11	22,00	0,44 Y
	Var	51	71,83	20	28,17	

Y:Ki kare test

Tartışma

Sporcularda SVH, uzun süreli ve yoğun egzersizlere bir adaptasyon olarak değerlendirilmektedir. Çalışmamızda, sporcu grubunda sol ventrikül geometrisi, Lvmı ve diyastolik fonksiyon parametrelerinde belirgin farklılıklar gözlemlenmemiştir. Bu bulgular, sporcuların kardiyak remodelling sürecinin fiziksel aktivite türüne ve bireysel faktörlere göre nasıl değişebileceğini göstermektedir. Sporcularda Sokolow-Lyon voltaj değeri anlamlı olarak daha yüksek bulundu ancak Cornell ve Gubner voltaj değerleri kontrol grubu ile benzerdi. Çalışmamızda Sokolow-Lyon voltajı≥ 35 olan 31 hastanın %9,67(n=3)'inde SVH saptanmıştır. Al-Rudainy ve arkadaşlarının yaptığı bir çalışmada Sokolow-Lyon kriterinin ekokardiyografik hipertrofisi ispatlanmış sporcularda bile düşük özgüllük ve duyarlılık ile SV hipertrofisini gösterebildiğini bildirmiştir[9]. Sporcu EKG'leri değerlendirirken sadece hipertrofi perspektifi ile değil daha kapsamlı Seattle ve Uluslararası kriterler göz önünde bulundurulmalıdır ve patolojik bir sonucu ulaşıldığında yeni ve daha sıkı değerlendirme gerekmektedir[10]. Yapay zeka algoritmaları, geleneksel yöntemler tarafından potansiyel olarak göz ardı edilen karmaşık kardiyak kalıpları belirlemede mükemmeldir ve sürekli izleme için giyilebilir teknolojilere giderek daha fazla entegre edilmektedir. Güncel çalışmalar spor hekimliği profesyonellerinin geleneksel tarama yöntemlerini son teknoloji yapay zeka teknolojileriyle birleştirmesini desteklemektedir. Bu yaklaşım, sporcu bakımında tanısal doğruluğu ve verimliliği artırmayı, sporcu katılım öncesi muayeneleri için de yapay zeka destekli EKG analizi yoluyla erken tespiti ve daha etkili izlemek faydalı bulunmuştur.[11]

Çalışmamızda sporcularda sol ventrikül geometrisinin büyük ölçüde fizyolojik bir adaptasyonu temsil ettiği gözlemlenmiştir. Sol ventrikül geometrisinin değerlendirilmesi, hipertrofik kardiyomiyopati gibi patolojik durumların ayrımında kritik öneme sahiptir. Çoğunluğu erkek olan popülasyonumuzda konsantrik hipertrofi ve ekzantrik hipertrofi sayı olarak az olmakla beraber gruplar arasında anlamlı farklılık oluşmamaktadır. Literatürde belirtildiği gibi, sporcuların çoğunda normal geometri gözlemlenirken, erkek sporcularda konsantrik hipertrofi veya remodelling oranının daha yüksek olduğu görülmüştür[3]. Ek olarak, dayanıklılık sporcularında eksantrik hipertrofi sıkça görülürken, dinamik sporlarla uğraşan kadın sporcuların büyük bir kısmında bu adaptasyonun daha belirgin olduğu bildirilmiştir[3, 12]. Çalışmamızda, sporcularda Lvmı değerlerindeki artışa rağmen geometrik parametrelerin büyük ölçüde normal sınırlar içinde olduğu saptanmıştır.

Diyastolik fonksiyon parametreleri, miyokardiyal gevşeme kapasitesinin önemli bir göstergesidir. Çalışmamızda sporcuların septal e' hızının kontrol grubuna göre anlamlı derecede yüksek bulunması, gelişmiş diyastolik fonksiyonun bir göstergesi olarak değerlendirilmiştir. Diyastolik disfonksiyonun önemli iki parametersi olan triküspit yetersizliği pik velositesi ve sol atriyum volüm indeksi anlamlı olarak sporcularda daha yüksek bulunmuştur. Ancak, bazı sporcularda diyastolik disfonksiyonun gözlenmesi, uzun süreli dayanıklılık sporlarının miyokardiyal

sertleşmeye neden olabileceğini göstermektedir[13, 14]. Literatürde, dinamik egzersizlere maruz kalan sporcularda diyastolik dolumun artırılmış olduğu belirtilmiştir. Ayrıca, hipertrofik kardiyomiyopatiden şüphelenilen durumlarda, diyastolik disfonksiyon parametrelerinin daha dikkatli değerlendirilmesi gerektiği bildirilmiştir[3, 15].

Lvmı, sol ventrikül hipertrofisinin belirlenmesinde kritik bir ölçüttür. Çalışmamızda sporcuların Lvmı değerleri kontrol grubuna göre daha yüksek bulunmuştur. Bu bulgular, dayanıklılık sporlarının sol ventrikül kitle artışını etkilediğini ve bunun genellikle fizyolojik bir adaptasyonu temsil ettiğini göstermektedir. Ancak, Lvmı'nin patolojik bir durumu işaret edip etmediğini anlamak için ek parametrelerle birlikte değerlendirilmesi gereklidir[12]. Genç sporcularda ani kardiyak ölüm kardiyomiyopatiler, iyon kanalı bozuklukları, koroner anomaliler ve edinilmiş kardiyak durumlar dahil olmak üzere kalbin çeşitli yapısal ve elektriksel bozukluklarından kaynaklanır. Yetişkin ve kıdemli sporcularda, aterosklerotik koroner arter hastalığı, büyük olumsuz kardiyovasküler olaylara yol açan birincil durumdur.[16] Adölesan ve genç yetişkinlerde ani ölüm için artan risk, yarışmalı sporlar sırasında şiddetli fiziksel eforla ilişkilendirildiğinde önemli ölçüde daha yüksektir (yani 2,8 kat daha fazladır). Egzersiz, altta yatan (ve genellikle şüphelenilmeyen) kalp hastalığının dayattığı duyarlılık göz önüne alındığında, ölümcül ventriküler taşikardiler için bir tetikleyici görevi görmektedir. Ani ölümün en sık nedeni hipertrofik kardiyomiyopatidir ve sporcu kalbi ile ayrımı net bir şekilde yapılmalıdır[17].

Maraton koşucularında yapılan bir çalışmada, RV5/V6 kriterlerinin Lvmı ile anlamlı bir korelasyon gösterdiği ve bu kriterlerin tarama aracı olarak kullanılabilirliği vurgulanmıştır[14]. Çalışmamızda, sporcu grubunda Sokolow-Lyon kriterinin ≥35 mm olması durumunda hipertrofi oranının arttığı, ancak bunun her zaman patolojik bir durumu temsil etmediği gözlemlenmiştir. Literatürde bu kriterin fizyolojik hipertrofiyi değerlendirmede yararlı olduğu belirtilmiştir[18]. Sporcularda SVH değerlendirilirken Sokolow-Lyon kriteri, RV5/V6 kriteri ve ekokardiyografik bulguların birlikte kullanılması önerilmektedir. Ancak, fizyolojik ve patolojik hipertrofinin ayrımında ileri görüntüleme teknikleri (ör. 3D ekokardiyografi, manyetik rezonans) ve biyobelirteçlerin kullanılması daha güvenilir sonuçlar sağlayabilir[12, 14, 15].

Çalışmanın Kısıtlılıkları

Bu çalışmanın bazı kısıtlılıkları bulunmaktadır. İlk olarak, örneklem büyüklüğü nispeten sınırlıdır ve yalnızca belirli iki hastaneden elde edilen verileri içermektedir. Dolayısıyla, farklı spor disiplinlerine ve demografik özelliklere sahip daha geniş bir popülasyonu temsil etmeyebilir. İkinci olarak, EKG ve TTE değerlendirmeleri, cihaz duyarlılığı ve gözlemciler arası değişkenlik gibi faktörlerden etkilenebilir. Bu çalışma tek merkezli ve kesitsel bir tasarıma sahip olduğundan, uzun vadeli kardiyak değişikliklerin takibi mümkün olmamıştır. Son olarak, çalışmada biyobelirteçler, kardiyak manyetik rezonans görüntüleme ve sporcularda görülen kardiyak değişimlerin genetik yatkınlıkla ilişkisini araştıran ileri moleküler analizler yapılmamıştır. Bu nedenle, gözlemlenen değişikliklerin bireysel genetik ve fizyolojik farklılıklarla ilişkisini değerlendirmek için daha kapsamlı çalışmalar gereklidir. Gelecekte yapılacak çalışmalar, daha geniş ve çeşitli sporcu gruplarını kapsayan, ileri görüntüleme yöntemleri ve uzun dönem takip verilerini içeren araştırmalar ile mevcut bulguların doğrulanmasına ve daha kapsamlı değerlendirmelere olanak sağlayacaktır.

Sonuç

Sokolow-Lyon kriterinin sporcularda hipertrofiyi öngörmedeki sınırlı duyarlılığı göz önünde bulundurularak, sporcu EKG'lerinin değerlendirilmesinde daha kapsamlı değerlendirmelerin dikkate alınması gerektiği vurgulanmıştır. Ayrıca, sol ventrikül geometrisinin değerlendirilmesi, patolojik durumların ayrımında önem taşımaktadır. Sporcularda görülen kalp değişikliklerinin büyük ölçüde fizyolojik adaptasyon olduğu sonucuna varılmıştır.

Maddi Destek ve Çıkar İlişkisi

Çalışmayı maddi olarak destekleyen kişi/kuruluş yoktur ve yazarların herhangi bir çıkar dayalı ilişkisi yoktur.

Kaynakça

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Research Article

Long-term oncologic safety of one-stage direct-to-implant immediate breast reconstruction without the use of acellular dermal matrix

Aselüler dermal matriks kullanılmadan gerçekleştirilen direkt implant ile tek aşamalı anında meme rekonstrüksiyonunun uzun dönem onkolojik güvenirliliği

Berkay Kilic[1]*, Burak Ilhan[2], Hasan Karanlik[1]

[1]Department of General Surgery, Oncology Institute of Istanbul University, Istanbul, Turkey
[2]Department of General Surgery, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey

Abstract

Aim: This study aimed to evaluate the oncologic safety of direct-to-implant immediate breast reconstruction without the use of an acellular dermal matrix (ADM) or mesh following nipple-sparing and skin-sparing mastectomy in patients with primary breast cancer.

Material and Methods: The medical records of 175 patients who underwent one-stage direct-to-implant breast reconstruction following mastectomy at the Istanbul University Oncology Institute between 2014 and 2022 were retrospectively reviewed. The primary objective was to assess the oncologic safety, including locoregional recurrence, distant metastasis, and survival outcomes. The secondary objective was to evaluate reconstruction-related complications.

Results: The median age of the patients was 44 years (range: 25-74), with a median follow-up period of 53 months (range: 19-101). HR+/HER2-, HR+/HER2+, and pure HER2+ subtypes were observed in 101 patients (57.7%), 26 (14.9%), 23 (13%), respectively. Triple-negative breast cancer was present in 16 patients (9.1%). Neoadjuvant chemotherapy was administered to 87 patients (49.7%), with a pathological complete response (pCR) rate of 17.2%. Skin necrosis (9.1%) and capsular contracture (8.6%) were the most common complications, with implant loss (occurring) in seven patients. Locoregional recurrence and distant metastasis rates were 9.7% and 13.1%, respectively. The five-year locoregional recurrence-free survival and distant metastasis-free survival rates were 95.4% and 90.3%. Additionally, 83.5% of patients reported their satisfaction as "excellent" or "good."

Conclusion: One-stage direct-to-implant immediate breast reconstruction without the use of an acellular dermal matrix or mesh is oncologically safe, with acceptable complication rates, making it a viable alternative to two-stage breast reconstruction or conventional mastectomy.

Keywords: direct-to-implant; contracture; immediate breast reconstruction; mesh

Corresponding Author*: Berkay Kilic, Department of General Surgery, Oncology Institute of Istanbul University, Istanbul, Turkey.
E-mail: berkaykilic28@yahoo.com
Orcid: 0000-0002-9050-7571
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Öz

Amaç: Bu çalışmada, primer meme kanseri olan hastalarda meme başı koruyucu ve cilt koruyucu mastektomi sonrası hücresiz dermal matris veya meş kullanılmaksızın gerçekleştirilen doğrudan implant ile yapılan anında meme rekonstrüksiyonunun onkolojik güvenliğini değerlendirmek amaçlandı.

Gereç ve Yöntemler: 2014-2022 yılları arasında İstanbul Üniversitesi Onkoloji Enstitüsü'nde mastektomi sonrası doğrudan implant ile tek aşamalı meme rekonstrüksiyonu yapılan 175 hastanın tıbbi kayıtları geriye dönük incelendi. Birincil hedef, bölgesel nüks, uzak metastaz ve sağkalım analizleri dahil olmak üzere onkolojik güvenliği değerlendirmekti. İkincil hedef ise rekonstrüksiyonla ilişkili komplikasyonları değerlendirmekti.

Bulgular: Hastaların medyan (yaşı) 44 yıl (aralık: 25-74) olup, medyan takip süresi 53 ay (aralık: 19-101) idi. HR+/HER2-, HR+/HER2+ ve saf HER2+ alt tipleri sırasıyla 101 (%57,7), 26 (%14,9) ve 23 (%13,1) hastada gözlemlendi. Üçlü negatif meme kanseri ise 16 (%9,1) hastada mevcuttu. Neoadjuvan kemoterapi 87 (%49,7) hastaya uygulanmış olup, patolojik tam yanıt (pCR) oranı %17,2 idi. Cilt nekrozu (%9,1) ve kapsüler kontraktür (%8,6) en sık görülen komplikasyonlardı ve komplikasyon nedeniyle yedi hastada implant kaybı yaşandı. Lokal-bölgesel nüks ve uzak metastaz oranları sırasıyla %9,7 ve %13,1 olarak kaydedildi. Beş yıllık lokal-bölgesel nükssüz sağkalım ve uzak metastazsız sağkalım oranları sırasıyla %95,4 ve %90,3 olarak bulundu. Ayrıca, hastaların %83,5'i memnuniyetlerini "mükemmel" veya "iyi" olarak bildirdi.

Sonuçlar: Hücresiz dermal matris veya mesh kullanılmadan doğrudan implant ile yapılan tek aşamalı anında meme rekonstrüksiyonu, onkolojik olarak güvenli olup kabul edilebilir komplikasyon oranlarına sahiptir. Ayrıca iki aşamalı meme rekonstrüksiyonu veya konvansiyonel mastektomiye iyi bir alternatif oluşturmaktadır.

Anahtar Kelimeler: direkt implant; kontraktür; anında meme rekonstrüksiyonu; meş

Introduction

Breast cancer is the most commonly diagnosed cancer worldwide with 2.3 million women diagnosed globally and 670,000 women dying from the disease annually, making it a significant health issue [1]. According to 2018 data, the incidence rate of breast cancer in Turkey is 48.6 per 100,000 women, with approximately 15,000 new cases diagnosed each year [2].

Early detection and advanced treatment methods have led to increased survival rates for breast cancer [3]. However, the treatment process presents significant physical and psychological challenges for patients. Since mastectomy involves the loss of a body part, it can be complemented with reconstructive surgery to address both aesthetic and psychological needs. This approach aims to restore the woman's body integrity, improve satisfaction with breast appearance, and enhance her quality of life [4].

Breast reconstruction can be performed either during the same surgical session (immediate) or at a later stage (delayed). The reconstruction may involve the use of the patient's own tissues or prosthetics, either through a single-stage or a two-stage procedure. Studies have reported varying oncologic outcomes and complication rates regarding the results of one-stage and two-stage procedures [5-7]. The timing of reconstruction is influenced by various factors, including the stage of the disease, the administration of radiotherapy, and the patient's preferences [8]. Concerns regarding the oncological safety of implant-based reconstruction have occasionally been raised, presenting challenges from a surgical standpoint.

The aim of this study is to evaluate whether one-stage direct-to-implant (ODTI) immediate breast reconstruction (IBR) following nipple-sparing mastectomy (NSM) and skin-sparing mastectomy (SSM) affects oncologic safety, including local recurrence, distant metastasis rates, and surgical complications.

Material and Methods

Between January 1, 2014, and December 31, 2022, a retrospective analysis was conducted on 323 consecutive breast cancer patients who underwent IBR following either NSM or SSM, using data prospectively collected from a surgical database at the Istanbul University Oncology Institute Breast Center, encompassing cases both before and after neoadjuvant chemotherapy (NACT).

Patients were included in the study based on TNM staging criteria, along with clinical and radiological imaging. Exclusion criteria were: distant metastases at diagnosis (n= 34), reconstruction using tissue expanders (n= 37), recurrent breast cancer (n= 46), and prophylactic mastectomy (n= 31). The analysis included 175 patients who underwent ODTI IBR with prostheses following NSM and SSM. Fine needle aspiration (FNA) was used for diagnosis in the presence of suspicious lymph nodes in the axilla, while core needle biopsy was employed for breast tissue. Routine radiological evaluations included ultrasonography (USG), mammography (MMG), and magnetic resonance imaging (MRI). When invasive tumors were present, staging was conducted using positron emission tomography-computed tomography (PET-CT).

The decision regarding neoadjuvant and adjuvant therapy, including the duration and methods to be employed, was made by oncologists during a multidisciplinary meeting at the institution. In patients receiving neoadjuvant therapy, clinical response was assessed according to the Response Evaluation Criteria in Solid Tumors (RECIST 1.1) criteria [9].

Clinical complete response was defined as the absence of a palpable lesion on physical examination and the absence of a contrast-enhancing lesion on MRI, along with the complete disappearance of the tumor on MMG and breast USG. A partial response was defined as a ≥30% reduction in tumor size. The absence of tumor size reduction despite treatment was classified as a progressive disease, while other scenarios were considered stable disease. In the context of neoadjuvant therapy, the ultimate goal, referred to as pathological complete response (pCR), was defined as the absence of invasive or in situ foci in the tumor assessment.

The study was approved by the Ethics Committee of Istanbul University Faculty of Medicine (Date: 23.12.2024, Decision Number: 3075139). Written informed consent was obtained from all patients prior to surgery.

Treatment

Neoadjuvant chemotherapy was administered based on institutional guidelines and the preference of the medical oncologist, utilizing (anthracycline and/or taxane-based regimens, with HER2+ tumors treated with trastuzumab and/or pertuzumab). Adjuvant radiotherapy (RT) was administered based on the radiation oncologist's decision for patients with axillary lymph node involvement or tumors larger than 5 cm. In most cases, the radiotherapy field included the chest wall, axillary region, supra- and infra clavicular areas.

One-stage DTI IBR was performed only if there was no clinical, radiological, or pathological evidence of involvement of the breast skin. All patients who underwent IBR had either NSM or SSM. Before reconstruction, all patients underwent retroareolar biopsy with intraoperative frozen section examination. If tumor presence was identified in either the intraoperative or final pathology, the nipple, either alone or with the areola, was removed, and the surgical procedure was converted to SSM. No patient was converted to conventional mastectomy (CMx) for this reason. The surgeries were performed by experienced breast surgeons (HK, SB, BK).

Follow-Up

Postoperative patients were monitored every three months for the first two years, every six months from the third to the fifth year, and annually thereafter. For patients who missed follow-up appointments, their status was inquired about via telephone. Locoregional recurrence (LR) was defined as the presence of tumors in the same-side chest wall, axillary, infra- and supraclavicular lymph nodes, or internal mammary lymph nodes. To detect LR, procedures such as punch biopsy, fine-needle aspiration biopsy, core needle biopsy, or excisional biopsy were performed. In patients with detected LR, the implant was removed, and conventional mastectomy was performed.

Distant metastasis (DM) was defined as the presence of tumors in any tissue other than regional sites and was primarily detected using PET-CT scans. In some cases, conventional CT scans and/or bone scintigraphy were conducted based on the oncologist's decision. Biopsy diagnosis was not always required for the diagnosis of distant metastasis. Patients with distant metastasis received a metastatic regimen.

Patient satisfaction was assessed through an institutional questionnaire after the completion of adjuvant radiotherapy. The questionnaire, consisting of 20 questions, evaluated the following parameters: breast shape, position and symmetry of the nipple-areola complex (NAC), surgical incision scars, and the psychosocial and sexual effects of reconstruction with implants. The total score was categorized as follows: <20 points= very poor, 21-40 points= poor, 41-60 points= satisfactory, 61-80 points= good, >80 points= excellent.

Statistical Analysis

Continuous parameters were presented as median, range, and percentage. The Overall Survival (OAS) duration was defined as the time from the start of treatment to death or last follow-up. Disease-free survival (DFS) was defined as

the time from the date of surgery to the date of recurrence. Locoregional recurrence-free survival (LRFS) was defined as the time until locoregional recurrence occurred. Distant metastasis-free survival (DMFS) was defined as the time until distant metastasis occurred from the date of surgery. Survival analyses were estimated using the Kaplan-Meier method. A p-value of <0.05 was considered statistically significant. Analyses were performed using Microsoft Excel and IBM SPSS Statistics version 21 (SPSS, Chicago, IL, USA).

Results

Characteristics of Patients, Tumors, and Treatments in the Cohort

The study included 175 patients with a median age of 44 years (range: 25-74). The majority of patients had a body mass index (BMI) between 25 and 30 (48%), with a smaller proportion had a BMI greater than 30. Approximately 39.4% of patients had a C cup breast size, followed by B cup (29.7%), and A cup (18.9%) sizes, while 21 (12%) patients had macromastia (≥D cup). Mild to moderate ptosis was present in 90.9% of patients, while severe ptosis was observed in 9.1%. Additionally, 99 patients (56.6%) were smokers, and 32 (18.3%) had diabetes mellitus.

The most common clinical tumor size was T2, found in 93 patients (53.2%), followed by T3 in 67 patients (38.3%), Tinsitu in 9 patients (5.1%), and T1 in 6 patients (3.4%). Among the total of 99 patients with T1 and T2 tumors, the decision for mastectomy was based on preoperative assessments indicating the presence of multicentric tumors, detection of BRCA1/2 gene mutations, and stable or progressive disease after chemotherapy. Unifocal (UF) tumors were found in 70 patients (40%), multifocal/multicentric (MFMC) tumors in 96 patients (54.9%), and extensive ductal carcinoma in situ (DCIS) in nine patients (5.1%). According to the TNM cancer classification, the majority of patients had stage II B (46.9%), followed by III A (22.3%) and II A (21.7%). The least common stages were T1N0 with three patients (1.7%) and T3N3 with four patients (2.3%). Clinically, 98 patients (56%) had lymph node involvement.

The molecular subtypes of the patients in the study group were as follows: 101 patients (57.7%) with HR+/HER2-, 26 patients (14.9%) with HR+/HER2+, 23 patients (13.1%) with HR-/HER2+, and 16 patients (9.1%) with triple-negative breast cancer (TNBC). The majority of patients (n= 136, 77.7%) had invasive ductal carcinoma, while invasive lobular carcinoma was seen in 13 patients (7.4%).

Upfront surgery was performed on 88 patients (50.3%), the majority of whom were hormone-positive, had ductal carcinoma in situ (DCIS), and had no axillary involvement. The number of patients who received neoadjuvant chemotherapy (NACT) was 87 (49.7%). The rates of pCR were 17.2% in the breast and 32.2% in the axilla. Intraoperatively, 61 patients (34.9%) with sentinel lymph node biopsy results reported as metastases underwent axillary lymph node dissection. Among the hormone-positive patients, 53 (30.3%) received only endocrine therapy as adjuvant treatment.

Excluding patients with DCIS reported in the final pathology, tumors smaller than 5 cm, and those without axillary lymph node metastasis, 75.4% of patients received adjuvant radiotherapy. Eight (4.6%) patients did not receive radiation therapy despite recommendations, due to various reasons including severe pneumonitis, cardiotoxicity, and patient preference (Details in Table 1).

Surgical Procedure

All patients underwent DTI IBR, with the approach being either subpectoral (89.7%) or prepectoral (10.3%). Nipple-sparing mastectomy was performed in 162 patients (92.6%). In 13 cases (7.4%), the procedure was converted to SSM due to tumor detection in the retroareolar biopsy results from intraoperative or final pathology reports. If necessary, excision of the nipple or nipple-areola complex was performed under sedoanalgesia during the postoperative period. In six patients (3.4%), the SSM procedure was conducted directly during surgery due to a very close tumor-to-nipple distance, along with the detection of invasive carcinoma or Paget's disease involving the nipple. No patient required conversion to a CMx for these reasons. The silicone gel implants used for reconstruction included: 1) Mentor CPG Gel Breast Implants (Johnson & Johnson Medical Ltd., USA) and 2) Allergan Breast Implants (AbbVie, USA).

Eleven out of 21 patients with larger cup sizes and severe ptosis underwent mastectomy with skin-reducing techniques, followed by prosthesis placement. The majority of patients had prostheses placed using the subpectoral reconstruction method (n= 157, 89.7%). In these cases, the exposed lateral part of the prosthesis was covered either with the fascia of the serratus anterior muscle or using separate, loose muscle-to-muscle sutures. Prepectoral reconstruction was preferred in 18 patients (10.3%) who were non-smokers, had no diabetes, had excess subcutaneous fat, and had preservation of the nipple-areola complex. In 20 patients with a BRCA1/2 gene mutation, contralateral prophylactic mastectomy and reconstruction with a prosthesis were included in the surgery (Details are provided in Table 1).

Table 1. Patients characteristics			
Patients, n (%)		175 (100)	
Follow-op, months, median (range)		53	(19-101)
Median age (range), years		44	(25-74)
Body mass index, kg/m2, n (%), mean (range)	≤25, n (%) >25-30, n (%) ≥30, n (%)	67 (38.3) 84 (48) 24 (13.7)	22.9 (16.3-24.8) 26.6 (25.1-29.4) 30.1 (32.1-36.2)
Smoking, n (%)	Yes No	76 (43.4) 99 (56.6)	
Diabetes mellitus, n (%)	Yes No	32 (18.3) 143 (81.7)	
Ptosis, n (%)	Mild Mild to moderate Severe	92 (52.6) 67 (38.3) 16 (9.1)	
Cup size, n (%)	A B C ≥D	33 (18.9) 52 (29.7) 69 (39.4) 21 (12)	
Clinical T stage, n (%)	Tins T1 T2 T3	9 (5.1) 6 (3.4) 93 (53.2) 67 (38.3)	
Clinical nodal status, n (%)	N0 N1 N2+	77(44) 78 (44.6) 20 (11.4)	
Clinical tumor size, n (%)			
Stage 0	TinsN0	9 (5.1)	
Stage I	T1N0	3 (1.7)	
Stage II A	T1N1 T2N0	3 (1.7) 35 (20)	
Stage II B	T2N1 T3N0	52 (29.7) 30 (17.2)	
Stage III A	T2N2 T3N1 T3N2	6 (3.4) 23 (13.2) 10 (5.7)	
Stage III C	T3N3	4 (2.3)	
Ki-67 index, n (%)	≤14 >14	42 (24) 133 (76)	
Invasive tumor focality, n (%)	UF MF/MC	70 (40) 96 (54.9)	

Histological type,
n (%)
	Invasive
	  Ductal
	  Lobular
	  Mixt
	DCIS
	Other
		
		136 (77.7)
		13 (7.5)
		7 (4)
		9 (5.1)
		10 (5.7)	

Grade, n (%)	1-2 3	109 (62.3) 57 (37.7)	
Lenfovascular invasion, n (%)	Yok Var	88 (50.3) 87 (49.7)	
Molecular subtypes, n (%)	HR+/HER2- HR+/HER2+ HR-/HER2+ TNBC	101 (57.7) 26 (14.9) 23 (13.1) 16 (9.1)	
Systemic therapy, n (%)	NACT Adjuvant CT+ ET Adjuvant ET	87 (49.7) 58 (33.1) 53 (30.3)	
pCR, n (%)	Yes No	15 (17.2) 72 (82.8)	
Adj. radiation therapy, n (%)	Yes No Recommended but not received	132 (75.4) 35 (20) 8 (4.6)	
Mastectomy types, n (%)	NSM SSM	162 (92.6) 13 (7.4)	
Reconstruction types, n (%)	Sub-pectoral Pre-pectoral	157 (89.7) 18 (10.3)	
Abbreviations: UF, unifocality; MF/MC, multifocality/multicentricity; DCIS, ductal carcinoma insitu; HR, hormone receptor; HER2, human epidermal growth factor receptor-2; TN, triple negative; pCR, pathological complete response; CT, chemotherapy; NACT, neoadjuvant chemotherapy; ET, endocrine theraphy; NSM, nipple sparing mastectomy; SSM, skin sparing mastectomy; Adj, adjuvant			

Complications

Non-operative complications were observed in the study, including delayed wound healing in 27 patients (15.4%), which was particularly more common among diabetics and smokers. Additionally, non-severe cellulitis or mild infection, manageable with antibiotics, occurred in 14 patients (8%). Spontaneous resolution of seroma in 11 patients (6.3%), rippling in eight patients (4.6%), and chronic pain in seven patients (4%).

The complications requiring surgery were as follows: partial necrosis, the most common complication, was observed in 16 patients (9.1%) and was treated with debridement followed by suturing. Capsular contracture occurred in 15 patients (8.6%), who underwent capsulotomy and/or capsulectomy. Extensive hematoma and animation deformity were observed in seven patients (4%), while severe infection occurred in six patients (3.4%). As a result of these complications, seven patients (4%) had their implants removed, and subsequently, they underwent conventional mastectomy (Details in Table 2).

Table 2. Surgical complications

		n	%
Complications (no need for re-operation)	Delayed wound healing	27	15.4
	Mild enfection	14	8
	Seroma	11	6.3
	Rippling	8	4.6
	Chronic pain	7	4
Complications (requiring minör re-operation)	Partial ischemia / necrosis	16	9.1
	Capsular contracture	15	8.6
	Animation defect	7	4
	Extensive hematoma	7	4
	Severe infection	6	3.4
	Implant displacement	4	2.3
Implant loss	Due to complications	7	4
	Due to local recurrence	12	6.9

Rates of Satisfaction

In both early and late postoperative institutional satisfaction questionnaires, 146 patients (83.5%) rated their experience as "excellent" or "good." In contrast, satisfaction was notably lower among patients who experienced implant loss in the early postoperative period, with 6.3% rating their experience as "poor" or "very poor" (Details in Table 3).

Table 3. Rates of satisfaction

	NSM, n= 162		SSM, n= 13	
	n	%	n	%
Excellent	64	36.6	4	2.3
Good	75	42.9	3	1.7
Satisfactory	13	7.3	5	2.9
Poor	3	1.7	1	0.6
Very poor	7	4	0	0

Abbreviations: NSM, nipple-sparing mastectomy; SSM, skin-sparing mastectoimy.

Follow-up Period

The median follow-up time was 53 months (range: 19-101). During this period, LR was observed in 17 patients (9.7%), and DM occurred in 23 patients (13.1%). Both LR and DM were most prevalent in the TNBC group, with rates of 18.8% and 18.8%, respectively. The overall recurrence rate was 22.8% (n= 40). In 12 (6.9%) patients with local recurrence in the breast region, the prosthesis was removed, and conventional mastectomy was performed.

In the entire cohort, 22 deaths occurred, of which 19 were due to breast cancer. The mean estimated time for local recurrence was 92.7±1.9 months (Figure 1). The mean estimated time for distant metastasis was 90.1±1.8 months (Figure 2). Overall survival was 93.2±2.0 months (Figure 3). Additionally, the 5-y LRFS and 5-y DMFS rates were 95.4% and 90.3%, respectively (Table 4).

Table 4. Rate of recurrences by molecular subtype and survival outcomes

Subtypes	n	LR, n (%)	DM, n (%)	Death, n (%) (Disease spesific)
HR+/HER2-	101	7 (6.9)	13 (12.9)	9 (8.9)
HR+/HER2+	26	3 (11.5)	3 (11.5)	4 (15.4)
HR-/HER2+	23	4 (17.4)	4 (17.4)	2 (8.7)
TNBC	16	3 (18.8)	3 (18.8)	4 (25)
DCIS	9	0	0	0
Recurrence rate	175	17 (9.7)	23 (13.1)	19 (10.9)
Survival outcomes	Mean, SD, (months)			
LRFS	92.7 ± 1.9			
DMFS	90.1 ± 1.8			
DFS	90.6 ± 1.8			
OAS	93.2 ± 2.0			
5-y LRFS (%)	95.4			
5-y DMFS (%)	90.3			
5-y DFS (%)	88.6			

Abbreviations: HR, hormone receptor; HER2, human epidermal growth factor receptor2; TNBC, triple negative breast cancer; SD, standard deviation; LR, locoregional recurrence; DM, distant metastasis; LRFS, locoregional recurrence free survival; DMFS, distant metastasis free survival; OAS, overall survival; DFS, disease free survival.

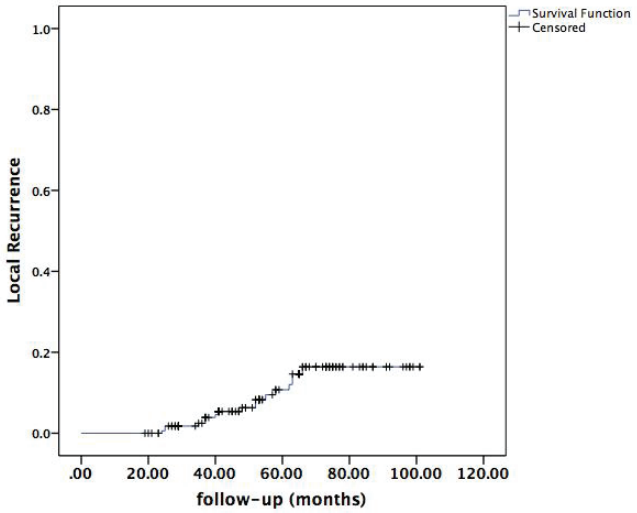

Figure 1: Estimated time for local recurrence

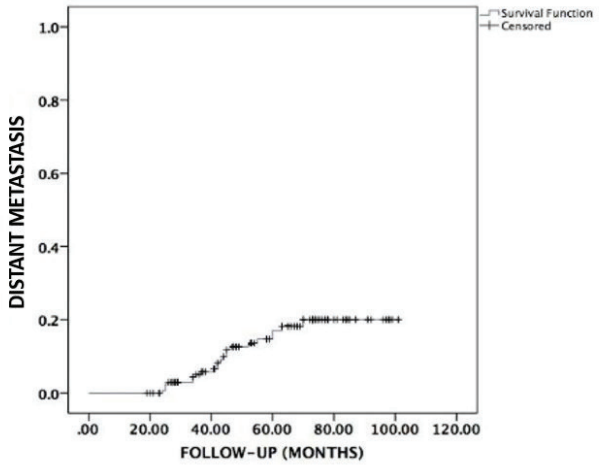

Figure 2: Estimated time for distant metastasis

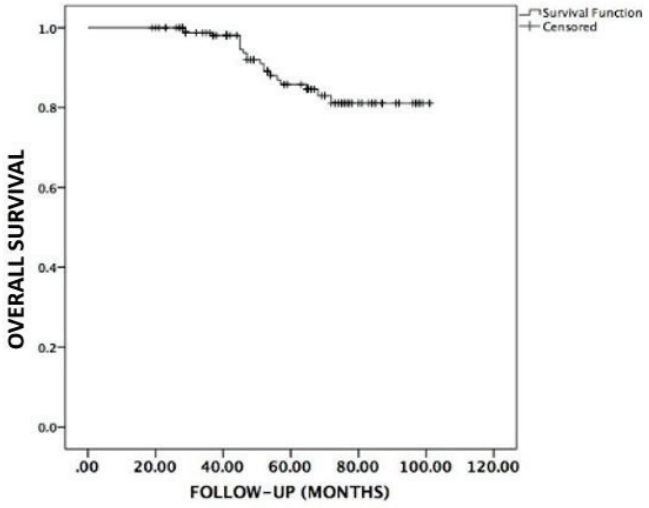

Figure 3: Overall survival

Discussion

In this study, with a median follow-up of 53 months (range: 19-101), a consecutive series of 175 patients underwent NSM or SSM followed by ODTI IBR. We found the LR rate of 9.7%, the DM rate of 13.1%, and the overall recurrence rate of 22.8%, alongside an acceptable rate of complications. Moreover, during this period, implant loss due to complications occurred in only seven patients (4%), and 83.5% of patients reported high satisfaction scores. These results indicate that ODTI IBR is safe from both an oncological and psychological perspective without the use of an acellular dermal matrix (ADM) or mesh, and it can be considered an alternative to CMx or the two-stage procedure. Furthermore, it is also more economically advantageous.

Surgical Techniques for Immediate Breast Reconstruction

Current breast reconstruction techniques include the use of tissue expanders and implants, as well as autologous tissue reconstruction utilizing pedicled, free, or perforator flaps. In recent years, implant-based breast reconstruction has gained increasing popularity. While the two-stage reconstruction approach that was common in the 1980s has largely been replaced by single-stage procedures, implants can now be placed either subcutaneously or submuscularly, depending on the surgeon's preference [10-12]. The use of an ADM has also become widespread in contemporary practice [13]. In our study, all patients underwent breast reconstruction with silicone implants featuring either anatomical or round designs and textured or smooth surfaces, without the use of ADM. The most suitable candidates for this technique are women without macromastia and severe ptosis [14]. In our cohort, 21 (12%) patients had macromastia or severe ptosis; 11 of these patients underwent reconstruction in conjunction with skin-reducing mastectomy.

The cost of ADM or mesh ranges from €1,200 to €2,400. Considering that the health insurance system in Turkey does not cover the costs of prostheses or ADM, the total surgery expenses can be significantly high. In our study, we performed breast reconstruction on 175 patients without using ADM or mesh, and our complication and prosthesis loss rates were comparable to those reported in series utilizing these materials. Furthermore, we achieved highly successful cosmetic results.

Follow-up and recurrence rates

The LR rate for conventional mastectomy (CM) has been reported to range between 6% and 16% in historical studies [15-17]. In another study, an LR rate of 8.8% and a DM rate of 14.8% were reported among 1.057 patients with stage 1-3 breast cancer who underwent a conventional mastectomy, with a median follow-up of six years [18]. In a cohort of 112 patients with locally advanced breast cancer, where 47.3% underwent reconstruction with a tissue expander and 32.1% with a silicone implant following mastectomy. During a median follow-up period of 50.7 months, LR and DM were 7.1% and 19.6%, respectively [19].

In our study, the highest recurrence rates were observed in patients with TNBC, followed by the HR-/HER2+ subtype, with the lowest rates occurring in the HR+/HER2- group. The overall cohort demonstrated an LR rate of 9.7% and a DM rate of 13.1%, which aligns with findings from other studies. Additionally, 5-year LRFS, DMFS, and DFS rates (95.4%, 90.3%, and 88.6%, respectively) were comparable to the outcomes reported in other studies.

Types of Implant, Complications and Radiotherapy

Anatomic cohesive gel implants were primarily used in breast reconstruction to achieve more natural aesthetic outcomes. However, smooth round implants were also utilized, particularly in patients who expressed a preference for them. Despite the frequent use of textured surface implants, polyurethane-coated implants were also chosen in suitable cases. Importantly, no cases of breast implant-associated anaplastic large cell lymphoma (BIA-ALCL), which has been increasingly reported in recent years, were observed among the patients in this study [20]. Delayed wound healing was the most commonly observed complication (15.4%). Rippling occurred in 4.6% of cases but did not require surgical intervention. The most common complication requiring minor re-operation was partial ischemia and/or necrosis (n= 16, 9.1%). In cases where healing was not achieved, necrotic tissue debridement was conducted, and the affected area was closed with primary sutures. Antibiotic therapy was administered until complete healing was attained. In the results of a 2015 meta-analysis comparing single-stage and traditional two-stage reconstruction, there were no statistically significant differences between the two groups in terms of infection, seroma, hematoma, and capsule contracture. However, flap necrosis and implant loss were higher in the single-stage surgery (p= 0.04) [21].

In the past, decisions regarding the stages of reconstruction were often influenced by whether the patient was scheduled to receive adjuvant RT. If adjuvant RT was planned, a two-stage reconstruction approach was generally preferred. However, recent advancements in RT technology and the increased experience of radiation oncologists and surgeons have allowed for one-stage reconstructions to be performed even in patients who will undergo RT. The effects of RT on reconstruction outcomes remain a topic of debate. Some studies suggest that RT increases the risk of capsular formation and infection, while others indicate no significant effect [22,23]. In our study, the proportion of patients requiring reoperation due to capsular formation was relatively low at 8.6%. Notably, all patients with capsular contracture, except one with ductal carcinoma in situ (DCIS), had received RT. We believe that while radiotherapy may increase the rate of complications, it is not an absolute contraindication for single-stage reconstruction. The critical factors for successful one-stage reconstruction include the quality of the flaps and the adequacy of vascular circulation.

Prosthesis displacement was infrequent, occurring in only 2.3% of cases, which we attribute to the loosening of the sutures used to cover the serratus anterior fascia. However, this problem was resolved with a re-operation. While our complication rates were elevated compared to conventional mastectomy, they were comparable to those reported in the literature for prosthetic reconstruction using the DTI technique [24,25]. A total of seven (4%) prosthesis losses occurred due to early complications, primarily caused by necrosis and severe infections that did not respond to antibiotic therapy. Although this rate was slightly higher, it remained similar to the 3.86% rate observed in a review of 14,585 cases, where factors such as older age, obesity, and smoking increased the risk of implant loss [26]. In 12 (6.9%) patients, prosthesis loss was related to re-surgery conducted due to local recurrence in the long term. Importantly, none of the patients, including those who required re-operation, experienced any delay in the administration of adjuvant therapy.

Cosmetic outcomes

The cosmetic results of ODTI IBR are generally favorable, with many patients reporting high levels of satisfaction [27,28]. This approach facilitates immediate breast reconstruction following mastectomy, minimizing the need for additional surgeries and often yielding a more natural appearance. Patients benefit from shorter recovery time and achieve their desired aesthetic outcomes in a single procedure.

In the early postoperative period, seven patients who experienced implant loss rated their satisfaction as "very poor." Overall, 83.5% of patients rated their satisfaction as "good" or "excellent," primarily due to the presence of reconstruction as an alternative to mastectomy.

Limitations

This is one of the few studies in the literature employing the DTI technique without using mesh. Despite demonstrating oncological safety and high patient satisfaction, our study has several limitations. These include the study's single-center retrospective nature and the absence of a control group. Since the research data are derived from a specific patient group, there may be selection bias and confounding factors; therefore, we opted to evaluate our long-term outcomes. However, oncologically safe results, manageable complication rates, and the method's feasibility of inappropriate patient selection demonstrate its applicability.

Conclusion

One-stage DTI IBR appears to be a safe approach for patients with breast cancer who receive neoadjuvant or adjuvant

chemotherapy followed by RT. The preference for a one-stage procedure, along with demonstrated oncological safety, low complication rates, and high patient satisfaction, supports its viability as an option for suitable candidates.

Breast reconstructions performed without mesh or using ADM can reduce costs while providing oncologically safe and economically viable options for patients. However, to better establish the appropriate indications for ODTI IBR, prospective randomized trials with well-defined study designs and outcome measures are necessary.

Financial support and conflict of interest

There is no person/organization that financially supports the study and the authors have no conflict of interest

Ethics Committee Approval

This study received approval from the Istanbul University Ethics Committee (Approval Date: 23.12.2024 with number 3075139)

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Author Contributions

Concept, Design, Data collection and/or processing, Writing: B.K., Analysis and/ or interpretation: B.I., Critical review and Supervision: H.K. All authors read and approved the final version of the manuscript.

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Research Article

Akne vulgaris hastalarında demodikozis sıklığı

Frequency of demodicosis in acne vulgaris patients

Özge Sevil Karstarlı Bakay*, Beyza Köstek

Pamukkale Üniversitesi Tıp Fakültesi, Dermatoloji Anabilim Dalı, Denizli, Türkiye

Öz

Amaç: Akne vulgaris farklı yaş gruplarından pek çok hastanın yaşam kalitesini etkileyen yaygın görülen bir hastalıktır. Demodeks akarları pilosebase foliküllerde mekanik tıkanmaya yol açabilmesi ve inflamatuar yanıtı tetikleyebilmesiyle akne patogenezinde rol oynayabileceği öne sürülmüş olsa da literatürde veriler kısıtlıdır. Çalışmamızda akne vulgaris hastalarında demodikozis sıklığını ve hastalık şiddetiyle ilişkisini araştırmayı amaçladık.

Gereç ve Yöntemler: Bu prospektif çalışmaya Pamukkale Üniversitesi dermatoloji polikliniğinde değerlendirilen 18-40 yaş arası hafif, orta, şiddetli olmak üzere akne vulgaris hastaları ve yaşı eşleştirilmiş sağlıklı gönüllüler dahil edildi. Akne vulgarisin şiddetini değerlendirmek için Araştırmacının Genel Değerlendirmesi (IGA) skorlama sistemi kullanıldı. Demodeks parazitlerini saptamak amacıyla yüzeysel deri biyopsisi tekniği uygulandı. Sayı 5/cm2'den fazla ise demodeks pozitif kabul edildi.

Bulgular: Çalışmaya 30 sağlıklı kontrol ve hafif, orta, şiddette toplam 90 akne vulgaris hastası dahil edildi. Kontrol grubunun %20'sinde (n=6), akne vulgaris hastalarının %43,3'ünde (n=39) demodeks pozitifliği saptandı ve bu fark istatistiksel olarak anlamlıydı (p=0.03). Akne vulgaris hastaları hastalık şiddetine göre kontrol grubuyla kıyaslandığında; hafif şiddetli akne hastalarının 12'sinde (%40), orta şiddetteki akne hastalarının 10'nunda (%33,3), şiddetli akne hastalarının 17'sinde (%56,7) demodeks pozitifliği saptandı. Şiddetli akne hastalarında demodeks pozitifliği kontrol grubundan anlamlı oranda yüksekti (p=0,003). Adolesan akne hastalarında demodeks pozitifliği %44,3 (n=43) iken post- adolesan grupta %12,5 (n=2) idi, bu fark istatistiksel olarak anlamlıydı (p=0,002).

Sonuç: Akne vulgaris hastalarında demodikozis sıklığının yüksek olması patogenezdeki olası rolünün yanı sıra hastalarda eşlikçi veya taklitçi olabilmesi yönüyle dikkat çekicidir. Özellikle şiddetli hastalarda akne tedavisinden yanıt alınamadıysa demodikozis araştırılması vakaların yönetimine katkı sağlayacaktır.

Anahtar Kelimeler: Akne vulgaris, demodeks, demodikozis

Sorumlu Yazar*: Ozge Sevil Karstarlı Bakay, Pamukkale Üniversitesi Tıp Fakültesi, Dermatoloji Anabilim Dalı, Denizli, Türkiye
E-posta: ozgekarstarli@hotmail.com
Orcid: 0000-0002-1523-3187
Doi: 10.18663/tjcl.1622146
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Abstract

Aim: Acne vulgaris is a common disease affecting the quality of life of many patients from different ages. Although it has been suggested that Demodex mites may play a role in the pathogenesis of acne by causing mechanical obstruction in pilosebaceous follicles and triggering an inflammatory response, the literature has limited data. Our study aimed to investigate the frequency of demodicosis in acne vulgaris patients and its relationship with disease severity.

Material and Methods: This prospective study included patients with mild, moderate, and severe acne vulgaris aged 18-40 years and age-matched healthy volunteers evaluated at the Pamukkale University dermatology clinic. The Investigator's Global Assessment (IGA) scoring system was used to assess the severity of acne vulgaris. Superficial skin biopsy technique was applied to detect demodex parasites. Demodex was considered positive if the count was greater than 5/cm2.

Results: The study included 30 healthy controls and 90 patients with mild, moderate, and severe acne vulgaris. Demodex positivity was found in 20% (n=6) of the control group and 43.3% (n=39) of the acne vulgaris patients and this difference was statistically significant (p=0.03). When acne vulgaris patients were compared with the control group according to disease severity, demodex positivity was found in 12 (40%) of mild acne patients, 10 (33.3%) of moderate acne patients, and 17 (56.7%) of severe acne patients. Demodex positivity was significantly higher in severe acne patients than in the control group (p=0.003). Demodex positivity was 44.3% (n=43) in adolescent acne patients and 12.5% (n=2) in the post-adolescent group, this difference was statistically significant (p=0.002).

Conclusion: The high frequency of demodicosis in acne vulgaris patients is noteworthy not only for its possible role in pathogenesis but also because it can be a companion or a mimic in patients. Especially in severe patients, if there is no response to acne treatment, investigating demodicosis will contribute to the management of the cases.

Keywords: Acne vulgaris, demodex, demodicosis

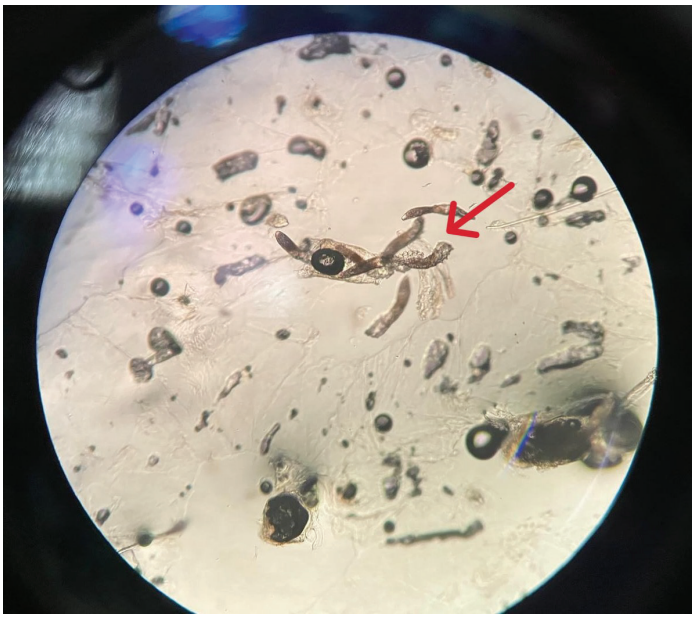
Giriş

Akne vulgaris esas olarak yüz ve gövdenin üst kısmını tutan, başlangıç aşamasında komedon, papül, püstül, nodül, apse ve ileri dönemde skarlaşma ile karakterize pilosebase ünite hastalığıdır (1). En yaygın deri hastalıklarından biri olan akne, ergenlik çağındaki gençlerin yaklaşık %85'ini etkilemekle birlikte her yaş grubunda ortaya çıkabilir (2). Kırk yaşındaki yetişkinlerin yaklaşık %1-%5'inde akne lezyonları görülmeye devam etmektedir; bu da nüfusun büyük bir kısmının hayatlarının bir döneminde aknenin potansiyel olumsuz etkileriyle karşı karşıya kalacağını göstermektedir (1). Akne vulgarisin duygusal işlevler, sosyal işlevler, ilişkiler, boş zaman aktiviteleri, günlük aktiviteler, uyku, okul ve iş üzerinde önemli etkileri vardır. Aknenin sağlıkla ilgili yaşam kalitesi etkisi astım, psoriaisis ve artrit gibi kronik rahatsızlıkların etkisine benzer bulunmuştur. Akne, damgalanma, zorbalık, depresyon, anksiyete, düşük öz saygı ve intihar düşüncesi risklerinin artmasıyla ilişkilidir (3).

Akne vulgarisin patogenezi çok faktörlüdür. Temel olarak, sebum üretiminin artması, komedon oluşumuna yol açan hiperkeratinizasyon , Cutibacterium acnes'in (C. acnes) foliküler kolonizasyonu ve pilosebase ünite etrafındaki artmış inflamatuar mediatörler patogenezde sorumlu tutulmakla birlikte patogeneze katkı sağlayan pek çok faktör bildirilmiştir (4,5). Aknenin oluşumunda ve klinik şiddeti üzerinde genetik ve hormonal faktörlerin yanı sıra deri mikrobiyomu da sorumlu tutulmaktadır (6).

Demodeks türleri, Arachnida sınıfının Acari takımının Demodicidae ailesine ait mikroskobik, zorunlu, uzun akarlardır. Demodeks folliculorum (D. folliculorum)ve brevis (D.brevis), normal yetişkin mikrobiyotanın bir parçası olarak insan pilosebase foliküllerinde düşük yoğunluklarda yaşayan komensal akarlardır (7). D. folliculorum (Şekil 1) başlıca yanaklar, alın, burun, şakaklar, saçlı deri, kulak kepçesi ve gözler gibi yüzün çeşitli bölgelerindeki kıl foliküllerinde, özellikle kaş ve kirpiklerde bulunur. D. brevis ise başlıca sebumla beslenir ve yüz, boyun ve gövdedeki yağ bezlerinde, göz kapaklarındaki meibomian bezlerinde yaşar (8). Demodeks akarları normal ciltte 5'ten az akar/cm2 yoğunlukta bulunabilir. Klinik belirtiler ortaya çıktığında ve 5'ten fazla akar/cm2 bulunduğunda veya dermise nüfuz ettiğinde demodeks enfestasyonu düşünülmelidir. Demodex akarlarının patojenitesi tartışmalı olsa da, pityriasis folliculorum, rozase, püstüler folikülit, perioral dermatit ve blefaritte rol oynadıkları bildirilmiştir (9). Demodeks akarlarının akne vulgaris patogenezindeki rolüne dair veriler kısıtlı olup bu çalışmaların sonuçları çelişkilidir (9, 10, 11, 12, 13, 14, 15, 16).

Bu çalışmada demodeks akarlarının akne vulgaris hastalarındaki sıklığı, akar varlığının hastalık şiddetine olası etkisinin araştırılması amaçlanmaktadır.



Şekil 1. Akne vulgaris hastasında yanaktan alınan yüzeysel deri biyopsisinde Demodeks folliculorum (kırmızı ok)

Gereç ve Yöntemler

Bu prospektif çalışmaya Pamukkale Üniversitesi dermatoloji polikliniğinde değerlendirilen 18-40 yaş arası hafif, orta, şiddetli olmak üzere her bir grupta 30 hasta olacak şekilde 90 akne vulgaris hastası ve 30 sağlıklı gönüllü dahil edildi. Bu çalışma, Helsinki Bildirgesi'ne uygun olarak Pamukkale Üniversitesi Etik Kurulu (No: E-60116787-020-539772) tarafından onaylandı. Tüm katılımcılardan yazılı bilgilendirilmiş onam alındı. Tüm hastalarda akne vulgaris tanısına ve şiddet sınıflamasına tek bir dermatolog tarafından açık ve/veya kapalı komedonlar, inflamatuar papüller, nodüller varlığına dayanarak klinik olarak karar verildi.

Akne vulgarisin şiddetini değerlendirmek için Araştırmacının Genel Değerlendirmesi (IGA) skorlama sistemi kullanıldı. Bu sistem, yüzdeki akne lezyonlarının tanımlayıcı kriterlerine bağlı olarak hastalık şiddetini 0-4 arasında derecelendirilir. Grade 0 (Temiz), akne lezyonlarının yokluğunu gösterir, ancak postinflamatuar hiperpigmentasyon ve eritem mevcut olabilir. Grade 1 (neredeyse temiz), birkaç dağınık komedon ve küçük papül bulunmasıdır. Grade 2 (hafif), yüzün yarısından azının komedon, papül ve püstüllerle etkilendiğini gösterir. Yüzün yarısından fazlası, bir nodül ile birçok komedon, papül ve püstül ile etkilenmişse, Grade 3 (orta) olarak kabul edilir. Grade 4 (şiddetli), tüm yüzün komedonlarla, çok sayıda papül, püstül, birkaç nodül ve kist ile kaplı olduğu durumu tanımlar.

Demodeks parazitlerini (folliculorum ve brevis) saptamak amacıyla yüzeysel deri biyopsisi tekniği uygulandı. Bu teknik için her iki yanak üzerine siyanoakrilat yapıştırıcı ile kaplanmış 1 santimetre kare (cm2) kare işaretli bir lam yerleştirilerek 1 dakika boyunca bekletildikten sonra lam kaldırıldı. Lamın materyal alınan bölgesine 2-3 damla immersiyon yağı damlatıp lamel ile kapatıldı. Mikroskobun x4 büyütmesi ile alan taraması yapılır ve ardından x10 ve x40 büyütmesinde diyafram hafif kapalı olarak işaretli alan taranır. Akarları saymak için her iki yanaktan örnekler incelendikten sonra, toplam ikiye bölünerek cm2 başına ortalama sayı hesaplandı. Sayı 5/cm2'den fazla ise demodeks pozitif kabul edildi.

İstatistiksel hesaplamalarda istatistik paket programı SPSS (Statistical Package for the Social Sciences Program, v26) programı kullanıldı. Kategorik değişkenleri karşılaştırmak için ki-kare testi kullanıldı. Parametrik verilerin analizi için Student t-testi, non-parametrik verilerin analizi için ise Mann-Whitney U testi kullanıldı. Kategorik değişkenler sayı ve oran (%) olarak ve sürekli değişkenler ortalama±standart sapma olarak ifade edildi, $p < 0.05$ değeri istatistiksel olarak anlamlı kabul edildi.

Bulgular

Çalışmaya 30 dermatolojik şikâyeti olmayan gönüllü ve hafif, orta, şiddette toplam 90 akne vulgaris hastası dahil edildi. Kontrol grubunun %63'ü (n=19), akne vulgaris hastalarının %75.5'i (n= 68) kadındı ($p>0.05$). Kontrol grubunun yaş ortalaması akne vulgaris hastalarının yaş ortalaması farkı istatistiksel olarak anlamlı değildi (Tablo 1).

Kontrol grubunun %20'sinde (n=6), akne vulgaris hastalarının %43,3'ünde (n=39) demodeks pozitifliği saptandı ve bu fark istatistiksel olarak anlamlıydı ($p=0.03$). Akne vulgaris hastaları hastalık şiddetine göre kontrol grubuyla kıyaslandığında; hafif şiddetli akne hastalarının 12'sinde (%40), orta şiddetteki akne hastalarının 10'nunda (%33,3), şiddetli akne hastalarının 17'sinde (%56,7) demodeks pozitifliği saptandı. Hafif ve orta şiddetli hastalarda demodeks pozitifliği kontrol grubuna göre istatistiksel olarak anlamlı değilken ($p>0.05$), şiddetli akne hastalarında demodeks pozitifliği kontrol grubundan anlamlı oranda yüksekti ($p=0.003$) (Tablo 2).

Akne vulgaris hastaları 18-25 yaş adolesan, 25 yaş üzeri post-adolesan olarak iki ayrı alt grupta kategorize edildiğinde adolesan grupta demodeks pozitifliği %44,3 (n=43) iken post- adolesan grupta %12,5 (n=2) idi, bu fark istatistiksel olarak anlamlıydı ($p=0,002$). Kontrol grubunda adolesanlarda demodeks pozitiflik oranı post-adolesanlardan yüksek olsa da bu fark istatistiksel olarak anlamlı değildi (sırasıyla, %34,7, %14,3, $p=0,3$). Adolesan ve post-adolesan hastaların dağılımında hastalık şiddeti açısından istatistiksel olarak anlamlı fark saptanmadı ($p=0,36$), (Tablo 3).

Tablo 1. Akne vulgaris hastaları ve kontrol grubunun demografik özellikleri ve demodeks pozitiflik oranları			
	Akne vulgaris (n=90)	Kontrol (n=30)	p değeri
Yaş (yıl)	22.4 ±4.6 22 (19-24)	23.4±3.7 22.5 (20.7-25.2)	p=0.079
Cinsiyet (K/E)	68/22	19/11	p>0.05
Demodeks pozitifliği (n, %)	n=6, %20	n=39, %43,3	p=0.03

Tablo 2. Şiddetli akne vulgaris hastaları ve kontrol grubunun demografik özellikleri ve demodeks pozitiflik oranları			
	Şiddetli Akne Vulgaris (n=30)	Kontrol (n=30)	p değeri
Yaş (yıl)	21.8 ±3.4 21.5 (19-23.2)	23.4±3.7 22.5 (20.7-25.2)	P=0.262
Cinsiyet (K/E)	23/7	19/11	P=0.616
Demodeks pozitifliği (n, %)	n=17, %56,7	n=39, %43,3	p=0.003

Tablo 3. Adolesan ve post- adolesan akne vulgaris hastalarının klinik özellikleri			
	Adolesan Hastalar (n=74)	Post-adolesan Hastalar (n=16)	p değeri
Cinsiyet (K/E)	56/18	12/4	
Akne şiddeti Hafif Orta Şiddetli	 22 25 27	 8 5 3	P=0.232
Demodeks pozitifliği (%, n)	n=43, %44,3	n=2, %12,5	p=0.002

Akne vulgaris hastalarının %27,7'si (n=25) sistemik antibiyotik %34.4'ü (n=3) oral isotretinoin kullanmaktaydı. Demodeks pozitif bireylerin %22,9'u, demodeks negatif bireylerin %20 ,8'i sistemik antibiyotik kullanmaktaydı (p=0.507). Demodeks pozitif bireylerin %35,4'ü, negatif bireylerin %19,7'si oral isotretionoin kullanmaktaydı (p=0.056).

Demodeks pozitif ve negatif bireyler arasında yaş farkı istatistiksel olarak anlamlı değildi (sırasıyla 21,7 vs 24,4, p= 0,55) Cinsiyete göre değerlendirildiğinde kadınların %37,9'unda (n=33), erkeklerin % 45,4'ünde (n=15) demodeks pozitifliği saptandı ve fark istatistiksel olarak anlamlı değildi (p=0,45).

Tartışma

Bu çalışmanın verilerine göre demodikozis sıklığı akne vulgaris hastalarında kontrol grubuna göre anlamlı olarak yüksekti. Şiddetli akne hastalarında demodeks pozitifliği daha belirgindi ve adolesan akne hastalarında post-adolesan dönemdeki hastalara göre anlamlı olarak yüksek saptandı.

Demodeks enfestasyonunun akne vulgaris ile ilişkisine dair çalışmaların sayısı giderek artmakla birlikte henüz bir fikir birliği oluşmamıştır. Bir meta-analizde akne ve demodeks pozitifliğini ele alan 60 Çince ve 3 İngilizce makale dahil edilmiş ve bunlardan 48'inde pozitif ilişki sonucuna varırken, geri kalan 15 makale ilişki bulunmadığı bildirilmiştir. Makalelerin önemli heterojenliğine rağmen, meta-analiz sonuçları demodeks enfestasyonu ile akne vulgaris arasında istatistiksel bir ilişki olduğunu göstermiştir (9). Daha güncel çalışmalarda ise akne vulgaris hastalarında demodikozis sıklığı sağlıklı popülasyondan yüksek saptanmış olsa da hepsinde istatistiksel anlamlılık bildirilmemiştir (10, 11, 12, 13, 14, 15). Erdal ve Albayrak dermatolojik hastalıklarda demodikozis sıklığını araştırdıkları çalışmalarında kontrol grubunda demodeks pozitifliği %6,8 iken akne hastalarında %10 olarak saptanmış ve bu fark anlamlı bulunmamıştır (11). Türkiye'den yakın zamanlı başka iki çalışmada kontrol grubunda demodeks pozitifliği sırasıyla %2,6 ve %12,3, akne vulgaris hastalarında sırasıyla %52 ve %42,6 olarak saptanmış ve bu fark anlamlı bulunmuştur (10, 13). Paichitrojjana ve Chalermchai ise çalışmalarında kontrol grubunda demodeks pozitifliğini %17,5, akne vulgaris hastalarında %22,5 olarak saptamış ve farkın anlamlı olmadığını bildirmişlerdir (15). Bizim çalışmamızda kontrol grubunun %20'sinde, akne vulgaris hastalarının %43,3'ünde demodeks pozitifliği saptandı. Çalışmalarda hem kontrol hem de akne vulgaris hastalarında demodeks pozitifliği oranlarının değişkenliği dikkat çekse de akne vulgaris hastalarında oran daha fazla bulunmuştur. Bu durum akarların hastalığın patogenezinde temel faktörlerden biri olmasa da rol oynayabilecek bir patojen olabileceğini düşündürmektedir.

Demodeks akarlarının pilosebase folikülleri mekanik olarak tıkaması, perifoliküler inflamasyona yol açması ve mikrobiyom değişikliklerine neden olması akne patogeneziyle örtüşmektedir (10). Akarların etki mekanizmasının anlaşılmasına rozase hastalarındaki çalışmalar önemli katkı sağlamıştır (10, 17, 18).Demodeks akarlarının patojenik özellik kazanmasındaki en önemli adım akar yoğunluğunun artması olarak öne sürülmektedir. D.folliculorum yoğunluğunun artmasıyla inflamasyon belirteçlerinde genel bir artış saptanmıştır (18). Deri için patern tanıma reseptörleri (PRR'ler), kritik bir savunma sistemi olarak, dış patojenlere karşı ilk savunma hattıdır. PRR'ler, sitoplazmik tanıma reseptörü ve Toll-like reseptörlere (TLR'ler) ait olan NOD-like reseptörler (NLR'ler) içerir (19). Akne vulgaris patogenezinde C.acnes'in uyarımı altında, aktive olmuş NLRP3 inflamazomu, kaspaz-1'in aktivasyonunu teşvik eder ve bu da daha sonra önemli proinflamatuar sitokinler IL-1β ve IL-18'in salgılanmasına neden olur. Akne vulgarisin inflamatuvar lezyonlarında bol miktarda bulunan IL-1β, foliküler hiperkeratoz ve akne vulgaris lezyonlarının oluşumunda rol oynar (20). Benzer şekilde demodeks kolonizasyonunun NLRP3 gen ekspresyonunu indükleyerek IL-1β'nin aşırı salgılanmasına neden olduğu ve rozase patogenezinde rol oynadığı düşünülmektedir (17).

Akne vulgaris hastalarında demodeks pozitifliğinin artmış olması kimi yazarlara göre neden değil sonuçtur. Bakteriyel aşırı çoğalmanın, doğal öldürücü hücrelerin ve lenfositlerin sayısını azaltarak bağışıklık tepkisini zayıflatan bir ortam yaratarak akarların çoğalmasına katkı sağlayabileceği öne sürülmüştür (15).Ayrıca akne vulgariste izlenen aşırı sebum üretiminin, demodeksler için daha iyi yaşam koşulları yaratarak akar sayısını artırması olasıdır (21).

Çalışmamızda demodeks pozitifliği şiddetli hastalığa sahip hastalarda anlamlı olarak daha yüksek orandaydı. Literatürde demodeks pozitifliği ile akne vulgaris şiddetini değerlendiren iki çalışmada verilerimizi destekler nitelikte demodex pozitifliği hastalık şiddeti ile ilişkili bulunmuştur (12, 13). Bu durum,demodeks akarlarının doğrudan inflamasyonu tetiklemesinin yanı sıra C. acnes ve S. aureus gibi akne vulgaris patogenezinde rol alan bakteriler için bir vektör görevi görerek hastalığın gelişimine ve şiddetlenmesine katkı sağlayabilecek olmasıyla ilişkilendirilmiştir (12).

Akne vulgaris hastaları yaşa göre değerlendirildiğinde post-adolesan akne vulgaris hastaları daha hassas ve daha az yağlı cilt gibi bazı klinik özelliklere sahiptir ve tedavilere dirençli olma eğilimindedirler (22, 23). Demodeks pozitifliği açısından adolesan ve post adolesan akneye ait veriler kısıtlıdır. Daha önceki bir çalışmada adolesan aknede demodeks pozitifliği 44.6% iken post adolesan dönemde 39.5% olarak bildirilmiştir (13). Bizim çalışmamızda adolesan dönemde demodeks pozitiflik oranının belirgin olarak yüksek olması bu verilerle uyumludur. Adolesan aknede daha yağlı bir cilt ortamının olması demodeksler için elverişli bir yaşam alanı sağlamasının bunu açıklayabileceğini düşünmekteyiz.

Demodikozis inflame papül ve püstüllerle akne vulgarisi taklit edebilecek olması klinik tabloyu daha karmaşık hale getirebilmektedir. Bununla birlikte, demodikoza yol açan bu akarların aşırı miktarda olması durumunda, akne semptomlarını şiddetlendirebilir ve kuru, pullu, kaşıntılı, batma, yanma ve tahriş olmuş cilde neden olabilir. Akne tedavisi bu semptomları iyileştirmeyebilir. Ayrıca, bazı topikal akne tedavileri de demodikozis semptomlarını kötüleştirerek akne tedavisine uyumu güç hale getirebilir (24).

Çalışmaya göreceli olarak az sayıda hasta dahil edilmiş olması çalışmanın kısıtlılığı olsa da prospektif tasarımı ve farklı şiddette akne vulgaris hastalarının dahil edilmiş olması çalışmanın güçlü yanlarıdır.

Sonuç

Akne vulgaris hastalarında özellikle şiddetli hastalığa sahip hastalarda demodeks pozitifliğinin yüksek oranda saptanmış olması akarların patogenezdeki olası rollerinin araştırılmaya değer kılmaktadır. Ayrıca klasik tedavilere yanıt vermeyen akne vulgaris hastalarında demodeks akar varlığının araştırılması hastalığı alevlendiren veya tabloyu taklit eden durumun ortadan kaldırılmasında önemlidir.

Yazarların katkısı

ÖSKB ve BK: Çalışmanın konsept ve tasarımlarının oluşturulması BK: verilerin toplanması. ÖSKB:Verilerin toplanması analizi. ÖSKB: Makalenin taslağının hazırlanması. ÖSKB ve BK: Makalenin basılmaya hazır son halinin onaylanması.

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Research Article

Splenectomy: a fifteen years experience of a tertiary center in Turkey

Splenektomi: Türkiye'deki bir üçüncü basamak merkezden on beş yıllık deneyim

Metin Yalcin*

Department of General Surgery, University of Health Sciences, Antalya Research and Training Hospital, Antalya, Turkey

Abstract

Aim: This study aimed to evaluate the clinical indications, surgical techniques, postoperative complications, and outcomes of patients who underwent splenectomy over a fifteen-year period at a tertiary center in Turkey.

Material and Methods: A retrospective review was conducted on 589 patients who underwent splenectomy between January 2008 and July 2022. Demographic data, comorbidities, operative approaches, postoperative complications, and 30-day mortality were recorded. Complications were categorized according to the Clavien-Dindo classification.

Results: The median age of patients was 48 years, with males comprising 60.1%. Trauma was the leading indication (27.0%), followed by iatrogenic causes (11.4%), immune thrombocytopenia (9.3%), and secondary malignancies (8.5%). However, the highest mortality rates were observed among patients who underwent splenectomy due to splenic infarction, spontaneous rupture, splenic artery aneurysm, or splenic necrosis. These were followed by higher-risk groups associated with secondary malignancies, iatrogenic injury, and trauma. Open splenectomy was the most performed procedure (77.8%), with higher complication (8.3%) and mortality (17.5%) rates compared to laparoscopic splenectomy (complication: 2.5%, mortality: 1.2%). Overall, 40 patients (6.8%) experienced complications, with Clavien-Dindo Grade 5 events contributing significantly to the 14.3% 30-day mortality rate.

Conclusion: This study demonstrated that splenectomy is associated with varying rates of complications and mortality depending on the indication. Trauma was the most common indication, while high-risk conditions such as malignancies and splenic artery aneurysms were associated with poorer outcomes. The lower complication and mortality rates observed with laparoscopic techniques support the potential of minimally invasive or spleen-preserving surgeries to improve patient prognosis.

Keywords: Cyst, complications, hematology, indications, mortality, splenectomy, tertiary care, trauma

Corresponding Author*: Metin Yalçın, Department of General Surgery, University of Health Sciences, Antalya Research and Training Hospital, Antalya, Turkey.
E-mail: drmetinyalcin@hotmail.com
Orcid: 0000-0003-2843-3556
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Öz

Amaç: Bu çalışma, Türkiye'deki bir üçüncü basamak merkezde 15 yıllık dönemde splenektomi uygulanan hastaların klinik endikasyonlarını, cerrahi tekniklerini, postoperatif komplikasyonlarını ve sonuçlarını değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Ocak 2008 ile Temmuz 2022 tarihleri arasında splenektomi yapılan 589 hastanın retrospektif analizi yapıldı. Hastaların demografik verileri, komorbiditeleri, cerrahi yaklaşımları, postoperatif komplikasyonları ve 30 günlük mortalite oranları kaydedildi. Komplikasyonlar Clavien-Dindo sınıflamasına göre kategorize edildi.

Bulgular: Hastaların medyan yaşı 48 yıl olup, %60.1'i erkekti. En sık splenektomi endikasyonu travmaydı (%27.0), bunu iyatrojenik nedenler (%11.4), immün trombositopenik purpura (%9.3) ve sekonder maligniteler (%8.5) izledi. Ancak, splenik enfarkt, spontan rüptür, splenik arter anevrizması ve splenik nekroz gibi durumlarda mortalite oranları en yüksek bulundu. Bu yüksek risk gruplarını sekonder maligniteler, iyatrojenik yaralanmalar ve travma izledi. En sık tercih edilen cerrahi yöntem açık splenektomi (%77.8) olup, bu yöntemde komplikasyon oranları (%8.3) ve mortalite (%17.5) oranları laparoskopik splenektomiye (komplikasyon: %2.5, mortalite: %1.2) kıyasla daha yüksekti. Genel olarak, 40 hastada (%6.8) komplikasyon gelişti ve Clavien-Dindo Grade 5 komplikasyonlar, %14.3'lük 30 günlük mortalite oranına önemli ölçüde katkıda bulundu.

Sonuçlar: Bu çalışma, splenektominin farklı endikasyonlarda değişen oranlarda komplikasyon ve mortalite ile ilişkili olduğunu göstermiştir. Travma, en sık endikasyon nedeniyken, maligniteler ve splenik arter anevrizmaları gibi yüksek riskli endikasyonlar daha kötü sonuçlarla ilişkilendirilmiştir. Laparoskopik yöntemlerin daha düşük komplikasyon ve mortalite oranlarına sahip olması, minimal invaziv veya dalak koruyucu cerrahilerin hasta prognozunu iyileştirebileceğini desteklemektedir.

Anahtar Kelimeler: Kist, komplikasyonlar, hematoloji, endikasyonlar, mortalite, splenektomi, üçüncü basamak bakım, travma

Introduction

The spleen plays a pivotal role in both hematologic homeostasis and immunologic defense. It serves as the primary site of filtering and phagocytosing aged or abnormal blood cells, as well as mounting effective immune responses against encapsulated organisms such as Streptococcus pneumoniae, Haemophilus influenzae, and Neisseria meningitides [1, 2]. Additionally, its function in sequestering and recycling iron and other essential components makes it crucial for maintaining normal red blood cell turnover [3]. Given this central role, any compromise to splenic function—whether from trauma, hematological disorders, or other pathologies—may predispose patients to severe and potentially life-threatening infections and complications [4].

Despite its recognized importance in host defense and hematologic regulation, the spleen occasionally must be surgically removed. Splenectomy is often indicated for various benign and malignant hematologic conditions—including hereditary spherocytosis, autoimmune hemolytic anemia, idiopathic thrombocytopenic purpura (ITP), and certain lymphoproliferative or myeloproliferative disorders—as well as for traumatic injuries leading to splenic rupture or laceration [5, 6]. Advances in surgical techniques have transformed splenectomy from a high-risk, open procedure into one that can frequently be accomplished through minimally invasive approaches such as laparoscopy or robotics. These innovations offer advantages like reduced postoperative pain, shorter hospital stays, and improved cosmetic outcomes [7, 8]. However, the choice between open and minimally invasive splenectomy remains multifactorial, influenced by the surgeon's expertise, the patient's comorbidities, and the underlying pathology [9]. On the other hand, the procedure carries the risk of rare yet serious complications, including bleeding, infection, or anastomotic leakage caused by accidental injury to neighboring gastrointestinal structures during surgery [10, 11].

This study aims to provide a comprehensive analysis of a fifteen-year splenectomy experience at a tertiary healthcare center in Turkey, with a focus on indications, surgical techniques, and postoperative outcomes.

Material and Methods

This retrospective study was conducted on patients who underwent splenectomy at the General Surgery Department of Antalya Training and Research Hospital between January 2008 and July 2022. The study was approved by the Antalya Hospital's Ethics Committee (Date: 11.07.2024, Decision No: 10/16) and was carried out in accordance with the relevant ethical guidelines and the Helsinki Declaration (2013 Brazil revision). The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

A total of 589 patients who underwent splenectomy for various indications during the study period were included

in this study. Patients younger than 18 years and those with missing data were excluded from the study. The patients' clinicopathological data (age, gender, comorbidities, indication for splenectomy), operation type, postoperative complications, and survival outcomes were retrospectively gathered from the hospital's electronic records or patient files. The Clavien-Dindo classification was used to categorize postoperative complications [12].

Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA) software. The normal distribution of numerical variables was assessed using the Kolmogorov-Smirnov test. Data exhibiting a normal distribution were presented as mean±standard deviation. Non-normally distributed data were displayed as median (interquartile range (IQR): 25-75 percentiles). Categorical variables were summarized as numbers and percentages.

Results

The median age of the 589 splenectomy patients was 48.0 years, with males comprising the majority (60.1%). Comorbid conditions were identified in 216 patients (36.7%), with cancer being the most common (18.7%), followed by cardiovascular diseases (8.7%) and diabetes mellitus (5.3%). Patient demographic characteristics are detailed in Table 1. The most common indication for splenectomy was trauma (27.0%), and all of these cases were classified as grade IV. This was followed by iatrogenic causes (11.4%), ITP (9.3%), and secondary malignancies (8.5%). Other notable indications included distal pancreatic masses (7.8%), thalassemia (6.6%), splenic cysts (6.5%), and hematological malignancies (6.3%) (Table 2).

Table 1. Demographic and comorbid conditions of patients.

Variables	All population n = 589
Age, years	48.0 (29.0-64.0)
Gender, n (%)	
Female	235 (39.9)
Male	354 (60.1)
Comorbidity, n (%)	216 (36.7)
Cancer	110 (18.7)
Cardiovascular disease	51 (8.7)
Hematology disease	42 (7.1)
Diabetes mellitus	31 (5.3)
Renal disease	11 (1.9)
Lung disease	10 (1.7)
Thyroid disease	8 (1.4)
Neurological disease	7 (1.2)
Rheumatological disease	3 (0.5)

The data are expressed as the mean ± SD or median (IQR) or number (%).

Postoperative complications were observed in 8 (5.0%) of 159 patients who underwent splenectomy due to trauma, with a 30-day mortality rate of 18.2% (29 patients). In the iatrogenic group, complications occurred in 6 patients (9.0%), and 30-day mortality reached 22.4% (15 patients). Splenic artery aneurysms had a complication rate of 25.0% and a 50.0% 30-day mortality rate. No complications were reported in the splenic necrosis or spontaneous rupture groups, but mortality rates were high (100.0% and 55.6%, respectively) (Table 2).

Open splenectomy was the most commonly performed procedure (77.8%), accounting for 38 postoperative complications (8.3%) and 80 deaths (17.5%) within 30 days. Laparoscopic splenectomy was performed electively in 81 cases (13.8%), with a lower complication rate (2.5%) and a 30-day mortality of 1.2%. Conversion from laparoscopy to an open approach occurred in 39 patients (6.6%), and among these, 2 (6.1%) died within 30 days. Organ-preserving approaches were rarely performed: splenorrhaphy (1.0%), partial splenectomy (0.3%), and partial cystectomy (0.5%) (Table 3).

Perioperative blood transfusions were administered in 351 patients (59.6%). Overall, 40 patients (6.8%) experienced postoperative complications, and 287 patients (48.7%) required an intensive care unit (ICU) stay at some point. The median length of ICU stay was 7.0 days (IQR 4.0–10.0). The 30-day mortality rate was 14.3%.

Of the 40 recorded complications, most fell under Clavien-Dindo Grade 3a or 3b. Grade 3a complications, managed with percutaneous drainage under local or radiological guidance, consisted of 2 cases of intra-abdominal ascites, 1 intra-abdominal hematoma, 3 pancreatic fistulas, 6 pleural effusions, and 3 subphrenic abscesses. Grade 3b complications, requiring relaparotomy under general anesthesia, included 1 diaphragmatic injury, 2 cases of eventration, 2 gastric injuries, 2 instances of intra-abdominal hemorrhage, and 2 subphrenic abscesses. Additionally, 15 patients were classified under Clavien-Dindo Grade 5 due to fatal complications—massive bleeding (n = 6), massive pulmonary embolism (n = 3), and sepsis following anastomotic leak (n = 6) — which contributed substantially to the overall 30-day mortality rate (Table 4).

Table 2. Indications for splenectomy and their postoperative complication and mortality rates.

Indications	All population n = 589	Complication	30 day mortality
Trauma	159 (27.0)	8 (5.0)	29 (18.2)
Fall	30 (5.1)	1 (3.3)	5 (16.7)
Traffic accident	25 (4.2)	4 (16.0)	5 (20.0)
Injury with a gun or cutting tool	104 (17.7)	3 (2.9)	19 (18.3)
Iatrogenic	67 (11.4)	6 (9.0)	15 (22.4)
Malignant conditions	37 (6.3)	4 (10.8)	10 (27.0)
Benign conditions	30 (5.1)	2 (6.7)	5 (16.7)
ITP	55 (9.3)	1 (1.8)	-
Secondary malignancies	50 (8.5)	6 (12.0)	14 (28.0)
Distal pancreatic mass	46 (7.8)	5 (10.9)	6 (13.0)
Thalassemia	39 (6.6)	6 (15.4)	-
Splenic cyst	38 (6.5)	1 (2.6)	2 (5.3)
Hematological malignancies	37 (6.3)	2 (5.4)	-
Hydatid cyst	18 (3.1)	-	-
Splenomegaly	18 (3.1)	-	2 (11.1)
Splenic abscess	16 (2.7)	1 (6.3)	1 (6.3)
Gastric cancer (D2 dissection)	12 (2.0)	-	-
Splenic infarct	10 (1.7)	3 (30.0)	5 (50.0)
Spontaneous rupture	9 (1.5)	-	5 (55.6)
Splenic artery aneurysm	4 (0.7)	1 (25.0)	2 (50.0)
Splenic necrosis	3 (0.5)	-	3 (100.0)
Autoimmune hemolytic anemia	3 (0.5)	-	-
Hereditary spherocytosis	2 (0.3)	-	-
Hemangioma	1 (0.2)	-	-
Portal hypertension	1 (0.2)	-	-
Splenic vein thrombosis	1 (0.2)	-	-

The data are expressed as number (%). The complication and 30-day mortality rates were determined according to the sample size for each indication. ITP, immune thrombocytopenic purpura

Table 3. Types of surgery and their associated postoperative complication and mortality rates.

Types of surgery	All population n = 589	Complications	30 day mortality
Open	458 (77.8)	38 (8.3)	80 (17.5)
Splenorraphy	6 (1.0)	-	1 (16.7)
Partial splenectomy	2 (0.3)	-	-
Partial cystectomy	3 (0.5)	-	-
Laparoscopy	81 (13.8)	2 (2.5)	1 (1.2)
Conversion to open surgery	39 (6.6)	-	2 (5.1)

The data are expressed as number (%). The complication and 30-day mortality rates were determined according to the sample size for surgery types.

Table 4. Postoperative complications based on Clavien-Dindo (C-D) classification.

C-D	Complication	Number of patients	Treatment
3a	Intra-abdominal ascites	2	Percutaneous drainage
	Intraabdominal hematoma	1	Percutaneous drainage
	Pancreatic fistula	3	Percutaneous drainage
	Pleural effusion	6	Percutaneous drainage
	Subphrenic abscess	3	Percutaneous drainage
3b	Diaphragmatic injury	1	Relaparotomy
	Eventration	2	Relaparotomy
	Gastric injury	2	Relaparotomy
	Intraabdominal hemorrhage	3	Relaparotomy
	Subphrenic abscess	2	Relaparotomy
5	Bleeding	6	Death
	Massive pulmonary embolism	3	Death
	Sepsis following anastamotic leak	6	Death

The data are expressed as number (%).

Discussion

Traumatic splenic injury was the leading indication for splenectomy, consistent with findings in the current literature. Although there is a growing preference for non-surgical management in such cases, studies have indicated that mortality rates remain comparable between patients undergoing splenectomy and those treated non-surgically [13-15]. In our cohort, 27.0% of patients underwent splenectomy for trauma, with a 30-day mortality rate of 18.2%. When stratified by mechanism of injury, mortality rates varied: 16.7% in fall-related trauma, 20.0% in motor vehicle accidents, and 18.3% in injuries caused by firearms or sharp objects. These findings reflect the severity of injuries requiring splenectomy and align with earlier studies reporting mortality rates ranging from 2% to 25% among individuals with severe splenic trauma requiring surgery [15-17]. The relatively high mortality in our cohort may be attributed to the severity of accompanying injuries and the physiological compromise typically observed in patients with Grade IV trauma. This highlights the critical importance of rapid resuscitative measures, judicious patient selection for operative versus non-operative management, and the need to address associated injuries when optimizing patient outcomes.

Iatrogenic splenic injury was the second most frequent indication for splenectomy in our study. Among abdominal operations, procedures in the upper left quadrant exhibit the highest incidence of iatrogenic lesions, ranging from 0.9% to 49%. In contrast, splenic injuries are least frequently observed in appendectomies and cholecystectomies [18]. Among these patients, 9% experienced complications, and 22.4% succumbed to mortality. Iatrogenic splenic injury is a known complication of abdominal surgery, associated with higher morbidity and mortality, longer operative times, and extended hospital stays [19, 20]. Common risk factors include prior abdominal surgeries (leading to adhesions), advanced patient age, obesity, and extensive dissection in the left upper quadrant, such as during mobilization of the splenic flexure or procedures involving the stomach or pancreas [21]. Early intraoperative recognition is crucial for minimizing blood loss and preserving the spleen whenever feasible. In some cases, splenorrhaphy or partial splenectomy may suffice to control hemorrhage and maintain immunological function. However, a delayed or missed diagnosis can lead to life-threatening bleeding, necessitating emergent splenectomy and potentially increasing both perioperative morbidity and mortality [20]. Consistent with other reports, our data underscore the considerable mortality risk in patients with iatrogenic splenic injuries, reflecting the severity of concurrent pathologies and the technical complexity often encountered in reoperative fields [22]. Although advanced laparoscopic and robotic platforms offer improved visualization and precision, the risk of splenic injury remains, particularly in patients with difficult anatomy or dense adhesions [23]. Meticulous surgical planning, careful mobilization of the splenic flexure, and, when appropriate, prophylactic measures such as preoperative splenic artery embolization or close proximity dissection under direct vision may further reduce inadvertent splenic damage in high-risk cases.

Hematologic pathologies comprise another major driver of

splenectomy [24]. Although therapeutic options for conditions such as ITP and hereditary spherocytosis have expanded considerably with the advent of newer medical treatments, splenectomy maintains a significant role, especially in cases that prove resistant or intolerant to medical therapy [25, 26]. Studies report ITP splenectomy success rates exceeding 60% to 80% in terms of achieving remission or partial response, underscoring the procedure's value in properly selected patients [27]. While hematologic malignancies can prompt splenectomy when the spleen is significantly enlarged or symptomatic, the ultimate impact on short- and long-term survival can be modest, highlighting the necessity of an individualized approach [28].

Non-traumatic splenic disease includes cysts, abscesses, and parasitic infestations, albeit on a less frequent basis [29, 30]. Patients who had splenectomy for hydatid cysts showed no mortality, consistent with existing studies [31]. On the other hand, splenic abscesses often arise from hematogenous spread or adjacent infection, and preexisting comorbidities like diabetes or immunosuppression heighten susceptibility [32]. Although splenectomy for abscess is generally effective, mortality can be considerable if diagnosis is delayed. In our study, 2.7% of patients had splenic abscesses, and 6.3% of these patients died. The mortality rate for splenic abscesses has been reported to range from 12.4% to 27.6% in the current literature [31]. These outcomes might be linked to the infection's local effects and the seriousness of the underlying disease.

A noteworthy subset of patients underwent splenectomy as part of combined procedures for malignancies, including gastric cancers with D2 dissections or distal pancreatic masses. Earlier work suggests that routine splenectomy for gastric cancer is no longer standard practice unless direct infiltration or significant lymphadenopathy necessitates it, due to the added morbidity and potential for infectious complications [33, 34]. Likewise, in distal pancreatectomies, surgeons may opt for spleen preservation when feasible to retain immunologic function, though it is not always technically or oncologically appropriate [35]. Our findings, which show relatively high complication rates following splenectomy, particularly pancreatic fistulas, in this group, align with meta-analyses reporting post-splenectomy pancreatic fistula rates of up to 12–30% [36, 37].

Laparoscopic splenectomy has gained favor due to reduced postoperative pain, shorter hospital stays, and fewer wound complications [38]. Although we observed a significantly lower complication rate among patients undergoing laparoscopic splenectomy, these advantages must be balanced against the need for conversion when encountering unexpected adhesions, uncontrolled hemorrhage, or massive splenic enlargement. Consistent with prior series, our conversion rate was around 4–20% [38-40]. Postoperative complications in our study were predominantly classified as Clavien-Dindo Grade 3a or 3b, requiring either radiologically guided interventions (e.g., percutaneous drainage) or surgical re-exploration (relaparotomy). While some prior literature has reported a modest risk of serious complications (e.g., hemorrhage, infection) 17, our data underscore that the procedure can still carry substantial morbidity. As in other series, fatalities (Clavien-Dindo Grade 5) predominantly arose from massive hemorrhage, pulmonary embolism, or sepsis [41].

Several limitations warrant consideration. As a retrospective analysis, our study depended on the accuracy and completeness of existing medical records. Certain nuances regarding patient selection for laparoscopic versus open approaches or extended details of comorbid conditions (e.g., severity of underlying diseases) were not captured. Additionally, the study spanned a 15-year period during which surgical techniques and perioperative care evolved substantially. Future prospective, multicenter trials with standardized protocols could offer more robust data regarding optimal patient selection and management strategies for splenectomy.

Conclusion

This study highlights the outcomes of 589 splenectomy cases over 15 years at a tertiary center, emphasizing the diverse indications and challenges of this procedure. Open splenectomy was the most common approach, but laparoscopic splenectomy showed lower complication and mortality rates, supporting its broader use when feasible. Trauma was the leading indication, yet high-risk groups like those with splenic artery aneurysms or malignancies had significantly higher complication and mortality rates. Postoperative complications, particularly Clavien-Dindo Grade 5 events, were major contributors to 30-day mortality. These findings underscore the need for careful patient selection, advanced surgical techniques, and robust perioperative management to optimize outcomes.

Conflict of Interest/ Funding

The study received no financial support from any individual or organization, and the authors declare no conflict of interest.

Conflicts of Interest: The authors declare they have no conflicts of interest.

Ethics Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Antalya Training and Research Hospital Clinical Research Ethics Committee (Date: 11.07.2024, Decision No: 10/16).

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author.

Authors' contribution

Concept, Design, Data collection and/or processing, Analysis and/or interpretation, and Writing – M.Y.

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Research Article

Comparison of the success rate of fascia lata graft and temporal muscle fascia graft in endoscopic treatment of anterior skull base cerebrospinal fluid rhinorrhea

Anterior kafa tabanı BOS rinoresinin endoskopik tedavisinde fasya lata grefti ile temporal kas fasya greftinin başarı oranlarının karşılaştırılması

Gorkem Dundar*, Serdar Ozer

Hacettepe University Faculty of Medicine, Department of Otolaryngology, Ankara, Turkey

Abstract

Aim: The aim of this retrospective study is to describe our experiences of cerebrospinal fluid (CSF) rhinorrhea and assess success rate of fascia lata and temporal fascia of repairing the skull base defects

Material and Methods: Patients with CSF rhinorrhea managed by department of otolaryngology from 2007 to 2021 were included. Demographic information, site of leak, etiology, body mass index (BMI), surgical approach, graft material, and any recurrence of leak of the patients was collected.

Results: Out of the 66 patients included in the study, 25 were male and 41 were female and the median age was found to be 43.7 (ranging from 19 to 72). The median Body Mass Index (BMI) was found to be 27.5 (ranging from 19 to 46). The success rate of endoscopic method in repairing CSF rhinorrhea was found to be 90.4%. Fascia lata was used as graft material in 35 patients, while temporal muscle fascia was used in 31 patients. Recurrent rhinorrhea was detected in 5 of 31 patients (16.1%) in whom temporal muscle fascia was used as a graft, while recurrence was detected in 2 of 35 patients (5.7%) in whom fascia lata graft was used (p=0.170). While rhinorrhea recurrence was detected in 6 of 27 obese patients (22.2%), revision surgery was required in only 1 (2.6%) non-obese patient (p=0.011). Complications such as hematoma, alopecia and leg pain related to the graft site were seen in 4 operated patients.

Conclusion: Patients presenting with CSF rhinorrhea can be successfully treated with endoscopic sinus surgery. The success rate of using temporal fascia graft and fascia lata graft in defect repair is similar in rhinorrhea repair. In our study, it was determined that the only factor affecting treatment success was high BMI.

Keywords: cerebrospinal fluid, endoscopic, rhinorrhea, skull base

Corresponding author*: Görkem Dündar, Hacettepe University Faculty of Medicine, Department of Otolaryngology, Ankara, Turkey.
E-mail: drgorkemdundar@gmail.com
Orcid: 0000-0002-1888-8218
Doi: 10.18663/tjcl.1626813
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Öz

Amaç: Bu retrospektif çalışmanın amacı, beyin omurilik sıvısı (BOS) rinoresi olan kafa tabanı defektlerinin onarımında fasya lata ve temporal fasyanın başarı oranını değerlendirmektir.

Gereç ve Yöntemler: 2007-2021 yılları arasında kulak burun boğaz kliniği tarafından tedavi edilen BOS rinoreli hastalar çalışmaya dahil edildi. Hastaların demografik bilgileri, sızıntının yeri, etiyolojisi, vücut kitle indeksi (VKİ), cerrahi yaklaşım, greft materyali ve herhangi bir sızıntı rekürrensi toplandı.

Bulgular: Çalışmaya 25'i erkek, 41'i kadın 66 hasta dahil edildi. Ortanca yaş 43.7 (19 - 72) olarak bulundu. Median Vücut Kitle İndeksi (VKİ) 27.5 (19-46) olarak bulunmuştur. Endoskopik yöntemin BOS rinoresini onarmadaki başarı oranı %90,4 olarak bulunmuştur. Greft materyali olarak 35 hastada fasya lata kullanılırken, 31 hastada temporal kas fasyası kullanıldı. Temporal kas fasyası kullanılan 31 hastanın 5'inde (%16,1) rekürren rinore saptanırken, fasya lata grefti kullanılan 35 hastanın 2'sinde (%5,7) rekürrens saptandı (p=0,170). Obez 27 hastanın 6'sında (%22,2) rinore nüksü saptanırken, obez olmayan sadece 1 (%2,6) hastada revizyon cerrahisi gerekmiştir (p=0,011). Ameliyat edilen 4 hastada greft bölgesine bağlı hematom, alopesi ve bacak ağrısı gibi komplikasyonlar görüldü.

Sonuç: BOS rinoresi ile başvuran hastalar endoskopik sinüs cerrahisi ile başarılı bir şekilde tedavi edilebilir. Defekt onarımında temporal fasya grefti ve fasya lata grefti kullanımının rinore onarımındaki başarı oranı benzerdir. Çalışmamızda tedavi başarısını etkileyen tek faktörün yüksek VKİ olduğu tespit edilmiştir.

Anahtar Kelimeler: beyin omurilik sıvısı, endoskopik, rinore, kafa tabanı

Introduction

Abnormal connections between structures separating the subarachnoid space and nasal cavity can lead to cerebrospinal fluid (CSF) leakage. CSF rhinorrhea can occur due to traumatic or non-traumatic reasons depending on the formation mechanism. Traumatic CSF rhinorrhea cases due to iatrogenic injuries during endoscopic sinus surgery are more common (1). Among non-traumatic reasons are congenital defects, spontaneous CSF rhinorrhea, or intracranial and nasal cavity tumors invading the skull base (2). After confirming that rhinorrhea is due to CSF leakage, the defect area should be identified with appropriate imaging techniques, and surgical repair should be performed to prevent the risk of meningitis and other intracranial complications.

Open intracranial approaches, which have limited indications today, have been replaced by endoscopic endonasal approaches with high success rates and low morbidity. In commonly used endoscopic repair techniques for CSF rhinorrhea, waterproof repair can be achieved with tissue grafts, vascularized flaps, and synthetic dural grafts (3). The success rate of multilayer repair with free grafts for most defects smaller than 1 cm in the skull base is over 90%, while vascularized local or regional flaps are preferred for repairing defects larger than 3 cm (4). Studies show that vascularized flaps are superior in large dural defects or high-flow CSF leaks, but the choice of a specific technique for repairing defects smaller than 1 cm is based on the surgeon's preference rather than evidence-based data (5).

The aim of this study is to evaluate the results of the endoscopic endonasal treatment of CSF rhinorrhea cases and to investigate the success rate of two graft type fascia lata and temporal fascia controlling the CSF rhinorrhea.

Material and Methods

This study was conducted after the approval of the local ethics committee. Between 2007-2021, demographic information, comorbid diseases, previous nasal surgeries, graft type, presenting complaints, localization of skull base defect, defect size, flow rate, presence of encephalocele, intraoperative and postoperative complications, revision surgery for CSF leakage, and clinical follow-ups of patients operated for CSF rhinorrhea were retrospectively reviewed from medical records.

Patients describing rhinorrhea and confirmed with preoperative beta-2 transferrin test were included in the study if they had undergone paranasal computed tomography (CT), magnetic resonance imaging (MRI), or MRI cisternography. Patients with anterior skull base defect size less than 1 cm and those with low flow rate were included in the study. Patients who had previously undergone CSF rhinorrhea repair, and those with missing information during the retrospective review and patients with high-flow CSF were not included in the study.

Surgical Technique

All patients in the study were operated with endoscopic endonasal approach under general anesthesia. Functional endoscopic sinus surgery was performed to recognize the skull base and to determine the defect location. The operation steps were modified according to the defect localizations and unnecessary sinus manipulations were avoided. In patients in whom the defect location could not be determined by pre-operative imaging methods, intrathecal fluorescein (0.1ml 10% fluorescein diluted in 10 ml CSF) was administered just before the surgery. After the location of the CSF leak was determined, the tissues around the defect were removed and the borders of the defect were determined. In cases with encephalocele, the encephalocele was excised with bipolar cautery and sent for histological examination. The bone at the edges of the defect was rounded and a smooth surface was obtained. Fascia lata and temporal muscle fascia graft are harvested using a standard technique. The graft material to be used for repair was determined according to the surgeons' preference. Two-layer repair was preferred for defect repair. The graft that was advanced through the skull base defect was laid underlay between the dura and the skull base, and then a second layer was laid overlay on the skull base. No tissue adhesive and rigid graft (bone or cartilage) were used. After placing oxidized cellulose (Surgicel; Ethicon, USA) and a nasal tampon on the graft, a foley catheter was inflated in the nasal cavity to support the graft inferiorly. No lumbar drainage was placed in any patient.

Post-operative Period

Mandatory bed rest was given to the patient in the first postoperative day and movement restriction was recommended for the following days. Patients were warned not to cough and strain. Treatment was given to prevent constipation. In addition to prophylactic antibiotic treatment, acetolazomide (250 mg) was given once daily for one week to reduce intra-cranial pressure. After the saline in the foley catheter was drained on the 5th postoperative day, the foley catheter was withdrawn on the 6th postoperative day and discharge was planned. One week after discharge, endoscopic examinations were performed in the outpatient clinic and desiccation was performed. The patients were followed up monthly for the first three months and then every 3 months for at least 1 year.

Statistical Analysis

The suitability of the variables for normal distribution was examined using the Shapiro-Wilk test. Since the data did not show a normal distribution, the Mann-Whitney U test was used for comparisons between two groups, and descriptive statistics were presented as median (minimum-maximum). Pearson Chi-Square test and Fisher's exact test were used to compare categorical variables between groups. Categorical variables were expressed as n (%). Statistical analyses were performed using SPSS v22.0 software. A significance level of p=0.05 was used for all statistical analyses.

Results

The data related to the study is shown in Table 1. Out of the 66 patients included in the study, 25 were male (%37.9) and 41 were female (%62.1). The median age was found to be 43.7 (ranging from 19 to 72). The median Body Mass Index (BMI) was found to be 27.5 (ranging from 19.6 to 46.6). The BMI median of patients with spontaneous cerebrospinal fluid (CSF) rhinorrhea was found to be 34.93 (ranging from 24 to 46). Out of the patients included in the study, 55 had rhinorrhea (83%), 10 had headaches (15%), and 1 had meningitis (2%). In terms of etiology, trauma was present in 34 patients (%51.5), and spontaneous CSF rhinorrhea in 32 patients (%48.5). The dural defect causing CSF rhinorrhea was in the cribriform plate in 24 patients (%36.4), in the ethmoid roof in 20 (%30.3) patients, in the frontal sinus in 4 patients (%6.1), and in the sphenoid sinus in 18 patients (27.3). Fascia lata was used as graft material in 35 patients (%53.1), while temporal fascia was used in 31 patients (%46.9). It was found that the patients were followed up for an average of 25 months (ranging from 12 to 61).

The success rate of endoscopic method in repairing CSF rhinorrhea was found to be 90.4%. The relationship between recurrence and demographic and treatment-related factors was presented in table 2. When patients with failed rhinorrhea repair were examined, it was found that there was no relationship between the location of the defect (3 patients with sphenoid sinus defect, 3 patients with cribriform plate defect and 1 patient with ethmoid roof defect) and repair unsuccessfulness (p = 0.588). Recurrent rhinorrhea was detected in 5 of 31 patients (16.1%) in whom temporal muscle fascia was used as a graft, while recurrence was detected in 2 of 35 patients (5.7%) in whom fascia lata graft was used (p=0.170). While rhinorrhea recurrence was detected in 6 of 27 obese patients (22.2%), revision surgery was required in only 1 (2.6%) non-obese patient (p=0.011). 4 patients had donor site related complications. In one patient who had

temporal muscle fascia harvested, hematoma was detected on postoperative second day and a suture were opened from the incision line and a penrous drain was placed after the hematoma was drained. Another patient who underwent temporal muscle fascia grafting developed alopecia at the incision site and was referred to the dermatology department for treatment. Two patients who underwent fascia lata grafting developed leg pain with walking and movement for 4 months after the operation. These patients were referred to the physiotherapy department and recommended for massage therapy to relax the muscle fascia. It was observed that prophylactic antibiotics and post-operative lumbar drain were not used in the patients included in the study. There were no complications related to the surgery such as new onset meningitis, increased pneumocephalus, hydrocephalus, or mucocele in the post-operative period.

Table I. Characteristics of the study population

Group		Number	(%)
Gender			
	Female	41	(62.1%)
	Male	25	(37.9%)
Revision surgery			
	No	59	(89.4%)
	Yes	7	(10.6%)
Graft type			
	Temporal Fascia	31	(46.9%)
	Fascia Lata	35	(53.1%)
Localization			
	Cribriform plate	24	(36.4%)
	Fovea ethmoidalis	20	(30.3%)
	Frontal sinus	4	(6.1%)
	Sphenoid sinus	18	(27.3%)
Fluorescein usage			
	No	58	(87.9%)
	Yes	8	(12.1%)
Etiology			
	Trauma	34	(51.5%)
	Spontaneous	32	(48.5%)
Body Mass Index Status			
	< 30	39	(59%)
	≥ 30	27	(41%)
Donor site complications			
	Fascia lata	2	(5.71%)
	Temporal fascia	2	(6.45%)
		Median	(min- max)
Age		43	(19 – 72)
Body Mass Index		27.5	(19.6 – 46.6)

Discussion

Advances in medical technology have significantly transformed the approach to repairing skull base defects. Many surgeries previously performed using open techniques can now be accomplished with endoscopic methods, resulting in high success rates, reduced invasiveness, and lower morbidity. This study presents the outcomes of using temporal muscle fascia or fascia lata grafts over 14 years of endoscopic treatment for patients admitted to our clinic with CSF rhinorrhea. The success rate of CSF rhinorrhea repair in our study was consistent with other studies in the literature, and both graft types demonstrated similar success rates in controlling rhinorrhea (6, 7).

The choice of graft to be used in CSF rhinorrhea repair is important for waterproof repair. In the treatment of patients presenting with CSF rhinorrhea, repairing with the same graft type in every patient and insisting on this graft selection may negatively affect the success of treatment. Many factors such as the location of the defect, the size of the defect, the mechanism of defect formation, CSF flow rate, easy and fast access to the graft are important in graft selection. In the literature, a wide range of graft materials such as fascia lata, temporal muscle fascia, cartilage, bone, turbinate mucosa, pedicled flaps and synthetic dura are utilized (8). According to our clinical experience, the use of rigid tissues such as bone and cartilage has a limited role in the control of rhinorrhea. It is difficult to adjust the graft thickness according to the location where the bone graft is taken and to fit this graft to the borders of the existing defect. Although there are opinions that the graft may dislodge with the valsalva maneuver and cause dural sagging in repairs performed without a rigid graft (9). In our study, dural sagging was not found in the follow-up of patients who underwent repair with fascia lata or temporal muscle fascia.

Although successful results are obtained in rhinorrhea repair with fascia lata graft, complications such as hematoma, seroma, hypoesthesia, deep vein thrombosis or pain in the leg while walking may be observed in some patients (10). In our study, the pain while walking observed in patients who had fascia lata harvested was thought to be due to fibrosis developing in the muscle fascia and these patients benefited from physiotherapy exercises. After harvesting the graft from the fascia lata, repairing this fascia and suturing it in accordance with anatomical plans may be effective in solving problems such as muscle herniation, fibrosis and bulging when walking. Deep vein thrombosis prophylaxis should be considered especially in patients with walking and mobility problems due to fascia lata.

Table II. Parameters affecting revision								
Group		Total		No Recurrence		Revision Surgery		p value
		Number	(%)	Number	(%)	Number	(%)	
Gender								0.266
	Female	41	(62.1%)	38	(64.4%)	3	(42.9%)	
	Male	25	(37.9%)	21	(35.6%)	4	(57.1%)	
Graft type								0.170
	Temporal Fascia	31	(46.9%)	26	(44.1%)	5	(71.4%)	
	Fascia Lata	35	(53.1%)	33	(55.9%)	2	(28.6%)	
Localization								0.588
	Cribriform plate	24	(36.4%)	21	(35.6%)	3	(42.9%)	
	Fovea ethmoidalis	20	(30.3%)	19	(32.2%)	1	(14.3%)	
	Frontal sinus	4	(6.1%)	4	(6.8%)	0	(0%)	
	Sphenoid sinus	18	(27.3%)	15	(25.4%)	3	(42.9%)	
Fluorescein usage								0.853
	No	58	(87.9%)	52	(88.1%)	6	(85.7%)	
	Yes	8	(12.1%)	7	(11.9%)	1	(14.3%)	
Etiology								0.199
	Trauma	34	(51.5%)	32	(54.2%)	2	(28.6%)	
	Spontaneous	32	(48.5%)	27	(45.8%)	5	(71.4%)	
Body Mass Index Status								0.011
	< 30	39	(59%)	38	(64.4%)	1	(14.3%)	
	≥ 30	27	(41%)	21	(35.6%)	6	(85.7%)	

Complications such as hematoma, seroma, alopecia and hypoesthesia can also be seen in patients with temporal muscle fascia. The most important step in the treatment of hematoma is to control hypertension, coagulation disorders or renal functions that may cause hematoma formation. Especially in obese patients presenting with spontaneous CSF rhinorrhea, control of metabolic problems may prevent these complications. In our first operated patients who received temporal muscle fascia graft, 2 cm above the ear helix was preferred for the initial incision. In our patients operated on in later periods, instead of the intra-hair incision, we started to make a parallel incision to the temporal hairline similar to the brow lift operation and tried to minimize the risk of alopecia. In our study, temporal muscle fascia, which showed a similar success rate with fascia lata graft, may be preferred because of easy access, rapid graft harvesting, and minimal complications on nasal functions and donor site.

Although rhinorrhea was successfully repaired in the majority of the patients in our study, some patients required revision surgery. It is important to identify the factors leading to revision surgery, and to take appropriate measures against them. In our study, the revision surgery rate was found similar to other studies in the literature (11). In the analysis of the causes of failure of CSF rhinorrhea repair, high BMI was found to be a significant risk factor independent of the type of graft used. In the literature, success rates of spontaneous CSF rhinorrhea in patients with high BMI have been found to be lower compared to other causes (12). In our study, similar to the scientific literature, more recurrence was detected in obese patients. Metabolic disorders and increased intracranial pressure in these patients make rhinorrhea repair difficult. In addition to skull base surgery, drawing a treatment plan with bariatric surgery or dietitian consultation may be beneficial in the treatment of these patients.

Certain limitations of our study include its retrospective design, small sample number, and patient selection and graft type selection. The inclusion of patients with skull base defects smaller than 1 cm and low CSF flow rate are another limitation's related to patient selection. In future studies on this subject, prospective studies can be performed to compare different graft options, different defect size, different flow rate and larger patient groups from multiple institutions are needed to provide better estimates of graft types.

Conclusion

Patients presenting with CSF rhinorrhea can be successfully treated with endoscopic sinus surgery. The success rate of using temporal fascia graft and fascia lata graft in defect repair is similar in rhinorrhea repair. In our study, it was determined that the only factor affecting treatment success was high BMI.

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Disclosure Statement

Authors declare no conflict of interest.

Ethical approval

Our study was carried out on receiving the approval of Hacettepe University Hospital Ethical Board, no. 2021/04-65.

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Conflict of interest

The authors declare that they have no conflict of interest.

Availability of data and material

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability

no code available.

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Research Article

Clinical outcomes of one-stent crossover approach for left main bifurcation in a single center

Sol ana koroner arter bifurkasyonu için tek stentli crossover yaklaşımın tek merkez klinik sonuçları

Ufuk Yildirim*, Alperen Altinbas

Ondokuz Mayis University Faculty of Medicine, Department of Cardiology, Samsun, Turkey

Abstract

Aim: For the majority of left main coronary artery (LM) bifurcation lesions treated with percutaneous coronary intervention, one-stent crossover technique and provisional approach to the side branch is recommended, which is simpler compared to complex two-stent techniques. In this study, we aimed to reveal the clinical outcomes of one-stent crossover approach for LM bifurcation.

Material and Methods: Patients who underwent one-stent crossover technique for unprotected LM bifurcation lesion between May 2020 and November 2023 in our center were included in this retrospective observational study. Clinical and procedural characteristics of the patients were recorded. All patients or their relatives were called to inquire about clinical outcomes. The primary endpoint was determined as target lesion failure (TLF), which was defined as clinically driven target lesion revascularization (TLR), target lesion-related myocardial infarction (TL-MI), or sudden cardiac death (SCD).

Results: A total of 86 patients were included in the study. Crossover stenting was performed from the LM to the left anterior descending artery (LAD) in 76 patients and from the LM to the left circumflex artery (LCX) in 8 patients. The median follow-up time was 22 (3-54) months. Clinically driven TLR occurred in 2 patients, TL-MI in 1 patient, and SCD in 1 patient. TLF criteria were met in only 3 patients. Of these patients, 2 had undergone LM-LAD and 1 had undergone LM-LCX crossover stenting.

Conclusion: One-stent crossover approach for LM bifurcation lesions is associated with very good clinical outcomes.

Keywords: one-stent; crossover stenting; left main bifurcation

Corresponding author*: Ufuk Yıldırım, Ondokuz Mayis University Faculty of Medicine, Department of Cardiology, Samsun, Turkey.
E-mail: ufukyildirim2715@yahoo.com.tr
Orcid: 0000-0002-8848-8711
Doi: 10.18663/tjcl.1599187
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Öz

Amaç: Perkütan koroner girişim ile tedavi edilen sol ana koroner arter (LM) bifurkasyon lezyonlarının çoğunda, kompleks çift stentleme tekniklerine kıyasla daha basit olan tek stentli crossover teknik ve yan dala provizyonel yaklaşım önerilmektedir. Bu çalışmada, LM bifurkasyonu için tek stentli crossover yaklaşımın klinik sonuçlarını ortaya koymayı amaçladık.

Gereç ve Yöntemler: Merkezimizde Mayıs 2020 ile Kasım 2023 tarihleri arasında, korumasız LM bifurkasyon lezyonuna tek stentli crossover teknik uygulanan hastalar retrospektif gözlemsel bu çalışmaya dahil edildi. Hastaların klinik ve prosedürel özellikleri kaydedildi. Tüm hastalar veya yakınları aranarak klinik sonuçlar sorgulandı. Birincil sonlanım noktası; kliniğe dayalı hedef lezyon revaskülarizasyonu (TLR), hedef lezyonla ilişkili miyokart enfarktüsü (TL-MI) veya ani kardiyak ölüm (SCD) olarak tanımlanan hedef lezyon başarısızlığı (TLF) olarak belirlendi.

Bulgular: Toplam 86 hasta çalışmaya dahil edildi. Bu hastaların 76'sında LM'den sol ön inen artere (LAD) doğru, 8'inde LM'den sol sirkumfleks artere (LCX) doğru crossover stentleme yapılmıştı. Ortanca takip süresi 22 (3-54) aydı. Hastaların 2'sinde kliniğe dayalı TLR, 1'inde TL-MI, 1'inde SCD gelişmişti. TLF kriterleri yalnızca 3 hastada gerçekleşmişti. Bu hastaların 2 tanesine LM-LAD, 1 tanesine LM-LCX crossover stentleme uygulanmıştı.

Sonuç: LM bifurkasyon lezyonları için tek stentli crossover yaklaşım oldukça iyi klinik sonuçlarla ilişkilidir.

Anahtar Kelimeler: tek stent; crossover stentleme; sol ana koroner arter bifurkasyonu

Introduction

Progress in interventional cardiology has led to an increasing utilization of percutaneous coronary intervention (PCI) in the management of unprotected left main coronary artery (LM) bifurcation disease. For the majority of LM bifurcation lesions treated with PCI, one-stent crossover technique and provisional approach to the side branch (SB) is recommended, which is simpler compared to complex two-stent techniques [1].

The evidence derived from the non-randomized studies indicated that a two-stent strategy for the treatment of LM bifurcation disease resulted in inferior outcomes [2,3]. However, the recent randomized studies have shown that a two-stent strategy for complex bifurcation lesions may be associated with a lower incidence of target lesion revascularization (TLR) in comparison to a provisional approach [4,5]. Conversely, the EBC MAIN trial furnished evidence to substantiate the efficacy of a provisional strategy for the management of true LM bifurcation lesions [6].

One-stent crossover technique and provisional approach to the SB remains the most common PCI strategy for LM bifurcation disease. In this study, we aimed to reveal the clinical outcomes of one-stent crossover approach for LM bifurcation in our center.

Material and Methods

Patients who underwent one-stent crossover technique for unprotected LM bifurcation lesion between May 2020 and November 2023 in our center were included in this retrospective observational study. The exclusion criteria were dual stenting of the LM bifurcation, prior stent implantation to the LM bifurcation, prior coronary artery bypass grafting, the presence of a ramus intermedius artery larger than 2 mm, cardiogenic shock at presentation, and lack of technical success. Technical success was accepted as Thrombolysis In Myocardial Infarction (TIMI) grade 3 flow in the left anterior descending artery (LAD) and the left circumflex artery (LCX) with residual stenosis <30% in the LM and crossover stented branch, and <75% in the ostium of the stentless branch. The study was approved by the local ethics committee, and informed consent was obtained from all participants.

The clinical characteristics of the patients were documented. Age, gender, smoking status, and body mass index were recorded. History of hypertension, diabetes, and prior PCI were noted. Hypercholesterolemia was accepted as total cholesterol higher than 240 mg/dL at any time [7]. Glycated hemoglobin level at presentation was recorded. The Modification of Diet in Renal Disease (MDRD) formula was utilized to ascertain the glomerular filtration rate (GFR). Patients exhibiting a GFR of less than 60 mL/min/1.73 m^2 for a minimum of 3 months were deemed to have chronic kidney disease [8]. Patients on maintenance dialysis were also noted. The modified Simpson method was employed for the estimation of the left ventricular ejection fraction. The diagnosis at admission was also documented.

Two-dimensional quantitative coronary angiography (2D-QCA) analysis was used to estimate the reference vessel diameter, diameter stenosis, and lesion length. The Medina classification of the LM bifurcation was noted. Moderate or severe calcification was defined as calcification more than just spots [9]. The bifurcation angle between the LAD and LCX was measured by 2D-QCA analysis in the left anterior oblique caudal view. Access site, intravascular ultrasound (IVUS) use, aorto-ostial stenting, total stent length per lesion, number of stents per lesion, the LM stent diameter, final kissing balloon inflation (KBI), final proximal optimization technique (POT), reached diameter with PCI in the LM and crossover stented branch, final diameter stenosis in the ostium of the stentless branch, and the choice of P2Y12 inhibitor were also recorded.

All patients or their relatives were called to inquire about clinical outcomes, which were also checked from the National Health Record System. Follow-up time, major bleeding, any coronary revascularization, TLR, target lesion-related myocardial infarction (TL-MI), in-stent restenosis, definite stent thrombosis, ischemic stroke, sudden cardiac death (SCD), all-cause death, target lesion failure (TLF), and time to TLF were documented. Major bleeding was accepted as Bleeding Academic Research Consortium (BARC) type 3 or 5 bleeding [10]. Clinically driven TLR was accepted as any repeat revascularization of a lesion within or 5 mm borders adjacent to the stent on the basis of clinical features of ischemia. SCD was defined as sudden, unexpected death from cardiovascular causes with loss of consciousness within 1 hour of symptom onset. The primary endpoint was determined as TLF, which was defined as clinically driven TLR, TL-MI, or SCD.

The Statistical Package for Social Sciences (SPSS) version 25 was utilized to upload and analyze the research data. Categorical variables are presented in terms of frequency and percentage. The Kolmogorov-Smirnov test was used to determine whether numerical variables were normally distributed. Numerical variables with a normal distribution are given as mean ± standard deviation, and those without a normal distribution are given as median (minimum-maximum).

Results

A total of 86 patients were included ultimately. Crossover stenting was performed from the LM to the LAD in 76 patients and from the LM to the LCX in 8 patients. The baseline and procedural characteristics of patients undergoing LM-LAD crossover stenting are presented in Table 1, and those of patients undergoing LM-LCX crossover stenting are presented in Table 2.

The median follow-up time was 22 (3-54) months. Major bleeding occurred in 2, any coronary revascularization in 6, TLR in 2, TL-MI in 1, in-stent restenosis in 1, definite stent thrombosis in 1, ischemic stroke in 3, SCD in 1, and all-cause death in 8 patients. TLF criteria were met in 3 patients, and the median time to TLF was 24 (16-30) months (Table 3). Of these patients, 2 had undergone LM-LAD and 1 had undergone LM-LCX crossover stenting.

Discussion

One-stent crossover technique is the accepted standard PCI approach for LM bifurcation disease in the absence of true bifurcation lesions. However, a recent randomized trial conducted by the European Bifurcation Club (EBC) suggested evidence in favor of a provisional stepwise approach also in true bifurcation lesions of the LM [6]. In our study, in which 13 of 86 patients had true bifurcation lesions, TLF occurred in only 3 patients.

The provisional stepwise approach adopted by the EBC implies evaluating the results at each step of the procedure. After crossover stenting and POT, the SB should be rewired and KBI performed with non-compliant balloons in the presence of a suboptimal SB result, as indicated by a TIMI grade <3 flow or >75% diameter stenosis. In the event that KBI is to be performed, it is recommended to complete with a final POT. Switching to a two-stent technique should only be reserved for a TIMI grade <3 flow in the SB, >90% diameter stenosis in the SB ostium, SB dissection type >A, abnormal physiology in the SB, or high-risk for SB closure [11].

In vitro data have shown that floating struts in the SB ostium may be associated with an increased susceptibility to thrombus formation [12]. However, clinical data have not demonstrated the benefit of routine KBI after LM crossover stenting [13]. In case of performing KBI, a final POT is advisable to restore proximal stent circularity [14]. Of the 86 patients in our study, 24 had undergone final KBI and 22 of these cases had been completed with final POT. Of the 3 patients with TLF, 1 had undergone final KBI and all of these cases had been completed with POT.

In contrast to LM-LAD crossover stenting, LM-LCX crossover stenting is not a well-defined technique. However, in some LM bifurcation lesions, LM-LCX crossover stenting may be an option due to lack of ostial LAD involvement, relatively larger LCX diameter, or unrevascularized chronic total occlusion in the LAD. In a study comparing LM-LAD and LM-LCX crossover stenting, the LCX ostium demonstrated a propensity for restenosis in both groups. Moreover, LM-LCX crossover

Table 1. Baseline and procedural characteristics of patients undergoing LM-LAD crossover stenting		
Variable		LM-LAD crossover stenting (n=78)
Age (year)		62.9 ± 11.3
Gender	Male (%*)	53 (67.9)
	Female (%*)	25 (32.1)
Smoking	Current (%*)	13 (16.7)
	Past (%*)	30 (38.5)
	Never (%*)	35 (44.9)
Hypertension (%*)		42 (53.8)
Diabetes (%*)		31 (39.7)
HbA1c (%)		6.0 (4.5-12.7)
Hypercholesterolemia (%*)		28 (35.9)
Body mass index (kg/m2)		28.8 (18.4-38.6)
Chronic kidney disease (%*)		17 (21.8)
GFR (mL/min/1.73 m2)		77.1 ± 24.9
Dialysis (%*)		3 (3.8)
Prior PCI (%*)		22 (28.2)
LVEF (%)		50 (30-72)
Diagnosis at admission	CCS (%*)	34 (43.6)
	UA (%*)	5 (6.4)
	NSTEMI (%*)	32 (41.0)
	STEMI (%*)	7 (9.0)
Medina classification	111 (%*)	7 (9.0)
	110 (%*)	26 (33.3)
	101 (%*)	1 (1.3)
	100 (%*)	5 (6.4)
	011 (%*)	2 (2.6)
	010 (%*)	37 (47.4)
Reference vessel diameter (mm)	LM	5.16 ± 0.42
	LAD	4.02 ± 0.29
	LCX	3.58 ± 0.54
Diameter stenosis (%)	LM	45 (0-99)
	LAD	80 (0-100)
	LCX	20 (0-70)
Lesion length (mm)	LM	7.5 (0-15)
	LAD	10 (0-75)
	LCX	5 (0-30)
Moderate/severe calcification	LM-LAD (%*)	25 (32.0)
	LCX (%*)	7 (9.0)
Bifurcation angle (°)		100 (40-160)
Access site	Femoral (%*)	58 (74.4)
	Radial (%*)	20 (25.6)
IVUS use (%*)		15 (19.2)
Aorto-ostial stenting (%*)		37 (47.4)
Total stent length per lesion (mm)		30 (16-104)
Number of stents per lesion		1 (1-4)
LM stent diameter (mm)		4.0 (3.0-4.5)
Final kissing balloon inflation (%*)		21 (26.9)
Final POT (%*)		76 (97.4)
Reached diameter with PCI (mm)	LM	5.00 ± 0.49
	LAD	4.05 ± 0.30
Final LCX diameter stenosis (%)		30 (0-70)
$P2Y_{12}$ inhibitor	Prasugrel (%*)	27 (34.6)
	Ticagrelor (%*)	31 (39.7)
	Clopidogrel (%*)	20 (25.6)

CCS, chronic coronary syndrome; GFR, glomerular filtration rate; HbA1c, glycated hemoglobin; IVUS, intravascular ultrasound; LAD, left anterior descending artery; LCX, left circumflex artery; LM, left main coronary artery; LVEF, left ventricular ejection fraction; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; POT, proximal optimization technique; STEMI, ST-segment elevation myocardial infarction; UA, unstable angina. *Column percentage.

Table 2. Baseline and procedural characteristics of patients undergoing LM-LCX crossover stenting		
Variable		LM-LCX crossover stenting (n=8)
Age (year)		70.0 ± 15.4
Gender	Male (%*)	5 (62.5)
	Female (%*)	3 (37.5)
Smoking	Current (%*)	2 (25.0)
	Past (%*)	4 (50.0)
	Never (%*)	2 (25.0)
Hypertension (%*)		7 (87.5)
Diabetes (%*)		3 (37.5)
HbA1c (%)		5.8 (5.4-8.2)
Hypercholesterolemia (%*)		3 (37.5)
Body mass index (kg/m2)		26.5 (24.1-33.2)
Chronic kidney disease (%*)		0
GFR (mL/min/1.73 m2)		82.9 ± 16.8
Dialysis (%*)		0
Prior PCI (%*)		3 (37.5)
LVEF (%)		55 (40-60)
Diagnosis at admission	CCS (%*)	1 (12.5)
	UA (%*)	0
	NSTEMI (%*)	6 (75.0)
	STEMI (%*)	1 (12.5)
Medina classification	101 (%*)	3 (37.5)
	100 (%*)	1 (12.5)
	001 (%*)	4 (50.0)
Reference vessel diameter (mm)	LM	5.14 ± 0.26
	LAD	3.78 ± 0.28
	LCX	3.91 ± 0.33
Diameter stenosis (%)	LM	40 (0-80)
	LAD	30 (0-40)
	LCX	87.5 (20-99)
Lesion length (mm)	LM	8.5 (0-12)
	LAD	4.5 (0-15)
	LCX	8 (5-15)
Moderate/severe calcification	LM-LAD (%*)	3 (37.5)
	LCX (%*)	1 (12.5)
Bifurcation angle (°)		85 (80-150)
Access site	Femoral (%*)	5 (62.5)
	Radial (%*)	3 (37.5)
IVUS use (%*)		0
Aorto-ostial stenting (%*)		3 (37.5)
Total stent length per lesion (mm)		22 (16-32)
Number of stents per lesion		1 (1-1)
LM stent diameter (mm)		3.75 (3.5-4.0)
Final kissing balloon inflation (%*)		3 (37.5)
Final POT (%*)		7 (87.5)
Reached diameter with PCI (mm)	LM	4.98 ± 0.49
	LCX	4.11 ± 0.30
Final LAD diameter stenosis (%)		30 (0-50)
$P2Y_{12}$ inhibitor	Prasugrel (%*)	1 (12.5)
	Ticagrelor (%*)	3 (37.5)
	Clopidogrel (%*)	4 (50.0)

CCS, chronic coronary syndrome; GFR, glomerular filtration rate; HbA1c, glycated hemoglobin; IVUS, intravascular ultrasound; LAD, left anterior descending artery; LCX, left circumflex artery; LM, left main coronary artery; LVEF, left ventricular ejection fraction; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; POT, proximal optimization technique; STEMI, ST-segment elevation myocardial infarction; UA, unstable angina. *Column percentage.

stenting was associated with a higher rate of TLR in the LAD ostium. The LAD ostium was involved in 5 of the 6 patients with TLR in the LM-LCX group, although final KBI had been performed in 4 of these patients [15]. In our study, among the 8 patients undergoing LM-LCX crossover stenting, TLR occurred in 1 patient, in whom the LAD ostium was totally occluded, and final KBI had not been performed in this case.

Table 3. Clinical outcomes of patients undergoing LM crossover stenting

Variable	LM crossover stenting (n=86)
Follow-up time (month)	22 (3-54)
Major bleeding (%*)	2 (2.3)
Any coronary revascularization (%*)	6 (7.0)
Target lesion revascularization (%*)	2 (2.3)
Target lesion-related MI (%*)	1 (1.2)
In-stent restenosis (%*)	1 (1.2)
Definite stent thrombosis (%*)	1 (1.2)
Ischemic stroke (%*)	3 (3.5)
Sudden cardiac death (%*)	1 (1.2)
All-cause death (%*)	8 (9.3)
Target lesion failure (%*)	3 (3.5)
Time to target lesion failure (month)	24 (16-30)

LM, left main coronary artery; MI, myocardial infarction.
*Column percentage.

Coronary bifurcation lesions are associated with an elevated risk of platelet reactivity and are therefore deemed to be a predisposing factor for ischemic events. However, current evidence is insufficient regarding the regimen and duration of dual antiplatelet therapy (DAPT) after PCI of the LM bifurcation. The diagnosis at admission, assessment of the bleeding risk, and stenting strategy should be taken into account in determining the DAPT regimen and duration [11].

Our study had several limitations. It was underpowered, with a small sample size and no comparison group, which limits the ability to draw firm conclusions. The decision to perform additional PCI to the SB following crossover stenting was at the discretion of the operator. Coronary physiological assessment was never utilized for the purpose of evaluating the severity of the SB subsequent to crossover stenting. Finally, intracoronary imaging guidance by IVUS, a proven method to improve the outcomes of LM PCI, was infrequent in our study.

Conclusion

One-stent crossover approach for LM bifurcation lesions is associated with very good clinical outcomes.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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Research Article

A new surgical method for the correction of unilateral alar base retraction

Tek taraflı alar taban retraksiyonunun düzeltilmesinde yeni bir cerrahi yöntem

Oguzhan Oguz*[1], Agah Yeniceri[2]

[1]Dr. Oğuzhan Oğuz Wellnose Clinic, Istanbul, Turkey
[2]Department of Otorhinolaryngology, Ministry of Health Ankara Bilkent City Hospital, Cankaya, Turkey

Abstract

Aim: Alar base retraction is a challenging deformity to correct, and various approaches have been suggested for fixing it with or without other nasal cone deformities. We focus on the surgical techniques for correcting unilateral alar base retraction, reporting their principles, applicability, and complications, and presenting our new method.

Material and Methods: Several established methods are available to correct alar base retraction, including conchal cartilage margin grafting, non-excisional suture techniques, excisional suture techniques, and tissue rearrangement, which can be used alone or in combination Whether utilizing a closed technique or an open technique, we access underneath the periosteum through a small gingival incision made at the level of the canine tooth, and we release the soft tissue by detaching the periosteum from the bone while remaining lateral to the nares. Elevation merges with the elevation of the nasal bone periosteum. The mucosa is sutured using a single stitch.

Results: This new technique avoids the major pitfalls of traditional methods, with excellent results and high patient satisfaction. A total of 55 patients were enrolled in this study, and all completed the follow-up. Based on data before and after the operation, clinical outcomes showed significant differences in nostril height (especially on the surgical side compared to the non-surgical side), columellar length, nasolabial angle, and patient satisfaction.

Conclusion: Many methods are applicable for correcting alar base retraction, but complete correction without relapse is challenging. New surgical procedures must be developed based mainly on underlying causative factors, alar medialization capabilities without tissue trimming, and strong nasal base support that avoids potential problems, such as limited alar base widening or dislocation of alar base manipulating techniques. These principles do not interfere with or contradict any previous methods. Still, they are instead intended to build upon them and contribute to newer and more standardized results with less relapse. The context of the present techniques will help to understand and give a more concrete idea of comprehension for the newer methods.

Keywords: Alar retraction, Alar base retraction, Nasal deformity

Corresponding author*: Oguzhan Oguz, Dr. Oğuzhan Oğuz Wellnose Clinic, Istanbul, Turkey
E-mail: oguzhanoguz2023@outlook.com
Orcid: 0009 0002 7019 1386
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Öz

Amaç: Alar taban retraksiyonu düzeltilmesi zor bir deformitedir. Alar taban retraksiyonunu düzeltmek için çeşitli yaklaşımlar önerilmiştir. Tek taraflı alar taban retraksiyonunun düzeltilmesi için kullanılan cerrahi teknikler, bunların prensipleri, uygulanabilirliği ve komplikasyonlarını değerlendirmeyi ve yeni yöntemimizi sunmayı amaçladık.

Gereç ve Yöntemler: Alar baz retraksiyonunu düzeltmek için konkal kıkırdağı greft ile desteklemek, eksizyonel olmayan sütür teknikleri, eksizyonel sütür teknikleri ve dokuların yeniden düzenlenmesi dahil olmak üzere tek başına veya kombinasyon halinde kullanılabilen çeşitli yöntemler tanımlanmıştır. Yöntemimiz açık veya kapalı teknik kullanılarak yapılabilir. Kanin dişi seviyesinde yapılan küçük bir dişeti kesisinden, periostun altına ulaşıyoruz ve burun kenarında, periostu, kemikten ayırarak üzerindeki yumuşak dokuyu serbestleştiriyoruz. Elevasyonu, nazal kemik periostunun elevasyonuna kadar ilerletiyoruz. Mukozayı tek bir dikiş kullanılarak dikerek işlemi tamamlıyoruz.

Bulgular: Bu yeni tekniğin, mükemmel sonuçlar ve yüksek hasta memnuniyeti ile geleneksel yöntemlerden daha başarılı sonuçlar verdiği gösterilmiştir. Bu çalışmaya toplam 55 hasta dahil edildi ve hepsi ameliyat sonrası takibi tamamladı. Ameliyat öncesi ve sonrası ölçümler karşılaştırıldığında, burun deliği yüksekliği (özellikle cerrahi tarafta, cerrahi olmayan tarafa kıyasla), kolumellar uzunluk, nazolabial açı önemli farklılıklar gösterdi.

Sonuç: Alar taban retraksiyonunu düzeltmek için birçok yöntem uygulanabilir, ancak nüks olmaması ve tam düzeltme elde etmek zordur. Esas olarak altta yatan nedene yönelik, doku rezeksiyonu olmadan alar medializasyon ve sınırlı alar taban genişletme yapılmalıdır. Geliştirilen yeni cerrahi prosedürler, önceki yöntemleri daha iyileştirmeli veya destek olmalıdır.

Anahtar Kelimeler: Alar Retraksiyon, Alar Baz Retraksiyonu, Alar taban

Introduction

Alar base retraction is a challenging deformity to correct, and various approaches have been suggested for correcting alar base retraction with or without other nasal cone deformities. We focus on the surgical techniques for correcting unilateral alar base retraction, reporting their principles, applicability, and complications, and presenting our new method. Unilateral alar base retraction can significantly impact a patient's quality of life. The depression of the affected alar base and nasolabial region can severely affect the patient's appearance. Current treatments for alar base retraction include implanting various materials to elevate the retracted alar base, repairing cartilage attachment, advancing alar base flaps, using filler injections and botulinum toxins, and repositioning the nasal tip. Regardless of the treatment method, the outcome is tied to the degree of improvement in clinical symptoms. However, clinical data and experience indicate that these commonly used methods for this condition have limitations, including minimal effects, loss of effectiveness, and the risk of infections, crusting, fibrosis, and more. Consequently, most patients require additional treatment to enhance the final clinical outcome. It is essential to develop a new, practical clinical approach to treat alar base retraction to overcome the limitations of these previous closed surgical procedures. [1,2,3]

This study aimed to visualize a new, innovative technique for treating unilateral alar base retraction and to apply this method. The primary outcome of interest was increased patient satisfaction and improved appearance after treatment compared to conventional correction. Notably, the assessment of alar stance was of particular interest. [2,3,4]

The alar base in rhinoplasty is a critical anatomical area that significantly impacts the aesthetic appearance of the nose due to its close contact with the mid-aspect of the philtrum laterally and its deep relationship to the nostril floor. In the area of the alar base, two large striated muscles, the zygomaticus minor muscle laterally and the levator labii superioris alaeque nasi cranially, pass from inside the nose to the upper nasomaxillary area, carrying the perinasal soft tissue over it. These striated muscles are followed caudally by the alar cartilages, the only structural elements of the alae of the nose. Unilateral alar base retraction is mainly visible in clinical pictures. As for etiology, it is assumed that both developmental and physical trauma processes are effective. The retraction causes asymmetry in the nasal valve, a decrease in nasal function, and aesthetic impairment due to the reduction of the nasal airway and the caudal movement of the alar side to the other side. [5,6]

Understanding the relationship of the skin, subcutaneous

tissue, skin muscle fascia, alar cartilage, lateral crus, medial crus, nostril sill, and vestibular skin is essential to understanding the retraction of the alar base. Therefore, we must take a general view of the anatomy of the alar base. For effective treatment, it is necessary to understand how the structures of the alar base are implicated by pathology. All these interactions are essential to address the disease effectively. Therefore, the relationship between the structures of the alar base and the causes of retraction is very complex. From this point of view, this ratio is to be tried to be solved anatomically. Because the nature of the issue does not allow us to deal with pathology alone. In short, we have an interdisciplinary relationship between anatomy, pathology, and surgical methods. [7,8]

In this study, we developed an innovative surgical method to correct alar base retraction more effectively and safely. We have found that most current treatment methods have some limitations and side effects that will unsatisfactorily influence the clinical effect.

Material and Methods

A total of 55 patients were enrolled in this study, and all completed the follow-up. Based on data before and after the operation, clinical outcomes showed significant differences in nostril height (especially on the surgical side compared to the non-surgical side), columellar length, nasolabial angle, and patient satisfaction.

Technique

The technique aims to correct unilateral alar retractions from the opposite view without interfering with the mimic muscles and minimizing damage to the soft tissues. Whether utilizing a closed technique or an open technique, we access underneath the periosteum through a small gingival incision made at the level of the canine tooth, and we release the soft tissue by detaching the periosteum from the bone while remaining lateral to the nares. (Figure 1,2) Elevation merges with the elevation of the nasal bone periosteum. The mucosa is sutured using a single stitch. Following the post-operative elevation, there may be some downward drop on the adhering side. It is a simple and effective surgical method. And it has a very low complication rate. The only complication was upper lip swelling that lasted about two weeks in some patients.

Two ENT specialists, other than the authors, who didn't know the surgeon and the applied method, evaluated the procedure's success through the preoperative and postoperative photos.

Figure 1: Planning the elevation of the soft tissue by detaching the periosteum from the bone while remaining lateral to the nares.

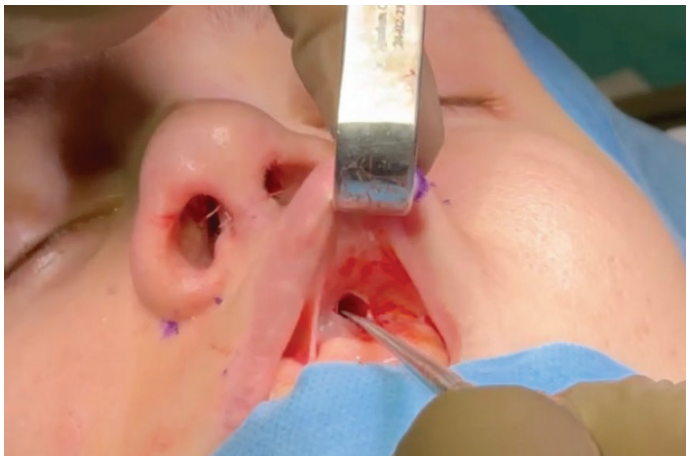

Figure 2: Access underneath the periosteum through a small gingival incision made at the level of the canine tooth

The same procedure can be performed endonasally, but it is not advisable because it excludes the vestibule skin and mucosa, which can cause soft tissue trauma and potential valve issues. Furthermore, the nares (Webster's triangle) are retracted laterally during the intraoral approach.

Results

This series of 55 patients included 19 males and 36 females—38 with left-sided ABR and 17 with right-sided ABR. The length of follow-up ranged from 8 to 25 months. A senior member of the surgical team and each patient independently rated the nasal profile as satisfactory or very satisfactory in all cases, in addition to being pleased with the degree of elevation. Furthermore, the minimally invasive technique was reflected in the low agreement on all points, with patient recovery being rated as either satisfactory or very satisfactory.

Surgical treatment generally does not require lengthy recovery

because incisions do not extend into the nasal vestibule. A 3-week waiting time is recommended between treating the alar base and the tip of the nose. The time necessary to correct an additional functional or aesthetic defect is relative and varies depending on the cause and type. No complications were observed in the cases discussed above. Still, complications that could be expected are bleeding during surgery and hematomas, which were not observed at any time during the study follow-up.

These data suggest that the proposed technique has great potential to improve the quality of life for patients affected by unilateral retraction of the alar base.

A potential disadvantage of these techniques is that new incisions are made, which increases the recovery period and might result in additional scar formation. Our described surgical technique offers significant advantages over existing methods for the following reasons: This new technique avoids the major pitfalls of traditional techniques, with excellent results and high patient satisfaction (figure3 -5).

Figure 3A-B: Preoperative and Postoperative views of a female patient

Figure 4A-B: Preoperative and Postoperative views of a female patient

Figure 5A-B: Preoperative and Postoperative views of a male patient

Discussion

Several established methods are available to correct alar base retraction, including conchal cartilage margin grafting, non-excisional suture techniques, excisional suture techniques, and tissue rearrangement, which can be used alone or in combination. Many methods exist for correcting alar base retraction, but achieving complete correction without relapse remains challenging. New surgical procedures should be developed primarily based on underlying causative factors, alar medialization capabilities without tissue trimming, and robust nasal base support that prevents potential issues, such as limited alar base widening or dislocation from alar base manipulation techniques. These principles do not contradict any previous methods. Instead, they aim to build upon them and contribute to newer, more standardized results with reduced relapse. Understanding the context of the current techniques will provide a clearer understanding of the newer methods. [9,10]

A new surgical method for correcting unilateral alar base retraction has been developed. This technique fundamentally differs from the existing techniques for the correction of alar base retraction in terms of the use of the graft and the design of the dissection area. The limitations of conventional techniques include recurrent alar retraction, technical errors, visually speculative results rather than functional results, the possibility of acute traction side effects on the alar margin, an extended learning or adaptation period for the new technique, and the high cost. In contrast, the goal of the developed method is to minimize the disadvantages and limit the invasiveness of incision, flap, and suture.

Conclusions

A new surgical procedure is presented in two perspectives: function and aesthetic outcome. This new surgical method for correcting unilateral alar base retraction has been developed in the process of convergence with the development of polishing or direct surgical implementation using surgical instruments and grafting. The desired result of the surgery is to significantly reduce the physical deformity through less invasive dissection and suturing, with the expected outcome being the improvement of patient satisfaction. [11,12]

We have developed a new surgical technique that offers a variety of advantages over existing methods. To conclude our discussion, we compare our techniques to those detailed. A traditional method for the correction of alar base retraction is the use of only tip contour grafts. The use of a dissection technique in the revision settings of bilateral alar base retraction has been described. The case series highlighted using an alar rim onlay graft in conjunction with an alar rim repositioning flap to correct bilateral alar base retraction. From the analysis, it is recommended that the primary use of the technique be before using a secondary procedure. [13,14]

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Research Article

Stage II-III colorectal cancer in geriatric patients: Clinicopathological features and chemotherapy utilization

Geriyatrik hastalarda evre II-III kolorektal kanser: Klinikopatolojik özellikler ve kemoterapi kullanımı

Yakup Duzkopru*[1], Ozlem Dogan[2]

[1]Aksaray Training and Research Hospital, Medical Oncology, Aksaray, Turkey

[2]Adıyaman Training and Research Hospital, Medical Oncology, Adıyaman, Turkey

Abstract

Aim: This study aims to assess the clinicopathological characteristics, treatment patterns, and survival outcomes of geriatric patients with stage II-III colorectal cancer.

Material and Methods: This retrospective study included 99 geriatric patients (aged ≥65 years) diagnosed with stage II-III colorectal cancer at a single center from 2020 to 2024. Clinical and pathological characteristics, treatment approaches, and survival outcomes were assessed.

Results: The median age at diagnosis was 73 years, and 63.6% of patients were male. Adjuvant chemotherapy was administered to 86.9% of patients, with a significantly higher rate in stage III cases compared to stage II (91.3% vs. 58.5%, $p < 0.001$). Capecitabine-based therapy was the most frequently used chemotherapy regimen. Surgical resection achieved negative margins in 97.9% of cases, with right hemicolectomy being the most frequently performed procedure (54.5%). The median recurrence-free survival (RFS) was 20 months, and recurrence or metastasis occurred in 20.2% of patients, with the liver being the most frequent metastatic site. Treatment-related toxicity was observed in 53.5% of patients, leading to chemotherapy discontinuation in six cases.

Conclusion: Adjuvant chemotherapy was more frequently administered in stage III patients, in line with current treatment guidelines. Differences in chemotherapy regimens between stage II and III patients underscore the importance of personalized treatment strategies in the geriatric population. Further research is required to optimize treatment decisions and improve clinical outcomes in this vulnerable group.

Keywords: colon cancer, colorectal cancer, geriatrics, adjuvant chemotherapy

Corresponding Author*: Yakup Duzkopru, Aksaray Training and Research Hospital, Medical Oncology, Sanayi, Tacin Street, 68200 Aksaray, Türkiye
E-mail: y_duzkopru@hotmail.com
Orcid: 0000-0003-2314-5870
Doi: 10.18663/tjcl.1647734
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Öz

Amaç: Bu çalışma, evre II-III kolorektal kanser tanısı almış geriyatrik hastaların klinikopatolojik özelliklerini, tedavi yaklaşımlarını ve sağkalım sonuçlarını değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, 2020-2024 yılları arasında tek bir merkezde evre II-III kolorektal kanser tanısı almış ve yaşı ≥65 olan 99 geriyatrik hasta dahil edilmiştir. Klinik ve patolojik özellikler, tedavi yaklaşımları ve sağkalım sonuçları değerlendirilmiştir.

Bulgular: Tanı anındaki medyan yaş 73 yıl olup, hastaların %63,6'sı erkekti. Adjuvan kemoterapi, hastaların %86,9'una uygulanmış olup, evre III hastalarda evre II hastalara kıyasla belirgin şekilde daha yüksek oranda uygulanmıştır (sırasıyla %91,3 ve %58,5, $p < 0,001$). En sık kullanılan kemoterapi rejimi kapesitabin bazlı tedaviydi. Cerrahi rezeksiyon yapılan hastaların %97,9'unda negatif cerrahi sınır elde edilmiş, en sık uygulanan prosedür sağ hemikolektomi (%54,5) olmuştur. Medyan nükssüz sağkalım (RFS) süresi 20 ay olup, hastaların %20,2'sinde nüks veya metastaz gelişmiş, en sık karaciğer metastazı gözlenmiştir. Tedaviye bağlı toksisite %53,5 oranında rapor edilmiş olup, altı hastada ciddi yan etkiler nedeniyle kemoterapi bırakılmıştır.

Sonuç: Adjuvan kemoterapi, evre III hastalara daha sık uygulanmış ve bu durum mevcut tedavi kılavuzları ile uyumludur. Evre II ve III hastalar arasındaki kemoterapi rejimi farklılıkları, geriyatrik popülasyonda kişiselleştirilmiş tedavi stratejilerinin önemini vurgulamaktadır. Bu hassas hasta grubunda tedavi kararlarını optimize etmek ve klinik sonuçları iyileştirmek için daha fazla araştırmaya ihtiyaç vardır.

Anahtar kelimeler: kolon kanseri, kolorektal kanser, geriatri, adjuvan kemoterapi

Introduction

Colorectal cancer (CRC) is one of the most commonly diagnosed malignancies worldwide and remains a leading cause of cancer-related mortality[1, 2]. With advancements in healthcare and increased life expectancy, the incidence of colon cancer among elderly populations has risen significantly[3]. Patients aged 65 and older constitute a substantial proportion of newly diagnosed CRC cases, necessitating tailored treatment strategies that consider age-related physiological changes, comorbidities, and treatment tolerability[4].

Surgical resection remains the cornerstone of treatment for localized colorectal cancer. However, the role of adjuvant chemotherapy in elderly patients, particularly in stage II and III disease, is still a topic of debate[5]. Recent studies have explored the impact of adjuvant therapy on overall survival (OS) and disease-free survival (DFS) in older adults. While some reports suggest a clear survival benefit with adjuvant chemotherapy, others highlight increased toxicity risks and the potential for overtreatment in frail patients[6, 7].

The decision to administer adjuvant therapy in elderly patients should be individualized based on tumor characteristics, functional status, and life expectancy. However, limited representation of older adults in clinical trials has led to uncertainties in treatment guidelines[6]. In this study, we aimed to analyze the clinicopathological characteristics and treatment preferences of geriatric patients with stage II-III colorectal cancer.

Material and method

Patients aged 65 years and older who were diagnosed with colorectal cancer at our hospital's oncology clinic between 2020 and 2024 were included in this study. Eligible patients were those over 18 years of age, with a histopathologically confirmed diagnosis, who underwent surgery and were classified as stage II or III based on pathological staging. Patients who were clinically staged but did not undergo surgery, had a second primary tumor, were classified as stage I or metastatic, or had incomplete data were excluded. A total of 142 patients were screened, and 99 patients meeting the inclusion criteria were enrolled in the study.

The pathological characteristics of the enrolled patients, their administered treatments, dates of recurrence or metastasis, and the last follow-up dates were recorded. The duration from the date of diagnosis to the last follow-up or death was considered overall survival (OS). The time from diagnosis to the first recurrence or metastasis was defined as recurrence-free survival (RFS).

Statistical analyses were conducted using IBM SPSS Statistical Software (SPSS 22.0, IBM Corp.). The clinical and demographic characteristics of the patients were presented using descriptive statistics. Categorical and numerical variables were expressed as frequency and percentage (n, %). DFS and OS were calculated using the Kaplan-Meier method. Hazard ratios (HR) and 95% confidence intervals (CI) were calculated using the Cox regression model. A p-value < 0.05 was considered statistically significant for all analyses.

The study received ethical approval from our hospital's ethics committee(no:2025/54), and the study protocol was conducted in accordance with the 1964 Helsinki Declaration.

Results

A total of 99 geriatric patients diagnosed with stage II-III colorectal cancer were included in the study. The median age of the cohort was 73 years (68–78 years, min-max). The gender distribution was 36.4% female and 63.6% male. 40.4% of patients had a history of smoking, and 23.2% had a family

history of malignancy. The clinicopathological characteristics of the patients are presented in Table 1.

Table 1. Clinicopathological characteristics of 99 geriatric colorectal cancer patients

Features	Frequency n(%)
Age (median, range)	73 (65-91)
Gender	
Female	36 (36,4)
Male	63 (63,6)
ECOG PS	
0-1	75 (75,8)
2-3	24 (24,2)
Family history of cancer	
No	76 (76,8)
Yes	23 (23,2)
Smoking	
No	59 (59,6)
Yes	40 (40,4)
Stage	
T3N0M0	41 (41,4)
T4N0M0	12 (12,1)
T3N1M0	20 (20,2)
T4N1M0	12 (12,1)
T3N2M0	10 (10,1)
T4N2M0	4 (4)
Adjuvant chemotherapy	
No	26 (26,3)
FOLFOX/CAPEOX	38 (38,4)
Capecitabine/FUFA	35 (35,4)
Diferantiation	
Well	17 (17,2)
Moderate	69 (69,7)
Poorly	13 (13,1)
Surgery	
Elective	71 (71,7)
Emergency	28 (28,3)
Surgical margin	
Positive	8 (8,1)
Negative	91 (91,9)
Tumor location	
Right colon	27 (27,3)
Left colon	48 (48,5)
Rectum	24 (24,2)
Lenfovascular invasion	
Yes	31 (31,3)
No	68 (68,7)
Perinoral invasion	
Yes	27 (27,3)
No	72 (72,9)
Site of metastasis	
Local	4 (20)
Liver	7 (35)
Lung	4 (20)
Lymph node	4 (20)
Periton	1 (5)

ECOG PS: Eastern Cooperative Oncology Group Performance Status

The most common tumor stage was T3N0M0 (41.4%), followed by T3N1M0 (10.1%). Adenocarcinoma was the predominant histological subtype (91.9%), with mucinous adenocarcinoma accounting for 6.1% of cases. Lymphovascular invasion (LVI) was present in 68.7% of cases, while perineural invasion (PNI) was detected in 72.7%.

A significant difference was observed between stage II and stage III patients regarding adjuvant therapy administration rates($p<0.01$), the selection of adjuvant chemotherapy regimens($p<0.01$), the presence of perineural invasion (PNI) (p: 0.04) and lymphovascular invasion (LVI) (p: 0.04). The comparison of clinical and pathological features between stage II and stage III patients is presented in Table 2.

Table 2. Comparison of Clinical and Pathological Features Between Stage II and Stage III Patients

	Stage II (n,%)	Stage III (n,%)	P Value
Gender			
Male	31 (58,5)	32 (69,6)	0.253
Female	22 (41,5)	14 (30,4)	
Adjuvant chemotherapy			
No	22 (41,5)	4 (8,7)	
Yes	31 (58,5)	42 (91,3)	<0.001
Chemotherapy regimen			
Capecitabine	22 (42,5)	13 (28,2)	
FOLFOX	5 (9,4)	17 (37)	<0.001
CAPEOX	4 (7,5)	12 (26,1)	
No treatment	22 (41,5)	4 (8,7)	
Surgical margin			
Positive	2 (3,8)	6 (13)	0.091
Negative	51 (96,2)	91 (91,9)	
ECOG PS			
0-1	42 (79,2)	33 (71,7)	0.385
2-3	11 (20,8)	13 (28,3)	
Perinoral invasion			
Positive	10 (18,9)	17 (37)	0.044
Negative	43 (81,1)	29 (63)	
Lymphovascular invasion			
Positive	12 (22,6)	19 (41,3)	0.046
Negative	41 (77,4)	27 (58,7)	
Tumor location			
Right	14 (26,4)	13 (28,3)	0.863
Left	27 (50,9)	21 (45,7)	
Rectum	12 (22,6)	12 (26,1)	
Recurrence/metastasis			
No	43 (81,1)	32 (69,6)	0.180
Yes	10 (18,9)	14 (30,4)	

ECOG PS: Eastern Cooperative Oncology Group Performance Status

All patients underwent surgical resection, with negative surgical margins achieved in 97.9%. The most common surgical approach was right hemicolectomy (54.5%). Adjuvant chemotherapy was administered to 86.9% of patients, predominantly using capecitabine-based regimens. Additionally, 19.7% of patients received neoadjuvant chemoradiotherapy.

The median follow-up duration was 23 months (14–33 months). The median RFS was 20 months (11–31.5 months). Local or distant recurrence was observed in 20.2% of patients, with the liver being the most common site of metastasis.

Among patients receiving chemotherapy, 53.5% experienced treatment-related toxicity, including neutropenia, diarrhea, mucositis, and fatigue. 6 patients discontinued chemotherapy due to severe adverse effects.

Discussion

In our study, the median age at diagnosis was 73 years. A previous prospective study involving patients aged 65 years and older with colon cancer reported a similar median age at diagnosis of 72 years [8]. In our cohort, 63.6% of patients were male, which is comparable to other studies evaluating geriatric patients with colon cancer, where the male patient proportion was reported as 57.2% and 56.9%, respectively [9, 10]. Additionally, the proportion of patients with an Eastern Cooperative Oncology Group Performance Status (ECOG PS) of 0–1 was 79.2% in our study, aligning with findings from a Dutch study evaluating patients over 75 years of age, in which 70% of patients had a good ECOG PS[11]. These results are consistent with the existing literature.

In our study, only 26.4% of tumors were located in the right colon. Similarly, a population-based study conducted in Italy by Maffei et al. reported that 34.6% of tumors in the 65–79 age group were located in the right colon. However, studies conducted in Korea and France found higher rates of right-sided colon tumors (43.5% and 51.6%, respectively) [10, 12, 13].

The findings of our study demonstrate significant differences in adjuvant therapy administration, chemotherapy regimen selection, and pathological characteristics between stage II and III geriatric colorectal cancer patients. The higher rate of adjuvant chemotherapy administration in stage III patients (91.3% vs. 58.5%, $p < 0.001$) is consistent with prior studies indicating that adjuvant treatment is more strongly recommended for this group due to their increased recurrence risk[14, 15]. However, for high-risk stage II patients, the benefits of adjuvant therapy remain a topic of debate, given the risks of toxicity and limited clinical trial data[5].

Comparison with existing literature reveals similar trends in chemotherapy regimen selection, with oxaliplatin-based regimens being more frequently administered to stage III patients, while a significant proportion of stage II patients either received capecitabine monotherapy or did not receive chemotherapy. These findings align with previous studies suggesting that elderly patients have increased susceptibility to chemotherapy-related toxicity, leading to a preference for fluoropyrimidine monotherapy over combination regimens[14, 15].

Additionally, our study found significantly higher rates of PNI and LVI in stage III patients, confirming their role as key prognostic factors associated with poorer outcomes[7, 10, 14]. The recurrence/metastasis rate was higher in stage III patients, though not statistically significant, which aligns with studies highlighting the aggressive nature of advanced-stage disease[6].

In the aforementioned prospective Korean study, the majority of patients (78%) received oxaliplatin-based adjuvant chemotherapy, whereas in our study, only 52% of patients who underwent chemotherapy received oxaliplatin-based regimens[8]. A pooled analysis of four different studies demonstrated that the addition of oxaliplatin to chemotherapy significantly improved OS. However, this benefit was found to be more limited in patients aged 70 years and older and was associated with increased toxicity. These findings highlight the need for careful risk-benefit assessment when considering oxaliplatin-based regimens in elderly patients, given their heightened susceptibility to treatment-related adverse effects[16].

Several limitations should be considered when interpreting our findings. First, this was a retrospective, single-center study, which may limit the generalizability of the results. Second, although we analyzed key prognostic factors such as PNI and LVI, comorbidity indices and functional status assessments were not included, which could have provided further insight into treatment decision-making. Finally, the follow-up duration may not have been sufficient to capture long-term survival outcomes and late toxicities associated with adjuvant therapy.

Conclusion

This study provides insights into the clinicopathological characteristics and treatment patterns of geriatric patients with stage II-III colorectal cancer. Adjuvant chemotherapy was more frequently administered to stage III patients, consistent with current treatment guidelines. Differences in chemotherapy regimen selection between stage II and III patients highlight the importance of individualized treatment decisions in the elderly. Despite the retrospective nature of the study, these findings contribute to existing knowledge and emphasize the need for further research to optimize treatment approaches in this population

Ethics Approval

The study received ethical approval from Aksaray University ethics committee (number: 2025/54), and the study protocol was conducted in accordance with the 1964 Helsinki Declaration.

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Conflict of interest

The authors declare that they do not have a conflict of interest and no funding was received for this study.

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Research Article

Effects of neoadjuvant and adjuvant chemotherapy on survival in muscle-invasive bladder cancer: A multicenter study

Kas-İnvaziv mesane kanserinde neoadjuvan ve adjuvan kemoterapinin sağkalım üzerine etkinliği: Çok merkezli çalışma

Nargiz Majidova*[1], Ahmet Emin Ozturk[2], Rumeysa Colak[3], Ozge Yalıcı[4], Mehmet Cihan İçli[5], Barıs Koksal[5], Murat Arcagok[6], Sevdenur Taşkın Kurşun[7], Yaprak Cağlar[7], Ali Kaan Guren[7], Erkam Kocaaslan[7], Pınar Erel[7], Yesim Agyol[7], Nadiye Sever[7], Abdussamet Celebi[7], Rukiye Arikan[7], Selver Isik[7], Ibrahim Vedat Bayoglu[7], Osman Kostek[7], Selçuk Şeber[4], Zuhat Urakçı[6], Murat Sarı[7]

[1]Division of Medical Oncology, VM Medical Park Maltepe Hospital, Istanbul, Turkey.

[2]Department of Internal Medicine, Division of Medical Oncology, Professor Dr Cemil Tascıoglu City Hospital, Health Science University, Istanbul, Turkiye

[3]Department of Internal Medicine, Division of Medical Oncology Bakirkoy Dr Sadi Konuk Training and Research Hospital, Istanbul, Turkey

[4]Department of Internal Medicine, Division of Medical Oncology, Tekirdag Namik Kemal University, Tekirdag, Turkey

[5]Department of Internal Medicine, Division of Medical Oncology, Hacettepe University Cancer Institute, Ankara, Turkey

[6]Department of Internal Medicine, Division of Medical Oncology, Dicle University School of Medicine, Diyarbakır, Turkey

[7]Department of Internal Medicine, Division of Medical Oncology, Marmara University School of Medicine, Istanbul, Turkey

Abstract

Aim: Muscle-invasive bladder cancer requires systemic treatment due to its high risk of metastasis. However, studies comparing neoadjuvant and adjuvant therapy regimens are currently limited. Our goal in this study was to compare the treatment efficacy of patients receiving neoadjuvant or adjuvant treatment in locally advanced bladder cancer.

Material and Methods: We retrospectively included 107 bladder cancer patients from 6 centres who underwent radical cystectomy and received perioperative chemotherapy. Patients were divided into 2 categories: (i) neoadjuvant chemotherapy (n=54) and (ii) adjuvant chemotherapy (n=53).

Results: Median follow-up was 31.6 months (95%CI 21.8-41.4). 30-month disease-free survival (DFS) was 58.9% in the whole group, 56.3% in neoadjuvant and 61.5% in adjuvant. 30-month DFS after neoadjuvant treatment was 70.1% in <pT2N0 and 41.1% in ≥pT2, according to substaging. After neoadjuvant treatment, 30-month DFS was 85.7% and 45.9% in the pathologic complete response (CR) and non-CR group, respectively. 30-month overall survival (OS) was 69.8% in the whole group, 71.7% in neoadjuvant and 68.2% in adjuvant. This rate in patients with neoadjuvant downstaging was 81.4% and 62% in the <pT2N0 and ≥pT2 groups, respectively. At the same time, 30-month OS in the pathologic CR and non-CR group was 100% and 62.6%, respectively.

Conclusion: In patients with locally advanced bladder cancer who show a pathologically complete response to neoadjuvant chemotherapy, it is important to be evaluated in a multidisciplinary consultation in order to give cisplatin-based treatment before surgery since it has a significant contribution in terms of both DFS and OS.

Keywords: Bladder cancer, neoadjuvant chemotherapy, radical cystectomy, adjuvant chemotherapy, outcome analysis

Corresponding author: Nargiz Majidova, Division of Medical Oncology, VM Medical Park Maltepe Hospital, Istanbul, Turkey
E-mail: nergiz.mecidova1991@gmail.com
Orcid: 0000-0002-2575-5819
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Öz

Amaç: Kasa invaze mesane kanserinin tedavisinde yüksek metastaz riski nedeniyle sistemik tedavi önerilmektedir. Neoadjuvan veya adjuvan tedaviyi karşılaştıran yeterli çalışma olmaması nedeniyle bu çalışmada amacımız lokal ileri evre mesane kanserinde neoadjuvan veya adjuvan tedavi alan hastaların tedavi etkinliğini karşılaştırmaktır.

Gereç ve Yöntemler: Radikal sistektomi yapılan ve perioperatif kemoterapi alan 6 merkezden 107 mesane kanseri hastası retrospektif olarak çalışmaya dahil edildi. Hastalar 2 kategoriye ayrıldı: (i) neoadjuvan kemoterapi (n=54) ve (ii) adjuvan kemoterapi (n=53). Ortanca takip süresi 31.6 aydı (%95CI 21.8-41.4). 30. ay hastalıksız sağkalım oranı (HSO) tüm grupta %58.9, neoadjuvanda %56.3 ve adjuvanda %61.5 idi. Neoadjuvan tedavi sonrası 30.ay HSS evrelemeye göre <pT2N0'da %70.1 ve ≥pT2'de %41.1 idi. Neoadjuvan tedavi sonrasında, 30.ay HSO patolojik tam yanıt (TY) ve TY olmayan grupta sırasıyla %85,7 ve %45,9 idi. 30.ay genel sağkalım oranı (GSO) tüm grupta %69,8, neoadjuvanda %71,7 ve adjuvanda %68,2 idi. Neoadjuvan tedavi ile evre gerilemesi olanlarda<pT2N0 ve ≥pT2 gruplarında 30.ay GSO sırasıyla %81.4 ve %62.0 idi. Aynı zamanda, patolojik TY ve TY olmayan grupta 30.ay GSO sırasıyla %100 ve %62.6 idi.

Sonuç: Neoadjuvan ve adjuvan kemoterapi, kas-invaziv mesane kanseri tedavisinde sağkalımı önemli ölçüde etkileyen yaklaşımlardır. Patolojik tam yanıt ve sisplatin bazlı rejimler, daha iyi sağkalım sonuçları ile ilişkilidir. Bu bulgular, tedavi planlamasında patolojik tam yanıtın ve rejim seçiminin önemini vurgulamaktadır ve tedavi kararı multidispliner olarak verilmelidir.

Anahtar Kelimeler: mesane kanseri, neoadjuvan kemoterapi, radikal sistektomi, adjuvan kemoterapi, sağkalım sonuçları

Introduction

Bladder cancer (BC) is the fourth most prevalent cancer among all new cases of cancer in men, with a prevalence three times higher than in women, according to recent statistics (1). The histopathological diagnosis of the patients is urothelial carcinoma with a rate of 90% (2). When the tumour invades the detrusor muscle, it is called muscle-invasive bladder cancer. The primary method of treatment is surgery, which includes pelvic lymph node dissection and radical cystectomy (RC). However, it's important to recall that 50% of patients have micro-metastases, which increase the risk of metastasis to distant organs and intra-abdominal lymph nodes. As a result, current guidelines suggest that systemic treatment should be considered in addition to local treatment at this stage (clinically T2) (3).

Systemic therapies can be administered as neoadjuvant (NAC) or adjuvant (AC) treatment from T2 clinically in non-metastatic bladder cancer. According to current treatment guidelines, adjuvant treatment should consist of platinum plus gemcitabine therapy and immunotherapy in selected patients. While studies have shown that AC contributes to DFS, no significant contribution to OS has been observed (4). However, it is important to note that serious complications after RC can delay AC for an average of 3 months in 30% of patients. Moreover, it has been observed that the risk of distant metastasis increases when AC is administered after 8 weeks (5). Therefore, it is recommended that NAC be administered whenever possible. While several studies have demonstrated that adjuvant platinum-based chemotherapies can enhance DFS, no improvement in OS has been observed (6).

The benefits of neoadjuvant treatment are to provide systemic control of the disease, to reduce the clinical and radiological stage, and to observe in-vivo treatment efficacy. Neoadjuvant treatment is also known to contribute to survival in bladder cancer (7). In the trial comparing the neoadjuvat regimen of vinblastine, doxorubicin, cisplatin, and methotrexate (MVAC) with surgery alone, the median overall survival in the NAC arm was 77 months, representing a two-fold increase compared to surgery alone. In addition, the pathological complete response (CR) rate is 38% (8). However, MVAC treatment is not a regimen that we actively use because of its haematological and gastrointestinal side effects. Phase 3 data for this regimen is not available and is mostly used based on metastatic disease data. In 40-67% of cases who underwent surgery alone without neoadjuvant treatment, pT3-T4a or lymph node positivity is observed, and 5th year survival is 25-30% (7). There is not a significant difference in the pathological CR rate between the cisplatin and gemcitabine with MVAC regimen compared to other studies that used NAC choosing. However, pathological complete response rate and survival results are more negative with gemcitabine and carboplatin (9).

In light of this information, our aim in this study was to compare the clinical efficacy of neoadjuvant and adjuvant

treatments in bladder cancer and to evaluate the parameters affecting survival.

Material and Methods

Patient characteristics

In our study, we included 107 patients with locally advanced bladder cancer, aged over 18 years, from six centers, who were followed between 2008 and 2023 at medical oncology clinics.

Patients with non-muscle-invasive bladder cancer who did not receive systemic chemotherapy (neoadjuvant or adjuvant) were excluded from the study. All patients received cisplatin-based treatment as neoadjuvant therapy. However, carboplatin was given to patients for whom cisplatin was ineligible (ECOG performance stats of > 1; creatine clearance less than 30 ml/min; grade 2 or greater peripheral neuropathy etc.) for adjuvant treatment.

Data on age at bladder cancer diagnosis, histological features of the tumor, ECOG-PS status, demographic, clinical and pathological characteristics (including gender, lymphovascular invasion, and surgical margin), treatments, and treatment response were recorded.

Follow-up time, DFS, OS data were also calculated.

The primary endpoint of DFS was defined as the time from the date of diagnosis to first progression, death, or last disease-free visit. OS was defined as the time from the date of diagnosis to death or last visit.

Every piece of data was analyzed using SPSS 23.0 software. Both univariate and multivariate analyses were conducted. In the study, results with $p<0.1$ in univariate analysis were included in multivariate analysis results. The standard deviation was represented by the symbol (±). To compare parametric variables between groups, the independent variable t test was employed. The nonparametric variables were assessed using the chi-square test. Cox Regression was used for multivariate analysis. The Kaplan-Meier test was used to analyze survival. A 95% confidence interval was assigned. A significant p-value was defined as <0.05.

This study was conducted in accordance with the principles of the Declaration of Helsinki. Approval was granted by Marmara University School of Medicine Ethics Committee dated 05.05.2023 and numbered 05.05.2023.627

Results

In this retrospective and multi-center study, 107 patients were investigated (Table 1). NAC was administered to 54 (50.4%) and AC to 53 (49.6%) patients. The median age of the patients was 63 years (IQR:39-86). In 93% of the patients, urothelial histopathology was normal. All patients underwent radical cystectomy. Table 1 also compares the demographic characteristics and treatment response of patients receiving neoadjuvant and adjuvant treatment. Perineural invasion, lymphovascular invasion and surgical margin positivity were less in the NAC group, which were statistically significant (p=0.004 vs p=0.005; p=0.02, respectively). All patients received cisplatin plus gemcitabine as NAC. Adjuvantly, 64% received cisplatin plus gemcitabine and 36% received carboplatin plus gemcitabine. The groups differed significantly in terms of the pathological T and N stages. The rate of pT0-1 was 58% in the NAC group and 6% in the AC group, and N0 was 96% vs 40%, respectively (p=0.001). In the NAC group, CR rate was 28% and pathological down-staging was 57%.

The median follow-up period of all patients was 31.6 months (95% CI 21.8-41.4). 30-month DFS was 58.9% in the whole group, 56.3% in those who received neoadjuvant treatment and 61.5% in those who received adjuvant treatment. 30-month DFS was according to down staging after neoadjuvant, <pT2N0 70.1% and 41.1% in the group with ≥ pT2. After neoadjuvant treatment, 30-month DFS was 85.7% vs 45.9% in pathological CR vs non-CR group, respectively. 30-month OS was 69.8% in the whole group, 71.7% in those receiving neoadjuvant treatment and 68.2% in those receiving adjuvant treatment. This rate in patients with neoadjuvant downstaging was 81.4% and 62% in the <pT2N0 and ≥pT2 groups, respectively. Meanwhile, 30-month OS in the pathological CR vs non-CR group was 100% vs 62.6%, respectively.

30-month OS and DFS rates are summarized in Table 2. 30-month OS was 69.8% in the whole group, 100% in the group with pathological CR and 62.6% in the non-CR group. This rate was 81.4% in the down staging (<pT2N0) group and 62% in the ≥ pT2 group. Cisplatin treatment was superior to carboplatin in both 30-month DFS and 30-month OS groups.

30-month DFS was 58.9% in the whole group, 85.7% in the group with pathological CR and 45.9% in the non-CR group. 30-month DFS was 70.1% in the down staging (<pT2N0) group and 41.1% in the ≥ pT2 group. Median DFS was 44.5 months (95% CI 23.4-65.6) in all patients. The median DFS was 25.4 months ((95% CI 5.6-45.1) in the non-CR group (p=0.02), while the median DFS was not reached in the CR group (Figure 1).

The group that achieved CR after neoadjuvant treatment had longer overall survival times than the group that received both non-CR and adjuvant treatment (Figure 2).

Tablo 1. Characteristics of patients by the treatment types				
	All (107)	NAC (54)	AC (53)	P
Age, year (median IQR)	63 (39-86)	62 (42-79)	63 (39-86)	0.350
Gender, n (%)				0.960
Female	18 (16.8)	9 (16.6)	9 (16.9)	
Male	89 (83.2)	45 (83.4)	44 (83.0)	
ECOG-PS, n (%)				0.780
0	72 (67.3)	37 (68.5)	35 (66.1)	
≥1	35 (32.7)	17 (31.5)	18 (33.9)	
Clinical T stage, n (%)				0.690
cT2	64 (59.8)	32 (59.3)	32 (60.4)	
cT3	28 (26.2)	13 (24.1)	15 (28.3)	
cT4	15 (14.0)	9 (16.6)	6 (11.3)	
Clinical N stage, n (%)				0.090
cN0	62 (57.9)	27 (50.0)	35 (66.1)	
cN+	45 (42.1)	27 (50.0)	18 (33.9)	
Clinical stage, n (%)				0.002
2	41 (38.3)	13 (24.1)	28 (52.8)	
3	66 (61.7)	41 (75.9)	25 (47.2)	
Lymphovascular invasion, n (%)				0.004
Absent	44 (41.1)	29 (53.7)	15 (28.3)	
Present	52 (48.5)	19 (35.1)	33 (62.2)	
Perineural invasion, n (%)				0.005
Absent	47 (43.9)	30 (55.5)	15 (28.3)	
Present	44 (41.1)	15 (27.7)	29 (I54.7)	
Surgical Margin, n (%)				0.020
Absent	82 (76.6)	44 (81.4)	38 (71.6)	
Present	14 (13.1)	3 (5.5)	11 (20.7)	
Treatment, n (%)				0.001
Cisplatin+gemcitabine	89 (83.1)	54 (100)	34 (64.1)	
Carboplatin+gemcitabine	20 (16.9)	0	19 (35.9)	
Pathological T stage, n (%)				0.001
pT0	14 (13.1)	14 (25.9)	0	
pT1	20 (18.7)	17 (31.4)	3 (5.7)	
pT2	22 (20.6)	11 (20.3)	11 (20.8)	
pT3	33 (30.8)	6 (11.1)	27 (50.9)	
pT4	18 (16.8)	6 (11.1)	12 (22.6)	
Pathological N stage, n (%)				0.001
pN0	73 (68.2)	52 (96.2)	21 (39.6)	
pN+	34 (31.8)	2 (3.7)	32 (60.3)	
Pathological stage, n (%)				0.001
0	15 (14.0)	15 (27.7)	0	
1	16 (15.0)	16 (29.6)	0	
2	18 (16.8)	10 (18.6)	8 (15.1)	
3	58 (54.2)	13 (24.1)	45 (84.9)	
Pathological down staging, n (%) *				
Yes	31 (57.4)	31 (57.4)		
No	23 (42.6)	23 (42.6)		

AC: Adjuvant chemotherapy; ECOG-PS: Eastern Cooperative Oncology Group-Performance score; NAC: Neoadjuvant chemotherapy; N: Node; p: Pathological; T: Tumor; * Pathological down staging are only given for patients who received neoadjuvant chemotherapy

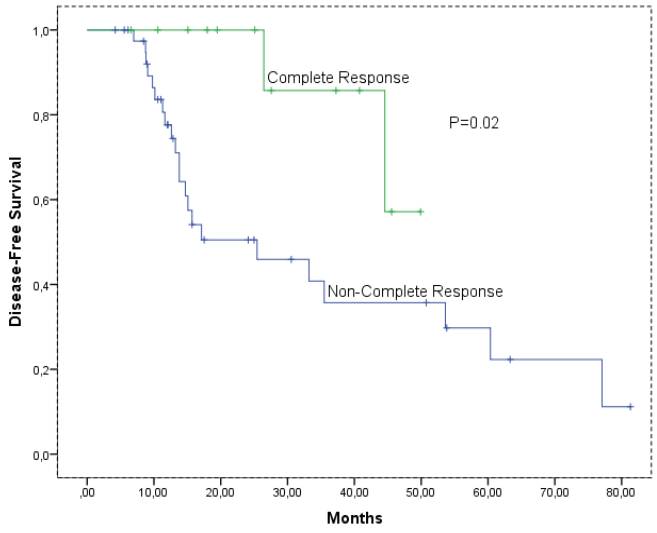

Figure 1. Comparison of Disease-Free Survival Between Complete Response and Non-Complete Response Groups

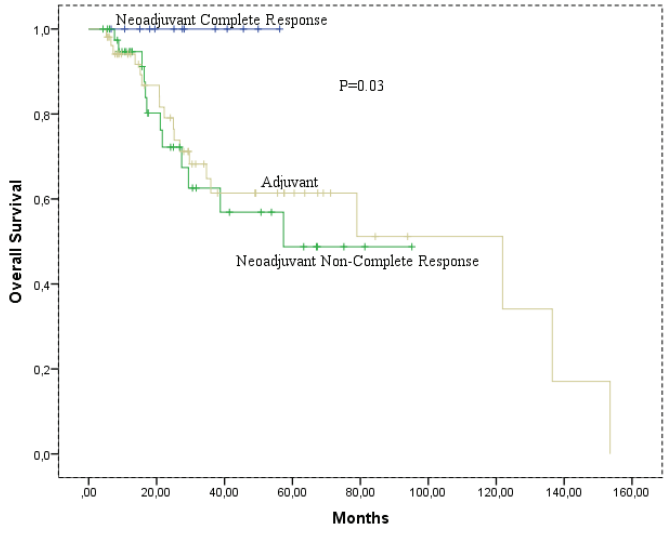

Figure 2. Comparison of Overall Survival Between Groups

Table 3 shows the univariate and multivariate analysis of potential prognostic factors for disease-free survival. Complete response (CR vs non-CR) was significant in both univariate and multivariate analyses. In multivariate analysis, there were HR=0.23 (0.10-0.49) P=0.01 patients with complete response.

In terms of OS, being treated with a cisplatin regimen longer overall survival times in both univariate and multivariate analyses. In multivariate analysis, there were HR=0.39 (0.17-0.86) P=0.01. In addition, patients older than 65 years had shorter overall survival times (HR=1.39 (1.27-3.86) P=0.03) (Table 4).

Table 2. 30-month DFS and OS in bladder cancer patients

	30-month DFS (%)	30-month OS (%)
General (n=107)	58.9	69.8
Age		
≤ 65	65.3	78.2
> 65	45.1	52.9
Gender		
Male	58.6	72.1
Female	59.6	62.3
Treatment		
Neoadjuvant	56.3	71.7
Adjuvant	61.5	68.2
Clinical stage		
2	62.7	75.2
3	57.3	70.5
Down staging		
<pT2N0	70.1	81.4
≥ pT2	41.1	62.0
Neoadjuvant treatment, platin		
1-3 cycles	63.5	76.2
4 cycles	55.4	68.8
Adjuvant treatment		
Cisplatin	75.1	81.0
Carboplatin	35.9	44.4
Pathological response		
Complete response (CR)	85.7	100
Presence of residue (non-CR)	45.9	62.6

DFS: disease free survival; OS: Overall survival

Discussion

The study findings suggest that patients who responded to neoadjuvant treatment for locally advanced bladder cancer (complete response or down staging) had a better prognosis than those who did not respond to adjuvant and neoadjuvant treatment. Additionally, the study identified advanced age as a factor that impacted overall survival.

According to current guidelines, cisplatin-based neoadjuvant treatment is recommended for bladder cancer starting from clinically staged T2. However, despite being the standard treatment for muscle-invaded bladder cancer, only 15% of patients receive it (7). This data emphasizes the importance of multidisciplinary evaluation. While neoadjuvant cisplatin-based combined chemotherapy regimens have demonstrated an overall survival advantage, it is important to acknowledge that 50% of these patients still have residual tumors at postoperative T2 and above (7). In our study, 54% of the patients received neoadjuvant treatment and all of them received cisplatin plus gemcitabine. In comparison with the literature, the CR rate after neoadjuvant treatment was 28% and pathologic down-staging was 57%. Therefore, it is important to explore alternative treatment strategies that may improve response rates and survival outcomes.

Table 3. Univariate and multivariate analysis of potential prognostic factors for disease-free survival

Parametres	Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	p
Age, >65 years vs <65 years	1.65 (0.89-3.04)	0.10	0.55 (0.40-1.70)	0.27
Gender, Male vs Female	0.72 (0.35-1.46)	0.36		-
Histopathology, Urotelyal vs Other	0.88 (0.27-2.86)	0.84		-
Smoking, Yes vs No	0.66 (0.33-1.31)	0.24		-
Alcohol, Yes vs No	0.77 (0.32-1.89)	0.57		-
BMI>25 vs <25	0.83 (0.45-1.52)	0.55		-
Stage, 3 vs 1-2	1.28 (0.66-2.46)	0.45		-
Treatment, Neoadjuvant vs Adjuvant	1.40 (0.77-2.56)	0.26		-
Cisplatin, Yes vs No	0.58 (0.29-1.15)	0.12		-
Complete Response, Yes vs No	0.21 (0.05-0.92)	0.03	0.23 (0.10-0.49)	0.01
Neoadjuvant treatment, 4 cycles vs 1-3 cycles	0.69 (0.32-1.48)	0.35		-
Down staging,<pT2N0 vs >pT2	0.55 (0.23-1.29)	0.17		-

CI: Confidence interval; HR: Hazard ratio

Table 4. Univariate and multivariate analysis of potential prognostic factors for overall survival

Parametres	Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	p
Age, >65 vs <65 years	2.58 (1.20-3.54)	0.01	1.39 (1.27-3.86)	0.03
Gender, Male vs Female	0.60 (0.26-1.38)	0.23		-
Histopathology, Urotelyal vs Other	0.52 (0.15-1.73)	0.28		-
Smoking, Yes vs No	0.46 (0.20-1.06)	0.15		-
Alcohol, Yes vs No	0.31 (0.07-1.39)	0.12		-
BMI>25 vs <25	0.65 (0.30-1.40)	0.27		-
Stage, 3 vs 1-2	0.95 (0.44-2.07)	0.91		-
Treatment, Neoadjuvant vs Adjuvant	0.86 (0.40-1.84)	0.71		-
Cisplatin, Yes vs No	0.49 (0.21-1.13)	0.09	0.39 (0.17-0.86)	0.05
Complete Response, Yes vs No	0.03 (NR-7.79)	0.21		-
Neoadjuvant treatment, 4 cycles vs 1-3 cycles	0.54 (0.20-1.46)	0.22		-
Down staging,<pT2N0 vs >pT2	0.60 (0.19-1.93)	0.40		-

CI: Confidence interval; HR: Hazard ratio; NR: Not reached

Tablo 5. Clincal trials outcomes

Pathologic Stage	MSK (n = 154)	Dash et al (n = 42)	Yeshchina et al (n = 37)	Majidova et al (n = 54)
Regimen	GC	GC	GC	GC
pT0N0, %	20	26	25	27
< pT2N0, %	44	36	50	55
≥ pT2, %	56	64	50	45

GC: gemcitabine plus cisplatin

Moreover, it is important to note that a significant proportion of patients who undergo radical cystectomy are unable to receive adjuvant treatment due to prolonged complications and comorbidities. Therefore, it is imperative to carefully assess eligible patients for neoadjuvant treatment.

As it is widely acknowledged, neoadjuvant chemotherapies have been shown to yield complete response rates of 30-40%. Unfortunately, even with these treatments, 50% of patients still have >pT2 residual tissue after radical cystectomy. In order to improve these response rates, it may be worth considering combinations of chemotherapy and immunotherapy, as has been seen in studies on lung cancer treatment (10). However, it is important to note that phase 2 studies did not show a significant increase in pathological response rates. It is possible that the results of phase 3 studies will lead to changes in clinical practice (11). As seen in Figure 2, it is a well-established fact that neoadjuvant treatment leads to longer survival times and is particularly beneficial for patients who achieve a complete response. The findings were consistent with the literature. While the 30-month OS rate was 71.7% in those who

received neoadjuvant treatment, this rate was 68.2% in those who received adjuvant treatment. As previous studies have shown, neoadjuvant treatment provides a survival advantage for patients who achieve a complete pathological response with NAC (12). Platinum-based NAC can increase the 5-year survival rate by 5-10% in the relevant population. Patients who respond to NAC have a 5-year survival rate of 80-90%, whereas non-responders have a rate of 30-40% (13).

When we look at other studies with neoadjuvant chemotherapy selection, there is no significant difference in terms of pathological complete response rate in the comparison of cisplatin plus gemcitabine and MVAC regimen. However, pathological complete response rate and survival results are more favorable with MVAC regimen. In the study comparing donse dens MVAC with gemcitabine cisplatin, although the pathological complete response rate (42% vs 35%) was not statistically significant, it was slightly superior in the dd-MVAC arm (p=0.2). However, pathological down-staging rates were better in the dd-MVAC arm (p=0.007). 3-year PFS with dd-MVAC was 64% and statistically significant (p=0.02) (9). Carboplatin is not recommended as a substitute for cisplatin, as the complete response rate with carboplatin is below 10% in patients for whom cisplatin is not suitable (14). The results of immunotherapy studies for these patient groups are encouraging (15, 16).

Apart from immunotherapies, pathological complete response rate is 35% when antibody drug conjugate (ADC) anti-Nectin-4 enfortumab and cisplatin are given neoadjuvantly in unsuitable patients. In terms of squamous histology, the efficacy of chemotherapy has not been clearly demonstrated and surgery may be a priority (17). In our study, 8 patients had squamous cell carcinoma. Seven patients received adjuvant treatment after direct surgery, 1 patient was operated only after neoadjuvant treatment and no pathological complete response was achieved. In our study, all patients received cisplatin plus gemcitabine as neoadjuvant treatment and our results are compared with other studies in Table 5, and our results are similar to other studies.

The role of postoperative adjuvant chemotherapy in BC remains unclear. So far, prospective randomised trials have demonstrated a contribution to progression-free survival in patients receiving cisplatin-based adjuvant chemotherapy, but this has not been reflected in overall survival (18). In the adjuvant immunotherapy group (nivolumab), 40% of patients underwent surgery after cisplatin-based chemotherapy and had residual tumors staged >T2, while the remaining patients were directly operated on because they were not suitable for cisplatin. This approach provided a two-fold advantage in disease-survival, which was the primary outcome. In conclusion, platinum base adjuvant therapy or nivolumab is recommended for patients with >T3 and node positivity after radical cystectomy without neoadjuvant treatment due to its contribution to DFS. In addition, adjuvant nivolumab may be considered for patients with residual disease after cisplatin-based postoperative treatment (19). In our study, adjuvant treatment was given to patients with residual disease who had not received neoadjuvant treatment before. While 60% of the patients received cisplatin combination therapy, 40% were treated with carboplatin-based therapy. We were unable to administer adjuvant immunotherapy to any of our patients due to the lack of reimbursement coverage in our country. However, 30-month OS was two times higher with cisplatin compared to carboplatin (81% vs 44%, respectively). If the patient has not received neoadjuvant treatment, cisplatin should be strongly considered for adjuvant therapy.

Limitations

The major limitation of our study is that data may be lost due to its retrospective nature and confounding factors may not be controlled. Although the number of patients was small and none received neoadjuvant dose-dense MVAC or immunotherapy as adjuvant treatment, the most important conclusion of this study is that neoadjuvant treatment and the response that it generates play a crucial role in determining patient prognosis.

Conclusion

In conclusion, neoadjuvant cisplatin-based chemotherapies significantly improved both pathologic response and survival in muscle- invasive bladder cancer. Age and chemotherapy intensity were found to be important prognostic factors, with younger patients and more cisplatin-based treatments achieving better outcomes. Surgery, radiotherapy and systemic treatment options in muscle invasive bladder cancer can be evaluated in multidisciplinary tumor consultations. Patients who can respond to neoadjuvant therapy should receive neoadjuvant therapy, but if neoadjuvant therapy is not feasible, adjuvant therapy can be considered. The lack of significant difference between the two treatment strategies emphasizes the importance of adjuvant therapy for patients who cannot undergo neoadjuvant treatment. Further prospective studies are needed to explore optimized chemotherapy regimens that may improve survival while minimizing toxicity, especially in elderly or high-risk patients.

Conflicts of interest

Authors declare no conflicts of interest.

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Araştırma Makalesi

Enterokok Bakteriyemileri: Son 5 Yılda E. faecium ve E. faecalis' in Direnç Profili ve Prognoza Etkisi

Enterococcal Bacteremia: The Resistance Profile and Prognostic Impact of E. faecium and E. faecalis Over the Past 5 Years

Nuran Sarı*, Nurefşan Tuba Kurt, Hande Arslan, Özlem Kurt Azap

Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji, Başkent Üniversitesi Tıp Fakültesi, Ankara Hastanesi, Ankara, Türkiye

Öz

Amaç: Son yıllarda enterokok bakteriyemilerinin sıklığı ve mortaliteleri artmaktadır. Çalışmamızda enterokok bakteriyemilerinde son beş yıllık antimikrobiyallere direnç değişimleri, mortalite gelişimine etkisi olabilecek risk faktörleri araştırılarak, ampirik tedavilere ve hasta izlemlerine katkı sağlamak, ilerde yapılacak çalışmalara yol gösterici olabilmek amaçlanmıştır.

Gereç ve Yöntemler: 2020-2024 tarihleri arasında 18 yaş üzeri enterokok bakteriyemileri kesitsel ve retrospektif olarak araştırılmıştır. Hastaların demografik verileri, komorbiditeleri, klinik bulguları, laboratuvar sonuçları, enfeksiyon odakları, yapılan invazif girişimler, etken dağılımları ve prognoz araştırılarak, SPSS 25.0 (IBM Corp., Armonk, NY, USA) programında analiz edilmiştir.

Bulgular: 279 enterokok bakteriyemisinin, 140'ı (%50.2) kadın hastaydı. En sık etken E. faecium 161 (%57.7), yaş ortalaması 66.3±16.2 saptandı. E. faecium bakteriyemisi daha genç yaşlarda, cerrahi bölümlerde, sekonder kaynaklı, sağlık hizmeti ilişkili olarak görülmekteydi (p<0.05). Intraabdominal ve apse odakları sıktı. Antibiyotiklere direnç durumu E. faecium'da diğer etkenlere göre yüksekti (p<0.05). E. faecalis bakteriyemisi ise daha çok toplum kaynaklı, primer odaklıydı. Kateter ilişkili kan dolaşımı enfeksiyonu ve endokardit daha sık, antibiyotiklere direnç oranları daha düşüktü (p<0.05). Mortalite %74.5 olarak saptandı. Sekonder bakteriyemiler, immünosüpresyon, malignite, COVID-19, hipoalbuminemi varlığı, perkütan endoskopik gastrostomi, nasogastrik sonda, idrar sondası, trakeostomi, mekanik ventilasyon gibi girişimler, antibioyotiklere direnç, YBÜ'de yatış, SIRS, sepsis varlığında mortalite yüksek saptandı. Pitt bakteriyemi skoru ve Charlson komorbidite indeksi ortalamaları da mortal seyredenlerde daha yüksekti (p<0.05).

Sonuçlar: Enterokok bakteriyemileri ileri yaşlarda görülen, sıklıkla sağlık hizmeti ilişkili enfeksiyonlardır ve mortalite oranları yüksektir. Antibiyotik direncinin ve yapılan girişimlerin mortaliteyi artırması nedeni ile antimikrobiyal yönetim çalışmalarının, komorbiditelerin, enfeksiyon odaklarının kontrolünün, gereksiz invazif girişimlerden kaçınılmasının enterokok bakteriyemilerinden korunmada önemli olduğu düşünülmektedir.

Anahtar Kelimeler: Enterokok bakteriyemileri, Epidemiyoloji, Antimikrobiyal direnç, E. faecalis, E. faecium

Sorumlu Yazar*: Nuran Sarı, Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji, Başkent Üniversitesi Tıp Fakültesi, Ankara Hastanesi, Ankara, Türkiye
E-posta: nuran_sari2003@yahoo.com
Orcid: 0000-0002-3165-4520
Doi: 10.18663/tjcl.1604966
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Abstract

Aim: The frequency and mortality of enterococcal bacteremias have been increasing in recent years. In our study, we aimed to contribute to empirical treatments and patient follow-up and to guide future studies by investigating changes in resistance to antimicrobials in enterococcal bacteremia in the last five years and risk factors that may affect the development of mortality.

Material and Methods: Enterococcal bacteremias in people over 18 years of age were investigated cross-sectionally and retrospectively between 2020 and 2024. Demographic data, comorbidities, clinical findings, laboratory results, infection foci, invasive interventions performed, agent distribution, and prognosis of the patients were investigated and analyzed in the SPSS-25.0 (IBM Corp., Armonk, NY, USA), program.

Results: Of the 279 patients with enterococcal bacteremia, 50.2% were female. The most common agent was E. faecium %57, and the average age was 66.3 ± 16.2 years. E. faecium was seen at younger ages, in surgical departments, and as secondary, healthcare related ($p<0.05$). Intraabdominal and abscess foci were frequent. Resistance to antibiotics was higher in E. faecium than other factors ($p < 0.05$). E. faecalis was more community-acquired and primary-focused, catheter-related bloodstream infection and endocarditis were more frequent, and antibiotic resistance rates were lower ($p< 0.05$). Mortality was determined as 74.5%.

Conclusions: Enterococcal bacteremias are frequently healthcare related infections that occur in older ages and have high mortality rates. Since antibiotic resistance and interventions increase mortality, antimicrobial management studies, control of comorbidities, infection foci, and avoidance of unnecessary invasive interventions are thought to be important in protecting against enterococcal bacteremia.

Keywords: Enterococcal bacteremia, E. faecalis, E. faecium, Epidemiology, Antimicrobial resistance

Giriş

Enterokoklar, doğada ve insan ile hayvan bağırsağında yaygın olarak bulunan, fakültatif anaerob, gram pozitif boyanan ve kısa zincirler halinde gruplaşan koklardır. Eskiden D grubu streptokoklar olarak sınıflandırılmışlardır. Kuruluk, yüksek ısı ve olumsuz çevresel koşullara karşı direnç gösteren bu mikroorganizmalar, oldukça dayanıklı yapıya sahiptirler [1].

İnsan mikrobiyotasında doğal olarak bulunmaları nedeniyle endojen enfeksiyonlara yol açabilmelerinin yanı sıra, çevresel bulaş yoluyla eksojen enfeksiyonlara da neden olabilirler. Enterokok enfeksiyonlarının gelişiminde ileri yaş, komorbiditeler, immünosüpresyon, santral venöz veya üriner kateter varlığı, geçirilmiş cerrahi girişimler ve geniş spektrumlu antibiyotik kullanımı gibi faktörler önemli risk faktörleri arasında yer almaktadır [1,2].

Enterokoklar toplum ve sağlık hizmeti ilişkili enfeksiyonlara (SHİE) neden olabilirler. Hastane kaynaklı enfeksiyonların en sık üçüncü etkeni olarak bildirilmektedirler. İdrar yolu, intraabdominal, deri-yumuşak doku enfeksiyonlarının yaygın etkenleri arasındadırlar [1-3]. Ayrıca bakteriyemi, infektif endokardit, menenjit gibi komplike, mortal seyirli enfeksiyonlara yol açabilirler. Enterokok bakteriyemileri primer odak olabileceği gibi, cerrahi alan, gastrointestinal, üriner sistem gibi sekonder odaklardan da kaynaklanabilmektedir [1-3].

Enterokok bakteriyemilerinde E. faecium ve E. faecalis en sık saptanan türlerdir [4,5]. Enfeksiyonların %30'unu ve vankomisin dirençli enterokoklar (VRE), %90'ını E. faecium oluşturmaktadır [2]. Bakteriyemilerin tedavisinde, enterokokların antibiyotiklere giderek artan antimikrobiyal direnç önemli bir sorundur [4,5]. Antimikrabiyal direnç doğal (intrensek) veya kazanılmış (ekstrensek) olarak gelişebilmektedir. Özellikle sefalosporin, ampisilin, gentamisin, vankomisin gibi en sık kullanılan antibiyotiklere gelişen direnç önemli bir sorundur [5,6]. Ülkemizde E. faecalis'de vankomisin direnci %3, E.faecium'da %20 civarındadır [7,8]. Avrupa sürveyansı verilerine göre E. faecium vankomisin direnci %21-25 arasında bildirilmektedir [9]. Direnç bakteriyemilerdeki tedaviyi zorlaştırmakta, kombinasyon ve yeni tedavi seçeneklerinin geliştirilmesini zorunlu kılmaktadır.

Bakteriyemilerde hızla tanı konulması, uygun ampirik ve etkene yönelik tedavilerin erken başlanması hastalar için hayati olabilmektedir. Bunun için mikrobiyolojik etkenlere yönelik dağılım ve direnç verilerinin dünya, ülke ve lokal hastane bazında yakından takip edilmesi gerekmektedir. Son yıllarda enterokok bakteriyemilerinin sıklığı artmaktadır. Çalışmamızda enterokok bakteriyemisindeki son beş yıldaki etken dağılımları, yıllar içinde antimikrobiyallere direnç değişimleri, prognoz ve mortalite gelişimine etkisi olabilecek risk faktörleri araştırılarak,

ampirik tedavilere ve hasta izlemlerine katkı sağlamak ve ilerde yapılacak çalışmalara yol gösterici olabilmek amaçlanmıştır.

Gereç ve Yöntemler

Araştırma, 1 Ocak 2020 ve 31 Aralık 2024 tarihleri arasını kapsayan kesitsel bir çalışmadır. Üçüncü basamak, üniversite hastanesi Mikrobiyoloji laboratuvarında, kan kültürlerinde enterokok üreyen, 18 yaş üzeri hastalar retrospektif olarak incelenmiştir. Polimikrobiyal üremeler, kontaminasyonlar, aynı hastada tekrarlayan üremeler çalışmaya dahil edilmemiştir. Hastaların demografik verileri, komorbiditeleri, klinik bulguları, laboratuvar sonuçları, enfeksiyon odakları, yapılan invazif ve diğer girişimler, etken dağılımları, mortalite durumları araştırılmıştır. Hastaneye yatmadan önce ya da yatıştan sonraki ilk 48 saat içinde gelişen enfeksiyonlar toplum kaynaklı, hastaneye yatıştan ≥48 saat sonra gelişen, hemodiyaliz, sağlık bakımı veren kuruluşta, sağlık hizmeti alma sonrasında gelişen enfeksiyonlar ise sağlık hizmeti ilişkili enfeksiyonlar (SHİE) olarak kayıt altına alınmıştır. Tam ilaç direnci için antibiyogramdaki tüm antibiyotiklere dirençli suşlar, çoklu ilaç direnci için üç antimikrobiyal kategoride en az bir antimikrobiyale direnç olarak tanımlanmıştır İnfeksiyonlar için sürveyans tanımları, Charlson komorbidite indeksleri, Pitt bakteriyemi skorları, SIRS, sepsis tanıları için ilgili literatürlerde belirtilen kriterler kullanılmıştır [10-16].

Laboratuvar Enterokok Bakteriyemisi Tanımlamaları

Enterokok bakteriyemilerini tanımlamak için laboratuvara gelen, ateşi olan hastalardan rutin alınmakta olan en az iki set kan kültürü, BD Bactec Fx (Becton, Dickinson and Company, ABD) cihazında ortalama beş gün bekletilmektedir. Cihaz üreme sinyali verdiğinde gram boyama yapılarak, gram pozitif kok saptananların kanlı ve eosin metilen blue (EMB) besiyerine ekimi yapılmaktadır. Kanlı besiyerindeki üremelerden katalaz testi negatif ve PYR testi (L-Pirolidonil-ß-naftilamid) pozitif olanlar disk difüzyon ile uygun antibiyograma alınmaktadır. Konvansiyonel yöntemler dışında laboratuvarda tüm kan kültürerinde üreyen tüm enterokokların BD PhoenixTM M50 (Becton, Dickinson and Company, ABD) tam otomatize cihazında tür tayini ve antibiyotik duyarlılıkları çalışılmaktadır. Türlerden E. faecalis, E. faecium, Enterococcus spp (non-faecium veya non-faecalis olarak; E. durans, E. raffinosus, E.gallinarum, E. casselifalvus türleri de tanımlanabilmektedir) olarak elde edilen sonuç bildirilmektedir.

İstatistiksel Analiz

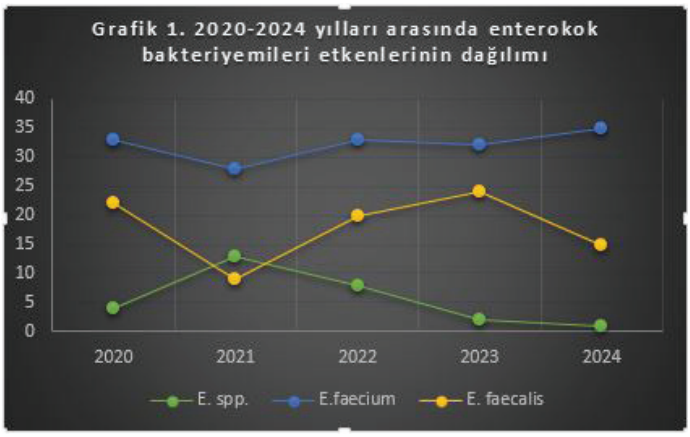
Verilerin analizi için SPSS (Statistical Package for the Social Sciences) versiyon 25.0 paket programı (IBM Corp., Armonk, NY, ABD) kullanılmıştır. Nicel verilerin normal dağılıma uygunluğu için Kolmogorov Smirnov veya Shapiro-Wilk testleri yapılmıştır. Tanımlayıcı analizlerde sürekli değişkenlerin karşılaştırılmasında normal dağılım saptandıysa parametrik testler, ortalama ± standart sapma, normal dağılım yoksa ortanca (IQR veya minimum-maksimum) değerlendirilmiştir. Nicel değişkenlerdeki bağımsız örneklerde iki grup karşılaştırmalarında normal dağılımda parametrik testlerden bağımsız örnekler T testi, ikiden fazla bağımsız grup karşılaştırmalarında ise tek yönlü varyans analizi (tek yönü ANOVA) kullanılmıştır. Normal dağılıma uymayanlarda iki bağımsız grup karşılaştımalarında nonparametrik Mann-Whitney U testi, ikiden fazla gruplarda Kruskal wallis yapılmıştır. Kategorik değişkenlerde frekans ve yüzde alınarak, aralarındaki ilişki Fisher kesin testi ve Pearson ki-kare testi ile araştırılmıştır. Tüm istatistiklerde $p<0.05$ değeri istatistiksel olarak anlamlı bulunmuştur.

Etik kurul

Araştırmamız Dünya Tabipler Birliği, Helsinki Bildirgesi'ne uygun olarak yürütülmüştür. Başkent Üniversitesi, Tıp ve Sağlık Bilimleri Araştırma Kurulu tarafından 02.01.2025 tarihinde değerlendirilerek, KA24/452 proje numarası ile onaylanmıştır. Başkent Üniversitesi Araştırma Fonunca desteklenmiştir.

Bulgular

Beş yıllık süre içerisinde 279 hastada enterokok bakteriyemisi saptanmıştır. Hastaların 140'ı (%50.2) kadındır. Etkenlerin tür dağılmı irdelendiğinde; 161 (%57.7) hastada E. faecium, 90 (%32.2) hastada E. faecalis, 28 (%10.1) hastada ise diğer enterokok tipleri tespit edilmiştir . 2021 yılında diğer enterokok türleri ikinci sıraya yerleşse de, yıllar içinde dalgalanmalarla E. faecium ve E. faecalis en sık iki etken olmuştur (Şekil 1).



Şekil 1. 2020-2024 yılları arasında enterokok bakteriyemi etkenlerinin dağılımı

Erkeklerde E. faecalis, kadınlarda diğer enterokok türleri (E. spp) daha sık saptanmıştır. (Tablo 1). E.faecium bakteriyemilerinde yaş ortalaması 66.3±16.2 olarak diğer etkenlerden daha düşüktür (p=0.006). Ayrıca 65 yaş altı hasta sayısı E. faecium' da diğere etkenlere göre anlamlı olarak yüksektir (p=0.028). Cerrahi bölümlerde E. faecium, dahili bölümlerde E. faecalis, yoğun bakım ünitesinde diğer Enterococcus spp. bakteriyemileri daha fazla tespit edilmiştir (p=0.001). Hastalarda malignite varlığı, immunsüpresif tedavi alıyor olmak, diyabet ve böbrek hastalıkları en sık eşlik eden komorbiditelerdir. Hastalara yatışları boyunca çok sayıda girişim uygulanmıştır. Komorbiditeler ve yapılan invazif girişimler ile etkenler arasında anlamlı farklılık görülmemiştir (Tablo 1).

Bakteriyemilerin %75'i SHİE, %25'i toplum kaynaklı enfeksiyonlardı E. faecalis bakteriyemilerinde toplum kaynaklı ve primer enfeksiyonlar daha sık görülürken (p=0.002), E. faecium ve diğer etkenlerin neden olduğu bakteriyemiler sıklıkla sekonder odaklı ve SHİ enfeksiyonlardı (p=0.001). Kateter ilişkili kan dolaşımı enfeksiyonu ve endokarditde E. faecalis, apse ve intraabdominal enfeksiyonlara sekonder gelişen bakteriyemilerde E. faecium yüksek saptanmıştır (p<0.05). Sekonder bakteriyemilerde intraabdominal enfeksiyonlar, idrar yolu enfeksiyonları en sık saptanan enfeksiyonlardır. Laboratuvar tetkiklerinde, beyaz küre, hemoglobin, trombosit sayımı, C-reaktif protein, karaciğer ve böbrek fonksiyon testlerinde etkenler arasında farklılık görülmemiştir (p>0.05). Ancak E. faecalis'de hipoalbuminemi daha sık saptanmıştır (p<0.05) (Tablo 2).

Tablo 1. Enterokok türlerine göre hastaların demografik verileri, girişimler ve komorbiditeler

Toplam n=279, (%)		Enterococcus spp.		Enterococcus faecium		Enterococcus faecalis		
		Sayı n=28	%	Sayı n=161	%	Sayı n=90	%	p
Cinsiyet								
Erkek	139 (49.8)	11	39,3	73	45,3	55	61,1	0.028*
Kadın	140 (50.2)	17	60,7	88	54,7	35	38,9	
Yaş	<65	7	25,0	70	43.5	26	28.9	0.028*
	>=65	21	75,0	91	56.5	64	71.1	
Ortalama ± SD	68.7± 15.8	74.4±12.8		66.3±16.2		71.1±15.2		0.006**
Bölümler								
Cerrahi		5	17.9	61	37,9	19	21,1	0.001*
Dahili		12	42.9	50	31,1	50	55,6	
Yoğun bakım ünitesi		11	39.3	50	31,1	21	23,3	
Girişimler								
Nazogastrik sonda		6	21,4	42	26,1	21	23,3	0.812*
Santral venöz kateter		17	60,7	114	70,8	59	65,6	0.469*
İdrar sondası		17	60,7	111	68,9	54	60,0	0.314*
Mekanik ventilasyon		9	32,1	48	29,8	25	27,8	0.892*
Trakeostomi		2	7,1	7	4.2	7	7,8	0.543*
Dekübit/yara varlığı		8	28,6	39	24,3	27	15,6	0.844*
Komorbiditeler								
Hipertansiyon		15	53,6	76	47.2	49	54,4	0.696*
Kronik böbrek yetmezliği		7	25,0	38	23,6	34	37,8	0.053*
Diyabet		7	25,0	46	28,6	34	37,8	0.383*
İmmunsüpresif tedavi		17	60,7	97	60,2	34	37,8	0.052*
Malignite		14	50.0	62	39.5	32	36.0	0.415*
Karaciğer hastalığı		2	7,1	33	20,5	16	17,8	0.238*

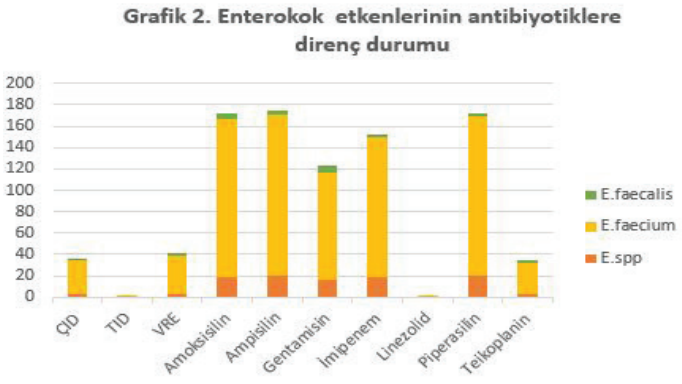
SD; Standart deviasyon, *Pearson ki-kare, ** Tek yönlü Anova (Post hoc test Tukey, Benferroni kullanıldı)

Tablo 2. Enterokok türlerine göre enfeksiyon odakları, laboratuvar verileri ve komplikasyonlar

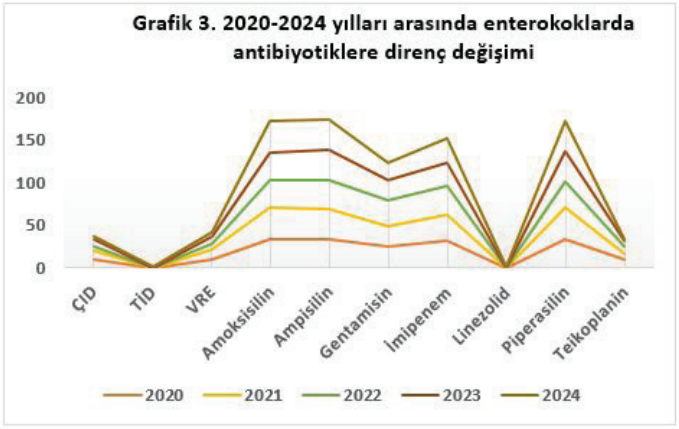
	Enterococcus. spp.		Enterococcus faecium		Enterococcus faecalis		
	Sayı n=28	%	Sayı n=161	%	Sayı n=90	%	p
Enfeksiyon kaynağı							
Primer	4	14.3	27	16.8	32	35.6	0.002*
Sekonder	24	85.7	134	83.2	58	64.4	
Enfeksiyonun edinildiği yer							
Toplum ilişkili	6	21.4	29	18.0	35	38.9	0.001*
Sağlık hizmeti ilişkili	22	78.6	124	83.0	19	21.1	
Eşlik eden diğer enfeksiyonlar							
Kateter ilişkili KDİ	2	7.1	20	12.4	27	30.0	0.001*
İntraabdominal enfeksiyon	11	39.3	76	47.2	20	22.2	0.001*
GIS perforasyon/fistül	7	25.0	54	34.4	21	23.6	0.172*
İdrar yolu enfeksiyonu	7	25.0	38	23.6	17	18.9	0.574*
İshal	2	7.1	1	0.6	1	1.1	0.029*
Laboratuvar							
Hipoalbuminemi >2.5 mg/dL	20	80.0	121	84.6	49	65.3	0.006*
Anemi **	25	89.3	135	83.9	73	81.1	0.586*
Kreatinin >1.3 mg/dL	15	53.6	80	49.7	46	51.1	0.923*
Komplikasyon varlığı							
Endokardit	1	3.6	3	1.9	9	10.0	0.022*
Diskit	1	3.6	0	0	3	3.3	
Apse	2	7.1	17	10.5	3	3.3	

* Pearson ki-kare testleri kullanıldı , p<0,05 anlamlı bulundu. Sütün yüzdeleri üzerinden değerlendirme yapılmıştır. ** Hemoglobin değeri ; kadın<12 mg/dL, erkek <14 mg/dL

Antibiyotiklere direnç araştırıldığında, çoklu ilaç direnci, vankomisin, teikoplanin, ampisilin, amoksisilin, piperasilin, gentamisin, imipenem direnci E faecium'da diğer etkenlerden yüksek saptanmıştır (Şekil 2). E. faecium'da vankomisin direnci %22.4, E. faecalis'de %2.2 bulunmuştur. Sepsis ve sistemik inflamatuvar cevap sendromu (SIRS) mevcutiyeti ve 30 günlük hastane mortalitesinde etkenler arası fark görülmezken, yoğun bakım ünitesinde yatış E. faecalis bakteriyemilerinde diğer etkenlerden daha düşük olduğu görülmüştür (p<0.004) (Tablo 3). Beş yıl içindeki antibiyotiklere direnç durumundaki değişiklikler araştırıldığında ampisilin, amoksisilin, gentamisin, imipenem, piperasilin, teikoplanin ve vankomisin direncinde artış olduğu saptanmıştır (Şekil 3).



Şekil 2. Enterokok bakteriyemilerinde antibiyotiklere direnç grafiği (ÇİD; Çoklu ilaç direnci, TİD; tam ilaç direnci, VRE; vankomisin dirençli enterokok)



Şekil 3. Yıllar içinde enterokoklarda antibiyotiklere direnç değişimi

Çalışmamızda tüm enterokok bakteriyemilerinde 30 günlük hastane mortalitesi %74.5 olarak saptanmıştır. Mortaliteye etki eden risk faktörleri incelendiğinde yaş ve cinsiyetler arasında fark görülmemiştir (p>0.05. Sekonder bakteriyemiler, immunsüpresyon, malignite, eşlik eden COVID-19 enfeksiyonu, hipoalbuminemi varlığı, YBÜ'de yatışı anlamlı bulunmuştur (p<0.05), (Tablo 4). Ayrıca yapılan PEG (perkütan endoskopik gastrostomi), nasogastrik sonda, idrar sondası, trakeostomi, mekanik ventilasyon gibi girişimler varlığında mortalite anlamlı olarak yüksektir (p<0.05), (Tablo 4).

Tablo 3. Enterokok türlerine göre antibiyotiklere direnç durumu, SIRS, sepsis ve hastane mortalitesi

	Enterococcus. spp.		Enterococcus faecium		Enterococcus faecalis		
	Sayı n=28	%	Sayı n=161	%	Sayı n=90	%	p
Antibiyotiklere direnç durumu							
Çoklu ilaç direnci	3	10,7	31	19,3	2	2,2	0.001*
Tam ilaç direnci	0	0,	1	0,6	0	0	0.692*
Vankomisin	3	10,7	36	22,4	2	2,2	0.001*
Amoksisilin	19	67,9	147	91,3	6	6,7	0.001*
Ampisilin	20	71,4	150	93,2	5	5,6	0.001*
Gentamisin	16	57,1	100	62,1	7	7,8	0.001*
İmipenem	19	67,9	131	81,4	2	2,2	0.001*
Linezolid	0	0	1	0,6	0	0	0.692
Piperasilin	20	71,4	149	92,5	3	3,3	0.001*
Teikoplanin	3	10,7	29	18,0	2	2,2	0.001*
SIRS	12	42.9	60	37.3	24	26.7	0.055*
Sepsis	11	39.3	58	36.0	24	26.7	0.250*
Yoğun bakım ünitesi yatışı	19	67.9	110	68.3	43	47.8	0.004*
Hastane mortalitesi (30. Gün)	23	82.1	124	77.0	61	67.8	0.170*

Pearson ki-kare testleri kullanıldı , p < 0,05 anlamlı bulundu. Sütun yüzdeleri üzerinden değerlendirme yapılmıştır.

Tablo 4. Enterokok bakteriyemilerinde mortaliteye etki eden faktörler

		Mortalite var		Mortalite yok		
		Sayı	Yüzde (%)	Sayı	Yüzde (%)	p
Yaş	<65	71	34,1	32	45,1	0.099
	>=65	137	65,9	39	54,9	
Cinsiyet	Kadın	111	53.4	29	40.8	0.068
	Erkek	97	46.6	42	50.2	
Bölümler	Cerrahi	58	27.9	27	38.0	0.001
	Dahili	72	34.6	40	56.3	
	YBÜ	78	37.5	4	5.6	
Enfeksiyon kaynağı	Primer	38	18.3	25	35.2	0.003
	Sekonder	170	81.7	46	64.8	
Eşlik eden enfeksiyonlar						
İntraabdominal enfeksiyon		86	41.3	21	29.6	0.078
Yara/dekübit		61	29.3	13	18.3	0.062
COVID-19		17	8.3	1	1.5	0.025*
Aspirasyon pnömonisi		19	9.2	1	1.5	0.033*
Predispozisyon yaratan durumlar						
Son 3 ayda hastaneye yatış		131	63.9	36	51.4	0.621
Son 3 ayda antibiyotik kullanımı		115	56.1	30	42.9	0.053
Malignite		88	42.7	20	29.4	0.048
İmmunsüpresyon varlığı		121	58.2	27	38.2	0.003
Hipoalbuminemi varlığı		158	85.4	32	55.2	0.001
Komplikasyon varlığı		30	14.4	9	12.7	0.714
Girişimler						
PEG		16	7,7	1	1,4	0.029*
Nasogastrik sonda		63	30,3	6	8,5	0.001*
Santral venöz kateter		149	71,6	41	57,7	0.001
İdrar sondası		155	74,5	27	38,0	0.001
Mekanik ventilasyon		78	37,5	4	5,6	0.001*
Trakeostomi		15	7.2	1	1,4	0.039*

*Fisher's Exact testi, Pearson ki-kare testleri kullanıldı , p<0,05 anlamlı bulundu. Sütun yüzdeleri üzerinden değerlendirme yapılmıştır.

Etkenlerin ve antibiyotik direncinin mortaliteye etkisi değerlendirildiğinde, etkenler arası fark görülmezken, ampisilin, gentamisin, imipenem, piperasilin, teikoplanin direnci varlığında mortalite anlamlı olarak yüksek saptanmıştır (p<0.05). Ayrıca SIRS, sepsis, yoğun bakım ünitesinde yatışında mortaliteyi artırdığı görülmüştür (p<0.05). Pitt bakteriyemi skoru ve Charlson komorbidite indeksi ortalamaları da mortal seyredenlerde daha yüksek olarak bulunmuştur (p< 0.05), (Tablo 5).

Tablo 5. Enterokok bakteriyemilerinde etkenler, direnç ve diğer risk faktörlerinin mortaliteye etkisi

	Mortalite var		Mortalite yok		
	Sayı	Yüzde (%)	Sayı	Yüzde (%)	p
Etkenler					
E.faecium	124	59,6	37	52,1	0.269*
E.fecalis	61	29,3	29	40,8	0.073*
Enterococcus spp.	23	11,1	5	7,0	0.331*
Antibiyotiklere direnç					
Ampisilin	142	68.3	33	46.5	0.002*
Gentamisin	107	51.5	17	23.9	0.001*
İmipenem	126	60.6	26	36.6	0.001*
Piperasilin	140	67.3	32	45.1	0.001*
Teikoplanin	30	14.4	4	5.6	0.036*
Vankomisin	34	16.3	7	9.9	0.183*
Diğer					
SIRS varlığı	87	41.8	9	12.7	0.001*
Sepsis varlığı	86	41.3	7	9.9	0.001*
Yoğun bakım ünitesinde yatış	144	69.2	28	39.4	0.001*
Pitt bakteriyemi skoru, mean + SD	2,71 ± 2.81		1.15 ± 1.13		0.001**
Charlson komorbidite indeksi, mean + SD	6.70 ± 2.72		5.04 ± 2.38		0.001**

*Pearson ki-kare, **Bağımsız Örneklem T testi kullanıldı, p<0,05 anlamlı bulundu. Sütun yüzdeleri üzerinden değerlendirme yapılmıştır.

Tartışma

Enterokoklar dünyada ve ülkemizde bakteriyemilerin en sık etkenlerinden biri olarak karşımıza çıkmaktadır [1,6,7,9,17-19]. Çalışmamızda beş yılda saptanan 279 enterokok bakteriyemisinin en sık etkeni E. faecium, ikinci sıklıkta E. faecalis'dir. Benzer şekilde bazı çalışmalarda en sık etken olarak E. faecium saptanmakla birlikte, E. faecalis'in en sık etken olduğu bildirimler de mevcuttur [2,6,17,19,20]. Çalışmamızda hastalarımızın %50.2'sini kadınlar oluşturmaktaydı ancak literatürde erkek hastalarda %50-75 arasında daha sık olduğuna dair veriler mevcuttur [6,19,20]. Hastaların yaş ortalaması 68.7±15.8 olarak saptanmıştır, literatürde de yaş ortancası 72'dir, enterokok bakteriyemileri ileri yaştaki hastaların enfeksiyonu olduğu görülmektedir [2].

Literatürde enterokok bakteriyemilerinin %80'i sağlık hizmeti ilişkili olarak bildirilmektedir, ve genellikle idrar yolu ve intraabdominal enfeksiyonlara sekonder gelişmektedir [20]. Çalışmamızda da bakteriyemilerin %75'i hastane kaynaklı enfeksiyonlardı. Sekonder bakteriyemilerde intraabdominal, idrar yolu enfeksiyonları en sık saptanan odaklardı. Özellikle E. faecium sağlık hizmeti ilişkili bakteriyemilerde daha sık saptanmıştır. E. faecium bakteriyemili hastalar diğer etkenlere göre daha genç yaş grubundadır. Ayrıca sekonder odak ve cerrahi bölümlerde yatış, intraabdomial girişimler veya apse varlığında E. faecium bakteriyemisi daha fazla karşımıza çıkmıştır. Çalışmamızda E. faecalis kaynaklı bakteriyemiler ise dahili bölümlerde cerrahi bölümlere veya yoğun bakım ünitesine göre daha sık saptanmıştır. Toplum kaynaklı enfeksiyonlar diğer etkenlere göre E. faecalis'te anlamlı olarak yüksek tespit edilmiştir. Kateter ilişkili kan dolaşımı infeksiyonlarında da E. faecalis diğer etkenlere göre daha fazladır. Kateter ilişkili kan dolaşımı enfeksiyonlarında enterokoklar stafilokoklardan sonra en sık saptanan gram pozitif etkenlerdir ve E. faecalis ilk sırada olmakla birlikte, E. faecium etken olduğunda antibiyotiklere direnç üç kata kadar arttığı bildirilmektedir [18,21]. Enterokoklar, endokarditin de stafilokok ve streptokoklardan sonra en sık saptanan üçüncü etkenidir. En sık E. faecalis bildirilmektedir ve komplike seyirli olabilmektedir [22,23]. Çalışmamızda da E. faecalis'de endokardit sıklığı diğer etkenlere göre daha fazla olduğu görülmüştür.

Dünyada son yıllarda artan antimikrobiyal direncinden enterokoklar da nasibini almıştır [5,24,25]. Özellikle E. faceium'da direnç diğer etkenlerden daha yüksektir [19,20,24] Çalışmamızda da yıllar içinde tüm antibiyotiklere direnç artışı görülmüştür. Çoklu ilaç direnci, vankomisin, teikoplanin, ampisilin, amoksisilin, piperasilin, gentamisin, imipenem

direnci E. faecium'da anlamlı olarak yüksek bulunmuştur. Ülkemizde son sürveyans verilerine göre vakomisin direnc ortalaması %20-23, etkenlere göre ise E. faecium' da %21.3, E. faecalis' de %3.4 olarak bildirilmektedir [7,8]. Avrupa sürveyans verilerine göre ise E. faecium'da vankomisine direnç, bölge ülkeleri arasında farklılıklar göstermektedir. Avrupada 44 ülkenin altısında (%14) %1'in altında, 17'sinde (%39) %25 ve üzerinde ve beşinde (%11'inde) ise %50 ve üzerindedir [9]. Çalışmamızda E. faecium' da vankomisin direnci %22.4, E. faecalis' de %2.2 bulunmuştur. Diğer antibiyotiklere (teikoplanin, ampisilin, amoksisilin, piperasilin, gentamisin) direnç ise E. faecium' da %60-90, E. faecalis' de %2-7 arasında değişmektedir. Hastanemizde vankomisin dirençli enterokok (VRE) kolonizasyonu, yeni yatışı olan hastalarda sadece yoğun bakım ünitelerinde ve kemik iliği ünitesinde rektal sürüntü ile araştırılmaktadır. Alınan örnekler sürveyans amacı ile kullanılmaktadır, kolonize hastalarda tedavi ya da izolasyon yapılmamaktadır. Ancak bakteriyemi yada diğer enfeksiyon odaklarının ampirik tedavisinde ve etkene yönelik tedavilerde bu direnç durumu göz önüne alınmaktadır.

Enterokok bakteriyemilerinde hastane mortalitesi %20-35 olarak bildirilmektedir [24,25]. Çalışmamızda %74.5 gibi çok yüksek bir oranda saptanmıştır. Mortaliteye etki eden risk faktörleri incelendiğinde yaş ve cinsiyetler arasında fark görülmemiştir. Ancak sekonder bakteriyemiler, immunsüpresyon, malignite, COVID-19 enfeksiyonu, hipoalbuminemi varlığında literatürle uyumlu olarak mortalite yüksek bulunmuştur [2,26-29]. Ayrıca yapılan PEG, nazogastrik sonda, idrar sondası, trakeostomi, mekanik ventilasyon gibi girişimler mortaliteyi artırmaktadır [2,26-29].

Etkenlerin ve antibiyotik direncinin mortaliteye etkisi değerlendirildiğinde, etkenler arası fark görülmezken, ampisilin, gentamisin, imipenem, piperasilin, teikoplanin direnci varlığında mortalite anlamlı olarak yüksek saptanmıştır. Vankomisin direncinin bazı çalışmalarda mortaliteyi artırdığı gösterilirken çalışmamızda anlamlı fark bulunmamıştır [6,19,20]. Ayrıca SIRS, sepsis, yoğun bakım ünitesinde yatışın da mortaliteyi artırdığı görüldü. Pitt bakteriyemi skoru ve Charlson komorbidite indeksi ortalamaları da mortal seyredenlerde literatürle benzer şekilde daha yüksek olarak bulunmuştur [2,29]. Yüksek antimikrobiyal direnç morbidite ve mortalite oranlarını artırmaktadır. Etkin antimikrobiyal yönetim çalışmalarının yapılması ve allta yatan kronik hastalıkların yakın takibi hastalar için hayati rol oynamaktadır.

Çalışmamızın kısıtlılıkları arasında sadece beş yıllık süreyi kapsaması, hasta sayısının kısıtlı olması ve geriye dönük bir araştırma olması gösterilebilir. İleriye dönük, çok merkezli, fazla hasta sayısı olan vaka-kontrol veya kohort araştırmaların daha faydalı olacağı aşikardır. Ancak yakın tarihli hasta verilerinin kullanılması, geriye dönük sistem kayıtlarından, enfeksiyon hastalıkları izlemlerinden net bilgilere ulaşılması nedeni ile elde ettiğimiz anlamlı sonuçlar bilimsel katkı sağlayacaktır.

Sonuç olarak enterokok bakteriyemileri daha çok ileri yaşlarda görülen, sıklıkla SHİ enfeksiyonlardır ve mortalite oranları yüksektir. E. faecium ve E. faecalis en sık saptanan etkenlerdir. E. faecium daha genç yaşlarda, cerrahi bölümlerde, sekonder kaynaklı, SHİ bakteriyemilerde daha sık etken olarak görülmektedir. İntraabdominal ve apse odakları diğer etkenlere göre E. faecium'da da sıktır. Antibiyotiklere direnç durumu E. faecium' da diğer etkenlere göre yaklaşık 10 kat daha fazladır. E. faecalis ise daha çok toplum kaynaklı olarak karşımıza çıkmıştır. Kateter ilişkili kan dolaşımı enfeksiyonu ve endokardit diğer etkenlere göre E. faecalis'de daha sık saptanmıştır. Antibiyotiklere direnç oranları daha E. faecalis' de düşüktür. Saptanan yüksek antibiyotik direncinin, yapılan girişimlerin mortaliteyi artırması nedeni ile antimikrobiyal yönetim çalışmalarının, komorbiditelerin, enfeksiyon odaklarının kontrolünün, gereksiz invazif girişimlerden kaçınılmasın enterokok bakteriyemilerinin kontrol altına alınmasında önemli olduğu düşünülmektedir.

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Research Article

The effect of poly-l-lactic acid dermal filler on tendon healing

Poli-l-laktik asit bileşenli dermal dolgunun tendon iyileşmesi üzerine etkisi

Melihcan Sezgiç*, Savaş Serel

Department of Plastic, Reconstructive and Aesthetic Surgery, Ankara University Faculty of Medicine, Ankara, Turkey

Abstract

Aim: Tendon healing is a slow and complex process that often results in incomplete recovery of mechanical strength. Collagen plays a key role in tendon integrity, and poly-L-lactic acid (PLLA) has been shown to enhance collagen synthesis. This study aimed to investigate the effects of PLLA-based dermal fillers on tendon healing in a rat model.

Material and Methods: Twenty four Wistar Albino female rats were divided in two groups randomly as Control group and PLLA group. In control group, right achilles tendon was cut from 4 mm proximal to its calcaneal insertion. In PLLA group, following the same procedure, PLLA-based dermal filler was injected in between 2 tendon sections. Rats were sacrified after 3 weeks and tendons were excised to examine macroscopically, biomechanically and histologically according to parameters. Histological scoring was evaluated according to Bonar Criterias.

Results: The mean macroscopic scores between the PLLA and control groups did not differ significantly (4.8 ± 0.7 vs. 4.4 ± 0.7, p = 0.178). Biomechanical analysis revealed significantly less reduction in failure load) and stiffness in the PLLA group compared to the control group (-14.0 ± 7.0 vs. -21.3 ± 6.3 N, p = 0.041; -7.1 ± 1.7 vs. -10.4 ± 2.2 N, p = 0.026; respectively). The control group had higher histological scores compared to the PLLA group (7.5 ± 1.0 vs. 5.2 ± 1.0, p = 0.004).

Conclusions: PLLA-based dermal fillers may enhance tendon healing by preserving biomechanical strength and improving histological organization, highlighting their potential as a minimally invasive treatment approach for tendon injuries.

Keywords: Collagen, poly-l-lactic acid, PLLA, tendon healing

Corresponding Author*: Melihcan Sezgiç, Department of Plastic, Reconstructive and Aesthetic Surgery, Ankara University Faculty of Medicine, Ankara, Turkey
Orcid: 0000-0002-8213-8526
E-mail: mlh_s@yahoo.com
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Öz

Amaç: Tendon iyileşmesi, genellikle mekanik gücün tam olarak geri kazanılamadığı yavaş ve karmaşık bir süreçtir. Kollajen, tendon bütünlüğünde kilit bir rol oynar ve poli-L-laktik asidin (PLLA) kollajen sentezini artırdığı gösterilmiştir. Bu çalışmada, PLLA bazlı dermal dolgu maddelerinin sıçan modelinde tendon iyileşmesi üzerindeki etkilerini araştırmayı amaçladı.

Gereç ve Yöntemler: Yirmi dört Wistar Albino dişi sıçan, Rastgele Kontrol Grubu ve PLLA Grubu olmak üzere iki gruba ayrıldı. Kontrol grubunda, sağ Aşil tendonu, kalkaneal yapışma yerinin 4 mm proksimalinden kesildi. PLLA grubunda ise aynı işlem uygulandıktan sonra iki tendon ucu arasına PLLA bazlı dermal dolgu enjekte edildi. Sıçanlar 3 hafta sonra sakrifiye edilerek tendonlar makroskopik, biyomekanik ve histolojik olarak parametrelere göre incelendi. Histolojik skorlama, Bonar kriterlerine göre yapıldı.

Bulgular: PLLA ve kontrol grupları arasında ortalama makroskopik skor açısından anlamlı bir fark bulunmadı (4.8 ± 0.7 vs. 4.4 ± 0.7, p = 0.178). Biyomekanik analiz, PLLA grubunda yük taşıma kapasitesinde ve sertlikteki azalmanın kontrol grubuna kıyasla anlamlı derecede daha az olduğunu gösterdi (sırasıyla; -14.0 ± 7.0 vs. -21.3 ± 6.3 N, p = 0.041; -7.1 ± 1.7 vs. -10.4 ± 2.2 N, p = 0.026). Histolojik değerlendirmede, kontrol grubunun histolojik skorlarının PLLA grubuna göre daha yüksek olduğu belirlendi (7.5 ± 1.0 vs. 5.2 ± 1.0, p = 0.004).

Sonuç: PLLA bazlı dermal dolgular, biyomekanik dayanıklılığı koruyarak ve histolojik organizasyonu iyileştirerek tendon iyileşmesini artırabilir ve bu da tendon yaralanmaları için minimal invaziv bir tedavi yaklaşımı olarak potansiyellerini vurgular.

Anahtar Kelimeler: Kollajen, poli-l-laktik asit, PLLA, tendon iyileşmesi

Introduction

Tendon injuries are a frequent and significant clinical challenge within the musculoskeletal system, often leading to substantial functional deficits and a high risk of long-term disability (1). In particular, flexor tendon injuries pose a unique challenge due to their complex anatomy, limited vascular supply, and the high risk of adhesion formation following surgical intervention (2). Generally, tendon healing progresses through the phases of inflammation, proliferation, and remodeling, but attaining full histological and biomechanical restoration remains challenging (3). Despite the body's intrinsic regenerative capacity, the specialized structure of tendons—characterized by a parallel arrangement of collagen fibers and relatively poor vascularity—often results in suboptimal healing outcomes, including reduced strength and persistent stiffness (4, 5).

In recent years, there has been growing interest in harnessing the potential of tissue engineering and regenerative medicine approaches to optimize tendon repair. Biodegradable and biocompatible polymers, such as poly-L-lactic acid (PLLA), have emerged as promising materials in the development of scaffolds, implants, and drug delivery systems (6, 7). PLLA is well-known for its relatively low immunogenicity, controlled degradation profile, and capacity to support cell adhesion and proliferation—features that make it attractive for various orthopedic and soft tissue applications (8, 9). PLLA has gained substantial attention in aesthetic medicine as a dermal filler, primarily for its ability to stimulate collagen synthesis and promote tissue remodeling (10, 11). This unique mechanism of action, which leads to gradual volumization and neocollagenesis, may also provide potential benefits for tendon healing. By supporting extracellular matrix (ECM) deposition and enhancing the proliferation and differentiation of resident cells, PLLA-based fillers or scaffolds could theoretically contribute to the restoration of structural integrity and functional capacity in injured tendons (12, 13).

Although initial findings suggest that PLLA can facilitate soft tissue repair, there remains a notable gap in the literature regarding its efficacy and safety specifically in tendon healing. Further investigation is therefore necessary to elucidate the molecular and cellular pathways through which PLLA exerts its effects and to determine whether these positive outcomes observed in soft tissue augmentation translate effectively to tendon tissues (12, 13). Hence, this study aimed to investigate the effects of PLLA on a rat tendon healing model.

Material and methods

This experimental study was conducted in 2017 at Ankara University Faculty of Medicine's Experimental Animals and Research Laboratory and was approved by the Local Ethics

Committee for Animal Experiments of Ankara University (Date: 05.03.2024 - No: 2024/03-21).

Study Design

A total of 26 female Wistar albino rats (mean weight: 308 ± 48 g) were included in this study. Of these, 2 rats were dedicated to a pilot assessment to familiarize the researchers with the regional anatomy. The remaining 24 rats were then randomly divided into a control group (n = 12) and an experimental (PLLA) group (n = 12).

In the control group, an incision was made in the right Achilles tendon. The paratenon and skin were subsequently sutured without the application of any additional material. Following a three-week recovery period, tendon samples were collected from all 12 rats. Macroscopic measurements of tendon thickness were performed. Histological analysis was conducted on 6 of these rats, while the remaining 6 underwent complete excision of both left and right muscle–bone–tendon units for biomechanical testing.

For the control group, an incision was made in the right Achilles tendon, with the paratenon and skin subsequently sutured. After three weeks, tendon samples were obtained, and macroscopic evaluations of tendon thickness were carried out for all 12 rats. Samples for histological examination were collected from 6 rats, while the remaining 6 underwent complete excision of the left and right muscle-bone-tendon units, which were then assessed via biomechanical testing.

In the experimental group, the right Achilles tendon was transected in the same manner, but a PLLA-based dermal filler (Sculptra) was injected into the transection site prior to closing the paratenon and skin. After three weeks, the same procedures were carried out: macroscopic measurements of tendon thickness were recorded for all 12 rats; 6 rats provided tissue samples for histological evaluation, and the remaining 6 underwent excision of both left and right muscle–bone–tendon units for biomechanical analysis.

Preparation of PLLA Dermal Filler

A vial of Sculptra (containing 367.5 mg powder: 150 mg Poly-L-Lactic Acid, 90 mg sodium carboxymethylcellulose, and 127.5 mg nonpyrogenic mannitol) was used as the filler material (Figure 1a). To prepare, 5 mL of 0.9% saline was added to the vial, which was then gently swirled and allowed to stand for 3 hours at room temperature before use. This procedure ensured uniform hydration of the PLLA particles.

Surgical Procedure

All surgeries were performed under sterile conditions. Prior to surgery, each rat was anesthetized using an appropriate combination of ketamine (45 mg/kg) and xylazine (5 mg/kg), administered intramuscularly. The surgical area was shaved, disinfected with povidone-iodine, and draped using sterile technique to minimize contamination. A longitudinal incision was made approximately 4 mm proximal to the calcaneal insertion of the right Achilles tendon (Figure 1a). The skin and subcutaneous tissues were carefully incised to expose the Achilles tendon (Figure 1c) and its paratenon. The plantaris tendon was transected to prevent internal splinting (Figure 1d). A full-thickness cut was made on the Achilles tendon ~4 mm proximal to the calcaneal insertion (Figure 1e).

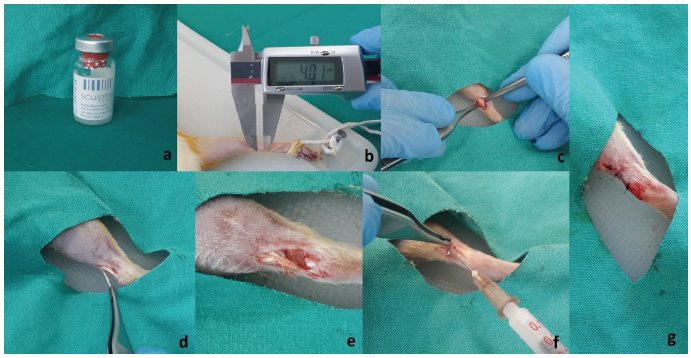

Figure 1.a) PLLA based dermal filler (Sculptra®), **b)** Planning the incision, **c)** exposure of right achilles tendon, **d)** Transection of plantaris tendon, **e)** Transection of achilles tendon, **f)** Sculptra injection, **g)** Closure of the incision.

In the control group, the paratenon and skin were sutured with 5/0 atraumatic round needle Prolene and surgery was terminated. In the PLLA group, approximately 0.1 mL of the prepared PLLA filler (Sculptra) was injected into the gap formed by the retraction of the proximal part of the tendon (Figure 1f). The paratenon and skin were then sutured in the same fashion as in the control group (Figure 1g).

In postoperative period, no external immobilization (splint or cast) was applied, and the rats were allowed free mobilization in their cages. Skin sutures were removed after 1 week.

Macroscopic Examination

Three weeks after surgery, all 24 rats were sacrificed using carbon dioxide (CO_2) inhalation. The right Achilles tendon in each rat was exposed along the previous incision line. Tendon morphology was assessed macroscopically using the scoring criteria described by Stoll et al. (14) and modified by Zhang et al. (15). A maximum score of 14 points indicated a healthy tendon appearance (Table 1).

Table 1. Macroscopic evaluation criteria (adapted from Zhang et al8)

	POINTS			
CRITERIA	3	2	1	0
Loading/Lameless	-	-	Hind leg fully loaded	NOT fully loaded
Tendon-Skin Connection(Slidability)	-	-	Slidable	Adhesion(+), NOT fully slidable
Tendon rupture	-	-	Non-existing	Existing
Inflammation	-	-	Non-existing	Existing(swelling, redness and edema)
Tendon Surface at the defect area	-	-	Intact, smooth	Firm, rough
Adjacent tendon properties	-	-	Unchanged	Changed(colour, thickness and surface)
Swelling/Redness of tendon	-	No swelling, redness	Palpable swelling, no redness	Palpable swelling and redness
Tendon-Paratendineum-Fascia Connection	-	-	Slidable	Adhesion(+), NOT slidable
Shape of tendon	Normal	Slightly thickened	Moderately thickened	Intensely thickened
Colour of tendon	-	-	Bright white	Translucent, dull white
M.gastrocnemius tendon strains	-	-	Normal, conjoined	Adhesion (+)
Higher the score the better tendon quality(Max :14, Min :0 pts)				

Biomechanical Evaluation

Biomechanical testing was carried out within 2 hour after the excision in the electro-mechanical testing device (Shimadzu AGS-X 1N-10kN Tensile Testing Machine, Columbia, MD, U.S.A.) located in the Biomedical Engineering department of Ankara University Faculty of Engineering (Figure 2). Six rats were randomly selected from both groups for biomechanical examination. For these selected rats, the incision was made from the calcaneus to the thigh, and the Achilles tendon was excised with the foot and distal 2/3 triceps surae muscle. In addition, the intact left achilles tendons were excised as muscle-bone-tendon unit also, for comparative test (Figure 3). The excised tendons were wrapped in gauze and soaked with a ringer's lactate solution, then held until testing. Before the test, tendon thickness and length was measured with a digital caliper (Watano) in the healing area. No stretching and adjustment was made to the tendons before the test, and the room temperature was at a constantly set at 25 °C. The free ends of the tendons were fixed with anti-slip plates and the speed of the test device was adjusted to 10 mm/min. With the help of the computer software that the test device was linked, the force/rupture graph curve was created. Also, load to failure (LF, N) and tendon stiffness (TS, N/mm) values was calculated separately for each tendon. Tendon stiffness value was calculated from the linear part of the force/rupture graph.

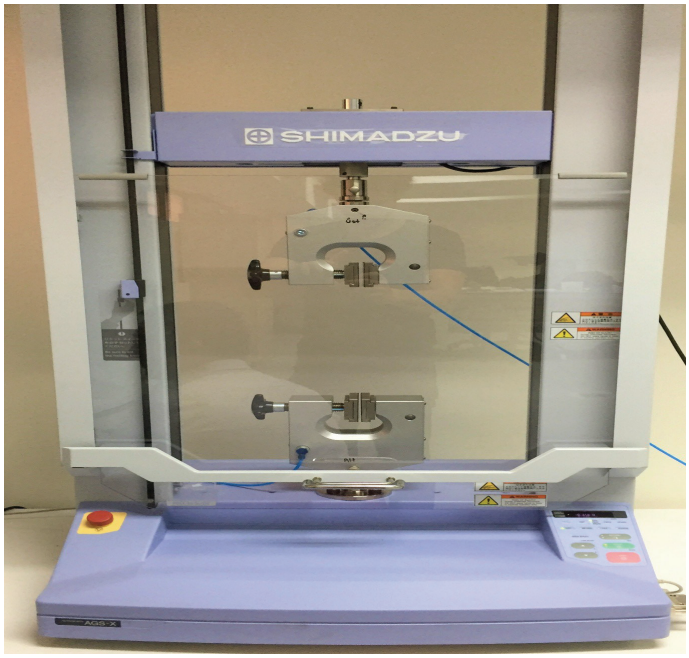

Figure 2. Shimadzu AGS-X 1N-10kN tensile test machine.

Histological Analysis

The remaining 6 rats from each group (n=6 per group) were used for histological examination. Tendons were fixed in 10% phosphate buffered formaldehyde for 24 hours, then washed under tap water. Dehydration was performed using graded ethanol series (75%, 96%, 100%). Tissues were made transparent with xylene after dehydration. After incubation for 3 hours in a 60 °C oven with liquid paraffin, it was buried in hard paraffin blocks. From the

paraffin blocks, 4 µm sections was taken with Leica® RM 2125RT "sliding" microtome. Also, in terms of comparison with the intact tendon section, the same procedure was applied to the sample taken from the left Achilles tendon of the rat and samples were taken. Hematoxylin-Eosin and Alcian Blue dyes were applied to the tissue sections. The prepared slides were examined with Zeiss ® Axio Scope A1 light microscope by one blinded investigator. Slide photos were provided with the help of Sysmex Pannoramic 250 Flash III digital pathology screening device located in the Pathology Department of Ankara University Medical Faculty.

Figure 3. Excised muscle-bone-tendon unit (left: injured, right: healthy).

For the assesment of prepared microscopic slides, The Bonar Criteria (Table 2) was used which was described by Maffulli et al (16). Tenocytes were evaluated according to spindle form, increased rounding, increased size and the amount of cytoplasm. The ground substance was scored using alcian blue dye. While evaluating collagen, demarcation and organization of the fibers were taken into account. Therefore, parameters of separation of fibers, loss of demarcation and tendon structure were examined. Vascularity was scored by examining the capillary vascular clumps between the collagen fibers in the tendon tissue.

Statistical Analysis

All statistical analyses were conducted using IBM SPSS program. The normality of numerical data distribution was assessed using the Kolmogorov-Smirnov test. Data were presented as mean ± standard deviation and median (min-max). Comparisons between two groups were performed using the Mann-Whitney U test. For comparisons involving more than two groups, the ANOVA test (post-hoc: Bonferroni) was used for normally distributed data, and the Kruskal-Wallis H test (post-hoc: Dunn's test) was used for non-normally distributed data. For biomechanical examination, Wilcoxon test was used to test whether the distribution of the two variables is the same, taking into account the dimensions of the differences between the paired groups. A p-value of $P < 0.05$ was considered statistically significant for all analyses.

Table 2. The Bonar Criteria (adapted from Maffulli et al9)

VARIABLES	Tenocytes	Ground Substance	Collagen	Vascularity
Grade 0 (0 point)	Insignificant elongated spindle shaped nuclei with no obvious cytoplasm at light microscopy	No stainable ground substance	Collagen arranged in tightly cohesive well-demarcated bundles with a smooth dense birght homogenous polarization pattern with normal crimping	Insignificant blood vessels coursing between bundles
Grade 1 (1 point)	Increased roundness (nucleus becomes more ovoid to round in shape without remarkable cytoplasm)	Stainable mucin between fibers but bundles still discrete	Diminished fiber polarization(seperation of individual fibers with maintenance of demarcated bundles)	Occasional cluster of capillaries, less than one per 10 high-power fields
Grade 2 (2 point)	Increased roundness and size(the nucleus is round, slightly enlarged and a small amount of cytoplasm is visible)	Stainable mucin between fibers with loss of clear demarcation of bundles	Bundle changes(seperation of fibers without demarcation of fibers giving rise to expansion of the tissue overall and clear loss of polarization pattern)	1-2 clusters of capillaries per 10 high power fields
Grade 3 (3 point)	Nucleus is round, large with abundant cytoplasm and lacuna formation(chondroid change)	Abundant mucin throught with inconspicuous collagen staining	Marked seperation of fibers with complete loss of architecture	Greater than 2 clusters per 10 high power fields
0 pt :Normal tendon, 12 pt: most abnormal tendon				

Results

Macroscopic Findings

On the 21st day of the study, the macroscopic morphology of the tendons was examined. Under normal conditions, healthy tendons appear white, feature a smooth surface, and exhibit no adhesion to surrounding tissues. In contrast, the operated tendons exhibited a dull white, thickened appearance, along with multiple adhesions extending to the paratenon, fascia, and subcutaneous tissue. Although both the control and PLLA groups exhibited thickening and adhesions involving the paratenon, fascia, and subcutaneous tissue in the Achilles tendons, the PLLA group showed relatively less thickening compared to the control group. However, the mean macroscopic scores between the PLLA and control groups did not differ significantly (4.8 ± 0.7 vs. 4.4 ± 0.7, p = 0.178) (Table 3).

Biomechanical Findings

In the control group, the mean LF value was higher in the healthy tendon group compared to the injured tendon group (45.7 ± 9.9 vs. 24.3 ± 5.8 N, p = 0.027). Similar findings were observed in the PLLA group (Healthy tendon: 41.5 ± 12.5 vs. Injured tendon: 27.5 ± 7.4 N, p = 0.028) (Table 4).

Table 3. Distribution of macroscopic scores in control and PLLA groups.

	PLLA group		Control group		
	Mean ± SD	Median (min - max)	Mean ± SD	Median (min - max)	P-value*
Macroscopic Score	4.8 ± 0.7	5.0 (4.0 - 6.0)	4.4 ± 0.7	4.0 (4.0 - 6.0)	0.178

Abbreviations: Max, Maximum; Min, Minimum; SD, standart deviation. *Mann Whitney U Test.

Table 4. Distribution of load to failure and tendon stiffness values in control and PLLA groups.

	PLLA group		Control group	
	Mean ± SD	Median (min - max)	Mean ± SD	Median (min - max)
Load to failure, N				
Healthy tendon	41.5 ± 12.5	37.5 (30.0 - 64.0)	45.7 ± 9.9	46.5 (35.0 – 62.0)
Injured tendon	27.5 ± 7.4	25.5 (20.0 - 37.0)	24.3 ± 5.8	23.5 (17.0 - 32.0)
P-value*	0.028		0.027	
Tendon stiffness, N/mm				
Healthy tendon	14.2 ± 1.8	13.9 (11.8 - 16.9)	15.4 ± 2.1	15.2 (12.5 - 18.0)
Injured tendon	7.1 ± 0.9	6.8 (6.2 - 8.2)	4.9 ± 0.6	5.0 (4.1 - 5.6)
P-value*	0.027		0.028	

Abbreviations: Max, Maximum; Min, Minimum; SD, standart deviation.*Wilcoxon Test

In the control group, the mean TS value was higher in the healthy tendon group compared to the injured tendon group (15.4 ± 2.1 vs. 4.9 ± 0.6 N/mm, p = 0.028). Similar results were noted in the PLLA group (Healthy tendon: 7.1 ± 0.9 N/mm, p = 0.027) (Table 4).

To quantify the biomechanical deficit resulting from tendon injury, the differences (Δ) in LF and TS values were calculated by subtracting the injured tendon measurements from the corresponding healthy tendon measurements. Table 5 provides a comparative overview of these differences for both the PLLA and control groups. In the PLLA group compared to control groups, the mean ΔLF (-14.0 ± 7.0 vs. -21.3 ± 6.3 N, p = 0.041) and mean ΔTS (-7.1 ± 1.7 vs. -10.4 ± 2.2 N, p = 0.026) levels was lower (Table 5).

Histological Findings

Before initiating the primary experimental analyses, histological examinations of healthy tendons were performed. The observations revealed spindle-shaped tenocyte nuclei, organized collagen fibers, and negligible capillary clusters, indicative of normal tendon architecture (Figure 4).

Table 5. Comparison of decrease in load to failure and tendon stiffness values between the control and PLLA groups.

	PLLA group		Control group		P-value*
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
ΔLoad to failure, N	-14.0 ± 7.0	-12.5 [(-27) - (-6)]	-21.3±6.3	-19.5 [(-32) - (-16)]	0.041
ΔTendon stiffness, N/mm	-7.1 ± 1.7	-7.2 [(-9.8) - (-5.1)]	-10.4±2.2	-10.4 [(-13.9) - (-7.2)]	0.026

Abbreviations: Max, Maximum; Min, Minimum; SD, standart deviation. *Mann Whitney U Test.

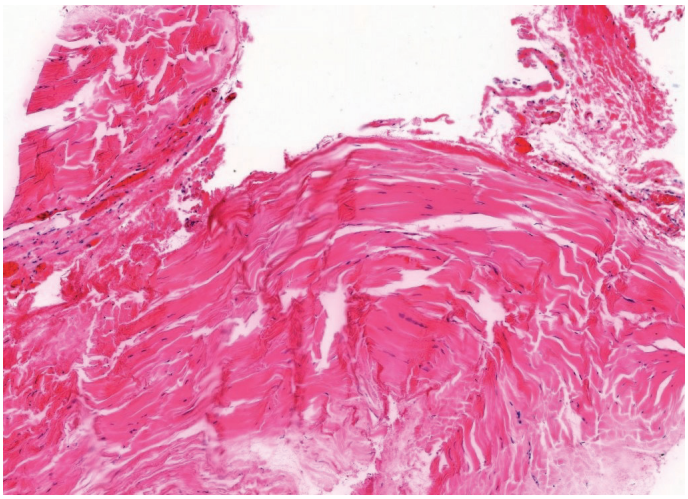

Figure 4. Microscopic slide of healthy tendon; Spindle shaped tenocyte nuclei, no obvious cytoplasm, organized collagen fibers.

Tenocyte morphology was found to be impaired in both groups of injured tendons. Notably, the control group displayed a higher rate of lacuna formation—suggestive of cartilage transformation—and rounding of tenocyte nuclei compared with the PLLA group (Figure 5a, b).

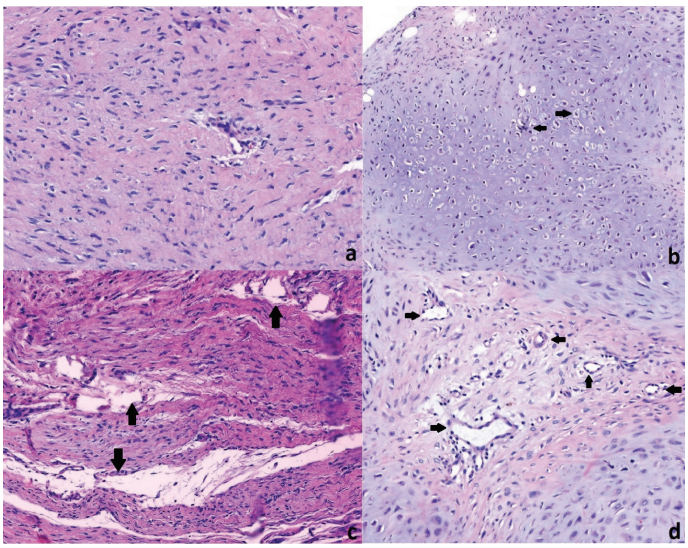

Figure 5. a) Increased roundness of tenocytes (Grade 1), **b)** Lacunae formation (sign of cartilage transformation), **c)** Separation of collagen fibers, **d)** Increased vascularity(arrows show capillary vessels)

Additionally, both groups exhibited a comparable degree of collagen fiber irregularity and separation (Figure 5c). When evaluating the intermediate material, mucin staining was observed to be more intense in the control group than in the PLLA group. Moreover, an increased capillary clusters was similarly noted in both groups (Figure 5d).

The control group had higher histological scores compared to the PLLA group (7.5 ± 1.0 vs. 5.2 ± 1.0, p = 0.004) (Table 6).

Discussion

This study is among the rare investigations highlighting the clinical efficacy of PLLA in tendon injuries. Our findings suggest that PLLA application may provide certain histological and biomechanical advantages in tendon repair, although its effects on macroscopic tendon morphology remain statistically insignificant.

Although there was no significant difference in the macroscopic score between the PLLA group and the controls, the PLLA group exhibited relatively better macroscopic tendon morphology. Moreover, tendons in the control group exhibited greater thickness and edema compared to those in the PLLA group. Previous studies suggest that in tendon repair models using PLLA, the tendon maintains its macroscopic integrity, with a smooth layer of connective tissue covering its surface (17, 18). In a study conducted on rabbits with a medial collateral ligament model, it was reported that the newly formed tissue obtained using a PLLA scaffold was macroscopically covered with normal connective tissue but initially appeared thicker (hypertrophic) compared to the normal tendon (17). This thickening was observed in the early phase due to the presence of dense fibrotic tissue around the scaffold but showed a tendency to resolve as the tissue matured over time. A study on animals implanted with a double-layered PLLA scaffold reported that the repair site was externally covered by a thin and uniform membrane, with no evident signs of significant inflammation (18). These results suggest that PLLA effectively integrates tendon ends, ensures structural integrity, and facilitates the formation of a macroscopically organized morphology.

Table 6. Comparison of histological scores between the control and PLLA groups.

	PLLA group		Control group		P-value*
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
Bonar Scores	5.2 ± 1.0	5.5 (4.0 - 6.0)	7.5 ± 1.0	7.5 (6.0 – 9.0)	0.004

Abbreviations: Max, Maximum; Min, Minimum; SD, standart deviation. *Mann Whitney U Test.

Various studies have emphasized the beneficial role of PLLA in preventing adhesion formation, which is an unfavorable complication in tendon healing. A previous study demonstrated that a double-layered PLLA fiber scaffold significantly reduced macroscopic adhesions and preserved a gliding space around the tendon (19). Another study assessed electrospun PLA and poly(ε-caprolactone) (PCL) membranes with varying degradation kinetics to investigate their anti-adhesive effects in Achilles tendon repair. The findings revealed that the electrospun PLA membrane group exhibited significantly superior anti-adhesive properties and tendon repair potential compared to the PCL membrane group (20). In this study, both the control and PLLA groups exhibited thickening and adhesions in the Achilles tendons, involving the paratenon, fascia, and subcutaneous tissue. However, it is well established that macroscopic changes in tissue healing occur later than microscopic alterations. Therefore, a longer waiting period between procedures may influence the observed results.

The observation that healthy tendons demonstrate significantly higher LF and TS values than injured tendons is an anticipated outcome, given that tendon injuries impair mechanical properties, thereby reducing both strength and stiffness (21). On the other hand, we found that the biomechanical deficits (ΔLF and ΔTS) were significantly lower in the PLLA-treated group compared to the control group. This suggests that PLLA treatment may mitigate the loss of mechanical properties following tendon injury. Similar outcomes have been reported in previous research. Gould et al. demonstrated that PLLA mesh augmentation in patellar tendon repair enhanced biomechanical stability, resulting in reduced gap formation and increased load-to-failure compared to repairs without augmentation (22). Additionally, studies have shown that PLLA scaffolds can promote tendon regeneration by providing structural support and facilitating cell proliferation, thereby improving the mechanical integrity of the healing tendon (23). Furthermore, a study evaluating a layered PLLA scaffold for infraspinatus tendon defects in a rabbit model supports these findings. The study demonstrated that PLLA scaffolds facilitated cell migration, promoted tissue regeneration, and ultimately restored biomechanical properties comparable to reattached tendons at 8 and 16 weeks postoperatively. Although tendon stiffness did not show significant improvement, the fact that PLLA-treated tendons achieved a failure load similar to native infraspinatus tendons suggests that PLLA-based scaffolds can effectively bridge tendon defects and contribute to mechanical restoration over time (24). Another study compared three biodegradable materials—poly-N-acetyl-D-glucosamine (chitin), PCL, and PLA—for tendon reconstruction in a rabbit model. The results indicated that PLA and chitin/p-CL composite tendons exhibited good initial strength and promoted fibrous tissue ingrowth, while chitin tendons degraded rapidly, leading to early strength loss. Notably, PLA-based implants supported the formation of both type I and type III collagen, which are essential for tendon regeneration (25). These findings align with our results, suggesting that PLLA scaffolds provide structural integrity during tendon healing and may enhance mechanical recovery by promoting extracellular matrix deposition.

Tendon healing is a complex process involving cellular proliferation, extracellular matrix remodeling, and vascularization. In this study, we observed that PLLA-treated tendons exhibited improved histological organization compared to the control group, with reduced signs of degenerative changes. These findings suggest that PLLA scaffolds may support a more favorable regenerative environment, potentially by modulating cellular behavior and matrix organization. Previous research has demonstrated that PLLA scaffolds enhance wound healing by promoting fibroblast proliferation and neocollagenesis (26, 27). PLLA has also been recognized as a deep tissue regenerator, as it increases fibroblast activity and collagen production through a controlled inflammatory response (28, 29). Neocollagenesis begins within the first month, peaks around the sixth month, and continues up to nine months before PLLA particles are completely eliminated (29, 30). This progressive collagen formation suggests that PLLA could play a significant role in the

maturation phase of tendon healing, which extends beyond the early inflammatory and proliferative stages. In our study, lacuna formation, a marker of severe degeneration, was observed in two control samples, and cell rounding was more pronounced in the control group. Additionally, mucin staining intensity was higher in the control group, suggesting greater extracellular matrix disorganization, while collagen fiber separation was similar in both groups. These findings align with previous studies indicating that collagen fiber organization is primarily a late-stage remodeling event, which may not be fully developed in the early healing phase (31-34). Rat tendon healing studies have shown that major histological changes occur within the first two weeks post-injury, making our three-week evaluation period appropriate for early-stage assessment (35).

This study has some limitations. First, the follow-up period was limited to three weeks, focusing on the early phase of tendon healing. Since PLLA-induced neocollagenesis continues for up to nine months, its long-term effects on tendon remodeling and mechanical strength remain unknown. Second, while histological scoring was performed, quantitative methods such as collagen fiber alignment analysis or molecular markers were not included. Third, the rat tendon model may not fully replicate human tendon healing, given species differences in biomechanics and load-bearing capacity. Finally, the long-term degradation profile and potential dose-dependent effects of PLLA dermal fillers remain unclear. Future studies incorporating extended follow-up periods, advanced quantitative assessments, and large-animal or clinical models are needed to fully elucidate PLLA's role in tendon healing.

Conclusion

This study demonstrates that PLLA improves tendon healing by reducing adhesions, preserving biomechanical strength, and enhancing histological organization. PLLA-treated tendons exhibited lower histological degeneration scores, healthier tenocyte morphology, and lower lacuna formation, contributing to improved tissue remodeling. PLLA's well-documented ability to stimulate fibroblast activity and neocollagenesis makes it a promising candidate for tendon regeneration. Additionally, its injectable form provides a minimally invasive alternative to traditional tendon repair strategies, allowing for post-injury application without the need for open surgery.

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Conflicts of Interest

The authors declare they have no conflicts of interest.

Ethics Approval

The study was approved by the Ankara University Animal Experiments Ethics Committee.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author.

Authors' contribution

Concept – M.S. and S.S., Design- S.S.; Supervision - S.S.; Data collection and/or processing – M.S. and S.S., Analysis and/or interpretation - M.S. and S.S., Writing – M.S.; Critical review- S.S. All authors read and approved the final version of the manuscript.

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Araştırma Makalesi

Anestezistlerin bidirectional endoskopi işlemlerinde prosedür sırası tercihleri ve belirleyici faktörler

Preferences and determinants of procedural sequencing in bidirectional endoscopy among anesthesiologists

Caner Genc*[1], Sezgin Bilgin[2], Hasan Cetinkaya[3], Hatice Kusderci[1], Sevda Akdeniz[1], Esra Turunc[2], Burhan Dost[2], Ozgur Komurcu[1]

[1]Samsun Üniversitesi, Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Anabilim Dalı, Samsun, Türkiye
[2]Ondokuz Mayıs Üniversitesi, Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Anabilim Dalı, Samsun, Türkiye
[3]Sungurlu Devlet Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Çorum, Türkiye

Öz

Amaç: Bu çalışmanın amacı, bidirectional endoskopi işlemlerinde (özofagogastroduodenoskopi [ÖGD] ve kolonoskopi) anestezistlerin prosedür sırası tercihlerini ve bu tercihlere etki eden faktörleri değerlendirmektir.

Gereç ve Yöntemler: Tanımlayıcı ve kesitsel tasarımda yürütülen bu anket çalışması, Kasım-Aralık 2024 tarihleri arasında Türkiye genelinde ameliyathane dışı anestezi uygulamalarında deneyimli anestezistlere çevrim içi platformlar aracılığıyla uygulanmıştır. Çalışmaya, endoskopi ünitelerinde aktif görev alan ve bidirectional endoskopi konusunda deneyimli 204 anestezist katılmıştır. Anket formu, katılımcıların demografik bilgileri, klinik pratikleri, prosedür sırası tercihleri ve tercih nedenlerini sorgulayan sorulardan oluşmuştur. Verilerin istatistiksel analizi SPSS 22.0 programı kullanılarak gerçekleştirilmiş, kategorik değişkenler Pearson Ki-Kare testi ile değerlendirilmiş ve $p<0,05$ anlamlı kabul edilmiştir.

Bulgular: Katılımcıların %63,7'si bidirectional endoskopilere ÖGD ile başlandığını belirtirken, %15,7'si kolonoskopiyi tercih etmiş, %20,6'sı ise belirli bir işlem sırası olmadığını ifade etmiştir. İşlem sırası tercihi; anestezistin yaşı ($p=0,010$), çalıştığı kurum türü ($p=0,002$) ve mesleki deneyimi ile ilişkili bulunmuştur. En sık tercih edilen intravenöz sedatif ajanlar propofol (%99,0), midazolam (%86,3) ve fentanil (%58,8) olmuştur. İşlem sırası tercihini etkileyen başlıca faktörler arasında endoskopistin tercihi (%69,1), ekipman uygunluğu (%56,4) ve hava yolu yönetimi güvenliği (%30,9) yer almıştır. Komplikasyonlar arasında en sık solunum depresyonu (%51,5) gözlenmiş olup, işlem sırasına göre komplikasyon oranlarında anlamlı fark saptanmamıştır ($p>0,05$).

Sonuç: Anestezistlerin bidirectional endoskopide işlem sırası tercihleri çeşitli hasta ve çevresel faktörlerden etkilenmektedir. Çoğu anestezist, hasta güvenliği ve ekip dinamiklerini göz önünde bulundurarak işlem sırası olarak ÖGD ile başlamayı tercih etmektedir. Elde edilen bulgular, multidisipliner ekip çalışmasının ve hasta özelliklerinin dikkate alınmasının, hasta güvenliği ve prosedürel başarı açısından önemini vurgulamaktadır.

Anahtar Kelimeler: bidirectional endoskopi, özofagogastroduodenoskopi, kolonoskopi, prosedür sırası, anestezi yönetimi

Sorumlu Yazar*: Caner Genç, Samsun Üniversitesi, Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Anabilim Dalı, Samsun, Türkiye
E-posta: caner.genc@samsun.edu.tr
Orcid: 0000-0002-2987-6909
Doi: 10.18663/tjcl.1646691
Geliş Tarihi: 25.02.2025 Kabul Tarihi: 14.03.2025

Abstract

Aim: This study aims to evaluate anesthesiologists' preferences regarding procedural sequencing in bidirectional endoscopy (esophagogastroduodenoscopy [EGD] and colonoscopy) and to identify the factors influencing these preferences.

Material and Methods: This descriptive and cross-sectional survey was conducted online between November and December 2024 among anesthesiologists experienced in non-operating room anesthesia practices across Turkey. A total of 204 anesthesiologists actively working in endoscopy units and experienced in bidirectional endoscopy participated in the study. The survey included questions on demographic information, clinical practices, procedural sequence preferences, and the reasons behind these preferences. Statistical analysis was performed using SPSS version 22.0, with categorical variables analyzed using the Pearson Chi-Square test, and a p-value of <0.05 was considered statistically significant.

Results: Among the participants, 63.7% reported starting bidirectional endoscopies with EGD, 15.7% preferred beginning with colonoscopy, and 20.6% indicated no specific procedural order. The choice of procedural sequence was significantly associated with the anesthesiologist's age (p=0.010), type of institution (p=0.002), and professional experience. The most commonly used intravenous sedatives were propofol (99.0%), midazolam (86.3%), and fentanyl (58.8%). Key factors influencing the choice of procedural order included the endoscopist's preference (69.1%), equipment availability (56.4%), and considerations regarding airway management safety (30.9%). The most frequently reported complication was respiratory depression (51.5%), with no statistically significant difference in complication rates based on procedural sequence (p>0.05).

Conclusion: Various patient-related and environmental factors influence anesthesiologists' preferences for procedural sequencing in bidirectional endoscopy. While starting with EGD is the most common approach, patient safety and team dynamics are critical determinants of procedural choices. These findings highlight the importance of multidisciplinary teamwork and the consideration of patient characteristics in optimizing procedural safety and success.

Keywords: bidirectional endoscopy, esophagogastroduodenoscopy, colonoscopy, procedural sequence, anesthesia management

Giriş

Bidirectional endoskopik prosedürler, üst gastrointestinal sistemin özofagogastroduodenoskopi (ÖGD) ve alt gastrointestinal sistemin kolonoskopi yöntemleri kullanılarak aynı seansta değerlendirilmesini ifade eder [1]. Bu yöntem, genellikle nedeni açıklanamayan demir eksikliği anemisi, gastrointestinal kanama, malignite taraması, açıklanamayan kilo kaybı, inflamatuar bağırsak hastalıkları gibi birçok durumlarda tanı ve gerekli durumlarda da tedavi amacı ile tercih edilmektedir [2,3]. ÖGD ve kolonoskopi prosedürlerinin "bidirectional" olarak birlikte performe edilmesi, tanısal sürecin hızlanmasına, hasta yönetiminin daha etkin bir şekilde gerçekleştirilmesine, ek stres ve maliyetlerin azaltılmasına olanak tanımaktadır.

İşlem sıralaması hem endoskopistlerin hem de anestezistlerin farklı önceliklerine göre değişiklik gösterebilmektedir [4]. Endoskopistlerin sıralama tercihlerinde genellikle tanı ve tedaviye yönelik klinik öncelikler belirleyici olurken, anestezistler için öncelikli konular arasında hasta güvenliği, sedasyon yönetimi ve komplikasyonların önlenmesi sayılabilir [5]. Bununla birlikte, bidirectional endoskopik prosedürler için işlem sıralamasına ilişkin anestezistlerin yaklaşımlarını ve bu tercihlere etki eden faktörleri detaylı bir şekilde ele alan çalışmaların literatürde sınırlı olduğu gözlemlenmektedir ve bu durum hasta yönetimi açısından daha fazla araştırmayı gerektirmektedir.

Bu çalışma, anestezistlerin bidirectional endoskopi işlemleri sırasında ÖGD ve kolonoskopi sıralamasına yönelik tercihlerini ve bu tercihleri etkileyen hasta ve çevresel faktörleri incelemeyi amaçlamaktadır. Özellikle, sigara içen bireyler gibi spesifik hasta gruplarında işlem sırasının klinik sonuçlar üzerindeki potansiyel etkilerini ele alarak, bu alandaki anlayışımızı genişletmeyi hedefliyoruz. Mevcut literatür genellikle genel popülasyon üzerine sonuçlar sunmuş olup, bu konuya yeterince odaklanmamıştır. Bu nedenle, çalışmamız endoskopi öncesi değerlendirme süreçlerini iyileştirmeye yönelik önerilerde bulunarak hem sigara içen hastaların hem de genel olarak bidirectional endoskopi gerektiren hastaların yönetimini optimize etmeye yönelik önemli bilgiler sunmaktadır. Bu açıdan bakıldığında, çalışmamız klinik pratiğe doğrudan uygulanabilir yenilikçi bilgiler sağlaması açısından değerlendirilebilir. Ayrıca, elde edilen bulguların multidisipliner ekip iş birliğini destekleyerek hasta yönetiminin iyileştirilmesine katkı sağlayacağı öngörülmektedir.

Gereç ve Yöntemler

Bu çalışma, tanımlayıcı ve kesitsel tasarımda bir anket çalışması olarak, online questionniarie kullanılarak, 1 Kasım 2024- 31 Aralık 2024 tarihleri arasında yürütüldü. Çalışma protokolü Samsun Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu'ndan GOKAEK 2024/19/3 sayı numarası ile etik kurul onayı alındı. Çalışmaya katılacak anestezistlere dijital platformlar üzerinden ulaşılmak suretiyle anket uygulaması gerçekleştirildi. Etik kurul onayı alındıktan sonra, Türk Anesteziyoloji ve Reanimasyon Derneği'ne üye anestezi uzmanları ve asistanlarına e-posta ve çeşitli sosyal medya platformları (WhatsApp, Twitter, LinkedIn) aracılığıyla ulaşıldı. Çalışmaya katılmayı kabul edenlerden anket sorularını yanıtlamaları istendi. Çalışmaya, ameliyathane dışı anestezi uygulamalarında deneyimli, endoskopi ünitelerinde aktif olarak görev alan ve bidirectional endoskopi uygulamaları hakkında bilgi ve deneyime sahip anestezistler dahil edildi. Anket verilerindeki eksiklik durumunda veya bu alanda yeterli deneyime sahip olmadığını belirten katılımcılar analiz dışı bırakıldı.

Bu çalışmada veri toplama aracı olarak kullanılan anket formu, demografik bilgiler, klinik pratikler ve prosedür tercihleri olmak üzere üç ana başlık altında yapılandırıldı. Anketin birinci bölümünde katılımcıların yaş, cinsiyet ve mesleki deneyim süresi gibi deskriptif ve sosyodemografik verileri sorgulandı. İkinci kısımda ise, klinik pratikler başlığı altında, bidirectional endoskopi sırasında prosedür sıralamasına yönelik tercihler ve bu tercihlere etki eden nedenler incelendi, ayrıca gastroskopi ve kolonoskopi sıralamasının tercih edilme nedenlerini değerlendiren kapalı uçlu ve yarı açık uçlu sorular yer aldı, katılımcılardan seçeneklerden birini işaretlemeleri istendi (bazı sorularda katılımcılara aynı soruda birden fazla seçeneği işaretleme hakkı verildi). Üçüncü bölümde, katılımcılardan bidirectional prosedürlere ilişkin tutumlarını aşağıdaki gibi beş noktalı Likert tipi ölçek kullanarak değerlendirmeleri istendi: 1, tamamen katılıyorum; 2, katılıyorum; 3, kısmen katılıyorum; 4, katılmıyorum; 5, hiç katılmıyorum. Çalışmamızın analizi, dijital ortamda gerçekleştirilerek elde edilen veriler temel alınarak yapılmış olup, anket formunun bu şekilde yapılandırılması, hedeflenen kapsamlı veri toplama ve analiz sürecine olanak tanımaktadır.

Örneklem büyüklüğü hesaplaması, çevrimiçi örneklem büyüklüğü hesaplama aracı kullanılarak gerçekleştirildi. Popülasyon boyutu 10.000 anestezist olarak belirlenmiş, %85 güven düzeyi ve %5 hata payı kabul edilmiştir. Buna göre, minimum örneklem büyüklüğü 204 olarak hesaplandı.

Verilerin istatistiksel analizi için SPSS (version 22.0, SPSS Inc.) paket programı kullanıldı. Kategorik değişkenler sayı (n) ve yüzde (%) olarak verildi. Değişkenler karşılaştırılırken Pearson Ki-Kare testi ile analiz edildi. Tüm karşılaştırmalarda istatistiksel olarak önemlilik için $p<0,05$ anlamlı düzey olarak kabul edildi.

Bulgular

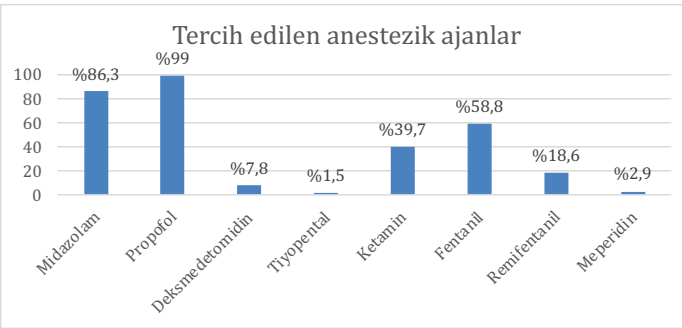
Çalışmaya dahil edilen 204 katılımcının %42,6'sı 24-35 yaş, %26,0'sı 36-45 yaş, %25,0'ı 46-55 yaş ve %6,4'ü >65 yaş grubundaydı. Katılımcıların %18,6'sı öğretim üyesi, %51,5'i uzman doktor, %29,9'u asistan doktorlardan oluşuyordu. "Bidirectional endoskopi işlemlerinde kurumunuzda rutin olarak hangi işleme başlanıyor?" sorusuna 130'u (%63,7) gastroskopi ile, 32'si (%15,7) kolonoskopi ile başlandığını belirtirken, çalıştıkları birimde rutinde bir işlem sırası olmadığını belirten 42 (%20,6) anestezist vardı.

Çalışmaya katılan anestezistlerin işlem sırası tercihlerine göre demografik özelliklerinin karşılaştırılması Tablo 1'de sunuldu. Yaş grupları açısından karşılaştırıldığında kolonoskopi ile başlayanların daha yüksek (%65,6) sıklıkta 24-35 yaş grubunda olduğu ve anestezistlerin işlem sırası tercihlerinin yaş grupları açısından anlamlı farklılık gösterdiği belirlendi ($p=0,010$). Gastroskopi grubunda en sık (%56,9) uzman doktor, kolonoskopi grubunda en sık (%50,0) asistan doktor ve rutin tercihi olmayan grupta ise (%47,6) uzman doktor yer alıyordu ve anestezistlerin işlem sırası tercihleri görev tanımlarındaki farklılık istatistiksel anlamlılığa oldukça yakındı ($p=0,073$). Benzer şekilde iş deneyimi açısından da işlem sırası tercihleri göre istatistiksel anlamlılığa yakın fark olduğu belirlendi ($p=0,075$). Çalışmaya en yüksek sıklıkta (%34,3) eğitim ve araştırma hastanelerinde çalışan anestezistler katıldı. Gastroskopi ile başlamayı tercih edenlerin %36,9'u eğitim ve araştırma hastanelerinde, kolonoskopi ile başlayanların %56,3'ü üniversite hastanesinde ve rutin başlama tercihi olmayanların %28,6'sı devlet hastanesinde çalışıyordu ve aralarındaki farklılık anlamlı düzeydeydi ($p=0,002$). Günlük işlem sayısı katılımcıların %32,8'i'nde günde 11-20 işlem ve %25,5'inde 6-10 işlem olarak belirlendi. Ancak tercih gruplarına göre işlem sayılarında farklılık yoktu ($p=0,281$) (Tablo 1).

Tablo 1. Anestezistlerin Demografik Özellikleri ve Bidirectional Endoskopi İşlem Sırası Tercihlerinin Karşılaştırmalı Analizi

Değişkenler		Toplam katılımcılar n (%)	Gastroskopi ile başlayanlar n (%)	Kolonoskopi ile başlayanlar n (%)	Tercihi için Rutini Yok n (%)	P değeri
Yaş grubu (yıl)	24-35	87 (42,6)	47 (36,2)	21 (65,6)	19 (45,2)	0,010
	36-45	53 (26,0)	36 (27,7)	9 (28,1)	8 (19,0)	
	46-55	51 (25,0)	35 (26,9)	2 (6,3)	14 (33,3)	
	≥ 56	13 (6,4)	12 (9,2)	0 (0,0)	1 (2,4)	
İş tanımı	Asistan Doktor	61 (29,9)	32 (24,6)	16 (50,0)	13 (31,0)	0,073
	Uzman Doktor	105 (51,5)	74 (56,9)	11 (34,4)	20 (47,6)	
	Öğretim Üyesi	38 (18,6)	24 (18,5)	5 (15,6)	9 (21,4)	
İş deneyimi	<3 yıllık asistan	36 (17,6)	17 (13,1)	11 (34,4)	8 (19,0)	0,075
	≥3 yıllık asistan	24 (11,8)	15 (11,5)	5 (15,6)	4 (9,5)	
	<10 yıllık uzman	54 (26,5)	33 (25,4)	8 (25,0)	13 (31,0)	
	≥10 yıllık uzman	90 (44,1)	65 (50,0)	8 (25,0)	17 (40,5)	
Çalıştığı Kurum	Devlet Hastanesi	53 (26,0)	36 (27,7)	5 (15,6)	12 (28,6)	0,002
	Özel Hastane	23 (11,3)	20 (15,4)	1 (3,1)	2 (4,8)	
	Eğitim ve Araştırma Hastane	70 (34,3)	48 (36,9)	8 (25,0)	14 (33,3)	
	Üniversite Hastanesi	55 (27,0)	23 (17,7)	18 (56,3)	14 (33,3)	
	Diğer	3 (1,5)	3 (2,3)	0 (0,0)	0 (0,0)	
Günlük ortalama işlem sayıları	0-5	48 (23,5)	29 (22,3)	5 (15,6)	14 (33,3)	0,281
	6-10	52 (25,5)	35 (26,9)	10 (31,3)	7 (16,7)	
	11-20	67 (32,8)	40 (30,8)	14 (43,8)	13 (31,0)	
	≥21	37 (18,1)	26 (20,0)	3 (90,4)	8 (19,0)	

Bidirectional endoskopi işlemlerinde prosedürel sedasyon sağlamak için tercih edilen intravenöz ajanlar sıklık sırasıyla; propofol (%99,0), midazolam (%86,3), fentanil (%58,8), ketamin (%39,7), remifentanil (%18,6), deksmedetomidin (%7,8), meperidin (%2,9) ve tiyopental sodyum (%1,5) olarak ifade edildi (Birden çok seçenek işaretlenmişti) (Grafik 1).



Grafik 1. Katılımcıların Bidirectional endoskopi işlemlerinde prosedürel sedasyon sağlamak için tercih ettikleri intravenöz ajanların dağılımı (Birden çok seçenek işaretlenmişti)

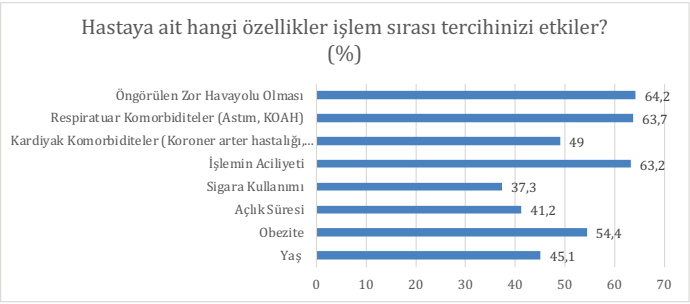
Katılımcıların "Bidirectional endoskopi tercihinizin nedeni nedir?" sorusuna verilen yanıtlarda, en sık belirttiği nedenler sırasıyla "Endoskopistin tercihini dikkate alıyorum" (%69,1), "Prosedür için gerekli ekipmanın uygunluğunu dikkate alıyorum (endoskop, kolonoskop sterilizasyon süreci, endoskopi kule uygunluğu gibi)" (%56,4) ve "Havayolu yönetiminin daha güvenli olduğunu düşünüyorum" (%30,9) şeklindeydi. Bidirectional endoskopi tercih nedenlerinin frekans dağılımları açısından tercih grupları arasında anlamlı farklılıklar olmadığı belirlendi (tüm karşılaştırmalarda p>0,05) (Tablo 2).

Hastaya ait hangi özellikler işlem sırası tercihinizi etkiler? sorusuna verilen yanıtlarda, katılımcıların %54,4'ü hastanın obez olmasının işlem sırası tercihini etkileyen en önemli faktörlerden biri olduğunu ifade etti. Gastroskopi ile başlayanlarda ve rutin tercihi olmayanlarda bu neden için verilen yanıtlar benzerdi (sırasıyla %56,9 ve %61,9). Ancak hasta obezitesinin tercihinde etkili olduğunu kolonoskopi ile başlayanlar, diğerlerinden anlamlı düzeyde daha az sıklıkta ifade etmişti (p=0,040). Hasta yaşının tercihinde etkili olduğunu tüm katılımcıların %45,1'i belirtirken, yine kolonoskopi ile başlayanlar, diğerlerinden anlamlı düzeyde daha az (%25,0) sıklıkta bu nedeni ifade etmişti (p=0,031). Hastanın kardiyak sorunları katılımcıların %49,0'nın işlem sırasını etkileyen bir diğer önemli faktördü ve kolonoskopi ile başlayanlar, diğerlerinden anlamlı düzeyde daha az (%28,1)

Tablo 2. Bidirectional Endoskopi Tercihleri ve İlişkili Klinik Parametrelerin Karşılaştırmalı Analizi						
Sorular		Toplam katılımcılar (n:204) n (%)	Gastroskopi ile başlayanlar n (%)	Kolonos-kopi ile başlayanlar n (%)	Tercih için Rutini Yok n (%)	P değeri
Bidirectional endos-kopi tercihinin nedeni nedir? *	Endoskopistin tercihini dikkate alıyorum	141(69,1)	94 (72,3)	20 (62,5)	27 (64,3)	0,420
	Yardımcı	21 (10,3)	14 (10,8)	2 (6,3)	5 (11,9)	0,699
	Prosedür için gerekli ekipmanın uygunluğunu dikkate alıyorum	115(56,4)	70 (53,8)	19 (59,4)	26 (61,9)	0,613
	Hasta güvenliği	54 (26,5)	39 (30,0)	5 (15,6)	10 (23,8)	0,232
	Pozisyon	44 (21,6)	30 (23,1)	4 (12,5)	10 (23,8)	0,396
	Havayolu yönetiminin daha güvenli olduğunu düşünüyorum	63 (30,9)	43 (33,1)	7 (21,9)	13 (31,0)	0,470
	İşlem	36 (17,6)	25 (19,2)	4 (12,5)	7 (16,7)	0,659
	Konfor	36 (17,6)	23 (17,7)	5 (15,6)	8 (19,0)	0,929
Bidirectional işlemlerden önce hastalarda sigara kullanımlarını sorgular mısınız?	Hemen hemen her zaman (>%75)	148 (72,5)	95 (73,1)	25 (78,1)	28 (66,7)	0,407
	Sıklıkla (%25–75)	26 (12,7)	18 (13,8)	4 (12,5)	4 (9,5)	
	Ara sıra (zamanın <%25'i)	19 (9,3)	9 (6,9)	3 (9,4)	7 (16,7)	
	Hiçbir zaman veya nadiren	11 (5,4)	8 (6,2)	0 (0,0)	3 (7,1)	
Hastaya ait hangi özellikler işlem sırası tercihinizi etkiler? *	Yaş	92 (45,1)	61 (46,9)	8 (25,0)	23 (54,8)	0,031
	Obezite	111(54,4)	74 (56,9)	11 (34,4)	26 (61,9)	0,040
	Açlık	84 (41,2)	53 (40,8)	11 (34,4)	20 (47,6)	0,512
	Sigara	76 (37,3)	48 (36,9)	11 (34,4)	17 (40,5)	0,858
	Respiratuar	130(63,7)	85 (65,4)	17 (53,1)	28 (66,7)	0,393
	Kardiyak	100(49,0)	69 (53,1)	9 (28,1)	22 (52,4)	0,036
	Aciliyet	129(63,2)	85 (65,4)	17 (53,1)	27 (64,3)	0,431
	Zor havayolu	131(64,2)	82 (63,1)	21 (65,6)	28 (66,7)	0,900
Bidirectional en-doskopide en sık karşılaştığınız kom-plikasyonlar nelerdir? *	Solunum depresyonu	10 (51,5)	66 (50,8)	15 (46,9)	24 (57,1)	0,658
	Hipotansiyon	50 (24,5)	32 (24,6)	5 (15,6)	13 (31,0)	0,315
	Bradikardi	37 (18,1)	26 (20,0)	5 (15,6)	6 (14,3)	0,651
	Taşikardi	23 (11,3)	18 (13,8)	3 (9,4)	2 (4,8)	0,252
	Öksürük	73 (35,8)	48 (36,9)	10 (31,3)	15 (35,7)	0,835
	Aritmi	19 (9,3)	12 (9,2)	5 (15,6)	2 (4,8)	0,281
	Hipertansiyon	18 (8,8)	15 (11,5)	1 (3,1)	2 (4,8)	0,188
	Aspirasyon	19 (9,3)	12 (9,2)	3 (9,4)	4 (9,5)	0,988
	Bronkospazm	52 (25,5)	35 (26,9)	4 (12,5)	13(31,0)	0,162
*Birden çok seçenek işaretlenmişti						

sıklıkta bu nedeni ifade etmişti (p=0,036). Hastanın respiratuar problemleri (%63,7) ve aciliyeti (%63,2) ve zor havayolu (%64,2) gibi faktörler en yüksek sıklıkta ifade edilmesine rağmen, gruplar arasında anlamlı farklar saptanmadı (tüm karşılaştırmalarda p>0,05) (Grafik 2) (Tablo 2).

Katılımcıların %72,5'i hemen hemen her zaman (zamanın>%75) bidirectional işlemlerden önce hastalarda sigara kullanımlarını sorguladıklarını belirtirken, sadece %5,4'ü hiçbir zaman sorgulamadıklarını ifade etmişti. Ancak yapılan karşılaştırmada gruplar arasında anlamlı fark olmadığı belirlendi (p=0,407). Bidirectional endoskopide en sık karşılaşıldığı belirtilen komplikasyon solunum depresyonuydu (%51,5). Bunu sırasıyla öksürük (%35,8), bronkospazm (%25,5) ve hipotansiyon (%24,5) izliyordu. Diğer belirtilen komplikasyonları (aritmi, hipertansiyon ve aspirasyon) ise %9,3-%8,8 sıklıktaydı. Yapılan değerlendirmelere göre bidirectional endoskopide sık karşılaşılan komplikasyonlar açısından tercih grupları arasında anlamlı farklılık olmadığı belirlendi (tüm karşılaştırmalarda p>0,05) (Tablo 2).



Grafik 2. "Hastaya ait hangi özellikler işlem sırası tercihinizi etkiler?" sorusuna katılımcıların verdikleri yanıtların dağılımları (Birden çok seçenek işaretlenmişti)

Anestezistlerin bidirectional endoskopi işlem sırası tercihlerine ilişkin bazı sorulara verdikleri "katılıyorum" cevaplarının değerlendirilmesi Tablo 3'te sunuldu. Katılımcıların %90,2'si işlem sırasının hasta özelliklerine göre belirlenmesinin komplikasyon riskini azaltacağını düşündüklerini belirtti. Gastroskopi ile başlayanlarda bu oran %90,8, kolonoskopi ile başlayanlarda %81,3, rutin bir tercih bildirmeyenlerde ise %95,2 olarak belirlendi (p=0,125). İşlem sırasının hasta özelliklerine göre belirlenmesinin anestezik ilaç tüketimini azaltabileceğini düşünenlerin oranı %88,2 olarak saptandı ve bu oran kolonoskopi ile işleme başlayanlarda (%75,0) diğerlerinden istatistiksel anlamlı düzeyde daha düşük bulundu (p=0,036). Sigara içen hastalarda gastroskopi ile başlamanın daha avantajlı olduğunu düşünenlerin oranı %56,9 olarak bulundu. Rutin bir tercih bildirmeyenlerde bu oran %71,4 ile en yüksek seviyede iken, gastroskopi ile başlayanlarda %55,4, kolonoskopi ile başlayanlarda ise %43,8 olarak tespit edildi ve aralarındaki fark anlamlı düzeydeydi (p=0,049). Sigara içen hastalarda kolonoskopi ile başlamanın daha avantajlı olduğunu düşünenler %54,9 sıklığındaydı ve tercih grupları açısından anlamlı farklılık yoktu (p=0,729). Gastroskopi ile başlamanın anestezi süresini kısaltabileceğini düşünenlerin oranı %65,7 olup, bu görüş rutin bir tercih bildirmeyenlerde %71,4, gastroskopi ile başlayanlarda %64,6, kolonoskopi ile başlayanlarda ise %62,5 olarak kaydedildi (p=0,662). Kolonoskopi ile başlamanın anestezi süresini kısaltabileceğini düşünenlerin oranı %38,7 sıklığında bulundu. Bu düşünce kolonoskopi ile başlamayı tercih edenlerde diğerlerine göre daha düşük sıklıkta (%21,9) olmakla birlikte ve gruplar arasında farklılık anlamlı düzeyde değildi (p=0,101). İşlem sırası tercihlerinin ekip uyumuna olan etkisi de değerlendirildi ve katılımcıların %95,1'i endoskopistin isteği ve yardımcı personelin önerisinin işlem sırasını etkilediğini belirtti. Bu oran gruplar arasında anlamlı bir farklılık göstermedi (p=0,868). Hasta memnuniyeti ve anksiyetesine ilişkin değerlendirmelerde ise, katılımcıların sırasıyla %60,8'i ve %61,3'ü işlem sırasının bu faktörler üzerinde etkili olduğunu düşündüklerini belirtti ancak gruplar arasında farklılık anlamlı düzeyde değildi (sırasıyla p=0,485 ve p=0,316) (Tablo 3).

Tartışma

Bu çalışma, anestezistlerin bidirectional endoskopi işlemlerinde işlem sırası tercihlerini ve bu tercihlerle ilişkili faktörleri değerlendiren geniş katılımlı bir anket çalışmasıdır. Çalışmamızda, işlem sırası tercihlerinin anestezistlerin yaş grubu, kıdem durumu ve çalıştıkları kurum ile ilişkili olduğu, ancak günlük işlem sayısı ile anlamlı bir farklılık göstermediği bulunmuştur. Bidirectional endoskopi işlemlerinde kurumunuzda hangi işleme öncelikle başlanıyor?" sorusuna yanıt veren anestezistlerden 130'u (%63,7) gastroskopi ile, 32'si (%15,7) ise kolonoskopi ile başlandığını belirtirken, rutin bir işlem sırası olmadığını ifade eden 42 anestezist (%20,6) vardı. Anestezi uygulamalarında propofol, midazolam ve fentanilin en sık tercih edilen ajanlar olduğu, tercih edilen işlem sırasının kullanılan ilaç kombinasyonlarında belirgin bir değişikliğe yol açmadığı gözlemlenmiştir. Anestezistlerin işlem sırası tercihlerinde endoskopistin isteği, ekipman uygunluğu ve hasta özellikleri (obezite, yaş, kardiyak hastalık) en belirleyici faktörler olarak öne çıkarken, anestezistlerin çoğunluğunun gastroskopiyi öncelikli olarak tercih ettiği görülmüştür. İşlem sırası ile advers etkiler arasında anlamlı bir ilişki saptanmamış olup, en sık bildirilen komplikasyonun solunum depresyonu olduğu belirlenmiştir. Bu bulgular, bidirectional endoskopilerde anestezi yönetiminin, hasta özellikleri ve ekip dinamikleri doğrultusunda belirlendiğini ve klinik uygulamaları yönlendiren temel etkenlerin tanımlanmasında önemli rol oynadığını göstermektedir. Ayrıca, çalışmamız ekip içi iletişim ve endoskopist beklentilerinin işlem sırası tercihlerinde etkili olduğunu ortaya koymuştur. Özellikle yüksek işlem hacmine sahip merkezlerde, ekip içi koordinasyonun işlem sırası tercihlerinde belirleyici bir unsur olduğu tespit edilmiştir. Bu durum, disiplinler arası etkili iş birliğinin hem hasta güvenliğini hem de prosedür başarısını artırmada kritik bir öneme sahip olduğunu göstermektedir.

Bidirectional prosedürlere ÖGD ile başlamak, öncelikle mide görüntülemesine olanak sağlamanın yanı sıra mide içeriğinin aspirasyonunu önleyerek potansiyel pulmoner enfeksiyon riskini azaltabileceğinden anestezistler için önemli bir tercih sebebi olabilir [6]. Choi ve arkadaşları [5], bidirectional endoskopi prosedürlerinde ÖGD ile başlanmasının, ÖGD sırasında endoskop yerleştirilmesinin daha fazla sedasyon gerektirmesinden, ayrıca kolonoskopiye göre daha kısa sürmesinden dolayı, genel sedatif ilaç ihtiyacını azaltıp derlenme süresini kısalttığını rapor etmişlerdir. Bu nedenle, ÖGD ile başlayıp ardından kolonoskopiye geçildiğinde, ÖGD sırasında sağlanan sedasyon etkisi nedeniyle kolonoskopi için gereken sedatif dozun daha düşük olması mümkün olabilir. Derin sedoanaljezinin

Tablo 3. Anestezistlerin Bidirectional Endoskopi İşlem Sırası Tercihleriyle İlgili Bazı Sorulara Verdikleri "Katılıyorum" * Cevaplarının İlk Tercih Ettikleri İşlem Türüne Göre Karşılaştırılması

Sorular	Toplam katılıyorum cevabı verenler n (%)	Gastroskopi ile başlayanlar n (%)	Kolonoskopi ile başlayanlar n (%)	İlk işlem tercihi için Rutini Yok n (%)	P değeri
İşlem sıralamasının hasta özelliklerine göre belirlenmesinin komplikasyon riskini azaltacağını düşünüyorum.	184 (90,2)	118 (90,8)	26 (81,3)	40 (95,2)	0,125
İşlem sıralamasının hasta özelliklerine göre belirlenmesinin anestezik ilaç tüketimini azaltabileceğini düşünüyorum.	180 (88,2)	117 (90,0)	24 (75,0)	39 (92,9)	0,036
Sigara içen hastalarda gastroskopi ile başlamanın daha avantajlı olduğunu düşünüyorum.	116 (56,9)	72 (55,4)	14 (43,8)	30 (71,4)	0,049
Sigara içen hastalarda kolonoskopi ile başlamanın daha avantajlı olduğunu düşünüyorum.	112 (54,9)	74 (56,9)	16 (50,0)	22 (52,4)	0,729
Bidirectional endoskopi işlemlerinde gastroskopi ile başlamak anestezi süresini kısaltabilir.	134 (65,7)	84 (64,6)	20 (62,5)	30 (71,4)	0,662
Bidirectional endoskopi işlemlerinde kolonoskopi ile başlamak anestezi süresini kısaltabilir.	79 (38,7)	55 (42,3)	7 (21,9)	17 (40,5)	0,101
İşlem sırası tercihimde endoskopist isteği ve yardımcı personelin önerisi etkilidir, çünkü ekip uyumunu önemli buluyorum.	194 (95,1)	123 (94,6)	31 (96,9)	40 (95,2)	0,868
Bidirectional endoskopi hastalarında gastroskopi ile başlandığında daha hızlı derlenme olduğunu düşünüyorum.	149 (73,0)	91 (70,0)	24 (75,0)	34 (81,0)	0,366
Bidirectional endoskopi hastalarında kolonoskopi ile başlandığında daha hızlı derlenme olduğunu düşünüyorum.	73 (35,8)	50 (38,5)	11 (34,4)	12 (28,6)	0,501
İşlem sırası tercihinin hasta memnuniyeti üzerinde etkili olduğunu düşünüyorum.	124 (60,8)	75 (57,7)	21 (65,6)	28 (66,7)	0,485
İşlem sırasının hasta anksiyetesi üzerinde etkili olduğunu düşünüyorum.	125 (61,3)	76 (58,5)	19 (59,4)	30 (71,4)	0,316

*Katılımcıların verdikleri "Katılıyorum", Kısmen Katılıyorum" ve "Kesinlikle katılıyorum" yanıtları birleştirilerek değerlendirilmiştir.

hastalarda solunum ve kardiyovasküler depresyon riski oluşturduğu dikkate alındığında, bidirectional prosedürleri kolonoskopi ile sonlandırmak, en azından ÖGD sırasında karşılaşılabilecek olası komplikasyonları yönetmek ve hastayı nispeten daha fazla gözlemleyebilmek açısından avantaj sunabilir [7–11].

Mokahal ve arkadaşları [12], bidirectional endoskopi prosedürlerine ilişkin sıralamanın klinik anlamda öneminin bulunmadığını rapor etmiştir; iyileşme süresi, kullanılan sedatif miktarı, hasta memnuniyeti, advers olaylar ve endoskopist memnuniyeti gibi parametrelerin değerlendirilmesi sonucunda iki sıralama arasında anlamlı farklılıklar tespit edilememiştir. Benzer şekilde, çalışmamızda da bidirectional prosedürlerde işlem sırasının iyileşme süresi, sedatif dozajı ve hasta memnuniyeti gibi parametreler üzerinde anlamlı bir fark yaratmadığı gözlemlenmiştir. Sayın ve arkadaşları ise [13] bidirectional prosedürlere kolonoskopi ile başlamanın daha avantajlı olabileceği vurgulamıştır. Buradan, prosedür sırasının klinik parametreler üzerindeki etkisinin sınırlı olduğu ve prosedür sırasına yönelik diğer faktörlerin (klinik rutin, kişisel tercihler, yardımcı personel durumu, endoskopistin talebi, hasta özellikleri) de belirleyici olduğu çıkarımında bulunulabilir.

Sigara kullanımı, her ne kadar büyük cerrahiler için bir risk faktörü ise, NORA da ki tüm uygulamalar için de anestezi ilişkili riskleri artırmaktadır [14]. Sigara kullanımının artmış anestezik ihtiyacı ile birlikte olabileceği, ayrıca hastalarda reaktif havayoluna bağlı sonradan gelişebilecek havayolu ilişkili komplikasyonları da takip edebilmek açısından bidirectional işlemlere ÖGD ile başlamak fayda sağlayabilir [15,16]. Her ne kadar bidirectional endoskopik prosedürlerin sıralaması ile ilgili farklı yaklaşımlar olsa da prosedürel sedasyon uygulanacak tüm hastalarda sigara içimi gibi kritik parametrelerin sistematik olarak sorgulanması gerekmektedir. Sedasyon öncesi yapılan hasta uygunluk

değerlendirmesinde, kardiyovasküler, solunum ve nörolojik komorbiditelerin yanı sıra, ilaç ve sedatif ajanlara karşı alerji, reaksiyon geçmişi, sigara içimi, alkol tüketimi ve mevcut medikal tedavi gibi etmenler detaylı olarak ele alınmalıdır. Bu yaklaşımla, işlem sırasından bağımsız olarak, her hastanın klinik durumu optimize edilerek olası komplikasyonların önüne geçilmesi hedeflenmektedir [17]. Bu konu ile ilişkili olarak, çalışmamızda yer alan katılımcıların %72,5'i hemen hemen her zaman (zamanın>%75) bidirectional işlemlerden önce hastalarda sigara kullanımlarını sorguladıklarını belirtmişti. Araştırmamızda, "Sigara içen hastalarda gastroskopi ile başlamanın daha avantajlı olduğunu düşünüyor musunuz?" sorusuna yanıt olarak katılımcıların %56,9'u (116 kişi) olumlu görüş bildirdi. İşlem sırasına göre detaylı incelendiğinde, gastroskopi ile başlayan grup içinde bu görüşü destekleyenlerin oranı %55,4 (72 kişi) iken, kolonoskopi ile başlayanlar arasında bu oran %43,8 (14 kişi) olarak belirlendi. Bu gruplar arasındaki farklılık istatistiksel olarak anlamlı bulunmuş olup, p değeri 0,049 olarak hesaplandı. Bu sonuçlar, sigara içen hastalar için işlem sırasının klinik karar verme sürecinde önemli bir faktör olduğunu göstermektedir. Yine de gastrointestinal endoskopik prosedürlerde %0,02 ile %0,37 arasında değişen komplikasyonlar ile karşılaşılabileceği rapor edilmiştir [18]. Amerikan Gastrointestinal Endoskopi Derneği (ASGE) tarafından yapılan bir ankette bu oran %0,54 olarak rapor edilmiştir; yakın zamandaki çok uluslu bir çalışmada [19] ise üst endoskopi sırasında %0,1, kolonoskopi sırasında ise %0,01 oranında bag-mask ventilasyona ihtiyaç duyulduğu rapor edilmiştir. Bu varyasyon, çalışma tasarımları, hasta popülasyonu ve sedasyon yöntemlerindeki farklılıklardan kaynaklanabilir. Özellikle miyokard enfarktüsü geçirmiş ve ileri yaş grubundaki hastalarda daha belirgin kardiyopulmoner risklerin söz konusu olduğu göz önüne alınmalıdır [20–23]. Ayrıca obezite, ileri yaş, diyabetik gastroparezi, özefagus-mide motilite bozuklukları veya gastroözofageal reflü gibi aspirasyon açısından yüksek riskli hasta gruplarında işlem sırası titizlikle planlanmalıdır [24].

Jowhari ve arkadaşları [25] bidirectional endoskopik prosedürlerde işlem sırası ve insuflasyon gazı tercihlerini (hava veya CO_2) değerlendirmiş, bidirectional işlemlere EGD ile başlandığında toplam anestezik ilaç ihtiyacının daha düşük olduğunu ve CO_2 insuflasyonu ile post-prosedürel abdominal ağrı, rahatsızlık ve şişkinliğin daha az görüldüğünü rapor etmişlerdir. Çalışmamızda, katılımcılara insuflasyon gazı olarak CO_2 ya da hava kullanılıp kullanılmadığı sorulmamıştır. Ayrıca, bidirectional işlemlerde hastaların toplam propofol ihtiyacının işlem sırasına bağlı olarak anlamlı bir farklılık göstermediğini, buna karşın yüksek BMI ve indüksiyon sırasında uygulanan yüksek doz propofolun advers olaylarla ilişkili olduğunu rapor ettik.

Çalışmanın sınırlılıkları arasında, anketin yalnızca belirli bir zaman diliminde uygulanmış olması ve sonuçların, farklı klinik uygulamalara ve hasta popülasyonlarına genellenememe olasılığı bulunmaktadır. Ayrıca, çalışmanın retrospektif doğası, neden-sonuç ilişkilerinin tam olarak ortaya konulmasını güçleştirmiştir. İleride yapılacak olan prospektif ve çok merkezli çalışmaların, bidirectional endoskopi işlemlerinde işlem sırasını etkileyen faktörleri daha detaylı inceleyerek literatüre katkı sağlayacağı düşünülmektedir.

Sonuç

Anestezistlerin %63,7'si bidirectional endoskopi işlemlerine gastroskopi ile başlamayı tercih etmiştir. Tercihlerde endoskopist yönlendirmesi, ekipman uygunluğu ve hasta özellikleri belirleyici olmuştur. Bu süreçte ekip uyumu ve multidisipliner iş birliği, hasta güvenliği ve prosedürel başarının artırılmasında kritik rol oynamaktadır.

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Maddi destek ve çıkar ilişkisi

Çalışmayı maddi olarak destekleyen kişi/kuruluş yoktur ve yazarların herhangi bir çıkar dayalı ilişkisi yoktur.

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Research Article

Bibliographic analysis of artificial intelligence-assisted publications used in abdominal ct imaging in the last 10 years

Son 10 yılda abdomen bt görüntülemede kullanılan yapay zeka destekli yayınların bibliyografik analizi

Gülay Güngör*

Department of Radiology, School of Medicine, Pamukkale University, Denizli, Türkiye

Abstract

Aim: This study presents a bibliometric analysis of artificial intelligence (AI)-assisted publications in abdominal computed tomography (CT) over the past decade. By examining publication trends, citation patterns, and research collaborations, this study offers insights into the evolving impact of AI in abdominal imaging.

Material and Methods: Data were retrieved from the Web of Science Core Collection using specific search criteria for 2014–2024. Bibliometric analysis was conducted using VOSviewer to generate co-occurrence networks, citation maps, and collaboration patterns. The study included keyword analysis, co-authorship analysis, co-citation analysis, and bibliographic coupling.

Results: A significant increase in AI-related publications in abdominal CT has been observed in recent years, with deep learning emerging as the dominant methodology. Citation network analysis identified key studies focused on image reconstruction, segmentation, and radiomics. Collaboration networks highlighted strong international and inter-institutional partnerships, particularly among institutions in the United States, China, and South Korea. Additionally, industry-academic collaborations, notably with GE Healthcare, have contributed to the advancement of AI in abdominal imaging.

Conclusions: AI-assisted abdominal CT imaging continues to expand as a critical area of research, demonstrating increasing interdisciplinary collaborations. Deep learning and radiomics have become focal points, influencing clinical decision support and quantitative imaging analysis. Future research should prioritize AI integration into routine radiology practice and explore its clinical effectiveness through large-scale validation studies.

Keywords: Artificial intelligence; deep learning; machine learning; abdominal CT; abdominal imaging; radiomics

Corresponding Author*: Gülay Güngör, Department of Radiology, School of Medicine, Pamukkale University, 20070, Kınıklı, Pamukkale, Denizli, Türkiye
E-mail: drgulaygungor@gmail.com
Orcid: 0000-0002-4470-9076
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Öz

Amaç: Bu çalışma, son on yılda abdomen bilgisayarlı tomografi (BT) alanında yapay zeka (YZ) destekli yayınların bibliyometrik analizini sunmaktadır. Yayın eğilimleri, atıf modelleri ve araştırma iş birliklerini inceleyerek, YZ'nin abdomen görüntülemedeki gelişen etkisine dair içgörüler sağlamayı amaçlamaktadır.

Gereç ve Yöntemler: Veriler, 2014–2024 yılları için belirli arama kriterleri kullanılarak Web of Science Core Collection'dan alınmıştır. Bibliyometrik analiz, VOSviewer kullanılarak eş görülme ağları, atıf haritaları ve iş birliği modellerini oluşturmak amacıyla gerçekleştirilmiştir. Çalışma kapsamında anahtar kelime analizi, ortak yazarlık analizi, ortak atıf analizi ve bibliyografik eşleşme analizleri yapılmıştır.

Bulgular: Son yıllarda abdomen BT'de YZ ile ilgili yayınlarda önemli bir artış gözlenmiş ve derin öğrenme baskın metodoloji olarak öne çıkmıştır. Atıf ağı analizi, görüntü rekonstrüksiyonu, segmentasyon ve radyomikler üzerine odaklanan temel çalışmaları belirlemiştir. İş birliği ağları, özellikle Amerika Birleşik Devletleri, Çin ve Güney Kore'deki kurumlar arasında güçlü uluslararası ve kurumsal ortaklıkları ortaya koymuştur. Ayrıca, GE Healthcare gibi endüstri-akademi iş birlikleri, abdomen görüntülemede YZ'nin ilerlemesine önemli katkılar sağlamıştır.

Sonuçlar: YZ destekli abdomen BT görüntüleme, artan disiplinler arası iş birlikleri ile gelişmeye devam eden kritik bir araştırma alanıdır. Derin öğrenme ve radyomikler, klinik karar destek sistemleri ve kantitatif görüntüleme analizlerini şekillendiren temel odak noktaları haline gelmiştir. Gelecekteki araştırmalar, YZ'nin rutin radyoloji pratiğine entegrasyonunu ve geniş ölçekli doğrulama çalışmaları ile klinik etkinliğinin araştırılmasını önceliklendirmelidir.

Anahtar Kelimeler: Yapay zekâ; derin öğrenme; makine öğrenmesi; abdomen BT; abdomen görüntüleme; radyomikler

Introduction

Artificial intelligence (AI) has transformed medical imaging, introducing advanced computational techniques that enhance diagnostic accuracy, automate image interpretation, and optimize radiology workflows [1]. Over the past decade, AI applications in computed tomography (CT) imaging have gained significant traction, particularly in abdominal imaging [2]. The integration of deep learning, machine learning, and radiomics has facilitated precise segmentation, improved image reconstruction, and enhanced lesion detection, contributing to more efficient clinical decision-making [3].

Abdominal CT serves as an essential imaging modality for diagnosing oncological, inflammatory, and metabolic conditions. However, conventional imaging techniques demand substantial radiologist expertise, are time-consuming, and are susceptible to inter-observer variability. AI-driven approaches mitigate these limitations by offering automated, standardized, and efficient image analysis tools [4]. Recent developments in convolutional neural networks (CNNs) and transformer-based architectures have further enhanced AI applications in abdominal imaging [5].

Bibliometric analysis provides a structured framework for assessing research productivity, citation trends, and influential contributions in a specific field. Analyzing AI-assisted abdominal CT literature allows for the identification of key contributors, thematic research trends, and global collaboration patterns. Understanding these elements is crucial for bridging knowledge gaps, shaping future research trajectories, and fostering interdisciplinary collaborations [6].

This study aims to systematically evaluate AI-assisted abdominal CT publications from the past decade. By analyzing keyword distributions, co-citation networks, co-authorship trends, and institutional collaborations, this bibliometric analysis will offer a comprehensive overview of emerging research directions [7]. The findings are expected to provide a strategic foundation for the future development of AI applications in abdominal imaging.

Material and Methods

Data Collection

This study utilized the Web of Science Core Collection (WoSCC), a well-established database for high-impact scientific publications. The search strategy was designed to retrieve publications from 2014 to 2024, focusing on AI applications in abdominal CT imaging. The Boolean search strategy included:

- TS=("Artificial Intelligence" OR "Deep Learning" OR "Machine Learning")
- AND TS=("Abdominal CT" OR "Abdominal Imaging")

• NOT TS=("Ultrasound" OR "Magnetic Resonance Imaging")

• AND WC=("Radiology, Nuclear Medicine & Medical Imaging")

• AND PY=(2014-2024)

Only peer-reviewed journal articles were included, excluding conference proceedings, book chapters, and editorials to ensure the analysis focused on high-impact research.

Data Processing and Analysis

Data cleaning and pre-processing were conducted using Microsoft Excel and VOSviewer to remove duplicates and incomplete records [8]. The final dataset included:

• Publication details (title, authors, year, journal)

• Abstracts and keywords

• Citation metrics (total citations, h-index, impact factor)

• Collaboration details (co-authorship, institutional affiliations, country of origin)

Bibliometric Techniques

To analyze the dataset, the following bibliometric methods were applied:

• Keyword Co-occurrence Analysis: This method has been widely applied in bibliometric studies to visualize keyword networks and research hotspots [9]. Identified frequently used keywords and their interconnections, revealing thematic research areas and emerging trends. The threshold value was set at 5 to include only significant keywords.

• Co-authorship Analysis: Bibliometric studies commonly use this technique to assess collaboration intensity and global research networks [10]. Assessed collaboration networks among authors, institutions, and countries to determine leading contributors. The threshold value was 3 co-authored publications per researcher.

• Co-citation Analysis: Co-citation networks help identify key intellectual foundations in a field, providing insights into citation dynamics [9]. Citation relationships between studies were evaluated to determine basic research in the field. The threshold value was set at 5 for co-cited studies.

• Bibliographic Coupling: This method is frequently employed in bibliometric research to group thematically similar studies based on shared references [10] Examined thematic similarities between research clusters using a threshold value of 5.

• Network Visualization and Interpretation

All bibliometric networks were visualized using VOSviewer to identify clusters and research hotspots. The networks were color-coded based on:

• Temporal trends (e.g., early foundational studies vs. recent emerging topics)

• Research themes (e.g., segmentation, image enhancement, radiomics)

• Collaborative groups (e.g., key institutions and global partnerships)

Statistical Analysis

Descriptive statistics were performed to quantify:

The number of publications per year.

The most frequently cited articles and authors.

The distribution of research topics over time.

The impact of collaborations on citation rates.

All statistical calculations were conducted using Python (Pandas, Matplotlib) and SPSS, ensuring a robust quantitative assessment of bibliometric data [11].

This methodological framework ensures a comprehensive evaluation of AI applications in abdominal CT research, facilitating deeper insights into research dynamics and future directions.

Results

Publication Trends

AI-assisted abdominal CT publications have grown exponentially over the past decade [7]. Research activity was relatively limited before 2019 but has since expanded significantly, peaking in 2023 with over 100 published articles (Figure 1 and 2). This trend highlights the growing interest and rapid advancements in AI applications within abdominal imaging [12, 13].

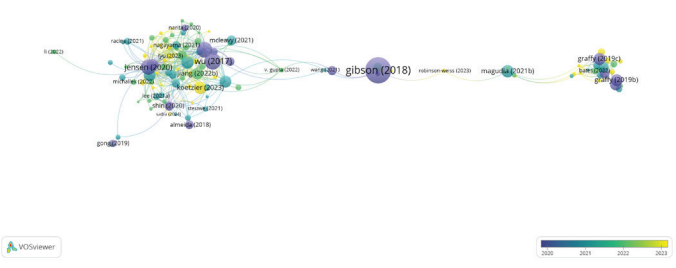

Figure 1. Citation Analysis Overlay Map. This figure presents a citation network analysis of AI-assisted publications in abdominal CT imaging. The network was generated using VOSviewer with a minimum citation threshold of 5, meaning only studies cited at least five times were

included. Each node represents a publication, with its size reflecting the number of citations received. The links between nodes indicate citation relationships, demonstrating intellectual connections among influential studies. The color gradient (blue to yellow) represents the chronological distribution of publications, where blue denotes older studies (2020 and earlier), and yellow highlights more recent contributions (2023 and beyond). Gibson (2018) and Jensen (2020) emerge as key citation hubs, signifying their foundational impact on AI applications in abdominal imaging [12, 13]. The clustering of newer studies suggests an increasing focus on deep learning, radiomics, and image reconstruction in recent years. This analysis provides insights into the evolution of research trends, identifying major contributors and thematic shifts in AI-driven abdominal imaging.

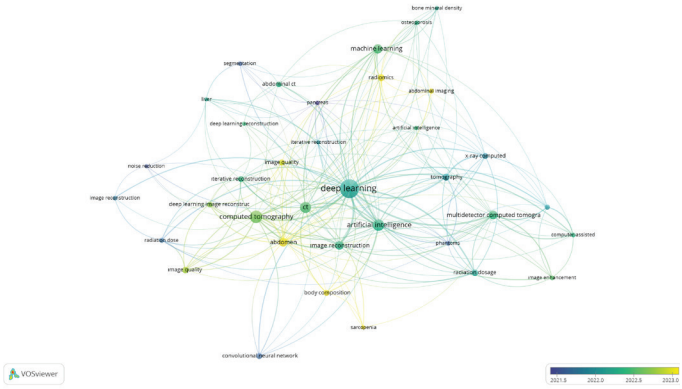

Figure 2. Keyword Co-occurrence Overlay Map. This figure illustrates the keyword co-occurrence network of AI-assisted publications in abdominal CT imaging. The network was generated using VOSviewer with a minimum threshold of 5 occurrences, meaning only keywords appearing in at least five studies were included. Each node represents a keyword, with larger nodes indicating more frequently used terms. The connections between keywords signify their co-occurrence in the same publications, highlighting thematic relationships. The color gradient (blue to yellow) represents the chronological distribution of keywords, where blue denotes older research focus areas (2021 and earlier), and yellow highlights more recent topics (2023 and beyond). The most prominent keywords include "deep learning," "artificial intelligence," "computed tomography," and "radiomics," indicating the dominant research themes in AI-assisted abdominal imaging. Emerging keywords such as "image enhancement," "body composition," and "transformer networks" suggest evolving research trends in quantitative imaging and AI-driven analysis. This visualization provides insights into the shifting research focus in AI-assisted abdominal CT imaging, emphasizing the increasing role of deep learning and radiomics in clinical applications.

Keyword and Citation Analysis

Frequently occurring keywords included "Deep Learning," "Artificial Intelligence," "Computed Tomography," "Radiomics," and "Image Reconstruction." The keyword co-occurrence network revealed distinct research clusters, with deep learning dominating the field (Figure 3 and 4). Emerging topics such as "Transformer Networks" and "Explainable AI" have gained prominence in recent years, reflecting ongoing advancements in AI-driven image analysis [11, 14-16].

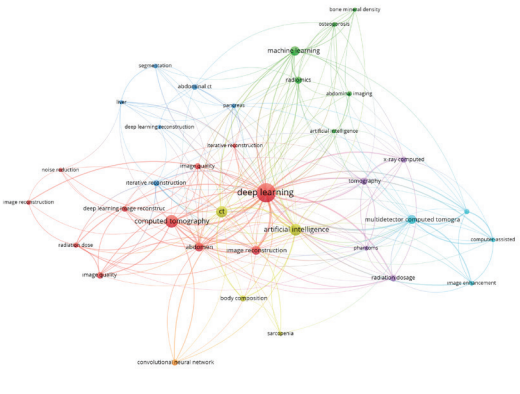

Figure 3. Keyword Co-occurrence Network Map. This figure represents the keyword co-occurrence network of AI-assisted publications in abdominal CT imaging, visualized using VOSviewer with a minimum occurrence threshold of 5 (i.e., only keywords appearing in at least five publications are included). Each node represents a keyword, and its size corresponds to the frequency of its occurrence. The links between nodes indicate co-occurrence relationships, highlighting thematic connections among different research topics. The color-coded clusters group related keywords based on their research focus, revealing distinct thematic areas. The red cluster, centered around "deep learning" and "computed tomography," represents core research themes, including image reconstruction, segmentation, and noise reduction. The green cluster focuses on "machine learning" and "radiomics," suggesting an emphasis on AI-driven feature extraction and quantitative imaging. The blue cluster includes terms related to image quality, iterative reconstruction, and liver imaging, reflecting AI applications in organ-specific imaging. The purple cluster groups terms like "multidetector computed tomography" and "X-ray computed tomography," indicating developments in AI-enhanced CT hardware and acquisition techniques. This network analysis highlights the interdisciplinary nature of AI applications in abdominal imaging, demonstrating strong interconnections between deep learning, radiomics, and image enhancement techniques.

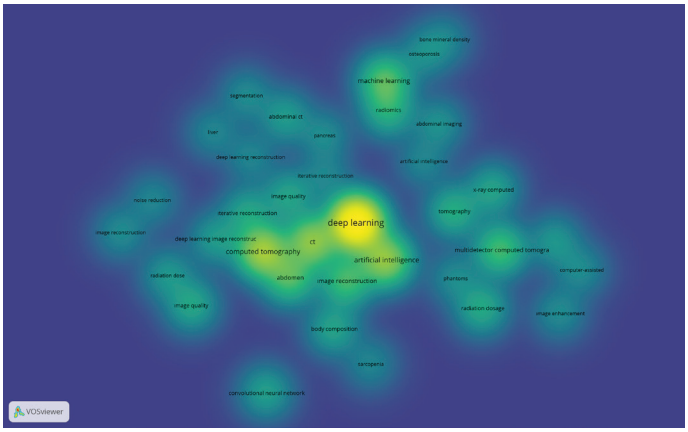

Figure 4. Keyword Density Map. This figure displays the keyword density map of AI-assisted publications in abdominal CT imaging, generated using VOSviewer with a minimum occurrence threshold of 5. The heatmap represents the concentration and frequency of keywords within the analyzed dataset. Brighter regions (yellow) indicate high-frequency keywords that appear more frequently in publications. Darker regions (blue/purple) represent less frequently occurring but still relevant terms. The most dominant keywords include "deep learning," "artificial intelligence," "computed tomography," and "image reconstruction," reflecting the core research themes in AI-assisted abdominal imaging. The distribution pattern shows a high concentration of studies focused on deep learning applications, radiomics, and quantitative imaging techniques, while emerging topics such as "body composition," "sarcopenia," and "computer-assisted imaging" indicate expanding research areas. This heatmap provides a visual representation of thematic focus areas, identifying hotspots in AI-driven abdominal imaging research and potential directions for future studies.

Citation analysis identified foundational studies on deep learning architectures, segmentation methodologies, and radiomics applications (Figure 5). The most cited works were published in prominent journals such as Radiology, European Radiology, and American Journal of Roentgenology [14-17].

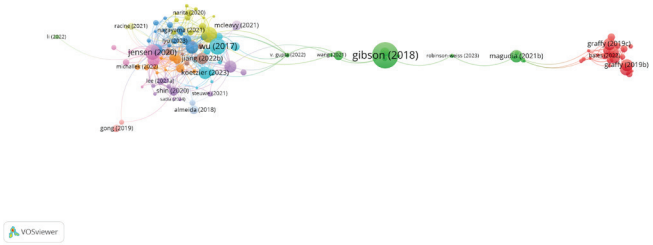

Figure 5. Citation Network Map. This figure illustrates the citation network of AI-assisted publications in abdominal CT imaging, created using VOSviewer with a minimum citation threshold of 5. Each node represents a publication, with its size corresponding to the number of citations received. The links between nodes indicate citation relationships, reflecting how studies are interconnected. Color-coded clusters group studies based on their citation patterns, revealing distinct research domains. Gibson (2018) and Wu (2017) emerge as key citation hubs, signifying their foundational impact on AI applications in abdominal imaging [12, 17]. The rightmost cluster (red) represents a distinct research line with a different thematic focus, likely emphasizing alternative AI applications or methodologies. The green cluster in the center suggests a bridge between early foundational studies and more recent research directions. This visualization provides insights into the evolution of citation relationships, identifying core studies and thematic shifts in AI-driven abdominal imaging research.

Collaboration Networks

Co-authorship analysis revealed that the United States, China, and South Korea are the most active countries in AI-assisted abdominal imaging research. Notably, Harvard Medical School, Seoul National University, and GE Healthcare emerged as key institutional collaborators (Figure 6). These findings highlight the increasing role of international and industry-academic partnerships in advancing AI applications in radiology [14, 16].

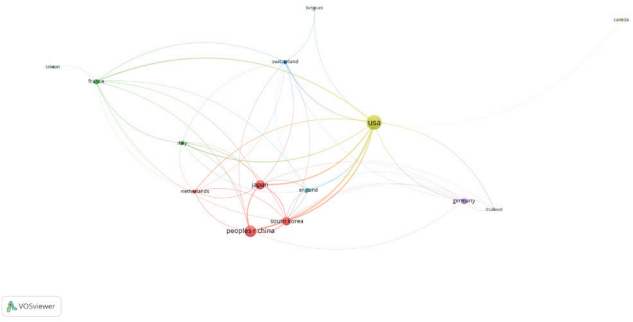

Figure 6. Co-authorship Network Map by Country. This figure presents the international co-authorship network in AI-assisted abdominal CT imaging research, visualized using VOSviewer with a minimum co-authorship threshold of 3 (i.e., only countries with at least three co-authored publications are included). Each node represents a country, and its size reflects the number of publications originating from that country. Lines between nodes indicate collaborative research efforts between countries, with thicker lines representing stronger collaborations. The USA appears as the most influential research hub, engaging in widespread collaborations with multiple countries, including China, Japan, and European nations. Clusters highlight regional collaboration patterns, such as: Red cluster: Strong research ties between China, Japan, and South Korea. Green cluster: European collaboration network led by France and Italy. Blue cluster: Switzerland, Belgium, and England forming a separate research group.

Figure 7. Institutional Co-authorship Network Map. This figure illustrates the institutional co-authorship network in AI-assisted abdominal CT imaging research, visualized using VOSviewer with a minimum co-authorship threshold of 4 (i.e., only institutions with at least four co-authored publications are included). Each node represents an institution, and its size corresponds to its research output in this field. Links between nodes indicate collaborative research relationships, with thicker lines representing stronger collaborations. Harvard Medical School, Seoul National University, and GE Healthcare emerge as major research hubs, engaging in extensive international and industry-academic collaborations. Clusters highlight institutional partnerships, such as: Green cluster: Strong collaborations among the University of Wisconsin, NIH Clinical Center, and Massachusetts General Hospital. Red cluster: Close research ties between Seoul National University, GE Healthcare, and Shanghai Jiao Tong University. Blue cluster: A distinct collaboration network centered around Nagoya University. This analysis provides insights into leading institutions and their collaboration patterns, demonstrating the growing role of industry-academic partnerships in AI-assisted abdominal CT imaging research.

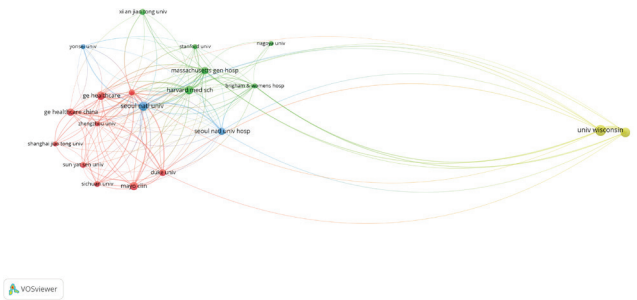

Figure 8. Institutional Co-authorship Network Map. This figure visualizes the institutional co-authorship network in AI-assisted abdominal CT imaging research, created using VOSviewer with a minimum co-authorship threshold of 5 (i.e., only institutions with at least five co-authored publications are included). Each node represents an institution, and its size corresponds to the number of publications produced by that institution. Links between nodes indicate collaborative relationships, where thicker lines represent stronger institutional collaborations. Major research hubs include Harvard Medical School, Seoul National University, and GE Healthcare, which exhibit extensive global and industry-academic partnerships. Clusters highlight regional and institutional collaborations, such as: Green cluster: Strong connections among the University of Wisconsin, Stanford University, and Massachusetts General Hospital. Red cluster: Intense collaborations among Seoul National University, GE Healthcare, and major Chinese universities. Blue cluster: A separate research network centered around Nagoya University. Compared to the lower-threshold version (Figure 7), this figure provides a more refined view of the strongest institutional collaborations, filtering out institutions with fewer connections. It offers a focused perspective on the leading research centers shaping AI applications in abdominal imaging.

Discussion

The findings of this study highlight the rapid growth and evolving landscape of AI applications in abdominal CT imaging. The increasing number of publications, particularly after 2019, reflects the expanding interest in AI-driven methodologies [18]. The dominance of deep learning-based approaches underscores their effectiveness in segmentation, image reconstruction, and quantitative imaging analysis [15].

The co-citation and bibliographic coupling analyses revealed that foundational AI research, such as deep learning architectures (e.g., U-Net) and radiomics methodologies, continues to influence contemporary studies [19]. While early AI applications focused on image enhancement and denoising, recent research emphasizes clinical decision support and explainable AI models [20].

Collaboration network analysis demonstrated strong inter-institutional and international partnerships. The United States, China, and South Korea emerged as leading contributors, with major institutions such as Harvard Medical School, Seoul National University, and GE Healthcare playing key roles [14, 16]. These collaborations indicate that AI in radiology is increasingly becoming a global effort, integrating expertise from multiple disciplines.

Despite advancements, several challenges remain. The standardization of AI models, ensuring generalizability across diverse patient populations, and addressing regulatory considerations are critical areas for future research [21]. Furthermore, the seamless integration of AI into routine radiological workflows necessitates rigorous validation through large-scale, multi-center clinical studies [22].

Conclusion

This bibliometric study comprehensively analyzes AI applications in abdominal CT imaging, highlighting key research trends and collaboration networks. The increasing prominence of deep learning and radiomics underscores the paradigm shift toward AI-assisted imaging analysis. Future research should focus on improving model transparency, obtaining regulatory approvals, and implementing real-time AI applications in clinical settings.

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This study received no financial support, and the authors have no conflicts of interest to declare.

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Research Article

Ağır ARDS hastalarında sedasyon yönetiminde bispektral indeks ve rass skorlarının karşılaştırılması: mortalite üzerine etkileri

Comparison of bispectral index and rass scores in sedation management of patients with severe ards: effects on mortality

Zerrin Özçelik[1]*, Yücel Gültekin[2]

[1]Prof. Dr Feriha Öz Acil Durum ve Pandemi Hastanesi Genel Yoğun Bakım, İstanbul, Türkiye
[2]Uşak Üniversitesi Tıp Fakültesi Genel Cerrahi Anabilim Dalı, Uşak, Türkiye

Öz

Amaç: Ağır akut respiratuvar distres sendromu (ARDS) hastalarında sedasyon yönetimi, yoğun bakım sonuçları üzerinde kritik bir rol oynamaktadır. Bispektral indeks (BİS) ve Richmond Ajitasyon ve Sedasyon Skalası (RASS), sedasyon düzeylerini belirlemede yaygın olarak kullanılan iki yöntemdir. Bu çalışmada, BİS ve RASS skorlarının karşılaştırılması ve bu skorların mortalite üzerindeki etkilerinin incelenmesi amaçlanmıştır.

Gereç ve Yöntemler: Bu retrospektif çalışmada, mekanik ventilasyon altındaki ağır ARDS tanısı almış 98 hasta değerlendirildi. BİS ve RASS skorları pron ve supin pozisyonlarında ölçüldü ve bu skorlar arasındaki korelasyon ile klinik parametreler analiz edildi. BİS ≤40 ve BİS >40 olmak üzere iki gruba ayrıldı ve mortalite açısından değerlendirildi.

Bulgular: BİS ve RASS skorları arasında hem supin ($r=0.53$, $p<0.001$) hem de pron ($r=0.46$, $p<0.001$) pozisyonlarında anlamlı ve orta dereceli bir korelasyon tespit edildi. BİS ≤40 ve BİS >40 grupları arasında mortalite oranları BİS ≤40 grubunda %88, BİS >40 grubunda %81.3 olarak belirlendi, ancak bu fark istatistiksel olarak anlamlı değildi ($p=0.35$).

Sonuç: BİS monitorizasyonu, ARDS hastalarında sedasyon yönetiminde değerli bir araç olmasına rağmen, sedasyon yönetiminde hem BİS hem de RASS skorlarının birlikte kullanılması daha doğru klinik sonuçlar elde edilmesine katkı sağlayabilir. BİS monitorizasyonu faydalı olmakla birlikte mortaliteye etkisi gösterilememiştir.

Anahtar kelimeler: Akut Respiratuvar Distres Sendromu, Bispektral İndeks, Sedasyon Skalası

Sorumlu Yazar: Zerrin Özçelik, Prof. Dr Feriha Öz Acil Durum ve Pandemi Hastanesi Genel Yoğun Bakım, İstanbul, Türkiye
E-mail: zeeerrinozcelik@hotmail.com
Orcid:0000-0001-5761-2022
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Abstract

Aim: Sedation management plays a critical role in the outcomes of patients with severe acute respiratory distress syndrome (ARDS). Bispectral index (BIS) and the Richmond Agitation-Sedation Scale (RASS) are two commonly used methods to assess sedation levels. This study aimed to compare BIS and RASS scores and evaluate the impact of these scores on mortality.

Materials and Methods: In this retrospective study, 98 patients diagnosed with severe ARDS and under mechanical ventilation were evaluated. BIS and RASS scores were measured in both prone and supine positions, and the correlation between these scores and clinical parameters was analyzed. Patients were divided into two groups: BIS ≤40 and BIS >40, and their mortality rates were assessed.

Results: A significant moderate correlation was found between BIS and RASS scores in both supine ($r=0.53$, $p<0.001$) and prone ($r=0.46$, $p<0.001$) positions. Mortality rates were 88% in the BIS ≤40 group and 81.3% in the BIS >40 group, but this difference was not statistically significant ($p=0.35$).

Conclusion: While BIS monitoring is a valuable tool in sedation management for ARDS patients, the combined use of BIS and RASS scores may contribute to more accurate clinical outcomes in sedation management. Although BIS monitoring is useful, its effect on mortality has not been demonstrated.

Keywords: Acute Respiratory Distress Syndrome, Bispectral Index, Sedation Scale

Giriş

Ağır akut respiratuvar distres sendromu (ARDS) hastalarında ventilasyon-perfüzyon uyumsuzluğunu düzeltmek, akciğer hasarını önlemek ve oksijenasyonu artırmak amacıyla derin sedasyon önemli bir tedavi bileşeni olarak öne çıkmaktadır. Bu süreçte sedatif hipnotikler, opioidler ve nöromüsküler ajanlar yaygın olarak kullanılmaktadır. Ancak sedasyonun derinliği, süresi ve dozuna yönelik standart bir değerlendirme yöntemi henüz tanımlanmamıştır. Yoğun bakım ünitelerinde sıklıkla kullanılan Richmond Ajitasyon ve Sedasyon Skalası (RASS), özellikle nöromüsküler ajanların kullanıldığı ARDS hastalarında yetersiz kalabilmektedir [1, 2].

Sedasyonun daha hassas yönetimi için bispektral indeks (BİS) monitorizasyonu kullanılabilir. BİS, hastanın bilinç düzeyini değerlendiren bir teknolojidir ve 0-100 aralığında değerler üretir. BİS değeri 60'ın altına düştüğünde, bilinç durumu ciddi oranda azalmış kabul edilmektedir. Mekanik ventilasyon altındaki ARDS hastalarında önerilen optimal sedasyon aralığı 40-60 BİS değeri olarak belirlenmiştir [3]. Bununla birlikte, ARDS hastalarında mortalite ile spesifik bir BİS değeri arasındaki ilişki net olarak ortaya konmamıştır.

Sedatif ajanların uzun süreli ve yüksek doz kullanımı, yoğun bakımda nöromyopati, artan enfeksiyon oranı, zor ekstübasyon ve maliyetlerin artması gibi komplikasyonlara neden olabilmektedir [4]. Bu nedenle, yoğun bakım hastalarında ideal sedasyon düzeyinin belirlenmesi büyük önem taşımaktadır. Bu çalışmanın amacı, şiddetli ARDS hastalarında RASS ve BİS değerlerini karşılaştırmak ve BİS ≤40 ile >40 olan hastaların mortalite açısından değerlendirilmesidir.

Gereçler ve Yöntemler

Bu retrospektif çalışma, ağır ARDS tanısı almış ve mekanik ventilasyon altında izlenen 98 hasta üzerinde gerçekleştirilmiştir. Sedasyon yönetiminde Covidien BİS Vista® cihazı ve probu ile BİS monitorizasyonu yapılmıştır. BİS ölçümleri cihaz kullanım kılavuzuna uygun olarak uzman hekim tarafından uygulanmıştır. Hastalarımız, oksijenizasyonu supine pozisyonda SaO_2 değeri %90 altına düştüğünde ve oksijenizasyon PEEP titrasyonu ve FiO_2 yükseltilmesine rağmen düzeltilemediğinde pron pozisyona alınmıştır. Supin pozisyondaki BİS değeri, Pron pozisyona alınmadan önceki BİS değeridir. Hastalar supin ve pron pozisyonlarında 6 saat aralıklarla BİS ve RASS değerleri ile izlenmiştir. Hastaların pron ve supin pozisyonlarına alınma zamanları ve bu pozisyonlarda kalma süreleri düzenli olarak kaydedilmiştir. Birden fazla değer kaydedildiği durumlarda bu değerlerin aritmetik ortalaması hesaplanmıştır. Pron pozisyonuna alındıkları gün itibarıyla hastaların 24 saatlik verileri değerlendirilmiştir. Çalışmaya yoğun bakımımıza COVID-19 pnömonisi nedeniyle ağır ARDS tanısı alan mekanik ventilatörde izlenen 18 yaş üstü hastalar dahil edildi. Ağır ARDS tanımı ve sınıflaması Tablo 1'de gösterilmiştir. İnotrop desteği çok yüksek olan, pron pozisyonu tolere edemeyen ve yatış süresi 24 saatten az olan hastalar çalışmaya dahil edilmemiştir.

Pron pozisyonlamanın ilk gününde kaydedilen veriler arasında BİS ve RASS değerleri, sistolik ve diyastolik kan basıncı, kalp hızı, vücut ısısı, kan glukoz düzeyi, inotrop kullanımı, sedatif ajan ve opioid dozları, entübasyon tüpü veya diğer kateterlerin yer

değiştirmesi gibi olumsuz olaylar yer almıştır. Ek olarak, yoğun bakımda kalış süresi, mekanik ventilasyon süresi ve mortalite verileri hasta dosyalarından elde edilmiştir. Çalışmamız İnsan Hakları Helsinki Bildirgesi'ne uygun yazılmıştır, çalışmaya katılan hastalardan onam belgesi alınmıştır ve hastanemiz etik kurulundan onay alınmıştır. (E-46059653-020)

Tablo:1 ARDS Kategorizasyonu

Oksijenizasyon	Entübe olmayan ARDS	Entübe ARDS	Kısıtlı kaynağı olan durumlarda modifiye tanımlama
	≤ 30 L/dak akış hızı ile uygulanan HFNO veya en azından 5 cmH2 0 PEEP uygulanan NİMV/ CPAP altında PaO2 / FiO2 ≤ 300 mmHg veya SpO2 /FiO2≤ 315 (eğer SpO2 ≤ %97 ise)	Hafif: 200 <PaO2 /FiO2 < 300 mmHg veya 235 ≤ SpO2 / FiO2 ≤ 315 (eğer SpO2 ≤ % 97 ise) Orta: 100 <PaO2 /FiO2 ≤ 200 mmHg veya 148 < SpO2 / FiO2 ≤ 235 (eğer SpO2 ≤ %97 ise) Ağır; PaO2 /FiO2 ≤ 100 mmHg veya SpO2 /FiO2 ≤ 148 (eğer SpO2 ≤ %97 ise)	SpO2 /FiO2 ≤ 315 (eğer SpO2 ≤ %97 ise) İmkanları kısıtlı durumlarda tanı için PEEP veya minimum oksijen akış hızı gerekmez

ARDS:Akut solunum sıkıntısı sendromu, PaO2 /FİO2 : Parsiyel oksijen basıncı/Fraksiyone oksijen oranı, PEEP: Pozitif ekspiryum sonu basınç, HFNO:High flow nasal oxygen, PaO2 /FİO2 : Parsiyel oksijen basıncı/ Fraksiyone oksijen oranı, SpO2 /FiO2 :Periferik oksijen saturayonu/ Fraksiyone oksijen oranı, CPAP:Sürekli pozitif havayolu basıncı.[7]

İstatistiksel analiz

İstatistiksel analizler SPSS-26 (SPSS Inc., Chicago, IL) programı ile yapıldı. Kalitatif veriler yüzde dağılımlarıyla, kantitatif veriler ise Kolmogorov-Smirnov testi kullanılarak normal dağılıma uygunluk açısından değerlendirildi. Normal dağılım gösteren değişkenler ortalama ve standart sapma ile normal dağılım göstermeyen değişkenler ise ortanca ve çeyrekler arası aralık (ÇAA) ile sunuldu. İki grup arasındaki mortalite farkı Ki-kare testi veya Fisher testi ile karşılaştırıldı. RASS ve BİS değerleri arasındaki korelasyon Spearman korelasyon testi ile değerlendirildi ve p < 0.05 istatistiksel anlamlılık sınırı olarak kabul edildi. G*Power 3 yazılımı, örneklem büyüklüğünü belirlemek amacıyla kullanılmıştır. %5 hata payı ve 0,80 güç ile çalışmada, Ki-kare testi kullanılarak örneklem büyüklüğünün yeterliliğini değerlendirmek için güç analizi gerçekleştirilmiştir. Çalışmanın temel hipotezi, BİS ≤40 ve BİS >40 grupları arasında mortalite açısından istatistiksel olarak anlamlı bir fark olup olmadığını belirlemektir. Önceki literatür verileri ve bu çalışmada gözlenen mortalite oranları (BİS ≤40: %88, BİS >40: %81,3) dikkate alındığında, %5 anlamlılık düzeyi (α=0.05) ve %80 güç (1-β=0.80) ile anlamlı bir farkın tespit edilebilmesi için her grupta en az 45 hastanın yer alması gerektiği hesaplanmıştır.

Bulgular

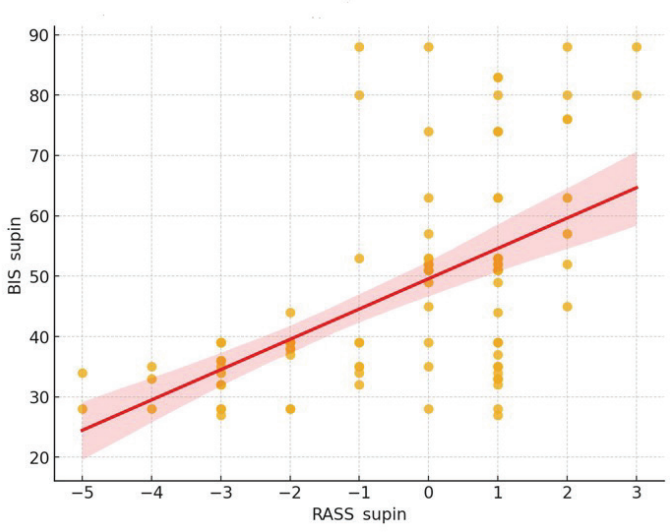
Çalışmaya dahil edilen toplam 98 hastanın demografik özellikleri tablo 2'de gösterilmiştir. Hastaların BİS supin, BİS pron, RASS supin ve RASS pron ortanca değerleri sırasıyla 39 (ÇAA 35-53), 44,5 (ÇAA 35-53), 0 (ÇAA -2-+5) ve 0 (ÇAA -2-+5) olarak bulunmuştur.

Tablo 2. Hastaların demografik özellikleri

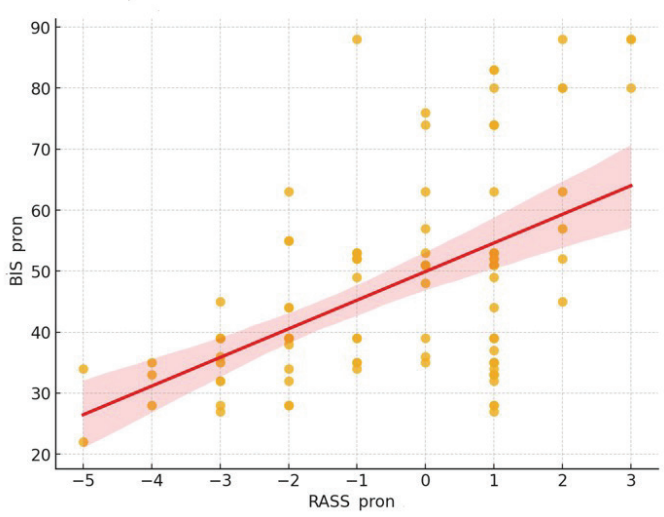
Parametre	
Cinsiyet (%)	Kadın (%42)
Yaş (SS)	60,3 (17)
APACHE II skoru (SS)	24 (3)
Charlson komorbidite indeksi (ÇAA)	16 (14,18)
Yoğun bakım yatış süresi (gün)(SS)	18,2 (14,7)
MV kalma süresi (gün) (SS)	14,2 (10,8)
Mortalite	%84,7
İnotrop desteği oranı	%89,8
Günlük Midazolam dozu (mg) (SS)	318 (246,5)
Günlük Fentanil dozu (µg) (SS)	5359,6 (1027,3)
Kan glukozu (mg/dL) (SS)	177,7 (51,3)

SS: Standart Sapma; APACHE II: Acute Physiology and Chronic Health Evaluation ÇAA: Çeyrekler Arası Aralık; MV: Mekanik ventilatör

Supin pozisyonda RASS ve BİS arasında anlamlı ve orta dereceli bir korelasyon tespit edilmiştir (p<0.001, r=0.53) (Şekil 1). Pron pozisyonunda da RASS ve BİS arasında anlamlı ve orta dereceli bir korelasyon olduğu görülmüştür (p<0.001, r=0.46) (Şekil 2).



Şekil 1. Supin pozisyonda BİS ve RASS korelasyon grafiği



Şekil 2. Pron pozisyonda BİS ve RASS korelasyon grafiği

Hastalar BİS >40 ve BİS ≤40 olarak değerlendirildiğinde, yaş (p=0.86), cinsiyet (p=0.82), Charlson Komorbidite İndeksi (p=0.45) ve APACHE (Acute Physiology and Chronic Health Evaluation) II skoru (p=0.89) açısından iki grup arasında anlamlı bir fark bulunmamıştır. Yaş, cinsiyet, inotrop kullanımı, PaO_2/ FiO_2 değerleri, kullanılan sedatif miktarı, vücut ısısı, açlık kan glukozu, mekanik ventilatör süresi, yoğun bakım yatış süresi ve açısından her iki grup arasında istatistiksel olarak fark bulunmamıştır.

BİS >40 olan grupta 39 (%81.3) ve BİS ≤40 olan grupta ise 44 (%88) hasta mortalite ile sonuçlanmıştır; ancak iki grup arasında mortalite açısından fark tespit edilmemiştir (p=0.35).

Tartışma

Kritik hastalarda sedasyonun optimal yönetimi, yoğun bakım sonuçları üzerinde önemli bir etkiye sahiptir. Uzun süreli ve yüksek doz sedatif kullanımı, ekstübasyon güçlüğü, yoğun bakım kalış süresinin uzaması ve artmış mortalite gibi olumsuz sonuçlara yol açabilir [5]. Ağır ARDS hastalarında koruyucu akciğer ventilasyonu uygulanırken hasta-ventilatöre uyumunun sağlanması gereklidir. Yetersiz sedasyon, asenkroniye ve alveoler aşırı gerilmeye neden olarak ventilatör ilişkili akciğer hasarını (VILI)ve nöromüsküler bloker kullanımını artırabilir. Fazla sedasyon ise solunum direncine, kas atrofisine ve uzamış mekanik ventilasyona yol açabilir. Bu nedenle hastanın sedasyon derinliğinin ölçülmesi önemlidir. Ağır ARDS tanılı hastalarda sedasyon derinliğinin saptanması ile ilgili çalışma sayısı azdır, çalışmamızın literatüre bu konuda katkı sağlayacağını düşünmekteyiz. Yoğun bakım ünitelerinde yaygın olarak kullanılan RASS, sedasyon değerlendirmesinde etkili olmakla birlikte, aralıklı ölçüm sağladığı ve tutarsız sonuçlara neden olabildiği için sınırlılıklar barındırmaktadır [6-8]. Buna karşın, BİS, sedasyon derinliğini sürekli ve objektif olarak ölçme avantajı sunar. Çeşitli çalışmalar, yoğun bakım hastalarında RASS ve BİS arasında anlamlı bir korelasyon olduğunu bildirmektedir [9-11]. Bu çalışma sonucunda, supin ve pron pozisyonlarında RASS ve BİS arasında orta dereceli bir korelasyon tespit edilmiştir.

Karamchandani ve arkadaşlarının çalışması da bizim bulgularımızla uyumlu olup, mekanik ventilatördeki hastalarda BİS ve RASS'ın korele olduğunu ve BİS'in sedasyon yönetiminde güvenilir bir araç olduğunu öne sürmektedir [12]. Bununla birlikte, bazı çalışmalarda bu korelasyonun olmadığı belirtilmektedir. Özellikle sepsis gibi sistemik inflamatuar yanıtın yaygın olduğu durumlarda, dokulardaki iskemi nedeniyle beynin etkilenebileceği ve bu hastalarda sedasyon derinliği ile bilinç düzeyinin uyumsuz olabileceği göz önünde bulundurulmalıdır [13-15]. Bu uyumsuzluk, yanlış BİS sonuçlarına yol açabilir. Vivien ve arkadaşları, BİS'in %100 spesifik olmadığını ve hipoglisemi gibi faktörlerin yanlış sonuçlara neden olabileceğini belirtmişlerdir [16]. Duarte ve arkadaşları ise kalp pili, ısıtıcı battaniye ve hipotermi gibi faktörlerin BİS ölçümlerini etkileyebileceğini ifade etmişlerdir [17].

Çalışmamız, sedasyon yönetiminde RASS ve BİS'in birlikte kullanılmasının tek başına yapılan ölçümlere göre daha üstün olduğunu düşündürmektedir. Yoğun bakım hastalarında birçok değişken faktör ve ilaç kullanımına bağlı olarak sedasyon yönetimi karmaşıktır [18-20]. Bu nedenle, sedasyon yönetiminde hem subjektif hem de objektif yöntemlerin bir arada kullanılması, klinik değerlendirmelerin doğruluğunu artırabilir.

Ağır ARDS hastalarında mortalite %50-60 civarındadır ve nöromüsküler blokaj ajanlarının kullanımı bu hastalarda sık görülmektedir [21]. Bu ajanların kullanımı, yoğun bakımda kalış süresini uzatmakta ve ventilatörden ayrılmayı zorlaştırmaktadır [4]. Derin sedasyonun bu süreçteki etkisini inceleyen çalışmalar, derin sedatize edilen hastalarda mortalitenin daha yüksek olduğunu göstermektedir [21,22]. Çalışmamızda, BİS değeri ≤40 ve >40 olan hastalar arasında mortalite farkı bulunmamıştır. Ancak, çalışma grubumuzda APACHE II skorlarının ve Charlson Komorbidite İndeksi'nin yüksek olması, mortalite oranlarımızın literatürdeki verilere kıyasla daha yüksek olmasını açıklayabilir.

Bu çalışmanın bazı kısıtlılıkları bulunmaktadır. Birincisi, çalışmanın tek merkezli ve retrospektif olarak yürütülmesi, sonuçların genelleştirilebilirliğini sınırlamaktadır. Farklı

merkezlerden daha geniş bir hasta popülasyonunu içeren çok merkezli çalışmalar, sonuçların daha sağlam bir şekilde değerlendirilmesine olanak sağlayabilir.

İkincisi, çalışma popülasyonu sadece ağır ARDS hastaları ile sınırlıdır. Bu durum, elde edilen bulguların hafif ve orta şiddetli ARDS vakalarına uygulanabilirliğini kısıtlamaktadır. Ayrıca, hasta sayısının kısıtlı olması, özellikle alt gruplar arasında yapılan analizlerde istatistiksel gücü düşürmüş olabilir.

Üçüncü olarak, yoğun bakım hastalarında sedasyon yönetimini etkileyebilecek birçok komorbidite ve ilaç kullanımı bulunmaktadır. Bu değişkenlerin tümünün ayrıntılı bir şekilde kategorize edilememesi, sonuçlar üzerinde potansiyel bir yanlılığa yol açabilir. Çalışmada, bu faktörlerin etkilerini tam olarak kontrol etmek mümkün olmamıştır.

Son olarak, BİS ve RASS değerlerinin ölçümlerinde subjektif ve objektif yöntemlerin birlikte kullanılması her ne kadar faydalı olsa da, kullanılan cihazların ve yöntemlerin doğruluğu, ölçüm tekniklerindeki farklılıklar nedeniyle değişkenlik gösterebilir.

Sonuç olarak, BİS, birçok faktörden etkilenebilmesine rağmen, objektif bir sedasyon değerlendirme aracı olarak faydalıdır. ARDS hastalarında sedasyon yönetiminde hem RASS hem de BİS birlikte kullanılmalı, ancak BİS'in mortalite üzerinde belirgin bir etkisi gösterilememiştir. RASS ve BİS'in birlikte kullanılması, sedasyon yönetiminin daha doğru yapılmasına katkı sağlayabilir ve daha iyi klinik sonuçlar elde edilmesine yardımcı olabilir.

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Araştırma Makalesi

Kuru kemik kalkaneus örneklerinin morfometrik incelenmesi ve açısal değerlendirilmeleri

Morphometric examination and angular evaluation of dry bone calcaneus specimens

Mehmet Yücens*[1], Samed Belenköylü[2], İbrahim Er[2], Sevin Sönmez[2], Ali Kasap[2]

[1]Pamukkale Üniversitesi Tıp Fakültesi Ortopedi ve Travmatoloji Anabilim Dalı, Denizli, Türkiye
[2]Pamukkale Üniversitesi Tıp Fakültesi öğrencisi, Denizli, Türkiye

Öz

Amaç: Bu çalışmanın amacı, kuru kalkaneus kemikleri üzerinde morfometrik ve açısal analizler yaparak bu kemiklerin topografik özelliklerini incelemek ve elde edilen bulguların klinik uygulamalarda kullanılabilecek yeni parametreler sunup sunamayacağını değerlendirmektir.

Gereç ve Yöntemler: Çalışma, toplam 32 kuru kalkaneus kemiği üzerinde gerçekleştirilmiştir. Deformite veya kırık içermeyen kemikler titizlikle seçilmiş ve dijital kumpas ile morfometrik ölçümler yapılmıştır. Ölçüm alanları arasında kalkaneus uzun aksı, posterior ve medial faset uzunlukları gibi parametreler yer almıştır. Açısal ölçümler için Gissane ve Böhler açıları dijital bir açı ölçer yazılımı ile kaydedilmiştir. Elde edilen veriler SPSS yazılımına yüklenmiş ve korelasyon analizleri gerçekleştirilmiştir.

Bulgular: Kalkaneus uzun aksı ortalama 73.76 mm, Gissane açısı ortalama 131.93°, Böhler açısı ise ortalama 35.63° olarak bulunmuştur. Korelasyon analizlerinde, Gissane ve Böhler açıları arasında anlamlı bir ilişki saptanırken, diğer uzunluk ve açılar arasında anlamlı bir korelasyon bulunmamıştır. Uzunluklar kendi içinde medial faset uzunlukları haricinde korele bulunmuştur.

Sonuçlar: Bu çalışmada, kalkaneus kemiklerinin morfometrik ve açısal özelliklerinin bireyler arasında önemli farklılıklar gösterdiği ve bu yapıların bağımsız değişkenler olduğu görülmüştür. Bu bulgular, özellikle kalkaneus kırıkları ve deformitelerinin tedavisinde daha etkili stratejiler geliştirilmesine katkı sağlayabilir.

Anahtar Kelimeler: Kalkaneus, Gissane açısı, Böhler açısı, Posterior faset

Sorumlu Yazar*: Mehmet Yücens, Adres: Pamukkale Üniversitesi Tıp Fakültesi Ortopedi ve Travmatoloji Anabilim Dalı, Denizli, Türkiye
E-posta: aflyucens@yahoo.com
Orcid: 0000-0001-6924-6613
Doi: 10.18663/tjcl.1641979
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Abstract

Aim: The aim of this study was to investigate the topographic characteristics of dry calcaneal bones using morphometric and angular analyses, and to evaluate whether the results can provide new parameters that can be used in clinical applications.

Materials and Methods: The study was performed on a total of 32 dry calcaneal bones. Bones without deformities or fractures were carefully selected and morphometric measurements were performed using digital callipers. Measurements included parameters such as calcaneal long axis, posterior and medial facet lengths. For angle measurements, Gissane and Böhler angles were recorded using digital protractor software. The data obtained were loaded into SPSS software and correlation analyses were performed.

Results: The mean long axis of the calcaneus was 73.76 mm, the mean Gissane angle was 131.93°, and the mean Böhler angle was 35.63°. Correlation analyses showed a significant correlation between Gissane and Böhler angles, but no significant correlation between other lengths and angles. Lengths were correlated within themselves, except for the medial facet lengths.

Conclusion: In this study, the morphometric and angular characteristics of the calcaneus bones showed significant differences between individuals and these structures were found to be independent variables. These findings may contribute to the development of more effective strategies, particularly in the treatment of calcaneal fractures and deformities.

Keywords: Calcaneus, Gissane angle, Böhler angle, Posterior facet

Giriş

Kalkaneus kemiği, ayak bileği ve ayağın anatomik yapısında kritik bir bileşendir ve vücut ağırlığının büyük bir kısmını taşıyan temel kemiklerden biridir [1]. Bu kemik, ayak biyomekaniğinin yanı sıra yürüyüş ve denge mekanizmasında da önemli bir rol oynar. Kalkaneus, ayak bileği eklemine yük taşıyan ve vücut ağırlığını dağıtan en önemli kemiklerden biri olarak, insan hareket sisteminde kritik bir role sahiptir [2]. Kalkaneus sadece vücut ağırlığını desteklemek ve şoku dağıtmakla kalmaz, aynı zamanda ayağın ana plantar fleksörleri için bir kaldıraç kolu olarak da önemli bir rol oynar [3]. Kalkaneus, talus ve küboid kemik ile eklem yaparak, ayak bileği eklemi ve ayak arkının stabilitesini sağlar. Hem karmaşık morfolojik yapısı hem de çevresel koşullara adaptasyonu, bu kemiğin fonksiyonel verimliliğini doğrudan etkiler. Kalkaneusun morfolojisi, genetik faktörler ve bireyin yaşam tarzına bağlı olarak büyük farklılıklar gösterebilirken, topolojisi de fonksiyonel yüklenmelere ve biyomekanik taleplere göre şekillenir [4]. Bu açıdan, kalkaneusun topolojisi ve morfolojik çeşitliliği, ortopedik uygulamalardan biyomekanik araştırmalara kadar birçok disiplinde ilgi çeken bir çalışma alanı oluşturur [5].

Kalkaneusun topografik yapısının incelenmesi, klinik pratiğe önemli katkılar sağlayabilir. Özellikle kırıkların tedavisinde ve ayak deformitelerinin düzeltilmesinde bu kemikle ilgili ayrıntılı anatomik bilgi büyük önem taşır. Kalkaneus kırıkları, ortopedik travmalar arasında sık görülen yaralanmalar olup, yanlış kaynama veya tedavi edilmediğinde ciddi fonksiyonel kayıplara neden olabilir[6]. Kalkaneal kırıklardan sonra kalkaneusun normal anatomik formunu geri kazandırmak, bireyin normal fonksiyonunu ve yürüyüşünü geri kazanması için kritik bir husustur. Bu nedenle, kalkaneusun anatomik yapısının doğru anlaşılması, tedavi yaklaşımlarının geliştirilmesi açısından gereklidir.

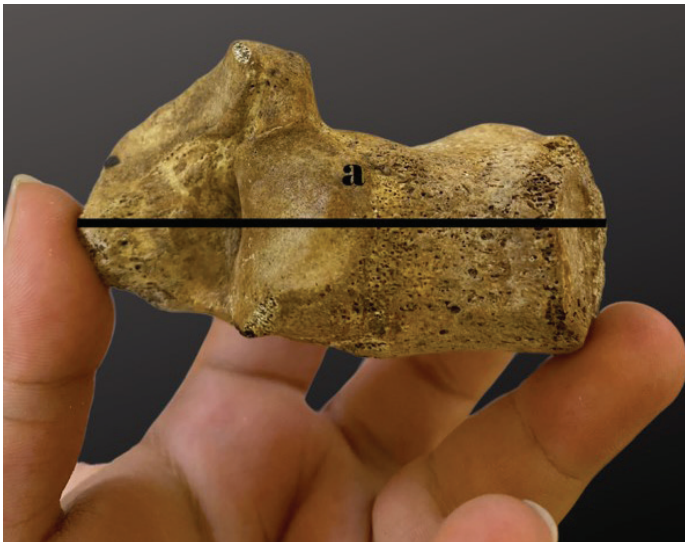
Bu çalışmada, kuru kemik kalkaneuslar üzerinde yapılan topografik analizlerle elde edilen açı ve uzunlukların birbiriyle olan ilişkisi incelenmiş ve literatürdeki diğer çalışmalarla karşılaştırılmıştır. Çalışmanın sonuçları, kalkaneusun klinik değerlendirmesinde kullanılabilecek yeni parametreler sunabilir.

Gereç ve Yöntemler

Bu çalışma, Pamukkale Üniversitesi Tıp Fakültesi Anatomi Anabilim Dalı'ndan 6 adet ve Aydın Adnan Menderes Üniversitesi Tıp Fakültesi Anatomi Anabilim Dalı'ndan 26 adet olmak üzere toplam 32 adet kuru kalkaneus kemiği üzerinde gerçekleştirilmiştir. Çalışmaya dahil edilen kemiklerde herhangi bir deformite veya kırık bulunmamasına dikkat edilmiştir. Deforme olduğu tespit edilen, Pamukkale Üniversitesi Anatomi AD'dan 2, Adnan Menderes Üniversitesi AD'dan 6 adet kuru kemik araştırmaya dahil edilmemiştir. Çalışmada kullanılan kalkaneus kemiklerinin topografik özellikleri 1/100 mm duyarlılıkta dijital kumpas kullanılarak ölçülmüştür. Açı ölçümleri için 1/100 mm hassasiyette Anglemeter 360 yazılımı kullanılmıştır. Elde edilen veriler, (SPSS) versiyon 23, IBM, Chicago yazılımına yüklenmiş ve pearson korelasyon istatistiksel analizleri yapılmıştır.

Ölçüm bölgeleri ve uzunluk ölçümleri

Kalkaneus uzun aksı (KUA): Posterior ucu ile anterior ucu arasındaki mesafe (şekil 1).



Şekil 1. Kalkaneus uzun aksı (KUA)

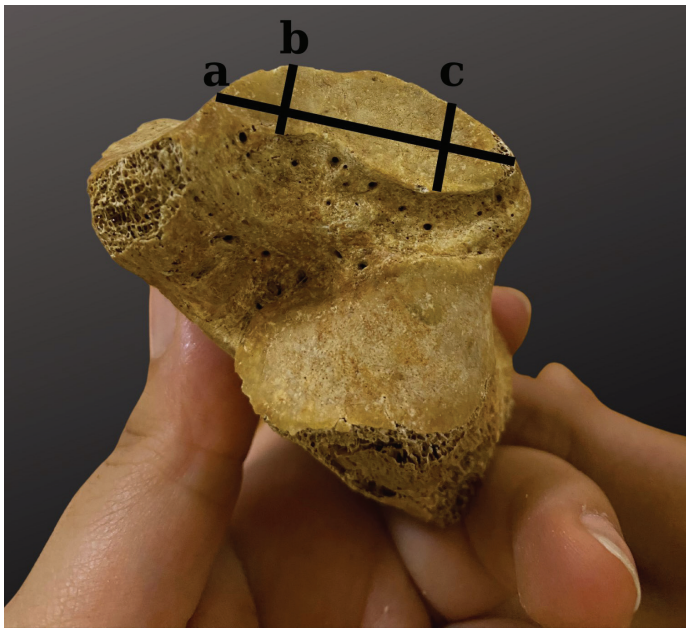
Posterior facet elipsoid uzun aksı (PFEUA): Posterior facetin en geniş elips yüzeyi üzerinde en uzak iki nokta arasındaki mesafe (şekil 2).

Şekil 2. Posterior facet elipsoid uzun aksı (PFEUA)

Posterior facet medial lateral uzunluk (PFMLU): Posterior facetin medial ve lateral kenarları arasındaki mesafe (şekil 2).

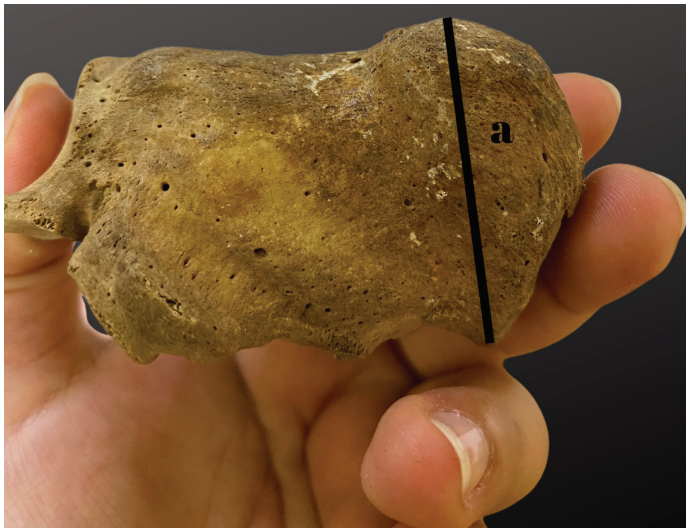
Medial facet uzunluğu (MFU): Sustentaculum tali'nin üzerinde yer alan medial eklem yüzeyinin uzunluğu (şekil 3).

Medial facet Posterior border (MFPB) ve Medial facet anterior border (MFAB): Medial facetin posterior ve anterior kenarları arasındaki mesafe (şekil 3).



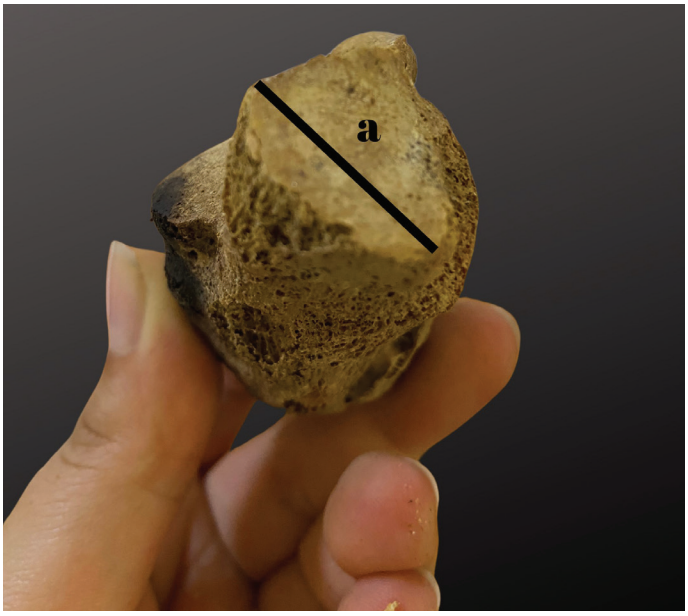
Şekil 3. Medial facet uzunluğu (MFU), Medial facet Posterior border (MFPB) ve Medial facet anterior border (MFAB)

Posterolateral yüzey iki çentik arası uzunluk (PLYU): Posterolateral yüzeydeki iki çentik arasındaki mesafe (şekil 4).



Şekil 4. Posterolateral yüzey iki çentik arası uzunluk (PLYU

Anterior yüz uzunluğu (AYU): Kalkaneoküboid eklemin kalkaneal eklem yüzünün uzun aks mesafesidir (şekil 5).



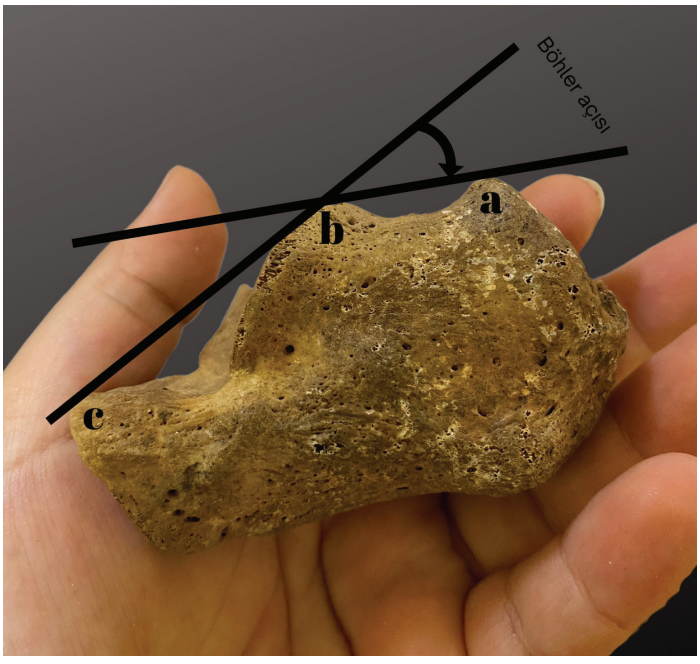
Şekil 5. Anterior yüz uzunluğu (AYU)

Medial yüz uzunlukları (MYU): Kalkaneusun medial yüzünde sustentaculum tali yapısından tuber calcaneiye olan mesafe.

Kalkaneus eninin uzunluğu (KEU): Kalkaneusun medial lateral en uzak iki referans noktası arası mesafe.

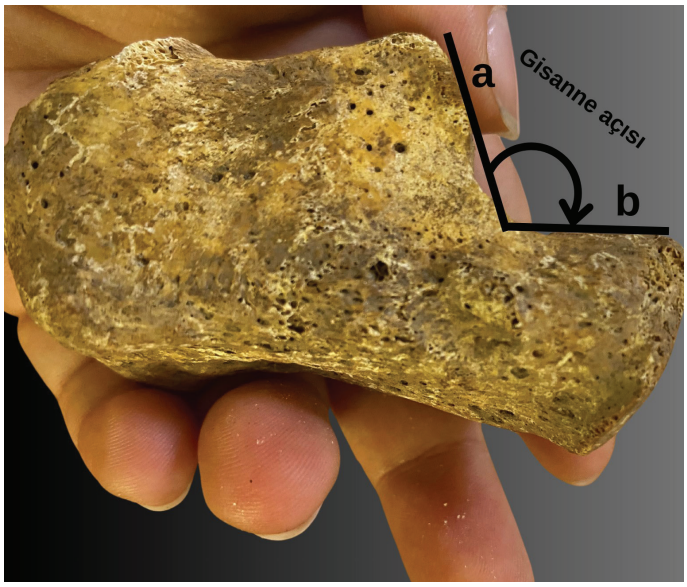
Açısal Ölçümler

Böhler Açısı (BA): Kalkaneusun posterior fasetinin en yüksek noktası ile tüber kalkaneinin en yüksek noktası arasında ölçülen açı (şekil 6).



Şekil 6. Böhler Açısı

Gissane Açısı (GA); Posterior fasetin lateral kenarından çekilen çizgi ile anterior fasetin lateral kenarından çekilen çizgi arasındaki açı (şekil 7).



Şekil 7. Gissane Açısı

Tip açısı (TA): Kalkaneus posterior plantar yüzeyindeki tip açısı (şekil 8).

Şekil 8. Tip açısı

Bulgular

Uzunluk Öçümleri Sonuçları (tablo 1)

Kalkaneus uzun aksı (KUA): Ortalama 73.76 mm ± 5.13 mm.

Posterior facet elipsoid uzun aksı (PFEUA): Ortalama 29.17 mm ± 2.36 mm.

Posterior facet medial lateral uzunluk (PFMLU): Ortalama 20.28 mm ± 1.68 mm.

Tablo 1. Kalkaneus uzunluklarının dağılımı

Uzunluk	Sayı	En yüksek değer	En düşük değer	Ort.±SS
KUA	24	84.04 mm	60.98 mm	73.76 mm ± 5.13 mm
PFEUA	24	35.61 mm	23.92 mm	29.17 mm ± 2.36 mm
PFMLU	24	23.77 mm	17.58 mm	20.28 mm ± 1.68 mm
MFU	24	42.22 mm	31.80 mm	52.53 mm ± 3.53 mm
MFPBU	24	13.97 mm	10.45 mm	11.71 mm ± 0.92 mm
MFABU	24	12.39 mm	8.04 mm	10.11 mm ± 1.11 mm
PLYU	24	47.77 mm	36.22 mm	42.90 mm ± 3.31 mm
MYU	24	57.20 mm	44.70 mm	52.02 mm± 3.62 mm
KEU	24	41.22 mm	31.16 mm	37.53 mm±2.56 mm
AYU	24	25.75 mm	17.66 mm	22.60 mm ± 2.50 mm

KUA:Kalkaneus uzun aksı, PFEUA:Posterior facet elipsoid uzun aksı, PFMLU:Posterior facet medial lateral uzunluk, MFU:Medial facet uzunluğu, MFPB: Medial facet Posterior border, MFAB: Medial facet anterior border, PLYU: Posterolateral yüzey iki çentik arası uzunluk, MYU:Medial yüz uzunlukları, KEU:Kalkaneus eninin uzunluğu, AYU: Anterior yüz uzunluğu

Medial facet uzunluğu (MFU): Ortalama 52.53 mm ± 3.53 mm.

Medial Faset Posterior border (MFPB):Ortalama 11.71 mm ± 0.92 mm.

Medial Faset Anterior border (MFAB):Ortalama 10.11 mm ± 1.11 mm.

Posterolateral yüzey iki çentik arası uzunluk (PLYU): Ortalama 42.90 mm ± 3.31 mm.

Anterior yüz uzunluğu (AYU): Ortalama 22.60 mm ± 2.5 mm.

Korelasyon analizinde MFU, MFPB, MFAB ile diğer uzunluklar arasında istatistiksel olarak anlamlı bir korelasyon saptanmamıştır (p≥0.05). Diğer uzunluklar kendi içinde istatistiksel olarak anlamlı olarak korele bulunmuştur (tablo 2).

Açısal Ölçüm Sonuçları (tablo 3)

Gissane Açısı: Ortalama 131.93° ± 6.48°.

Böhler Açısı: Ortalama 35.63° ± 7.16°.

Tip açısı: Ortalama 118.84° ± 5.90°.

Tablo 2. Uzunluklar arası korelasyon analizi sonuçları

		Korelasyon							
		KUA	PFEUA	PFMLU	MFU	MFPB	MFAB	PLYU	MYU
KUA	Pearson Correlation	1	,622**	,680**	,395	-,167	-,142	,608**	,647**
	Sig. (2-tailed)		,001	,000	,056	,436	,507	,002	,001
	N	24	24	24	24	24	24	24	24
PFEUA	Pearson Correlation	,622**	1	,561**	,083	-,120	,107	,453*	,719**
	Sig. (2-tailed)	,001		,004	,701	,576	,618	,026	,000
	N	24	24	24	24	24	24	24	24
PFMLU	Pearson Correlation	,680**	,561**	1	,503*	-,190	,151	,590**	,655**
	Sig. (2-tailed)	,000	,004		,012	,375	,482	,002	,001
	N	24	24	24	24	24	24	24	24
MFU	Pearson Correlation	,395	,083	,503*	1	-,128	-,010	,353	,314
	Sig. (2-tailed)	,056	,701	,012		,550	,962	,090	,135
	N	24	24	24	24	24	24	24	24
MFPB	Pearson Correlation	-,167	-,120	-,190	-,128	1	,263	,087	-,006
	Sig. (2-tailed)	,436	,576	,375	,550		,213	,688	,979
	N	24	24	24	24	24	24	24	24
MFAB	Pearson Correlation	-,142	,107	,151	-,010	,263	1	-,184	,203
	Sig. (2-tailed)	,507	,618	,482	,962	,213		,391	,341
	N	24	24	24	24	24	24	24	24
PLYU	Pearson Correlation	,608**	,453*	,590**	,353	,087	-,184	1	,287
	Sig. (2-tailed)	,002	,026	,002	,090	,688	,391		,174
	N	24	24	24	24	24	24	24	24
MYU	Pearson Correlation	,647**	,719**	,655**	,314	-,006	,203	,287	1
	Sig. (2-tailed)	,001	,000	,001	,135	,979	,341	,174	
	N	24	24	24	24	24	24	24	24

**. Korelasyon 0.01 düzeyinde anlamlıdır (2-tailed).
*. Korelasyon 0.05 düzeyinde anlamlıdır (2-tailed).

Gisanne ve Böhler Açısı açıları ile uzunluklar arasında istatistiksel olarak anlamlı bir korelasyon saptanmamıştır (p≥0.05). Gisanne ve Böhler Açısı kendi içinde istatistiksel olarak anlamlı korele bulunmuştur (tablo 4).

Tablo 3. Kalkaneus açılarının dağılımı

Açılar	Sayı	Ort±SS
Gisanne Açısı	24	131.93° ± 6.48°
Böhler Açısı	24	35.63° ± 7.16°
Tip açısı Açı	24	118.84° ± 5.90°

Tablo 4. Açısal ölçümler ve uzunluklar arası korelasyon analizi sonuçları

		Korelasyon									
		KUA	PFEUA	PFMLU	MFU	MFPB	MFAB	PLYU	MYU	böhler	gisanne
böhler	Pearson Correlation	-,297	-,253	-,324	-,174	,266	-,175	-,381	-,180	1	,679**
	Sig. (2-tailed)	,158	,233	,122	,417	,210	,413	,067	,400		,000
	N	24	24	24	24	24	24	24	24	24	24
gisanne	Pearson Correlation	-,216	-,250	-,397	-,291	,360	-,018	-,437*	-,239	,679**	1
	Sig. (2-tailed)	,311	,239	,054	,168	,084	,935	,033	,261	,000	
	N	24	24	24	24	24	24	24	24	24	24

**. Korelasyon 0.01 düzeyinde anlamlıdır (2-tailed).
*. Korelasyon 0.05 düzeyinde anlamlıdır (2-tailed).

Tartışma

Bu çalışmada elde edilen bulgular, kalkaneus kemiklerinin ölçülen uzunlukları ve açıları arasında anlamlı bir korelasyon olmadığını ortaya koymuştur. Ancak gisanne ve böhler açısı kendi içinde korele bulunmuştur. Schmutz ve arkadaşlarının yapmış olduğu çalışmada da genel uzunluklar ve açılar arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır [7]. Bu çalışmada kalkaneusların middle ve anterior fasetinin %85'i Boyan ve arkadaşlarının sınıflamasına göre tip B olarak bulunmuş ve medial faset olarak adlandırılmıştır [8]. Prasad ve ark. Boyan ve ark. sınıflamasını tip B1 ve tip B2 olarak almışlar ve çalışılan kalkaneusların % 81 inin tip B olduğunu bulmuşlardır [9]. Medial fasetin anteriorunun en geniş yeri ve posteriorunun en geniş yeri ve uzun aks uzunlukları ölçülmüştür. Korelasyon analizinde MFU, MFPB, MFAB ile diğer uzunluklar arasında istatistiksel olarak anlamlı bir korelasyon saptanmamıştır (p≥0.05). Diğer uzunluklar kendi içinde istatistiksel olarak anlamlı korele bulunmuştur (p≤0.05). Koshy ve ark. Yapmış olduğu çalışamada da uzun aks uzunlukları kendi içinde istatistiksel olarak anlamlı bulunmuştur [10]. Kalkaneusun yük taşıyan ve en geniş eklem yüzü olan posterior faset kalkaneus boyutundan etkilenmektedir ancak rotasyona katılan medial faset kalkaneus boyutundan etkilenmemektedir. Bu sonuç gelişimsel süreçte ayak basma kinematiği ve ayak diziliminin özellikle medial fasetin yapısını ve sonuç olarak da kalkaneus morfolojisini değiştirdiğini göstemektedir [11].

Bu çalışmanın aksine Seyahi ve ark. gisanne ve böhler açısı arasında anlamlı bir koreasyon saptamamışlardır [12]. Ancak çalışmaları iki boyutlu x-ray ölçümleri üzerinden yapılmıştır.

Bu çalışmada kalkaneus uzun aksı ortalama 73.76 mm bulunmuştur. Koh ve arkadaşlarının güney Asya popülasyonunda yapmış olduğu radyolojik çalışmada bu çalışmanın sonuçlarına benzer olarak ortalama kalkaneusun en uzun aksı 72.1 mm olarak bulunmuştur [13]. Türk toplumunda Dursun ve arkadaşlarının yapmış olduğu kuru kemik çalışmasında kalkaneus uzunluğu 75.49 mm olarak bulunmuştur [14]. Kuru kemik ve radyolojik çalışmalar arasındaki karşılaştırmalı üstünlük arasında genellikle bir tartışma vardır. Kuru kemik grubu nispeten daha yaşlı (homojen olmayan yaş dağılımı) bir popülasyondan oluşma eğilimindedir. Cinsiyet belirlemede zorluk, kemiğin aşınması ve yıpranması ve bilinmeyen öykü nedeniyle patolojik kemiği çalışmaya dahil etme ihtimalinin daha yüksek olduğu kabul edilmektedir [15]. Ancak ölçümler birebir kemik üzerinden yapıldığı için radyolojik olarak açısal duruşlardan ve superpozisyondan etkilenmemektedir. Böylelikle yapılan ölçümlerde ölçümsel hata olmamaktadır. Schmutz ve ark. yapmış olduğu çalışmada iki boyutlu tomografilerde yapılan ölçümler ile üç boyutlu tomografilerde yapılan ölçümler bile farklılıklar olabileceği ortaya konmuştur [7].

Literatürde Böhler açısının 25-40° arasında olması Gissane açısının ise 100-130° arasında olduğu gösterilmiştir. Bu çalışmada Böhler açısı ortalama 35.63 derece 26-47° ve Gissane açısı ortalama 131.93 derece 120-144° bulunmuştur. Gissane ve Böhler açılarının bireyler arasında farklılıklar göstermesi, klinik uygulamalarda bu açıların dikkatle ele alınması

gerektiğini ortaya koymaktadır. Kalkaneusun topografik yapısının bireyler arasında önemli farklılıklar gösterdiğini ve bu yapıların birbirinden bağımsız olarak değerlendirilmesi gerektiğini göstermektedir.

Kalkaneus kırıkları ve deformiteleri tedavi edilirken, bu kemiklerin anatomik yapısının ayrıntılı bir şekilde incelenmesi, daha etkili tedavi stratejileri geliştirilmesine katkı sağlayabilir [16]. Özellikle cerrahi müdahalelerde, kalkaneus açıları ve uzunluklarının doğru hesaplanması, tedavi başarısını artırabilir [17]. Bununla birlikte, çalışmada kullanılan örneklerin sınırlı sayıda olması, daha geniş örneklem gruplarıyla yapılacak ek çalışmalara ihtiyaç duyulduğunu göstermektedir.

Sonuç

Bu çalışmada kuru kemik kalkaneusların topografik özellikleri ve açıları incelenmiş, elde edilen bulgular klinik uygulamalarda kullanılabilecek yeni bilgiler sağlamıştır. Kalkaneus kemiklerinin açılarının ve uzunluklarının bağımsız değişkenler olduğu sonucuna varılmıştır. Gelecekte, daha geniş örneklem grupları ve farklı metodolojik yaklaşımlarla yapılacak çalışmalar, bu kemik yapısının daha iyi anlaşılmasına katkı sağlayabilir.

Maddi destek ve çıkar ilişkisi

Yazarlar herhangi bir maddi destek almadıklarını ve çıkar ilişkisi içinde olmadıklarını beyan ederler.

Teşekkür

Pamukkale Üniversitesi Tıp Fakültesi Anatomi Anabilim dalı öğretim üyesi Prof. Dr.Esat Adıgüzel ve Aydın Adnan Menderes Üniversitesi Tıp Fakültesi Anatomi Anabilim dalı öğretim üyesi Prof. Dr. Ilgaz Akdoğan'a destekleri için teşekkür ederiz.

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Research Article

C-reactive protein to albumin ratio as a prognostic marker in community-acquired pneumonia mortality

Toplum kökenli pnömonide mortaliteyi öngören bir belirteç olarak C-reaktif protein/albumin oranı

İzzet Ustaalioğlu*[1], Özge Kibici[2]

[1]Specialist of Emergency Medicine, Gönen State Hospital, Department of Emergency Medicine, Balıkesir, Turkey

[2]Specialist of Emergency Medicine, Kartal Dr. Lütfi Kırdar City Hospital, Department of Emergency Medicine, Istanbul, Turkey

Abstract

Aim: This study aimed to evaluate the prognostic value of the C-reactive protein-to-albumin ratio (CAR) in predicting 30-day mortality among patients diagnosed with community-acquired pneumonia (CAP) presenting to the emergency department (ED).

Material and Methods: A retrospective study was conducted on 312 patients diagnosed with CAP who presented to the ED of a tertiary care hospital between January 1, 2022, and January 1, 2024. Demographic, clinical, and laboratory data were collected, including C-reactive protein (CRP) and albumin levels. CAR was calculated by dividing CRP levels (mg/dL) by albumin levels (g/L). The primary outcome was 30-day mortality. The prognostic performance of CAR was evaluated using receiver operating characteristic (ROC) curve analysis.

Results: Of the 312 patients included, 87 (27.9%) died within 30 days. The deceased group had significantly higher CAR values compared to survivors (1.18 ± 0.62 vs. 0.52 ± 0.25, $p < 0.001$). CAR demonstrated excellent discriminatory power for predicting 30-day mortality, with an area under the curve (AUC) of 0.837 (95% CI: 0.791–0.876, $p < 0.001$). At a cut-off value of >0.77, CAR achieved a sensitivity of 75.9% and a specificity of 86.7%. Deceased patients also exhibited significantly lower systolic and diastolic blood pressures, oxygen saturation, and albumin levels, along with higher CRP levels and respiratory rates. Comorbidities such as stroke and congestive heart failure were more prevalent in the deceased group compared to survivors.

Conclusion: The C-reactive protein-to-albumin ratio is a reliable prognostic marker for predicting 30-day mortality in CAP patients presenting to the ED. Its ease of calculation and strong discriminatory power make CAR a valuable tool for risk stratification and clinical decision-making. Prospective studies are warranted to confirm these findings in diverse populations.

Keywords: Albumin, community-acquired pneumonia, C-reactive protein, C-reactive protein-to-albumin ratio, mortality.

Corresponding Author*: İzzet Ustaalioğlu, Specialist of Emergency Medicine, M.D., Gönen State Hospital, Department of Emergency Medicine, Balıkesir, Turkey
E-mail: izzetustaalioglu@gmail.com
Orcid: 0000-0001-9703-8344
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Öz

Amaç: Bu çalışma, acil servise (AS) başvuran toplum kökenli pnömoni (TKP) tanısı almış hastalarda C-reaktif protein/albumin oranının (CAR) 30 günlük mortaliteyi öngörmedeki prognostik değerini değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntemler: Bu retrospektif çalışma, 1 Ocak 2022 ile 1 Ocak 2024 tarihleri arasında üçüncü basamak bir hastanenin AS'ine başvuran ve TKP tanısı konulan 312 hastayı içermektedir. Demografik, klinik ve laboratuvar verileri, C-reaktif protein (CRP) ve albumin düzeyleri dahil olmak üzere toplanmıştır. CAR, CRP düzeyinin (mg/dL) albumin düzeyine (g/L) bölünmesiyle hesaplanmıştır. Birincil sonuç, 30 günlük mortalite olarak belirlenmiştir. CAR'ın prognostik performansı, ROC eğrisi (receiver operating characteristic) analizi kullanılarak değerlendirilmiştir.

Bulgular: Çalışmaya dahil edilen 312 hastanın 87'si (%27,9) 30 gün içinde hayatını kaybetmiştir. Hayatta kalamayan hastalar, sağ kalanlara kıyasla anlamlı derecede yüksek CAR değerlerine sahipti (1,18 ± 0,62'ye karşı 0,52 ± 0,25, p < 0,001). CAR, 30 günlük mortaliteyi öngörmede mükemmel ayırt edici güce sahipti (Eğri altındaki alan (AUC): 0,837, %95 GA: 0,791–0,876, p < 0,001). >0,77 eşik değeri kullanıldığında, CAR %75,9 duyarlılık ve %86,7 özgüllük gösterdi.Hayatta kalamayan hastalar ayrıca daha düşük sistolik ve diyastolik kan basıncına, oksijen satürasyonuna ve albumin düzeylerine sahipken, daha yüksek CRP düzeyleri ve solunum hızları gösterdi. Ayrıca, inme ve konjestif kalp yetmezliği gibi komorbiditeler hayatta kalamayan hastalarda sağ kalanlara kıyasla daha yaygındı.

Sonuç: C-reaktif protein/albumin oranı (CAR), TKP hastalarında 30 günlük mortaliteyi öngörmede güvenilir bir prognostik belirteçtir. Kolay hesaplanabilirliği ve güçlü ayırt edici gücü nedeniyle, CAR risk sınıflandırması ve klinik karar verme süreçlerinde değerli bir araç olabilir. Bu bulguların farklı popülasyonlarda doğrulanması için prospektif çalışmalara ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Albumin, community-acquired pneumonia, C-reactive protein, C-reactive protein-to-albumin ratio, mortality.

Introduction

Community-acquired pneumonia (CAP) is one of the leading causes of morbidity and mortality worldwide (1-3). It represents an acute infection of the pulmonary parenchyma acquired outside healthcare settings. Clinically, CAP manifests in a spectrum ranging from mild respiratory symptoms to severe cases requiring intensive care, often complicated by sepsis and respiratory failure (4). Despite advancements in diagnostic and therapeutic approaches, CAP remains a significant burden on healthcare systems, accounting for substantial hospital admissions and resource utilization (5).

C-reactive protein (CRP) and serum albumin are widely utilized biomarkers in clinical practice. CRP, an acute-phase reactant, reflects the intensity of systemic inflammation and is commonly elevated in bacterial infections, including pneumonia (6). Serum albumin, on the other hand, serves as an indicator of nutritional status and systemic inflammation. Hypoalbuminemia has been associated with poor outcomes in various critical illnesses (7).

The CRP/albumin ratio (CAR) integrates these two parameters, offering a combined assessment of inflammation and nutritional status. CAR has been explored in several clinical settings, including sepsis, malignancies, and cardiovascular diseases, as a prognostic marker (8-10). While its role in CAP has been less extensively studied, Its use in CAP has the potential to improve clinical decision-making and patient outcomes.

This study aims to evaluate the relationship between the CAR and mortality in patients diagnosed with community-acquired pneumonia presenting to the emergency department (ED).

Material And Methods

Study design

This retrospective study was conducted on patients diagnosed with CAP who presented to the ED of a tertiary care hospital. Ethical approval for the study was obtained from the Kartal Dr Lütfi Kırdar City Hospital Ethics Committee (Approval Number: 2024/010.99/10/56; Date: 29.11.2024). The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Selection of participants

This study included patients who presented to the ED between January 1, 2022, and January 1, 2024, with a diagnosis of CAP and were admitted to the hospital. The diagnosis of CAP was based on clinical findings, including fever, cough, dyspnea, and/or pleuritic chest pain, combined with radiological evidence of a new pulmonary infiltrate on chest X-ray or computed tomography, and laboratory markers indicative of infection, such as elevated C-reactive protein or procalcitonin levels (11). Patients were included if they were aged 18 years or older, had

a confirmed diagnosis of CAP at the time of ED admission, and had complete clinical, radiological, and laboratory data available. Hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP) cases were excluded from the study. Additionally, patients with incomplete data or those lost to follow-up were not included in the analysis.

Outcomes

The primary outcome of this study was the relationship between the CAR and 30-day mortality in patients diagnosed with CAP. Mortality data were obtained through hospital electronic medical records and, if necessary, follow-up phone calls to the patients' families or caregivers.

Data collection

Data for this study were retrospectively collected from the electronic medical records of patients who presented to the ED between January 1, 2022, and January 1, 2024, with a diagnosis of severe CAP. Demographic variables, including age, gender, and comorbidities, were extracted alongside clinical findings such as vital signs (systolic and diastolic blood pressure, oxygen saturation, respiratory rate, and body temperature) recorded during the initial ED evaluation. Laboratory data, including CRP, albumin levels, white blood cell (WBC) counts, and differential counts, were also collected. The CAR was calculated for each patient to evaluate its potential prognostic significance. All data were anonymized and securely stored.

Analysis

Descriptive statistics were used to summarize demographic, clinical, and laboratory parameters. Continuous variables were presented as means with standard deviations (mean ± SD) for normally distributed data or medians with interquartile ranges (IQR) for non-normally distributed data. Categorical variables were expressed as frequencies with percentages (n, %). Comparisons between survivors and deceased groups were performed using the Student's t-test for normally distributed continuous variables and the Mann-Whitney U test for non-normally distributed variables. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

The diagnostic performance of the CAR for predicting mortality was evaluated using receiver operating characteristic curve analysis. The area under the curve and its 95% confidence interval were calculated to assess discrimination. The Youden Index was used to determine the optimal cut-off value for CAR, maximizing the balance between sensitivity and specificity. Sensitivity and specificity values at fixed thresholds were estimated and presented with their corresponding 95% confidence intervals. All statistical analyses were performed using SPSS version 30.0 (IBM Corp, Armonk, NY, USA) and MedCalc Statistical Software (MedCalc Software Ltd., Ostend, Belgium). A p-value < 0.05 was considered statistically significant.

Results

A total of 312 patients with severe pneumonia were included, comprising 225 survivors (72.1%) and 87 deceased patients (27.9%). The mean age of the deceased group was statistically significantly higher than that of the survivor group (74.9 ± 14.0 vs. 70.5 ± 13.3 years, p < 0.001). Sex distribution was similar between groups, with male patients comprising n=118 (52.4%) of the survivor group and n=42 (48.3%) of the deceased group (p = 0.297).

Deceased patients exhibited statistically significantly lower systolic (91.6 ± 20.9 vs. 115.3 ± 29.9 mmHg, p < 0.001) and diastolic blood pressures (63.9 ± 13.8 vs. 79.4 ± 19.0 mmHg, p < 0.001), lower oxygen saturation (84% [IQR 78–92%] vs. 90% [IQR 86–93%], p < 0.001), and higher respiratory rates (17 [IQR 12–20] vs. 14 [IQR 11–18] breaths/min, p < 0.001) compared to survivors. Body temperature was also statistically significantly lower in the deceased group (36.1°C [IQR 34.8–37.3 °C] vs. 37.3°C [IQR 37.0–37.7 °C], p < 0.001).

In terms of comorbidities, stroke was more frequent in the deceased group (n=23, 26.4%) compared to the survivor group (n=27, 12.0%, p = 0.002). Congestive heart failure was also statistically significantly higher in deceased patients (n=23, 26.4%) compared to survivors (n=31, 13.8%, p = 0.008). There were no statistically significant differences in the rates of hypertension (n=30, 34.5% vs. n=72, 32.0%, p = 0.386), diabetes mellitus (n=30, 34.5% vs. n=73, 32.4%, p = 0.415), chronic kidney disease (n=5, 5.7% vs. n=13, 5.8%, p = 0.615), or COPD (n=29, 33.3% vs. n=65, 28.9%, p = 0.263; Table 1).

Laboratory findings demonstrated statistically significantly higher CRP levels (33.1 ± 17.0 vs. 17.8 ± 8.7 mg/dL, p < 0.001) and neutrophil counts (11.5 ± 7.5 vs. 8.3 ± 4.3 x10^3/µL, p < 0.001) in the deceased group, with lower albumin levels (28.3 ± 2.8 vs. 34.9 ± 3.9 g/L, p < 0.001). The CRP-to-albumin ratio (CAR) was statistically significantly higher in the deceased group (1.18 ± 0.62 vs. 0.52 ± 0.25, p < 0.001), while WBC and lymphocyte counts were similar between groups (p = 0.090 and p = 0.614, respectively; Table 1).

The CAR demonstrated excellent discriminatory power for predicting mortality, with an area under the curve (AUC) of 0.837 (95% CI: 0.791–0.876, p < 0.001). At an optimal cut-off value of >0.77, CAR had a sensitivity of 75.9% (95% CI: 65.5–84.4) and a specificity of 86.7% (95% CI: 81.5–90.8), with a Youden Index of 0.625 (Table 2, Figure 1).

Table 1. Comparison of Demographic, Clinical, and Laboratory Parameters Between Survivors and Deceased Patients				
Parameter	All (n=312)	Survivor (n=225)	Deceased (n=87)	p
Age (years)	71.7 ± 11.7	70.5 ± 13.3	74.9 ± 14.0	<0.001
Sex (male), n (%)	160 (51.3)	118 (52.4)	42 (48.3)	0.297
Altered mental status, n (%)	70 (22.4)	47 (20.9)	23 (26.4)	0.183
Systolic BP (mmHg)	108.7 ± 29.7	115.3 ± 29.9	91.6 ± 20.9	<0.001
Diastolic BP (mmHg)	75.0 ± 19.0	79.4 ± 19.0	63.9 ± 13.8	<0.001
Body temperature (°C)	37.2 (36.7 - 37.7)	37.3 (37.0 - 37.7)	36.1 (34.8 - 37.3)	<0.001
Oxygen saturation (%)	89 (85 - 93)	90 (86 - 93)	84 (78 - 92)	<0.001
Respiratory rate (breaths/min)	15 (11 - 18)	14 (11 - 18)	17 (12 - 20)	<0.001
Hypertension, n (%)	102 (32.7)	72 (32.0)	30 (34.5)	0.386
Diabetes mellitus, n (%)	103 (33.0)	73 (32.4)	30 (34.5)	0.415
Chronic kidney disease, n (%)	18 (5.8)	13 (5.8)	5 (5.7)	0.615
Stroke, n (%)	50 (16.0)	27 (12.0)	23 (26.4)	0.002
COPD, n (%)	94 (30.1)	65 (28.9)	29 (33.3)	0.263
Congestive heart failure, n (%)	54 (17.3)	31 (13.8)	23 (26.4)	0.008
WBC (x10^3/μL)	22.6 ± 3.9	22.0 ± 4.0	24.3 ± 2.8	<0.001
Neutrophils (x10^3/μL)	9.2 ± 5.6	8.3 ± 4.3	11.5 ± 7.5	<0.001
Lymphocytes (x10^3/μL)	2.2 ± 0.8	2.2 ± 0.8	2.1 ± 0.9	0.614
CRP (mg/dL)	22.1 ± 13.5	17.8 ± 8.7	33.1 ± 17.0	<0.001
Albumin (g/L)	33.1 ± 4.7	34.9 ± 3.9	28.3 ± 2.8	<0.001
CRP-to-albumin ratio	0.70 ± 0.49	0.52 ± 0.25	1.18 ± 0.62	<0.001
BP: Blood Pressure; COPD: Chronic Obstructive Pulmonary Disease; CRP: C-Reactive Protein; WBC: White Blood Cell Count;				

Table 2. Diagnostic Performance of C-Reactive protein-to-Albumin Ratio for Predicting Mortality						
Variable	AUROC (95% CI)	P	Youden Index (J)	Criterion	Sensitivity (95% CI)	Specificity (95% CI)
CAR	0.837 (0.791-0.876)	<0.001	0.625	>0.77	75.9 (65.5-84.4)	86.7 (81.5-90.8)
CAR: C-Reactive Protein-to-albumin ratio; CI: confidence interval						

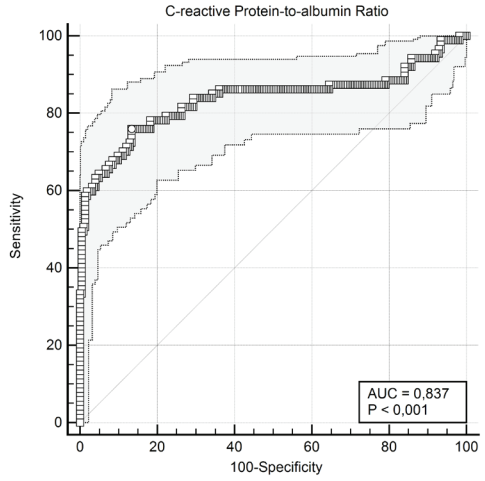

Figure 1. Receiver operating characteristic (ROC) curve of the CRP-to-albumin ratio for predicting mortality.

Discussion

In this study, we found that the CAR demonstrated significant prognostic value in predicting 30-day mortality among patients with CAP.

The CAP is a leading cause of morbidity and mortality worldwide, particularly among vulnerable populations such as the elderly and those with underlying comorbidities. Its clinical significance lies not only in its high prevalence but also in its potential to progress rapidly to severe complications, including sepsis and respiratory failure. Older age and chronic comorbidities are well-established risk factors for worse outcomes in CAP, as they can compromise the immune response and exacerbate the severity of the disease (12-14). Consistent with these observations, our study demonstrated that the mean age of deceased patients was significantly higher compared to

survivors, and chronic conditions such as stroke and congestive heart failure were more prevalent among those who deceased to the disease. In addition, lower oxygen saturation levels were observed in deceased patients, supporting the role of hypoxia as a critical determinant of mortality in CAP. Similarly, Umaç et al. reported that oxygen saturation levels were significantly reduced in patients with respiratory diseases during the COVID-19 pandemic, emphasizing the prognostic significance of hypoxia in respiratory illnesses (15).

The CRP and albumin are essential biomarkers used in the clinical assessment of systemic inflammation and nutritional status. CRP, as an acute-phase reactant, indicates the severity of inflammatory responses, while albumin reflects both nutritional reserves and the impact of chronic or acute inflammation (16,17). The CAR, by combining these two parameters, provides a comprehensive marker that captures both inflammatory and nutritional dynamics in patients.

CAR has been shown to be a reliable prognostic marker in critical illnesses (18-20). Its ability to integrate inflammation and nutritional status makes it particularly valuable in predicting outcomes and guiding clinical management. In this study, the significantly higher CAR values observed in deceased CAP patients highlight its importance as a prognostic tool, particularly in emergency settings where timely risk assessment is crucial.

In this study, the significantly higher CAR values observed in deceased CAP patients highlight its importance as a prognostic tool, particularly in emergency settings where timely risk assessment is crucial. Luo et al. identified CAR as a significant marker of CAP severity, showing a strong correlation with the CURB-65 score and demonstrating enhanced diagnostic accuracy when combined with other inflammatory indices such as FAR, NLR, and PLR. Their findings suggest that CAR effectively reflects the inflammatory burden in CAP patients and offers practical value in clinical decision-making (21). Likewise, Ozdemir et al. reported that elevated CAR values are strongly associated with short-term mortality in CAP, emphasizing its applicability in emergency departments for rapid risk stratification (22). Additionally, Lee et al. demonstrated that incorporating CAR into existing scoring systems such as the Pneumonia Severity Index (PSI) improved prognostic performance, with low albumin and high CRP levels independently linked to higher mortality rates (23). These studies demonstrate the potential of CAR as a practical and reliable prognostic marker, contributing to improved risk stratification and clinical management in patients with CAP.

Limitations

This study has several limitations. First, its retrospective design may introduce selection bias, as only patients with complete clinical and laboratory data were included. Second, the single-center nature of the study may limit the generalizability of the findings to other populations or healthcare settings. Third, while we accounted for key comorbidities, other unmeasured confounding factors could have influenced the relationship between CAR and mortality. Lastly, the reliance on electronic medical records for data collection may have introduced inaccuracies or missing information.

Conclusions

The CAR is a readily available and clinically meaningful biomarker that demonstrates significant prognostic value in predicting 30-day mortality among patients with CAP presenting to the ED. Its incorporation into routine clinical practice may aid in the early identification of high-risk patients, allowing for timely and appropriate interventions. Future prospective studies are needed to validate these findings in broader and more diverse populations.

Availability of data and materials

The authors agree to the conditions of publication including the availability of data and materials in our manuscript.

Informed consent

Retrospective study.

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Conflicts of Interest

Authors declare that they have no conflicts of interest.

Human rights

The principles outlined in the Declaration of Helsinki have been followed.

Ethical Approval

This study was approved by the local ethics committee (ethics committee ruling number: 2024/010.99/10/56, date: 29.11.2024).

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Research Article

Factors associated with in-hospital mortality in patients with chronic obstructive pulmonary disease hospitalized to the intensive care unit due to septic shock

Septik şok nedeniyle yoğun bakım ünitesine yatırılan kronik obstrüktif akciğer hastalığı olan hastalarda hastane içi mortalite ile ilişkili faktörler

Korhan Kollu*[1], Selma Özlem Çelikdelen[2]

[1]Department of Internal Medicine, Division of Intensive Care, University of Health Sciences, Konya City Hospital, Konya, Turkey

[2]Department of Internal Medicine, University of Health Sciences, Konya City Hospital, Konya, Turkey

Abstract

Aim: This study aimed to evaluate in-hospital mortality-related factors in patients with chronic obstructive pulmonary disease (COPD) who were admitted to the intensive care unit (ICU) due to septic shock.

Material and Methods: This retrospective study included 62 COPD patients diagnosed with septic shock in a tertiary ICU. The Sepsis-3 criteria were used to establish the diagnosis of sepsis shock. Demographic and clinical data, including comorbid conditions, laboratory parameters, inflammatory markers, Acute Physiology and Chronic Health Evaluation II (APACHE II) scores, Sequential Organ Failure Assessment (SOFA) scores, and clinical outcomes were collected from electronic medical records. The modified Charlson Comorbidity Index (mCCI) calculation was based on the available comorbid conditions collected in the prehospital setting.

Results: The mean age of the study population was 70.6 ± 11.0 years, and 67.7% were male. Higher mCCI scores [Hazard ratio (HR): 1.23, $p = 0.002$], along with elevated APACHE II (HR: 1.15, $p < 0.001$) and SOFA scores (HR: 1.35, $p < 0.001$), were independent predictors of in-hospital mortality. Among laboratory parameters, higher procalcitonin (HR: 1.04, $p < 0.001$), and C-reactive protein (HR: 1.03, $p< 0.001$) were associated with mortality in univariate analysis but did not remain significant in multivariate regression. The optimal mCCI cut-off for predicting mortality was ≥7, yielding a sensitivity of 72.5% and specificity of 94.7%.

Conclusion: The mCCI, along with APACHE II and SOFA scores, serves as a significant independent predictor of mortality in COPD patients with septic shock. The mCCI may be a useful tool for risk stratification in this high-risk population.

Keywords: Comorbidity, chronic obstructive pulmonary disease, inflammation, septic shock, survival

Corresponding Author*: Korhan Kollu, Department of Internal Medicine, Division of Intensive Care, University of Health Sciences, Konya City Hospital, Konya, Turkey
E-mail: korhankollu@gmail.com
Orcid: 0000-0002-0973-724X
Doi: 10.18663/tjcl.1651695
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Öz

Amaç: Bu çalışma, septik şok nedeniyle yoğun bakım ünitesine (YBÜ) kabul edilen kronik obstrüktif akciğer hastalığı (KOAH) olan hastalarda hastane içi ölüm ile ilişkili faktörleri değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, bir üçüncü basamak yoğun bakım ünitesinde septik şok tanısı almış 62 KOAH hastası dahil edildi. Sepsis-3 kriterleri, septik şok tanısını koymada kullanıldı. Elektronik tıbbi kayıtlar aracılığıyla demografik ve klinik veriler, komorbid durumlar, laboratuvar parametreleri, inflamatuar belirteçler, Akut Fizyoloji ve Kronik Sağlık Değerlendirme II (APACHE II) skoru, Sekansiyel Organ Yetmezliği Değerlendirme (SOFA) skoru ve klinik sonuçlar toplandı. Modifiye Charlson Komorbidite İndeksi (mCCI), hastaların hastane öncesi dönemde sahip olduğu komorbid durumlar kullanılarak hesaplandı.

Bulgular: Çalışma popülasyonunun ortalama yaşı 70.6 ± 11.0 yıl olup, %67.7'si erkekti. Daha yüksek mCCI skorları [Hazard oranı (HR):1.23, p = 0.002], yüksek APACHE II (HR: 1.15, p < 0.001) ve SOFA skorları (HR: 1.35, p < 0.001) ile birlikte hastane içi ölümün bağımsız öngörücüleriydi. Laboratuvar parametreleri arasında, yüksek prokalsitonin (HR: 1.04, p < 0.001) ve C-reaktif protein (HR: 1.03, p < 0.001) seviyeleri tek değişkenli analizde mortalite ile ilişkili bulundu, ancak çok değişkenli regresyon analizinde anlamlılığını korumadı. Mortaliteyi öngörmede mCCI eşik değeri ≥7 olarak belirlendi ve bu değer, %72.5 duyarlılık ve %94.7 özgüllük gösterdi.

Sonuç: Septik şoklu KOAH hastalarında, mCCI, APACHE II ve SOFA skorlarıyla mortalitenin önemli bir bağımsız öngörücüsü olarak belirlendi. Bu yüksek riskli popülasyonda, mCCI risk sınıflandırması için yararlı bir araç olabilir.

Anahtar kelimeler: Eşlik eden hastalık, kronik obstrüktif akciğer hastalığı, inflamasyon, septik şok, sağkalım

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent respiratory condition characterized by persistent airflow limitation and chronic inflammatory responses in the airways and lungs [1]. Patients with COPD are at an increased risk of developing severe infections, including sepsis and septic shock, leading to higher morbidity and mortality rates [2, 3]. In fact, COPD is one of the most common chronic comorbidities observed in patients with sepsis [4]. Mortality risk in sepsis is influenced by multiple factors, including disease severity, underlying comorbidities, infection source, and associated complications [5, 6]. Hence, accurately predicting mortality risk at an early stage in ICU-admitted COPD patients is vital for effective disease management and improving survival rates.

Several factors contribute to the elevated mortality observed in COPD patients with sepsis or septic shock. Many of these patients tend to be older and have significant comorbid conditions that compromise their physiological reserve. Comorbid cardiovascular diseases are especially prevalent in COPD and have been linked to poor outcomes in critical illness [7]. It has been demonstrated that septic patients with COPD exhibit a greater burden of comorbidities compared to those without COPD [8]. The Charlson Comorbidity Index (CCI) is a validated tool used to predict mortality by classifying and weighting comorbid conditions. In COPD populations, a higher CCI has been associated with increased mortality [9, 10]. Similarly, a study in septic patients found that age-adjusted regression analysis showed a 2.3-fold increase in mortality risk among patients with moderate CCI scores and a 4.2-fold increase in those with high CCI scores, compared to those with low CCI scores [11]. The modified CCI (mCCI) version incorporates age as an additional factor, providing a more comprehensive assessment of a patient's overall health status [12]. A recent investigation in septic shock patients demonstrated that a mCCI score ≥ 6 was associated with significantly higher 30-day mortality [13].

In addition to comorbidities, elevated inflammatory biomarkers have been linked to worse prognoses in these patients. A systematic review and meta-analysis found that COPD patients with high C-reactive protein (CRP) and procalcitonin levels had a significantly higher risk of long-term mortality compared to those with lower CRP levels [14-17]. However, a thorough analysis that includes mCCI and other laboratory parameters in predicting mortality among ICU-admitted COPD patients with septic shock has yet to be performed.

Given the significant overlap and interplay between COPD, comorbidities, and the septic inflammatory response, it is crucial to identify which factors most strongly influence survival in COPD patients facing septic shock. Therefore, this study aimed to investigate the in-hospital mortality-related factors in COPD patients admitted to the ICU due to septic shock.

Material and Methods

This retrospective study was carried out at the ICU of Internal Medicine in University of Health Sciences Konya City Hospital between June 2023 to June 2024, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the Medical Faculty of the Non-Drug and Non-Medical Device Research at KTO Karatay University Faculty of Medicine (Date: 26.09.2024, Decision No: 2024/005). Given the retrospective nature of the study, the Local Ethics Committee waived the requirement for informed consent.

Study Population

Our hospital's internal medicine ICU has a capacity of 45 beds. Throughout the study period, a total of 508 sepsis patients hospitalized in ICU were retrospectively reviewed for study eligibility. The inclusion criteria consisted of COPD patients over 18 years of age with a confirmed diagnosis of septic shock. The Sepsis-3 criteria were used to establish the diagnosis of sepsis shock [18]. Exclusion criteria included patients without COPD, those with metastatic malignancies, those with hematological malignancy, those with acute pancreatitis, those with trauma, recent major surgery, pregnancy, and incomplete data. After applying the exclusion criteria, 62 patients were included in the final analysis.

Data Collection

Demographic, and clinical data were retrospectively collected from electronic patient records. The comorbid conditions of all patients prior to ICU admission were documented, and mCCI scores were calculated accordingly. As described earlier, mCCI is a more simplified form of the CCI, consisting of 12 comorbid conditions with a weighted total score ranging from 0 to 24. The age-adjusted score is determined by adding 1 point for every 10 years beyond the age of 50 [12].

Biochemical parameters were obtained from patient records based on venous blood samples collected at the time of ICU admission. The ratio of partial pressure of oxygen (PaO2) to fraction of inspired oxygen (FiO2) and partial pressure of carbon dioxide (PCO2) was determined using the initial arterial blood gas analysis conducted by ABL90 FLEX PLUS device (Radiometer, Copenaghen, Denmark) in the ICU department. Patients' venous blood samples were evaluated using a Roche Cobas 8000 device (Roche Diagnostics, Mannheim, Germany). Levels of platelet were determined the impedance method, CRP using the immunoturbidimetric method, albumin through the bromocresol green method, and creatinine with the kinetic colorimetric Jaffe method. Acute Physiology and Chronic Health Evaluation (APACHE II) scores, which indicate mortality risk, and Sequential Organ Failure Assessment (SOFA) scores, used as diagnostic criteria for sepsis, were calculated based on the worst clinical and laboratory findings within the first 24 hours of ICU admission. For patients who died within the first 24 hours of ICU admission, APACHE II scores were determined using their most severe clinical and laboratory parameters.

The length of stay (LOS) in both the hospital and ICU was calculated using admission and discharge dates. Clinical outcomes (alive or deceased) in the ICU and hospital were extracted from electronic medical records. Mortality was considered as any death occurring during the 30-day period between the patient's admission to the intensive care unit and discharge.

Statistical Analysis

All data were analyzed with STATA/MP v.16 software (StataCorp LLC, Texas, USA). Numerical data determined to be normally distributed based on the results of Kolmogorov-Smirnov tests are given as mean ± standard deviation values, while non-normally distributed variables are given as median (25th-75th quartiles) values. Univariable Cox regression analysis was used to identify demographic and clinical parameters associated with mortality. Independent predictors of mortality were determined using multivariable Cox regression analysis with the backward Wald method. The results of the regression analysis were presented as hazard ratios (HR) with 95% confidence intervals (CI). The survival plot was created using the Kaplan-Meier method. The receiver operating characteristic (ROC) curve analysis was applied to assess diagnostic performance, and the results of area under the curve (AUROC), standard error (SE), and sensitivity and specificity are reported. The optimal threshold value of the inflammation indices was determined by the Youden index method. Significance was accepted at $P < 0.05$ (*) for all statistical analyses.

Results

A total of 62 patients were included in the study, with a mean age of 70.6 ± 11.0 years. The majority of the population was male (67.7%, n=42), while females accounted for 32.3% (n=20). Comorbid conditions were prevalent among the study population, with hypertension (58.1%) and diabetes mellitus (45.2%) being the most common. Other significant comorbidities included coronary artery disease (48.4%), acute renal failure (35.5%), chronic renal failure (21.0%), congestive heart failure (24.2%), dementia (24.2%), cancer (29.0%), asthma (19.4%), and gastrointestinal bleeding (6.5%). The median mCCI was 5.0 (IQR: 4.0–7.0). Regarding disease severity, the mean APACHE II score was 29.2 ± 7.1, while the median SOFA score was 10.0 (IQR: 8.0–14.0). The median ICU LOS was 9.0 days (IQR: 4.0–17.5), while the median hospital LOS was 19.0 days (IQR: 11.0–26.0). In-hospital mortality rate was 62.9%.

Older age was significantly associated with increased mortality (HR: 1.05, 95% CI: 1.02 – 1.08, p = 0.002). Among the comorbid conditions, acute renal failure was associated with a higher mortality risk (HR: 2.15, 95% CI: 1.14 – 4.04, p=0.017). Other comorbid conditions did not show a significant effect on mortality. A higher mCCI score was significantly associated with increased mortality (HR: 1.23, 95% CI: 1.07 – 1.40, p=0.002). Similarly, higher APACHE II scores were associated with mortality (HR: 1.15, 95% CI: 1.09 – 1.22, p<0.001), as well as higher SOFA scores (HR: 1.35, 95% CI: 1.21 – 1.50, p<0.001) (Table 1).

Higher leukocyte counts (HR: 1.04, 95% CI: 1.01 – 1.07, p = 0.017), increased count neutrophils counts (HR: 1.03, 95% CI: 1.01 – 1.08, p = 0.035), elevated procalcitonin levels (HR: 1.04, 95% CI: 1.02 – 1.06, p < 0.001), and higher CRP levels (HR: 1.03, 95% CI: 1.01 – 1.05, p < 0.001) were associated with mortality. Other laboratory parameters, including platelet count, glucose, albumin, creatinine, and electrolyte levels, were not significantly associated with mortality (Table 2).

Table 1. Relationship between demographic characteristics and mortality in patients with septic shock.

Variables	Alive	Deceased	HR	%95 CI		P-value
	n=23	n=39		lower	upper	
Gender, n (%)						
Female	4 (17.4)	16 (41.0)	ref			
Male	19 (82.6)	23 (59.0)	1.03	0.54	1.98	0.927
Age, years	62.4 ± 7.1	75.4 ± 10.0	1.05	1.02	1.08	0.002*
Comorbidity, n (%)						
Diabetes mellitus	6 (26.1)	22 (56.4)	1.61	0.85	3.06	0.142
Hypertension	10 (43.5)	26 (66.7)	1.11	0.56	2.18	0.764
CHF	5 (21.7)	10 (25.6)	1.01	0.49	2.08	0.973
Dementia	2 (8.7)	15 (38.5)	1.45	0.76	2.76	0.263
CRF	6 (26.1)	7 (17.9)	0.56	0.24	1.32	0.185
ARF	3 (13.0)	19 (48.7)	2.15	1.14	4.04	0.017*
GI bleeding	2 (8.7)	2 (5.1)	0.39	0.09	1.63	0.196
Asthma	6 (26.1)	6 (15.4)	0.88	0.37	2.11	0.776
CAD	9 (39.1)	21 (53.8)	1.17	0.62	2.20	0.622
Cancer	5 (21.7)	13 (33.3)	1.24	0.63	2.44	0.542
mCCI	4.0 (3.5-5.0)	7.0 (5.0-8.0)	1.23	1.07	1.40	0.002*
APACHE II score	24.3 ± 4.3	32.0 ± 6.9	1.15	1.09	1.22	<0.001*
SOFA score	8.0 (6.0-10.0)	12.0 (10.0-17.0)	1.35	1.21	1.50	<0.001*
ICU LOS, days	7.0 (4.0-9.5)	12.0 (3.0-19.5)	0.99	0.95	1.03	0.503
Hospital LOS, days	23.0 (17.0-30.0)	12.0 (5.5-21.0)	-	-	-	-

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. APACHE II, Acute Physiology and Chronic Health Evaluation II; ARF, Acute Renal Failure; CAD, Coronary Artery Disease; CHF, Congestive Heart Failure; CI, Confidence Interval; CRF, Chronic Renal Failure; GI, Gastrointestinal; HR, Hazard Ratio; ICU, Intensive Care Unit; LOS, Length of Stay; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

Table 2. Relationship between laboratory paramters and mortality in patients with septic shock.

Variables	Alive	Deceased	HR	%95 CI		P-value
	n=23	n=39		lower	upper	
Leukocytes, 106/μL	10.8 (8.8-13.8)	15.7 (10.9-21.7)	1.04	1.01	1.07	0.017*
Neutrophils, 106/μL	8.8 (7.2-12.1)	13.6 (6.3-15.9)	1.03	1.01	1.08	0.035*
Lymphocytes, 106/μL	1.0 (0.5-1.1)	0.8 (0.4-1.3)	1.00	0.98	1.02	0.290
Platelets, 103/μL	197.0 (122.0-234.0)	123.0 (75.0-192.0)	0.99	0.98	1.03	0.698
Glucose, mg/dL	132.0 (103.0-224.5)	129.0 (89.5-216.0)	1.00	0.98	1.03	0.934
Lactate, mmol/L	2.8 (2.3-4.0)	3.6 (2.5-4.5)	1.02	1.01	1.04	0.022*
Procalcitonin, μg/L	1.0 (0.5-5.9)	2.5 (0.8-6.4)	1.04	1.02	1.06	<0.001*
Albumin, mg/dL	2.8 ± 0.6	2.6 ± 0.5	1.05	0.56	1.99	0.872
CRP, mg/L	98.4 (37.3-176.7)	132 (64.0-201.7)	1.03	1.01	1.05	<0.001*
Creatinine, mg/dL	1.2 (0.8-2.4)	1.7 (1.0-3.0)	1.13	0.92	1.39	0.242
Sodium, mg/dL	138.5 ± 7.1	136.0 ± 7.9	0.96	0.92	1.01	0.106
Potassium, mg/dL	4.5 ± 0.6	4.6 ± 1.1	1.32	0.93	1.86	0.123
INR	1.3 (1.1-1.5)	1.4 (1.3-2.3)	1.19	0.91	1.55	0.207

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. CI, Confidence Interval; CRP, C-reactive protein; HR, Hazard Ratio; INR, International Normalized Ratio.

The multivariate regression analysis, which accounted for all potential risk factors, identified higher mCCI, increased APACHE II scores, and elevated SOFA scores as independent predictors of mortality. Notably, each one-point rise in mCCI was linked to a 1.28-fold increase in mortality risk, independent of other contributing factors (Table 3). Each of the three scoring systems exhibited comparable diagnostic performance in predicting mortality (Figure 1) (Table 4). For predicting mortality, the optimal mCCI threshold was ≥7, yielding a sensitivity of 72.5% and a specificity of 94.7% (AUROC = 0.85) (Table 4). Patients with mCCI ≥7 exhibited a 2.92-fold increased risk of mortality compared to those with mCCI <7 (Figure 1).

Table 3. Independent predictors of mortality in patients with septic shock.

Variables	HR	%95 CI		P-value	-2 Log Likelihood
		Lower	Upper		
mCCI	1.28	1.10	1.49	0.002*	228.6
APACHE II score	1.11	1.04	1.19	0.003*	
SOFA score	1.23	1.09	1.39	0.001*	

*p<0.05 indicates statistical significance. APACHE II, Acute Physiology and Chronic Health Evaluation II; CI, Confidence Interval; Hazard Ratio; HR, Hazard Ratio; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

Table 4. Diagnostic performance of independent predictors associated with mortality.

ROC Curve findings	mCCI	APACHE II	SOFA
AUC ± SE	0.85 ± 0.05	0.90 ± 0.04	0.84 ± 0.05
95% CI	0.76-0.95	0.79-0.96	0.73-0.92
Sensitivity, (%)	72.5	76.9	61.5
Specificity, (%)	94.7	86.9	95.6
Threshold	≥7	>26	>10

APACHE II, Acute Physiology and Chronic Health Evaluation II; AUC, area under the curve; CI, confidence interval; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

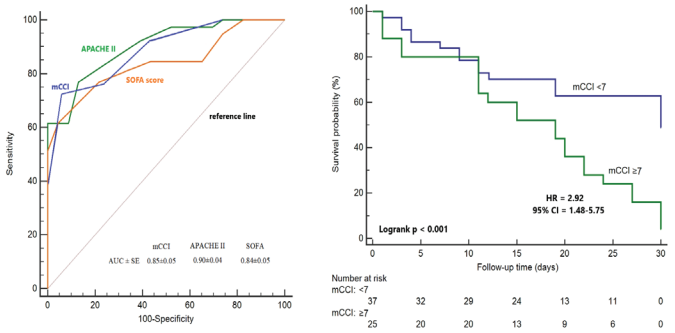

Figure 1. Diagnostic performance of mCCI, APACHE II score, and SOFA score in predicting mortality (left side), and mortality risk according to mCCI threshold value.

Discussion

This study identified several key factors associated with increased mortality in COPD patients admitted to the ICU due to septic shock. Notably, older age, higher mCCI scores, elevated APACHE II and SOFA scores, and increased levels of inflammatory markers such as leukocyte count, procalcitonin, and CRP were significantly associated with higher mortality risk. Among these potential risk factors, mCCI, APACHE II score, and SOFA score were independently associated with mortality, yet they exhibited similar diagnostic performance.

The finding that older age correlates with increased mortality aligns with existing literature, as advanced age often contributes to diminished physiological reserves and a reduced capacity to respond to severe infections [19, 20]. In our study, deceased patients had a higher prevalence of coronary artery disease, cancer, acute renal failure, dementia, hypertension, and diabetes mellitus. However, among these conditions, only acute renal failure was significantly linked to mortality. Previous study noted that coronary artery disease was about twice as common in COPD patients who died in ICU, with CAD nearly tripling the odds of ICU mortality [7]. Similarly, heart failure, diabetes, and renal impairment each showed elevated odds of death in COPD patients with critical illness [8, 21, 22]. Similarly, the association between higher mCCI scores and increased mortality underscores the impact of comorbid conditions on patient outcomes. The mCCI is a well-established tool for predicting mortality by accounting for various comorbidities, and its significance in this study is consistent with previous research demonstrating its prognostic value in critically ill populations. A previous study on critically ill patients with COPD exacerbation reported that 66.7% of deceased patients had sepsis, and the vast majority of these patients had chronic kidney failure, heart failure, and coronary artery disease [23]. In the same study, older age, a higher APACHE II score, an increased CCI score, and elevated lactate levels at admission were defined as independent risk factors for 28-day ICU mortality [23]. A study including 529 patients treated in a mobile ICU reported that 154 patients had septic shock, with the primary suspected source of infection being pulmonary in origin. Analysis of this subgroup revealed that patients with a modified prehospital CCI score greater than 5 had a 1.12-fold higher 30-day mortality risk [13]. Compared to the referenced study, our study identified mCCI threshold for mortality prediction as 7. This variation may be due to the fact that all patients in our study had septic shock. This findings strongly supports that a high comorbidity burden portends worse survival in COPD patients with septic shock, reinforcing the need to account for chronic illnesses when prognosticating and managing these patients.

Elevated APACHE II and SOFA scores were also identified as independent predictors of mortality. These scoring systems are widely used to assess disease severity and organ dysfunction in ICU patients, and their predictive value has been validated in numerous studies [24, 25]. The strong association observed in this study reinforces their utility in prognostication and guiding clinical decision-making. A recent cohort of 128 septic shock patients found that non-survivors had significantly higher APACHE II scores than survivors, and APACHE II discriminated mortality with an AUROC of about 0.78 [26]. A previous study on sepsis patients reported reported SOFA's AUROC around 0.77 for in-hospital mortality, nearly identical to APACHE II's performance (AUROC ~0.78) [27]. Interestingly, in our study, APACHE II and SOFA scores demonstrated higher AUROC values compared to previous reports. This may be attributed to the specific population studied, as our cohort consisted exclusively of COPD patients with septic shock. Previous studies have shown that APACHE II calibration can vary by population, sometimes underestimating actual mortality [26]. On the other hand, the inflammatory response of the patients may have had an impact on the scoring systems.

A decline in procalcitonin during the first 2–5 days signals infection control and improving status; one study reported that a >50% decrease in procalcitonin levels from day 0 to

day 5 was the single independent predictor of survival in multivariable analysis [28]. Likewise, it has been reported that temporal changes in CRP levels serve as a reliable predictor of mortality in ICU-admitted septic patients [29]. Another study demonstrated that a CRP level greater than 100 mg/dL on day 3 was linked to an elevated sepsis-related mortality risk. However, CRP was found to be a less reliable mortality predictor than the SOFA score [30]. In our study, inflammatory markers such as procalcitonin and CRP were associated with mortality in univariate analysis but were not retained as independent predictors in multivariate regression. This may be explained by the stronger prognostic role of organ dysfunction scores, such as SOFA, in septic shock. In previous study conducted on severe sepsis/septic shock patients, baseline serum IL-6 and procalcitonin levels showed a significant correlation with the SOFA score, whereas the APACHE II score correlated strongly only with sTREM-1 (a myeloid cell activation marker) [28]. Another study found that IL-6 levels rise in proportion to organ failure severity: patients stratified by SOFA had significantly different IL-6 – higher SOFA groups had markedly higher IL-6 peaks [31]. These findings may explain why, in our cohort, inflammatory markers did not remain independent predictors after adjusting for disease severity scores.

This study has several limitations. First, it was conducted in a single center, which may limit the generalizability of the findings to other ICU settings with different patient populations and management protocols. Second, the retrospective study design may introduce selection bias and restrict the ability to establish causal relationships between risk factors and mortality. Third, although inflammatory markers such as CRP and procalcitonin were associated with mortality in univariate analysis, their dynamic changes over time were not evaluated, which might have provided additional prognostic insights. Finally, due to the exclusion of patients with hematological malignancies and metastatic cancer, the findings may not be applicable to critically ill COPD patients with advanced oncological diseases. To address these limitations, future research should focus on prospective multicenter studies with larger cohorts, include serial inflammatory biomarker measurements, explore the long-term impact of sepsis in COPD patients, and refine predictive models by integrating additional clinical and laboratory variables.

Conclusion

This study demonstrated that higher mCCI, as well as elevated APACHE II and SOFA scores, were associated with an increased risk of mortality. These results emphasize the critical role of comorbid burden and disease severity and organ dysfunction in determining outcomes for COPD patients with septic shock. Given the compounded effect of pre-existing chronic diseases and sepsis-induced organ failure, early identification of high-risk patients using mCCI and severity scores may facilitate targeted interventions to improve survival.

Ethics Committee Approval

The study was conducted with the permission of the KTO Karatay University Hospital Ethics Committee (Date: 26.09.2024, Decision No: 2024/005).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Authors' contribution

Conceptualization – K.K., Design – K.K., Data curation – K.K. and S.Ö.Ç., Validation – K.K., Formal analysis – K.K. and S.Ö.Ç., Resources – K.K. and S.Ö.Ç., Writing – K.K., Critical review – S.Ö.Ç. All authors read and approved the final version of the manuscript.

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Research Article

The impact of additional right ventricular branch grafting on electrocardiographic and echocardiographic parameters

Sağ ventrikül dalına ek bypass greftlemenin elektrokardiyografik ve ekokardiyografik parametreler üzerindeki etkisi

Onur Yıldırım*[1], Yunus Nazlı[2], Necmettin Çolak[2], Ömer Zühtü Yöndem[3], Özcan Özdemir[4]

[1]Department of Cardiology, Lokman Hekim University, Ankara, Turkey
[2]Department of Cardiovascular Surgery, Lokman Hekim University, Ankara, Turkey
[3]Department of Anesthesiology and Reanimation, Lokman Hekim University, Ankara, Turkey
[4]Department of Cardiology, University of Health Sciences, Etlik City Hospital, Ankara, Turkey

Abstract

Aim: This study aimed to evaluate the impact of additional coronary artery bypass grafting (CABG) to right ventricular (RV) branches on echocardiographic and electrocardiographic parameters, with a focus on RV function and electrical stability.

Material and Methods: A retrospective review was conducted on patients who underwent CABG with significant right coronary artery (RCA) disease between January 2017 and December 2022. Patients were included and divided into two groups: Group 1 (n = 34) received grafts only to the distal RCA branches (posterior descending artery or posterolateral branch); Group 2 (n = 34) underwent grafting to both the distal RCA and the RV branch. Preoperative and discharge periods, echocardiographic and electrocardiographic parameters were compared between groups.

Results: Both groups had comparable baseline characteristics, including echocardiographic and electrocardiographic parameters. At discharge, tricuspid annular plane systolic excursion (TAPSE) was lower in Group 1 compared to Group 2 (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; $p < 0.001$). The ratio of diastolic dysfunction was higher in Group 1 compared to Group 2 (91.2% vs. 61.8%; $p < 0.001$). The mean QT dispersion (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; $p = 0.031$) and mean P wave dispersion (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; $p = 0.048$) levels were lower in Group 2 compared to Group 1.

Conclusion: Additional bypass grafting of the RV branch in patients with significant RCA disease was associated with improved RV function and more favorable electrocardiographic parameters.

Keywords: Coronary artery bypass grafting, P-wave dispersion, right ventricular function, right coronary artery, ventricular repolarization, TAPSE, transannular plane systolic excursion

Corresponding Author*: Onur Yıldırım, Department of Cardiology, Lokman Hekim University, Ankara, Turkey

E-mail: onuryildirim2487@gmail.com

Orcid:0000-0002-9750-5413

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Öz

Amaç: Bu çalışma, sağ ventrikül (SV) dallarına ek koroner arter bypass greftleme (KABG) işleminin ekokardiyografik ve elektrokardiyografik parametreler üzerindeki etkisini, özellikle SV fonksiyonu ve elektriksel stabiliteye odaklanarak değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Ocak 2017 ile Aralık 2022 tarihleri arasında belirgin sağ koroner arter (SKA) hastalığı nedeniyle KABG uygulanan hastalar retrospektif olarak incelendi. Hastalar dahil edilerek iki gruba ayrıldı: Grup 1 (n = 34), sadece distal RCA dallarına (posterior desendan arter veya posterolateral dal) greft uygulanan hastaları içerirken, Grup 2 (n = 34), hem distal SKA hem de SV dalına greft uygulanan hastaları içeriyordu. Gruplar arasında ameliyat öncesi ve taburculuk dönemindeki ekokardiyografik ve elektrokardiyografik parametreler karşılaştırıldı.

Bulgular: Gruplar arasında başlangıçta ekokardiyografik ve elektrokardiyografik parametreler dahil olmak üzere temel özellikler açısından fark bulunmamaktaydı. Taburculuk döneminde, triküspit anüler düzlem sistolik ekskürsiyonu (TAPSE) değeri Grup 1'de Grup 2'ye kıyasla daha düşüktü (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; $p < 0.001$). Diyastolik disfonksiyon oranı Grup 1'de Grup 2'ye göre daha yüksekti (%91.2 vs. %61.8; $p < 0.001$). Ortalama QT dispersiyonu (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; $p = 0.031$) ve ortalama P dalgası dispersiyonu (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; $p = 0.048$) değerleri Grup 2'de Grup 1'e kıyasla daha düşüktü.

Sonuçlar: Belirgin RCA hastalığı olan hastalarda RV dalına ek bypass greftleme, SV fonksiyonlarında iyileşme ve daha olumlu elektrokardiyografik parametrelerle ilişkilendirildi.

Anahtar Kelimeler: Koroner arter bypass greftleme, P dalgası dispersiyonu, sağ ventrikül fonksiyonu, sağ koroner arter, ventriküler repolarizasyon, triküspit anüler düzlem sistolik ekskürsiyonu

Introduction

The right coronary artery (RCA) plays a critical role in supplying blood to the right atrium and right ventricle (RV). Is main branches include the conus branch, sinoatrial nodal branch, RV, right marginal branches, atrioventricular (AV) nodal branch, posterolateral (PL) branch, and the posterior descending artery (PDA) (1). The majority of RCA stenosis or occlusions occur in the proximal segment, likely due to the anatomical predisposition for atherosclerotic plaque formation in this region (2).

Coronary artery bypass grafting (CABG) is a well-established treatment for advanced coronary artery disease, and revascularization of the RCA is traditionally achieved with a single graft anastomosis (3). In most conventional CABG procedures, grafting is directed to the PDA or the PL branch of the RCA (4). However, the right ventricular branches often arise from the proximal portion of the RCA, which may be less frequently targeted. As a result, the right ventricle may not receive optimal blood supply, and postoperative right ventricular dysfunction may occur if critical RV branches remain inadequately revascularized (5, 6).

Previous studies suggest that a sequential grafting strategy for the RCA, addressing not only the distal branches (PL/PDA) but also the proximal right ventricular branches, could improve RV function postoperatively (7, 8). Based on these findings, we hypothesized that performing an additional anastomosis to the RV branch might lead to differences in right ventricular functions when compared to grafting a single distal segment of the RCA. Therefore, this study aimed to evaluate the impact of additional CABG to RV branches on echocardiographic and electrocardiographic parameters, with a focus on RV function and electrical stability.

Material and Methods

This retrospective study was conducted on patients who underwent CABG surgery at the Cardiovascular Surgery Clinic of Lokman Hekim University Health Practice and Research Center between January 2017 and December 2022. The study was approved by the Lokman Hekim Hospital's Ethics Committee (Date: 23.12.2021, Decision No: 2021/158) and was carried out in accordance with the relevant ethical guidelines and the Helsinki Declaration (2013 Brazil revision). The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

During the study period, a total of 150 patients who underwent CABG surgery with both stenotic/occluded suitable (>1.5 mm) RCA RV branches and stenotic/occluded distal RCA were retrospectively evaluated. The inclusion criteria were patients over the age of 18 with complete data. Exclusion criteria included patients who underwent conversion, valve procedures, or had a history of CABG, as well as those who required intra-aortic balloon pump or extracorporeal membrane oxygenation. Patients with unobstructed or adequately sized RV branches were also excluded. A total of 89 patients who met the inclusion and exclusion criteria were assessed for eligibility in the analysis. All patients had RCA-dominant coronary anatomy and significant RCA stenosis. The patients were divided into two groups. Group 1 included 50 patients whose RV branch diameter was insufficient (<1.5 mm), where distal anastomoses were performed on the RCA trunk or its posterior branches, and no additional bypass was performed to the RV branch. Group 2 consisted of 39 patients with a sufficient RCA RV branch diameter who received grafts both to the distal RCA and the RV branch. After matching both groups in a 1:1 ratio for age and gender, a total of 68 patients were included in the study, with 34 patients in each group.

The hospital's electronic information system and patient files were used to gather demographic and clinical data at both the preoperative and discharge periods.

Surgical Technique

Standard anesthesia monitoring, including radial arterial and central venous catheters, was utilized. Central venous access was typically via the jugular vein, and midazolam was used for anxiolysis when needed. Anesthesia was induced and maintained with propofol, etomidate, volatile anesthetics, opioids (sufentanil or fentanyl), and muscle relaxants. Patients were kept in a supine position at normothermia, with the cardiopulmonary bypass pump prepared but unprimed.

A median sternotomy was performed to harvest the left and right internal thoracic arteries (LITA and RITA), as well as radial artery and saphenous vein grafts. Heparin (2 mg/kg) was administered before distal LITA ligation, maintaining an activated clotting time of 200–300 seconds. Epicardial stabilizers, including the Octopus and Starfish devices (Medtronic), were used for immobilization during anastomoses, with suction pressures set to −400 mmHg. Coronary arteries were taped proximally and distally with silastic sutures, and coronary shunts were routinely applied.

The procedure began with bypassing the RCA and its right ventricular branches, followed by proximal anastomoses. Subsequent anastomoses were performed in the circumflex (Cx) region and diagonal arteries. The LITA-to-LAD anastomosis was completed last to avoid tension on the graft during earlier steps. Doppler ultrasound was used to measure graft blood flow (mL/min) after all anastomoses, followed by protamine administration.

Electrocardiography

A 12-lead ECG recorder (Nihon Kohden, Tokyo, Japan) was utilized, set to a paper speed of 25 mm/s and a sensitivity of 10 mm/mV. All ECG recordings were assessed by a single cardiologist who was blinded to the patients' details. ECG parameters, including minimum and maximum P wave duration (Pmin, Pmax), P wave dispersion (Pd), PR distance (PRd), minimum and maximum QT wave duration (QTmin , QTmax), QT dispersion (QTd), were measured across all leads, and their averages were calculated. The onset and offset of the P wave were evaluated as the junction between the P wave pattern and the isoelectric line. The Pmax was accepted as the lengthiest P wave and the lengthiest atrial conduction time. The Pd was computed with the formula Pd = Pmax - Pmin. The QT interval was evaluated as the distance between the onset of the Q wave and the offset of the T wave. The QTd dispersion was calculated using the measurements of the highest and lowest values of QT interval.

Echocardiography

Echocardiography was evaluated using a 2.5-MHz transducer and the Vivid-5 System (GE Medical Systems, Horten/Norway) with by an experienced cardiologist. Left ventricular ejection fraction (LVEF) was computed using the modified Simpson's biplane method. Transannular plane systolic excursion (TAPSE) was measured in the apical four-chamber view using an M-mode cursor positioned at the lateral tricuspid annulus, where the tricuspid valve plane intersects with the free wall of the right ventricle. A value of less than 16 mm was indicative of right ventricular systolic dysfunction (9). Systolic pulmonary artery pressure (sPAP) is calculated by summing right atrial pressure with peak pressure gradient between the peak of the right ventricle and the apex of the right atrium. To assess diastolic

dysfunction, the E and A waves were recorded using pulse wave (PW) Doppler positioned at the tips of the mitral valve leaflets in the apical four-chamber view. An E/A ratio below 1 was considered indicative of stage 1 diastolic dysfunction.

Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA) software. The normal distribution of numerical variables was assessed using the Kolmogorov-Smirnov test. Data exhibiting a normal distribution were presented as mean ± standard deviation, and comparisons between groups were made using the Student's T-test. Non-normally distributed data were displayed as median (interquartile range (IQR): 25-75 percentiles) and comparisons between groups were conducted using the Mann-Whitney U test. Value of $P < 0.05$ were considered statistically significant.

Results

The study included 68 patients with a mean age of 63.4 ± 9.0 years, of whom 56 were men and 12 were women. The mean age and male ratio were comparable between Group 1 and Group 2. Hypertension was present in 82.4% of the patients, while 57.4% had diabetes mellitus, with no significant intergroup differences. The use of medications, including RAS inhibitors, beta blockers, and statins, was comparable between the groups. The mean number of diseased vessels was 2.5 ± 0.8, and the average number of grafts per patient was 3.3 ± 0.8, with no statistically significant intergroup differences. Regarding graft types, 83.8% of patients received LITA grafts, while radial artery grafts and saphenous vein grafts were used in 57.4% and 100%, respectively. On-pump procedures were performed in 50% of patients, with no significant intergroup variation ($p = 0.999$). Postoperative inotropic agent use was required in 33.8% of patients, with similar rates between groups ($p = 0.333$). Postoperative atrial fibrillation (AF) occurred in 10.3% of patients, with no significant difference between groups ($p = 0.271$) (Table 1).

Table 1. Demographic and clinical characteristics of the study population.

Variables	All population n = 68	Group 1 n = 34	Group 2 n = 34	P-value
Age, years	63.4 ± 9.0	63.6 ± 8.0	63.1 ± 10.0	0.821
Male gender, n (%)	56 (82.4)	26 (76.5)	30 (88.2)	0.203
Smoking, n (%)	51 (75.0)	25 (73.5)	26 (76.5)	0.779
Hypertension, n (%)	56 (82.4)	28 (82.4)	28 (82.4)	0.999
Diabetes mellitus, n (%)	39 (57.4)	18 (52.9)	21 (61.8)	0.462
Drugs, n (%)				
RAS inhibitors	47 (69.1)	27 (79.4)	20 (58.8)	0.066
Beta Blockers	42 (61.8)	20 (58.8)	22 (64.7)	0.618
Statin	31 (45.6)	15 (44.1)	16 (47.1)	0.808
OAD-Insulin	39 (57.4)	18 (52.9)	21 (61.8)	0.462
Inhalers	7 (10.3)	3 (8.8)	4 (11.8)	0.690
Antiplatelets	40 (58.8)	17 (50.0)	23 (67.6)	0.139
Anticoagulants	2 (2.9)	0	2 (5.9)	0.151
No. of vessels with disease	2.5 ± 0.8	2.4 ± 0.8	2.5 ± 0.8	0.608
No. of grafts	3.3 ± 0.8	3.1 ± 1.1	3.5 ± 1.0	0.140
Type of graft, n (%)				
LITA	57 (83.8)	29 (85.3)	28 (82.4)	0.747
Radial artery	39 (57.4)	21 (61.8)	18 (52.9)	0.461
Saphenous vein	68 (100)	34 (100.0)	34 (100.0)	0.999
On-pump, n (%)	34 (50.0)	20 (58.8)	14 (41.2)	0.146
Inotropic agent required, n (%)	23 (33.8)	13 (38.2)	10 (29.4)	0.442
Postoperative AF, n (%)	7 (10.3)	5 (14.7)	2 (5.9)	0.231
1-years mortality, n (%)	4 (5.9)	3 (8.8)	1 (2.9)	0.303

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at $p < 0.05$. AF, atrial fibrillation; LITA, left internal thoracic artery; OAD, oral antidiabetic drugs; RAS, renin-angiotensin system.

Preoperatively, LVEF was similar between groups (Group 1: 46.5 ± 11.7% vs. Group 2: 46.9 ± 9.1%; p = 0.881). The means of sPAB, TAPSE, heart rate, Pd and QTd were also comparable between between Group 1 and Group 2 (p > 0.05 for all). Diastolic dysfunction was present in 97.1% of patients overall, with Group 1 showing a slightly higher prevalence (100% vs. 94.1%, p = 0.473) (Table 2).

At discharge, LVEF improved across all patients, with no significant intergroup differences (Group 1: 49.7 ± 10.1% vs. Group 2: 49.4 ± 7.9%; p = 0.994). TAPSE was significantly lower in Group 1 compared to Group 2 (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; p < 0.001). Similarly, sPAB tended to be lower in Group 2, but the difference did not reach statistical significance (p = 0.089). The ratio of diastolic dysfunction was higher in Group 1 compared to Group 2 (91.2% vs. 61.8%; p < 0.001). The mean QTd (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; p = 0.031) and mean Pd (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; p = 0.048) levels were lower in Group 2 compared to Group 1 (Table 2).

At discharge, the decreases in sPAB, Pd, and QTd levels were more pronounced in Group 2 than in Group 1 s (Δp < 0.05). Group 1 exhibited a more pronounced reduction in TAPSE levels compared to Group 2 (Δp < 0.05). At the time of discharge, Group 2 showed a greater reduction in the proportion of patients with diastolic dysfunction compared to preoperative levels (Δp < 0.05) (Table 3).

Discussion

To the best of our knowledge, this study is one of the few to evaluate the impact of additional CABG to RV branch arteries on electrocardiographic and echocardiographic parameters. Our findings suggest that grafting to RV branches is associated with improvements in RV function.

Decreased RV function following CABG is a clinically significant problem, particularly in the early postoperative period (10). In this context, several mechanisms have been proposed, including perioperative myocardial ischemia, cardiopulmonary bypass, intraoperative cardiac injury, cardioplegia, inflammation, pericardial disruption or adhesions, and inadequate revascularization of critical RV branches (11-13). Even mild reductions in RV performance can adversely affect hemodynamics and clinical outcomes, emphasizing the need for tailored surgical strategies to preserve RV function.

Anatomically, most significant lesions of the RCA occur in its proximal segment or main trunk. Since the RV marginal branches often originate proximally, these branches are at risk of inadequate perfusion when stenosis or occlusion occurs in the proximal RCA (14). Sequential grafting or dedicated bypasses to these RV branches can improve RV perfusion.

Table 2. Comparison of electrocardiography and echocardiographic parameters before and after surgery in Group 1 and Group 2.

Variables	All population n = 68	Group 1 n=34	Group 2 n=34	P-value
Preoperative				
LVEF, %	46.7 ± 10.4	46.5 ± 11.7	46.9 ± 9.1	0.881
sPAB, mm Hg	35.1 ± 9.0	34.5 ± 9.3	35.6 ± 8.2	0.607
Diastolic dysfunction, n (%)	66 (97.1)	34 (100.0)	32 (94.1)	0.473
TAPSE, mm	18.4 ± 3.1	18.2 ± 3.6	18.7 ± 2.3	0.524
HR, beats / minute	84.8 ± 21.0	84.4 ± 18.6	85.3 ± 23.4	0.859
Pd, msn	28.3 ± 7.5	28.9 ± 8.3	27.7 ± 6.6	0.490
QTd, msn	75.6 ± 22.1	76.0 ± 21.4	75.2 ± 23.2	0.892
Discharge				
LVEF, %	49.3 ± 9.0	49.7 ± 10.1	49.4 ± 7.9	0.994
sPAB, mm Hg	30.7 ± 7.1	32.1 ± 7.7	29.1 ± 6.6	0.089
Diastolic dysfunction, n (%)	52 (76.5)	31 (91.2)	21 (61.8)	0.004*
TAPSE, mm	13.4 ± 2.8	11.7 ± 2.7	15.1 ± 2.3	<0.001*
HR, beats / minute	80.5 ± 15.9	81.1 ± 14.5	80.0 ± 17.1	0.201
Pd, msn	24.5 ± 7.4	26.2 ± 8.8	22.5 ± 5.3	0.048*
QTd, msn	59.2 ± 17.4	63.7 ± 18.5	54.6 ± 15.4	0.031*

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at p < 0.05. HR, heart rate; LVEF, left ventricular ejection fraction; Pd, P-wave dispersion; QTd, QT dispersion; sPAB, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

Table 3. Electrocardiography and echocardiographic parameter changes at discharge between Group 1 and Group 2.

Variables		Preoperative	Discharge	P-values	ΔP-values
LVEF, %	Group 1	46.5 ± 11.7	49.7 ± 10.1	<0.001*	0.885
	Group 2	46.9 ± 9.1	49.4 ± 7.9	<0.001*	
sPAB, mm Hg	Group 1	34.5 ± 9.3	32.1 ± 7.7	<0.001*	0.008*
	Group 2	35.6 ± 8.2	29.1 ± 6.6	<0.001*	
Diastolic dysfunction, n (%)	Group 1	34 (100.0)	31 (91.2)	0.083	<0.001*
	Group 2	32 (94.1)	21 (61.8)	0.001*	
TAPSE, mm	Group 1	18.2 ± 3.6	11.7 ± 2.7	<0.001*	<0.001*
	Group 2	18.7 ± 2.3	15.1 ± 2.3	<0.001*	
HR, beats / minute	Group 1	84.4 ± 18.6	81.1 ± 14.5	<0.001*	0.754
	Group 2	85.3 ± 23.4	80.0 ± 17.1	<0.001*	
Pd, msn	Group 1	28.9 ± 8.3	26.2 ± 8.8	0.009*	<0.001*
	Group 2	27.7 ± 6.6	22.5 ± 5.3	<0.001*	
QTd, msn	Group 1	76.0 ± 21.4	63.7 ± 18.5	<0.001*	<0.001*
	Group 2	75.2 ± 23.2	54.6 ± 15.4	<0.001*	

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at $p < 0.05$. ΔP-values denotes the changes in parameters before and after surgery, highlighting the differences between the groups. HR, heart rate; LVEF, left ventricular ejection fraction; Pd, P-wave dispersion; QTd, QT dispersion; sPAB, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

The current study had several notable limitations. First, the retrospective design may limit the ability to establish causal relationships between treatment patterns and outcomes. Second, potential confounding factors such as lifestyle behaviors, dietary sodium intake, and medication adherence were not thoroughly explored. Additionally, medication adherence was not examined. Finally, the sample was limited to a single healthcare setting, which may limit the generalizability of findings to broader populations. A previous study reported that additional grafting to the RV branch significantly reduced postoperative pressures of RA, pulmonary systolic and diastolic, and pulmonary capillary wedge, while also indirectly reducing left ventricular end-diastolic pressure (15). In this study, patients who underwent additional grafting to the RV exhibited a more pronounced decrease in sPAB levels.

The rate of diastolic dysfunction at discharge was reduced in patients who underwent additional RV grafting. A previous study found that the rate of RV dysfunction was lower in the group with complete revascularization of extended RCA branches than in the single bypass group (16). A study involving 35 coronary artery disease patients, 20 with sequential grafts and 5 with individual grafts, reported that sequential complete revascularization of the right coronary artery enhanced RV diastolic function (7). Additionally, TAPSE values, which reflect RV systolic function, significantly decrease after CABG (17). In the present study, TAPSE—a key indicator of RV systolic function—was notably higher at discharge in the group receiving grafts to both the distal RCA and the RV branch. A study on patients with significant RCA stenosis found that those who received bypasses grafting to both the distal RCA and RV branch experienced a smaller reduction in TAPSE values by postoperative day 7 compared to those who underwent a single distal bypass. TAPSE values normalized by postoperative day 90 in the former group (6). Although our findings align with previous observations that complete revascularization of all relevant RV branches can preserve or enhance TAPSE, additional prospective trials would be beneficial to elucidate the precise mechanistic link.

Atrial fibrillation is also the most prevalent complication in cardiac surgery (18). Following coronary bypass surgery using sequential and single grafting techniques, the reported incidence of atrial fibrillation ranges from 2% to 42% (6, 19, 20). In a previous study, the incidence of postoperative atrial fibrillation was reported to be lower in patients who received grafts to both the distal RCA and the RV branch compared to those who underwent a single distal bypass (6). Similarly, in this study, patients who underwent additional grafting to the RV branch showed a trend toward a reduced incidence of postoperative atrial fibrillation. This finding aligned with the more pronounced decrease in postoperative Pd levels

noted in this group. Elevated Pd has been associated with atrial conduction heterogeneity and a higher risk of atrial arrhythmias, particularly atrial fibrillation (21). By improving RV perfusion—and potentially ameliorating right atrial stretch—comprehensive RCA revascularization may help stabilize atrial electrical activity, thereby lowering Pd and possibly reducing the burden of postoperative arrhythmias. On the other hand, QTd reflects the variability in ventricular repolarization times and is a known risk factor for ventricular arrhythmias. This study demonstrated a significant decrease in QTd among patients receiving additional RV branch grafts. This finding implies that improved RV perfusion through targeted grafting not only enhances mechanical function but also contributes to electrical stability, thereby potentially reducing the risk of life-threatening ventricular arrhythmias post- sequential CABG.

Several limitations should be considered in interpreting these findings. First, the retrospective design and relatively small sample size may limit the generalizability of the results. Second, the exclusion of patients with valve procedures might reduce real-world applicability. Third, long-term outcomes were not available, restricting our ability to assess the sustained impact of comprehensive RCA revascularization on RV function and cardiac events. Future prospective, multicenter studies with larger cohorts and extended follow-up are warranted to validate these findings and elucidate the long-term benefits of RV branch grafting in CABG procedures.

Conclusion

This study highlights that additional grafting to RV branches during CABG improves RV function and enhances electrical stability, as shown by higher TAPSE values and reduced P-wave and QT dispersion. Incorporating RV branch grafting into CABG procedures may lead to better mechanical and electrical outcomes, particularly in patients with significant RCA stenosis. Moreover, extensive RCA revascularization, encompassing the RV branch, could enhance hemodynamics and lower the likelihood of postoperative arrhythmias.

Conflict of Interest/ Funding

The study received no financial support from any individual or organization, and the authors declare no conflict of interest.

Ethics Committee Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Lokman Hekim University Non-Interventional Clinical Research Ethics Committee (Date: 23.12.2021, Decision No: 2021/158).

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Conflicts of Interest

The authors declare they have no conflicts of interest.

Financial Disclosure

The authors declared that this study has received no financial support.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author, [O.Y.].

Author Contributions

Concept – O.Y., Design- O.Y. and Ö.Ö., Supervision – O.Y. and Ö.Ö., Data collection and/or processing - O.Y., Y.N., N.Ç., and Ö.Ö., Analysis and/or interpretation - O.Y., Y.N., N.Ç., and Ö.Ö., Writing – O.Y., Critical review- Y.N., N.Ç., and Ö.Ö. All authors read and approved the final version of the manuscript.

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Research Article

Risk evaluation of above-knee amputation and mortality according to ABO blood groups in patients with diabetic foot

Diyabetik ayaklı hastalarda ABO kan gruplarına göre diz üstü amputasyon ve mortalite risk değerlendirmesi

Javid Mohammadzadeh Azarabadi*

Department of Orthopedics and Traumatology, Faculty of Medicine, Başkent University, Konya, Turkey

Abstract

Aim: This study aimed to assess the distribution of ABO blood groups in diabetic patients who underwent major joint amputation and to identify which blood group is related to the risk of above-knee amputation (AKA) and mortality.

Material and Methods: This retrospective study included 120 diabetic foot patients who underwent major lower-extremity amputation between January 2020 and January 2024. Demographic, clinical, and laboratory data were retrospectively collected from electronic patient records. Patients were stratified by ABO blood group, and the frequency of AKA and mortality rates were compared across groups.

Results: The mean age of patients were 66.5 ± 11.9 years and median disease duration was 17 years. The frequency of AKA was 46.3% in blood group A, 54.2% in blood group B, 50% in blood group AB, and 28.2% in blood group O. AKA and mortality rates were higher in patients with non-O blood groups than in those with blood group O (28.2% vs. 49.4%, p = 0.032 for AKA; 48.7% vs. 67.9%, p = 0.048 for mortality; respectively). Independent of other confounders, blood group O had a 3.12-fold (1/OR) lower risk of AKA (OR =0.32, p = 0.049) and a 2.17-fold (1/HR) lower risk of mortality (HR =0.46, p = 0.045) compared to non-O blood groups.

Conclusion: This study identifies ABO blood group as a potential factor influencing amputation severity and mortality in diabetic foot patients. Blood group O appears to confer a protective effect against AKA and mortality, whereas non-O groups, particularly B, show a tendency toward worse outcomes.

Keywords: ABO blood group, diabetic foot, above-knee amputation, survival

Corresponding Author*: Javid Mohammadzadeh Azarabadi, Department of Orthopedics and Traumatology, Faculty of Medicine, Başkent University, Konya, Turkey

E-mail: dr_jma_md@yahoo.com

Orcid: 0000-0003-2393-3535

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Öz

Amaç: Bu çalışmada, majör eklem amputasyonu geçiren diyabetik hastalarda ABO kan gruplarının dağılımını değerlendirmek ve hangi kan grubunun diz üstü amputasyon (AKA) ve mortalite riskiyle ilişkili olduğunu belirlemek amaçlanmıştır.

Gereç ve Yöntemler: Bu retrospektif çalışmaya Ocak 2020 ile Ocak 2024 arasında majör alt ekstremite amputasyonu geçiren 120 diyabetik ayak hastası dahil edilmiştir. Demografik, klinik ve laboratuvar verileri elektronik hasta kayıtlarından retrospektif olarak toplanmıştır. Hastalar ABO kan grubuna göre sınıflandırılmış ve AKA sıklığı ve mortalite oranları gruplar arasında karşılaştırılmıştır.

Bulgular: Hastaların ortalama yaşı 66,5 ± 11,9 yıl ve ortanca hastalık süresi 17 yıldı. AKA sıklığı A kan grubunda %46,3, B kan grubunda %54,2, AB kan grubunda %50 ve O kan grubunda %28,2 idi. AKA ve mortalite oranları O kan grubu olmayan hastalarda O kan grubu olanlara göre daha yüksekti (%28,2'ye karşı %49,4, p = 0,032 AKA için; %48,7'ye karşı %67,9, p = 0,048 mortalite için; sırasıyla). Diğer karıştırıcı faktörlerden bağımsız olarak, O kan grubunun AKA riski 3,12 kat (1/OR) daha düşüktü (OR =0,32, p = 0,049) ve mortalite riski 2,17 kat (1/HR) daha düşüktü (HR =0,46, p = 0,045).

Sonuç: Bu çalışma, diyabetik ayak hastalarında amputasyon şiddetini ve mortaliteyi etkileyen potansiyel bir faktör olarak ABO kan grubunu tanımlamaktadır. O kan grubu, AKA ve mortaliteye karşı koruyucu bir etki sağlıyor gibi görünmektedir, buna karşın O olmayan gruplar, özellikle B, daha kötü sonuçlara doğru bir eğilim göstermektedir.

Anahtar sözcükler: ABO kan grubu, diyabetik ayak, diz üstü amputasyon, sağkalım

Introduction

Diabetic foot ulceration (DFU) is a severe complication of diabetes mellitus, affecting approximately 15% of diabetic patients over their lifetime [1, 2]. DFU frequently lead to infection and progressive tissue necrosis, often necessitating lower-extremity amputation (LEA) to prevent life-threatening complications [3]. Among these, above-knee amputation (AKA) represents the most extensive and debilitating form of limb loss, associated with a significantly poor prognosis [4]. The five-year post-amputation survival rate for patients undergoing major diabetes-related amputations is estimated to be 40–79% [5, 6]. This high mortality rate underscores the critical need to identify risk factors that contribute to severe diabetic foot outcomes to improve early intervention strategies and patient management.

Emerging evidence suggests that inherited factors, such as ABO blood type, may influence the progression and severity of diabetes-related complications. Previous studies have demonstrated a relationship between ABO blood group and type 2 diabetes mellitus (T2DM) susceptibility, with individuals of blood type B exhibiting a higher predisposition to T2DM, while those with blood type O appear to have a lower risk [7]. Moreover, ABO blood type has been implicated in diabetes-associated vascular complications, particularly peripheral arterial disease (PAD), a key contributor to diabetic foot pathology [8, 9]. Notably, non-O blood groups have been associated with increased severity and complexity of PAD [10]. Furthermore, an analysis of amputation cases indicated a disproportionate representation of non-O blood types, particularly B positive group, among patients undergoing dysvascular amputations [11].

Despite these findings, data remain limited regarding how specific blood types might predispose patients to above-knee amputation and increased mortality in patients with diabetic foot. Based on the current evidence, we hypothesize that diabetic foot patients with non-O blood groups are more likely to undergo above-knee amputation and exhibit higher mortality rates compared to those with blood group O. Therefore, this study aimed to assess the distribution of ABO blood groups in diabetic patients who underwent major joint amputation and to identify which blood group is related to the risk of above-knee amputation and mortality.

Material and Methods

This retrospective study was carried out at the Başkent University Practice and Research Hospital Orthopedic Clinic between January 2020 and January 2024, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the Başkent University Hospital Ethics Committee (Date: 21/05/2024, Project no: KA24/220). Given the retrospective nature of the study, the Local Ethics Committee waived the requirement for informed consent.

Study population

During the study period, 152 diabetic patients who underwent major joint amputation and were followed up in the Orthopedic Clinic were retrospectively assessed for study eligibility. Patients were included in the study if they had a confirmed diagnosis of diabetic foot ulceration that necessitated major amputation, which was defined as any amputation at or above the ankle level. Amputation decisions were made by a multidisciplinary diabetic foot committee, which included specialists in orthopedic surgery, vascular surgery, endocrinology, and infectious diseases. Patients who did not undergo major lower-extremity amputation, such as those with minor amputations limited to the toes or forefoot, were excluded. Additionally, individuals who had undergone knee disarticulation were not included. Patients who had been referred to another diabetes center and had incomplete follow-up data were also excluded. Furthermore, individuals with a history of malignancy, which could independently influence both survival and diabetes progression, were not included in the analysis. Lastly, patients with a prior history of lower-extremity surgery or those who had undergone revision surgery following an initial amputation were excluded to prevent confounding related to prior surgical interventions. After applying these exclusion criteria, a total of 120 patients met the inclusion criteria and were included in the final analysis.

Data collection

Demographic, clinical, and laboratory data were retrospectively collected from electronic patient records. The demographic variables included age, sex, body mass index (BMI), ABO blood group, and Rh factor status. Clinical characteristics such as diabetes duration, type of diabetes treatment (insulin therapy or combination therapy with oral antidiabetic drugs), and presence of comorbidities, including cardiovascular disease, endocrinological disorders, PAD, and hemodialysis dependence, were documented. Amputation-related variables, including the laterality of the procedure (right, left, or bilateral) and the level of amputation, were recorded, with a particular focus on distinguishing between below-knee amputation (BKA) and AKA.

To evaluate the infectious profile of the patients, microbiological culture results from wound specimens were examined, and patients were categorized as having either culture-positive or culture-negative infections. Laboratory parameters obtained prior to amputation included glycated hemoglobin (HbA1c), C-reactive protein (CRP), blood urea nitrogen (BUN), and serum creatinine levels. Postoperative outcomes were assessed by recording the incidence of AKA and mortality. Mortality data were retrieved from hospital records and, where necessary, verified through national death registries.

Statistical analysis

All data were analyzed with STATA/MP v.16 software (StataCorp LLC, Texas, USA). Numerical data determined to be normally distributed based on the results of Kolmogorov-Smirnov tests are given as mean ± standard deviation values, while non-normally distributed variables are given as median (25th-75th quartiles) values. ANOVA test (post-hoc: Bonferroni test) or Kruskall Wallis H test (post-hoc: Dunn's test) were used for comparisons between more than two groups. Categorical variables were presented as numbers and percentages, and comparisons between groups were performed using Chi-square and Fisher exact tests. The effect of ABO blood groups on AKA was analyzed using logistic regression, with findings presented as odds ratios (OR) and 95% confidence intervals (CI). Cox regression analysis was employed to evaluate mortality, with results reported as hazard ratios (HR) and 95% CI. Significance was accepted at $P < 0.05$ (*) for all statistical analyses.

Results

This study involved 120 patients, with a mean age of 66.5 ± 11.9 years, the majority being male (57.5%). The median disease duration was 17 years. The ABO blood group distribution was 34.2% A, 20% B, 13.3% AB, and 32.5% O, with 7.5% of patients being Rh-negative. Bilateral diabetic foot was detected in 8.3% of cases. Hypertension was found in 70% of patients, cardiovascular disease in 25.8%, endocrine disorders in 55.0%, and PAD in 30%. Among the patients, 49.2% had positive culture results. The prevalence of AKA was 41.7%, and the mortality rate was 61.7%.

Demographic characteristics showed no significant differences among ABO blood groups (Table 1). Patients with O blood group had lower CRP levels than those with blood groups A, B, and AB. While this group had lower rates of AKA and mortality compared to blood groups A, B, and AB, the difference did not achieve statistical significance (Table 1).

Similarly, demographic characteristics did not differ between non-O and O blood groups. However, AKA and mortality rates were significantly higher in patients with non-O blood groups than in those with blood group O (28.2% vs. 49.4%, $p = 0.032$ for AKA, Figure 1; 48.7% vs. 67.9%, $p = 0.048$ for mortality; respectively) (Table 2). This association remained statistically significant even after adjusting for potential confounders (Table 3). Independent of other confounders, blood group O had a 3.12-fold (1/OR) lower risk of AKA (OR =0.32, $p = 0.049$) and a 2.17-fold (1/HR) lower risk of mortality (HR =0.46, $p = 0.045$) compared to non-O blood groups (Figure 1) (Table 3).

Table 1. Demographic and clinical characteristics of patients.

Variables	ABO blood group				P-value
	A n = 41	B n = 24	AB n = 16	O n = 39	
Age, years	64.5 ± 9.5	69.5 ± 14.1	62.6 ± 11.6	68.3 ± 12.6	0.155
Male gender, n (%)	25 (61.0)	15 (62.5)	8 (50.0)	21 (53.8)	0.813
BMI, kg/m2	30.7 ± 3.8	28.8 ± 2.3	30.2 ± 2.8	28.9 ± 6	0.660
Rh (+), n (%)	37 (90.2)	23 (95.8)	15 (93.8)	36 (92.3)	0.959
DM duration, years	15 (5-30)	21 (7-40)	18.5 (10-20)	17 (3.5-37)	0.506
Treatment, n (%)					
Insulin	13 (31.7)	5 (20.8)	6 (37.5)	9 (23.1)	0.557
OAD&Insulin	25 (61.0)	12 (50.0)	10 (62.5)	25 (64.1)	0.730
Comorbidity, n (%)					
Hypertension	30 (73.2)	19 (79.2)	12 (75.0)	24 (61.5)	0.496
CAD	17 (41.5)	10 (41.7)	7 (43.8)	11 (28.2)	0.531
Endocrine diseases	25 (61.0)	13 (54.2)	8 (50.0)	20 (51.3)	0.825
PAD	14 (34.1)	9 (37.5)	5 (31.3)	8 (20.5)	0.438
Hemodialysis, n (%)	11 (26.8)	6 (25.0)	6 (37.5)	11 (28.2)	0.849
Side, n (%)					
Right	22 (53.7)	15 (62.5)	7 (43.8)	15 (38.5)	0.532
Left	15 (36.6)	7 (29.2)	8 (50.0)	21 (53.8)	
Bilateral	4 (9.8)	2 (8.3)	1 (6.3)	3 (7.7)	
Culture findings, n (%)					
Negative	20 (48.8)	11 (45.8)	7 (43.8)	23 (59.0)	0.643
Positive	21 (51.2)	13 (54.2)	9 (56.3)	16 (41.0)	
Laboratory findings					
HBA1C	9.3 ± 1.9	9.3 ± 1.6	9.1 ± 2.5	9.2 ± 2.3	0.836
CRP	159.5 (87-203)	188 (97-206)	138 (81-186.5)	96 (45-103)	0.048*
BUN	32 (20-52)	30 (18.5-44)	35.5 (18.5-55.5)	35 (23-61)	0.668
Creatinine	1.3 (0.9-2.5)	1.5 (1.0-2.5)	1.4 (1.5-2.4)	1.4 (0.7-3.8)	0.582
Outcomes, n (%)					
Above knee amputation	19 (46.3)	13 (54.2)	8 (50.0)	11 (28.2)	0.180
Mortality	27 (65.9)	17 (70.8)	11 (68.8)	19 (48.7)	0.487

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. Differences between groups are highlighted in bold characters. Abbreviations: BMI, body mass index; BUN, blood urea nitrogen; CAD, coronary artery diseases; CRP, C-reactive protein; HbA1c, glycated hemoglobin.

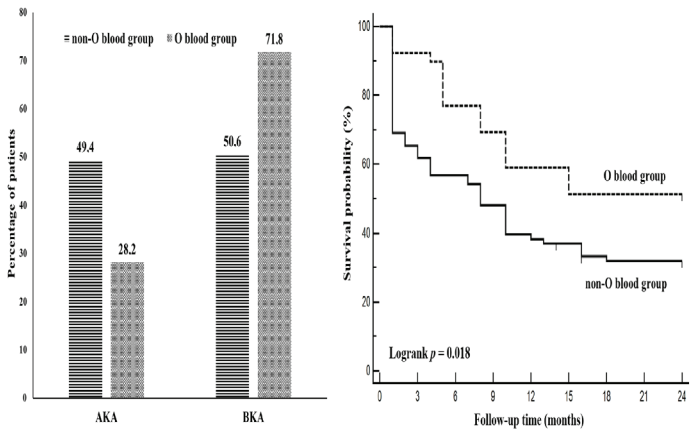

Figure 1. Above-knee amputation frequency (left) and mortality risk (right) according to ABO blood groups.

Discussion

To the best of our knowledge, this study is the first to highlight variations in AKA and mortality risk across ABO blood groups in patients undergoing major amputation for diabetic foot. The results indicate that blood group O is linked to a lower likelihood of AKA and mortality relative to other blood groups. These results suggest a potential role of ABO blood type in modulating diabetic foot outcomes, possibly through mechanisms related to coagulation, endothelial dysfunction, and inflammatory pathways.

Our findings indicate that non-O blood groups are linked to an increased risk of AKA and mortality in diabetic foot patients, whereas blood group O appears to have a protective effect

Table 2. Comparison of demographic and clinical characteristics of patients with non-O blood group and O blood group.

Variables	ABO blood group		P-value
	Non-O n = 81	O n = 39	
Age, years	65.6 ± 11.6	68.3 ± 12.6	0.203
Male gender, n (%)	48 (59.3)	21 (53.8)	0.694
BMI, kg/m2	30.2 ± 3.3	28.9 ± 6.0	0.613
Rh (+), n (%)	75 (92.6)	36 (92.3)	0.999
DM duration, years	17 (5-40)	17 (3.5-37)	
Treatment, n (%)			
Insulin	24 (29.6)	9 (23.1)	0.518
OAD&Insulin	47 (58.0)	25 (64.1)	0.557
Comorbidity, n (%)			
Hypertension	61 (75.3)	24 (61.5)	0.137
Cardiovascular disease	34 (42.0)	11 (28.2)	0.163
Endocrine diseases	46 (56.8)	20 (51.3)	0.696
PAD	28 (34.6)	8 (20.5)	0.139
Hemodialysis, n (%)	23 (28.4)	11 (28.2)	0.999
Side, n (%)			
Right	44 (54.3)	15 (38.5)	0.217
Left	30 (37.0)	21 (53.8)	
Bilateral	7 (8.6)	3 (7.7)	
Culture findings, n (%)			
Negative	38 (46.9)	23 (59.0)	0.246
Positive	43 (53.1)	16 (41.0)	
Laboratory findings			
HBA1C	9.1 ± 1.9	9.2 ± 2.3	0.984
CRP	130 (83-376)	96 (45-103)	0.035*
BUN	31.5 (9-144)	35 (23-61)	0.215
Creatinine	1.5 (0.3-90)	1.4 (0.7-3.8)	0.747
Outcomes, n (%)			
Above knee amputation	40 (49.4)	11 (28.2)	0.032*
Mortality	55 (67.9)	19 (48.7)	0.048*

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. Differences between groups are highlighted in bold characters. Abbreviations: BMI, body mass index; BUN, blood urea nitrogen; CAD, coronary artery diseases; CRP, C-reactive protein; HbA1c, glycated hemoglobin.

Table 3. Effect of O blood group compared with non-O blood group on above-knee amputation and mortality based in crude and adjusted models.

Variables	Above-knee amputation			Mortality		
	OR	95% CI	P-value	HR	95% CI	P-value
Crude	0.43	0.18-0.92	0.030*	0.56	0.33-0.92	0.031*
Adjusted Model I	0.38	0.12-0.95	0.038*	0.55	0.28-0.95	0.038*
Adjusted Model II	0.32	0.10-0.98	0.049*	0.46	0.23-0.98	0.045*

Regression Model I adjusted for the effects of age, sex, BMI, diabetes duration, and diabetes treatments. Regression Model II for the effects of comorbid conditions, culture findings, and laboratory parameters in addition to the Model I. Abbreviations: CI, confidence interval; HR, hazard ratio; OR, odds ratio.

against these outcomes. The increased risk of AKA in non-O blood groups is consistent with prior studies linking ABO blood type to vascular complications. Non-O blood group individuals frequently exhibit the rs505922 variant at the ABO locus (9q34), which has been linked to a higher risk of pancreatic cancer and other diabetes-related complications [12, 13]. Patients suffering from both diabetes and PAD are highly susceptible to severe complications, with amputation being one of the most critical risks [14]. Non-O blood groups have been associated with higher prevalence and severity of PAD [9]. In the Multi-Ethnic Study of Atherosclerosis, blood type A was associated with prevalent PAD and reduced ankle–brachial index (a measure of leg circulation) [14, 15]. This relationship may be driven by the pro-thrombotic profile of non-O blood groups, characterized by elevated levels of von Willebrand factor (vWF) and Factor VIII, which predispose individuals to arterial thrombosis and ischemia [16, 17]. In this study, ABO blood groups showed variations in PAD, which is a key factor influencing amputation risk. Non-O individuals had more PAD, suggesting that blood type 0 might be somewhat protective against limb ischemia. Better blood flow in blood type 0 could help limit the extent of tissue necrosis in the foot, possibly resulting in fewer major amputations. By contrast, A or B blood types, with higher PAD propensity, may present with more extensive arterial blockages requiring AKA when ulcers occur.

Another potential mechanism could be the higher predisposition of non-O blood groups to atherosclerosis and cardiovascular diseases [9]. The presence of A or B antigens may promote atherosclerosis through poorly understood mechanisms (possibly involving lipid profile or endothelial function). Epidemiological data show a modest but significant increase in coronary and cerebral arterial disease risk for non-O blood groups [18, 19]. Furthermore, a previous study identified non-O blood groups as independent predictors of both PAD and coronary artery disease [9]. While ABO effects are less pronounced in microvasculature than in large vessels, there is some evidence that ABO-related endothelial differences could impact microcirculation. The ABO gene significantly affects levels of soluble E-selectin, an adhesion molecule on endothelium involved in leukocyte trafficking. Individuals with blood group O (genotype OO) have markedly higher soluble E-selectin levels than those with A or AB alleles, indicating differences in endothelial activation [20]. Higher E-selectin might reflect an enhanced ability to recruit blood flow or immune cells to injured tissue. Conversely, lower E-selectin (in A or AB individuals) could mean attenuated inflammatory signaling in microvessels, potentially impairing wound healing or collateral circulation development [20, 21]. While direct links to diabetic microangiopathy are not fully proven, it's notable that ABO polymorphisms modulate endothelial function markers that are relevant to tissue perfusion and repair. On the other hand, diabetic wounds often have impaired healing due to microvascular thromboses. Non-O blood group, tends to have the highest vWF levels and has been observed to confer particularly high thrombosis risk in some studies [22, 23]. Such a thrombotic propensity could manifest as extensive microvascular clotting in an infected diabetic foot, leading to demarcation and tissue loss that extends further up the leg. Clinically, this could explain why patients with blood group AB have disproportionately high rates of AKA, as their circulatory compromise is worsened by microvascular clots. These results align with previous studies that have identified a strong correlation between dysvascular amputation and non-O blood groups, particularly blood group B [11].

Another possible mechanism could be the increased vulnerability of certain ABO blood groups to infections. A previous systematic review and meta-analysis reported that non-O blood group individuals are more prone to viral and non-viral infections than those with blood blood group O [24]. Our findings indicate that patients with blood group O showed a tendency toward a lower incidence of positive cultures than those with non-O blood groups. To our knowledge, no study has reported infection or mortalite rates based on ABO blood groups in diabetic foot patients. The collective impact of the aforementioned potential risk factors may play a role in the elevated mortality risk observed in non-O blood groups. However, the current study's findings are in agreement with reports from other diseases indicating that non-O blood group is associated with an increased mortality risk [25-28].

This study has some important limitations. The retrospective design may introduce selection bias, and causality cannot be firmly established. While the association between ABO blood group and amputation risk reached statistical significance, the sample size for each blood group, particularly AB, was relatively small, which may limit the generalizability of the findings. A larger, multi-center study is required to validate these results. Although potential biological explanations have been proposed, the study did not measure plasma vWF levels or endothelial function. Future research should incorporate biomarker analyses to directly assess the mechanistic role

of ABO blood type in diabetic foot complications. Finally, ABO blood group distribution varies across populations, and regional differences in diabetes prevalence, healthcare access, and surgical decision-making may influence amputation rates. Future studies should explore ABO blood group associations in diverse ethnic cohorts to ensure broader applicability.

Conclusion

Our study indicates that non-O blood groups are associated with an increased risk of AKA and mortality among diabetic patients undergoing major joint amputation. These findings suggest that ABO blood grouping could serve as a valuable marker in risk stratification and management of diabetic patients with foot complications. Further research is necessary to confirm these associations and to explore the potential benefits of incorporating blood group analysis into clinical practice for personalized patient care.

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Conflicts of Interest

The authors declare they have no conflicts of interest.

Ethics Approval

This study was approved by Başkent University Institutional Review Board (Date: 21/05/2024, Project no: KA24/220).

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author.

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Araştırma Makalesi

Trakeostomi hastalarında konuşma valfi uygulamasının hastaların yaşam kalitesi ve bakım veren yükü üzerindeki etkisi

The effect of speaking valve application on patients' quality of life and caregiver burden in tracheostomized patients

Demet Aygün Üstel*[1], Burak Manay[2], Merve Savaş[2], Alperen Şentürk[2], Hakan Parlak[3], Serkan Bengisu[2]

[1]Department of Neurology, Istanbul Atlas University, Faculty of Medicine, Istanbul, Turkey
[2]Department of Speech and Language Therapy, Istanbul Atlas University, Faculty of Medicine, Istanbul, Turkey
[3]Department of Anesthesiology and Reanimation, İstinye University, Faculty of Medicine, Istanbul, Turkey

Öz

Amaç: Trakeostomi işlemi hastaların duygu durumunu, iletişim becerilerini ve yaşam kalitesini ciddi derecede bozmaktadır. Bu çalışma trakeostomili yetişkin hastalarda konuşma valfi sonrası yaşam kalitesi skorlarındaki farklılıkları ve bakım verenlerin yaşadığı stres düzeylerindeki değişimi Zarit Bakıcı Yükü Ölçeği (ZBYÖ) ile değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Bu retrospektif çalışmaya konuşma valfi takılmış 36 hasta dahil edildi. Konuşma valfi takılmadan önce ve takıldıktan 2 hafta sonra yaşam kalitelerini değerlendirmeye yönelik hastanın kendi yaşam kalitesini değerlendirdiği Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu Türkçe Versiyonu (WHOQOL-BREF-TR) ve hastaların bakım verenlerine ZBYÖ skorları retrospektif olarak toplandı.

Bulgular: Çalışmaya dahil edilen katılımcıların ortalama yaşı 56,3 ± 17,0 yıl (aralık: 21-82 yıl) olup, %55,6'sı (n = 20) erkekti. Konuşma valfi sonrası Easy Breath durumuna kıyasla ortalama WHOQOL-BREF-TR puanı artış gösterirken (Easy Breath: 46,4 ± 7,8 vs. Konuşma valfi sonrası: 72,2 ± 14,8; $p < 0,001$), ortalama ZBYÖ puanı ise azalma gösterdi (Easy Breath: 52,8 ± 12,8 vs. Konuşma valfi sonrası: 33,2 ± 5,4; $p < 0,001$). Bu bağlamda konuşma valfi sonrası trakeostomi hastalarının ve bakım verenlerinin yaşam kalitesi ölçeği puanı Easy Breath durumuna kıyasla daha yüksekti.

Sonuç: Trakeostomili hastalarda konuşma valfi kullanımı, artan yaşam kalitesinin yanısıra azalan bakım verenlerin stres düzeyleri ile ilişkilidir.

Anahtar kelimeler: konuşma, konuşma valfi, trakeostomi, yaşam kalitesi

Sorumlu Yazar*: Demet Aygün Üstel, Department of Neurology, Istanbul Atlas University, Faculty of Medicine, Istanbul, Turkey
E-mail: demetaygun@yahoo.com
Orcid: 0000-0002-1828-1811
Doi: 10.18663/tjcl.1651922
Geliş Tarihi: 06.03.2025 Kabul Tarihi: 21.03.2025

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Abstract

Aim: The tracheostomy procedure significantly impairs patients' emotional state, communication skills, and quality of life. This study aimed to evaluate the differences in quality of life scores after the application of a speaking valve in adult tracheostomy patients and the changes in caregiver stress levels using the Zarit Caregiver Burden Scale (ZCBS).

Material and Methods: This retrospective study included 36 patients who had a speaking valve applied. The World Health Organization Quality of Life Scale-Short Form Turkish Version (WHOQOL-BREF-TR), which evaluates the patients' self-reported quality of life, and the ZCBS scores of their caregivers were retrospectively collected before and two weeks after the application of the speaking valve.

Results: The mean age of the participants was 56.3 ± 17.0 years (range: 21-82 years), and 55.6% (n = 20) were male. Compared to the Easy Breath condition, the mean WHOQOL-BREF-TR score increased after the application of the speaking valve (Easy Breath: 46.4 ± 7.8 vs. Post-speaking valve: 72.2 ± 14.8; $p < 0.001$), while the mean ZCBS score decreased (Easy Breath: 52.8 ± 12.8 vs. Post-speaking valve: 33.2 ± 5.4; $p < 0.001$). In this context, both tracheostomy patients and their caregivers had higher quality of life scores after the application of the speaking valve compared to the Easy Breath condition.

Conclusion: The use of a speaking valve in tracheostomy patients is associated with improved quality of life and reduced caregiver stress levels.

Keywords: speech, speaking valve, tracheostomy, quality of life

Giriş

Trakeostomi, kritik hastalar için yaygın bir acil müdahale olup, hava yolunun güvenli yönetimini sağlamak amacıyla sıklıkla uygulanır [1]. Trakeostomi, trakeanın ön duvarında bir açıklık oluşturmak için yapılan cerrahi bir işlemdir. Stomanın ve dolayısıyla hava yolunun açıklığını korumak için bir trakeostomi tüpü, açıklıktan trakeaya yerleştirilir [2]. Solunum yetmezliği, üst hava yolu tıkanıklığı veya alt hava yolu sekresyon birikimi gibi durumlar trakeostomi gerektirir [3]. Uzun süreli trakeostomi, hava yolu bütünlüğünü bozarak, solunum, yutma, konuşma ve koku alma gibi fonksiyonlarda bozulmalara yol açabilmekte, bu da yaşam kalitesinin düşmesi ile sonuçlanmaktadır [4, 5]. Ayrıca, trakeostomi iletişim yeteneğini etkileyerek, hastaların anksiyete, depresyon ve güçsüzlük gibi olumsuz duygular yaşamasına neden olabilmektedir [6].

Easy Breath, trakeostomi hastalarının solunumunu desteklemek amacıyla tasarlanmış, hava yoluna sürekli ve kontrollü bir hava akışı sağlayan bir sistemdir. Trakeostomi tüpüne bağlanan bu cihaz, havanın akciğerlere düzenli bir şekilde iletilmesini kolaylaştırarak hastaların solunum sırasında yaşadığı zorlukları azaltır ve daha konforlu nefes almalarına yardımcı olur. Konuşma yeteneğinin kaybına bağlı ortaya çıkan olumsuzlukları azaltmak amacıyla, trakeostomi kanülüne takılan konuşma valfleri geliştirilmiştir. Konuşma valfi, tek yönlü çalışan ve hastanın verdiği nefesi tekrar gırtlağa yönlendirerek ses üretmesini sağlayan bir cihazdır [7].

Önceki çalışmalar, konuşma valfi uygulanmasının hastaların yaşam kalitesi üzerinde belirgin iyileşmeler sağladığını ortaya koymaktadır. Özellikle yoğun bakım ortamında yürütülen bir gözlemsel çalışmada, trakeostomili mekanik ventilatör hastalarında sesin geri kazanılmasıyla birlikte kendini ifade edebilme ve neşe durumunda anlamlı düzelme görülmüştür [8]. Benzer şekilde, Pandian ve arkadaşlarının randomize kontrollü çalışmasında konuşma valfi kullanamayan hastalara özel bir "konuşan trakeostomi tüpü" uygulanmış; sonuçta müdahale grubunun sesle ilişkili yaşam kalitesi skorları ve genel yaşam kalitesi puanları kontrol grubuna kıyasla anlamlı düzeyde yüksek bulunmuştur [9]. Trakeostominin etkileri yalnız hastayla sınırlı kalmayıp aile bireylerine de yansımakta ve aile üyeleri fiziksel, duygusal ve sosyal yük altına girebilmektedir. İletişim güçlüğü, aspirasyon ve kanül bakımı gibi günlük zorluklar bu yükü artıran başlıca etkenlerdir [10]. Ayrıca, hastanın yaşam kalitesinin düşmesinin bakım veren yükünü artırdığı gösterilmiştir [6].

Literatürde, trakeostomi tüpü olan hastalarda konuşma valfi sonrası yaşam kalitesi verilerine ve bakıcı yükündeki değişikliklerin incelendiği sınırlı çalışma bulunmaktadır. Bu çalışma trakeostomili yetişkin hastalarda konuşma valfi sonrası yaşam kalitesi skorlarındaki farklılıkları ve bakım verenlerin yaşadığı stres düzeylerindeki değişimi Zarit Bakıcı Yükü Ölçeği (ZBYÖ) ile değerlendirmeyi amaçladı.

Gereç ve Yöntemler

Helsinki Bildirgesi'nde belirtilen ilkelere uygun olarak, bu tek merkezli retrospektif çalışma Kasım 2024 ile Ocak 2025 tarihleri

arasında Atlas Üniversitesi Tıp Fakültesi Nöroloji Kliniği'nde yürütülmüştür. Çalışma için Atlas Üniversitesi Tıp Fakültesi Etik Kurulu'ndan onay alınmıştır (Onay Tarihi: 19.11.2024, Karar No: E-22686390-050.99-54939). Bu çalışma Atlas üniversite hastanesinde onayları alınan hastalar ve bakıcıları ile birlikte yapılmış olan anketlerin hastane hasta dosyalarından retrospektif olarak elde edilen kayıtları üzerinden yürütülmüştür.

Araştırma Popülasyonu

Çalışmaya tarihleri arasında konuşma valfi takılmış tüm hastalar retrospektif olarak incelendi. Hastaların 18 yaş ve üzerinde olması, son 3 hafta-9 ay aralığında konuşma valfi takılmış olması, hastanede takibine en az 2 ay devam etmesi, en az bir elin parmaklarını aktif olarak kullanabildiğine dair bilginin dosyada dökümante edilmesi ve ölçek sorularını cevaplamış olması dahil edilme kriterleri olarak kabul edildi. Ölçek sonuçlarını etkileyebilecek düzeyde işitme kaybı olan hastalar ise çalışma dışı bırakıldı. Bakım verenlerin dahil edilme kriterleri arasında ise hasta tarafından bu süreçte hastanede kendisine birincil olarak yardımcı olan kişi olması, 18 yaş ve üzerinde olması, iletişime engel bir durumu olmaması yer aldı. Dahil edilme ve dışlama kriterlerini karşılayan 36 katılımcı analizlere dahil edildi.

Veri Toplama Araçları

Trakeostomi uygulanan hastaların geçmiş verilerinden, 3 hafta-9 ay aralığında konuşma valfi takılmış hastalara konuşma valfi takılmadan önce ve takıldıktan iki hafta sonra hastanın kendi yaşam kalitesini değerlendirdiği Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu Türkçe Versiyonu (WHOQOL-BREF-TR) ve hastaların bakım verenlerine ZBYÖ anketleri retrospektif olarak toplandı. Ayrıca, anketlerin yapıldığı dönemde hem katılımcıların hem de bakım veren kişilere ait bilgi formu incelendi ve demografik özellikler bu formlardan toplandı.

Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu Türkçe Versiyonu

Sağlıkla ilişkili yaşam kalitesi ölçeği Dünya Sağlık Örgütü tarafından geliştirmiş, Eser ve arkadaşları tarafından geçerlik ve güvenirliği yapılmıştır. Ölçeğin uzun (WHOQOL-100) ve kısa (WHOQOL-27) formu olmak üzere iki sürümü vardır. Ölçek bedensel, ruhsal, sosyal ve çevresel iyilik hallerini ölçmekte ve 26 sorudan oluşmaktadır. Her bir alan, birbirinden bağımsız olarak kendi alanındaki yaşam kalitesini ifade ettiği için, alan puanları 4-20 arasında hesaplanmaktadır. Puan arttıkça yaşam kalitesi artmaktadır [11].

Zarit Bakıcı Yükü Ölçeği

ZBYÖ Ruhsal ve fiziksel sağlığa, sosyal ve duygusal yaşantılara, ekonomik duruma, kişiler arası ilişkilere yönelik 19 sorudan oluşan Zarit ve arkadaşları tarafından geliştirilmiş bakım gereksinimi olan bireye bakım verenlerin yaşadığı stresi değerlendirmek amacıyla kullanılan ZBYÖ, bakım verenleri değerlendirmek için kullanılmıştır. Ölçek puanının yüksek olması yaşanılan yükün fazla olduğunu göstermektedir. Bakım verenin verebileceği en düşük puan 19, en yüksek puan 95'tir. Ölçek 'asla', 'nadiren', 'bazen', 'sık sık' ya da 'hemen her zaman' şeklinde 1'den 5'e kadar değişen likert tipi değerlendirmeye sahiptir. İnci ve Erdem tarafından 2008 yılında Türkçeye uyarlanarak geçerlilik ve güvenilirlik çalışması yapılmıştır [12].

İstatiksel Analiz

Veriler SPSS programıyla analiz edilmiştir. Sürekli değişkenler, ortalama standart sapma, ortanca (minimum-maksimum değerler) ve kategorik değişkenler sayı (n) ve yüzde (%) olarak verilmiştir. Tüm ölçeklerde puanların normal dağılıp dağılmadığı Shapiro Wilk test ile tespit edilmiştir. Bağımlı örneklem T testi ve Bağımsız örneklem T testi uygulanmıştır. Tüm istatistik analizler %95 güven aralığında, anlamlılık ise p <0,05 düzeyinde değerlendirilmiştir.

Bulgular

Çalışmaya dahil edilen katılımcıların ortalama yaşı 56,3 ± 17,0 yıl (aralık: 21-82 yıl) olup, %55,6'sı (n = 20) erkekti. Easy Breath takılı kalma süresi ortalama 54,4 ± 29,8 gündü (aralık: 18-125 gün). Easy Breath durumunda, ortalama WHOQOL-BREF-TR puanı 46,4 ± 7,8 ve ortalama ZBYÖ puanı 52,8 ± 12,8 idi. Hastaların demografik özellikleri Tablo 1'de gösterildi.

Tablo 1. Demografik özellikler

Değişkenler	Tüm popülasyon n = 36
Cinsiyet, n (%)	
Erkek	20 (55,6)
Kadın	16 (44,6)
Yaş, yıl	56,3 ± 17,0
Minimum	21
Maksimum	82
Easy Breath takılı kalma süresi, gün	54,4 ± 29,8
Minimum	18
Maksimum	125
WHOQOL-BREF-TR	46,4 ± 7,8
Minimum	34
Maksimum	65
ZBYÖ	52,8 ± 12,8
Minimum	32
Maksimum	77

Kategorik değişkenler sayı yüzdeleri olarak gösterildi. Sayısal değişkenler ortalama ± standart sapma olarak gösterildi. Kısaltmalar: WHOQOL-BREF-TR, Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği Kısa Formu Türkçe Versiyonu; ZBYÖ, Zarit Bakıcı Yükü Ölçeği.

Konuşma valfi sonrası, ortalama WHOQOL-BREF-TR puanı 72,2 ± 14,8 ve ortalama ZBYÖ puanı 33,2 ± 5,4 idi. Konuşma valfi sonrası Easy Breath durumuna kıyasla ortalama WHOQOL-BREF-TR puanı artış gösterirken (Easy Breath: 46,4 ± 7,8 vs. Konuşma valfi sonrası: 72,2 ± 14,8; p < 0,001), ortalama ZBYÖ puanı ise azalma gösterdi (Easy Breath: 52,8 ± 12,8 vs. Konuşma valfi sonrası: 33,2 ± 5,4; p < 0,001) (Tablo 2). Bu bağlamda konuşma valfi sonrası trakeostomi hastalarının ve bakım verenlerinin yaşam kalitesi ölçeği puanı Easy Breath durumuna kıyasla daha yüksekti.

Tablo 2. Konuşma valfi sonrası yaşam kalitesi ölçeği ve zarit bakıcı yükü ölçeğindeki değişimler

Değişkenler	Easy Breath	Konuşma valfi sonrası	P-değeri
WHOQOL-BREF-TR	46,4 ± 7,8	33,2 ± 5,4	<0,001
Minimum	34	24	
Maksimum	65	46	
ZBYÖ	52,8 ± 12,8	72,2 ± 14,8	<0,001
Minimum	32	41	
Maksimum	77	105	

Sayısal değişkenler ortalama ± standart sapma olarak gösterildi. Kısaltmalar: WHOQOL-BREF-TR, Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği Kısa Formu Türkçe Versiyonu; ZBYÖ, Zarit Bakıcı Yükü Ölçeği.

Tartışma

Bu çalışma, trakeostomili hastalarda Easy Breath kullanımına kıyasla konuşma valfi uygulanmasının yaşam kalitesinde belirgin bir iyileşme sağladığını ortaya koymuştur. Ayrıca, hastaların yaşam kalitesindeki bu artışın, bakım verenlerin yükünde de anlamlı bir azalmayla paralellik gösterdiği belirlenmiştir. Elde edilen sonuçlar, konuşma valfi kullanımının, trakeostomi hastalarının rehabilitasyon sürecinde önemli bir unsur olduğunu ve sadece hastaların değil, bakım verenlerin de yaşam kalitesini iyileştirdiğini göstermektedir.

Önceki çalışmalar konuşma valflerinin tidal hacmi artırabildiği, ventilatör dekompresyonu sırasında akciğer resüsitasyonunu desteklediği gösterilmiştir [13, 14]. Ayrıca bu valflerin yutma fonksiyonlarını iyileştirerek aspirasyon riskini önlemede etkili olduğu, biyohidrodinamik mekanizmalar yoluyla subglottik basıncın yeniden şekillendirilebildiği belirtilmiştir [15]. Bunun yanı sıra konuşma valfi, subglottik reseptörlerin etkisi ve boğaz hissinin yeniden modellenmesi yoluyla glottik kapanma refleksini ve öksürük refleksini yeniden yapılandırabilir ve böylece konuşma rehabilitasyonunu teşvik edebilir ve iletişimi ve yaşam kalitesini iyileştirebilir [16]. Ayrıca, trakeostomili hastalarda konuşma valflerinin kullanılması koku alma duyusunu da iyileştirebilir ve hava yolu sekresyonunu azaltabilir [17].

Yukardaki mekanizmalarla tutarlı olarak, konuşma valfi uygulaması sonrasında hastaların yaşam kalitesinin arttığını belirledik. Literatürde de benzer şekilde, trakeostomili hastalarda sesin geri dönmesinin psikososyal iyilik hâline olumlu katkıları olduğu bildirilmiştir. Örneğin, yoğun bakımdaki trakeostomili hastalarla yapılan bir gözlemsel çalışmada, konuşma yetisi kazanıldıktan sonra hastaların "başkaları tarafından anlaşılabilme" ve "neşelilik" düzeylerinde belirgin artış görülmüş; ancak genel yaşam kalitesinde anlamlı bir değişiklik saptanmamıştır [8]. Pandian ve arkadaşlarının 2020 yılında yaptığı randomize kontrollü çalışmada, konuşmayı mümkün kılan özel bir trakeostomi tüpü kullanan hastaların yaşam kalitesinde, standart bakıma göre belirgin iyileşme olduğu bildirilmiştir. Ayrıca sesle ilişkili yaşam kalitesi puanları müdahale grubunda ortalama 39'dan 50'ye yükselirken, kontrol grubunda hemen hemen değişmeden kalmıştır [9]. Bu sonuç, iletişim yeteneğinin geri kazandırılmasının hastaların özbildirimine dayalı yaşam kalitesini anlamlı ölçüde artırdığını desteklemektedir. Benzer biçimde, Endonezya'da fenestre kanüllü ve konuşma valfli trakeostomi hastalarını karşılaştıran bir çalışmada, konuşma valfi kullanan grubun fiziksel ve sosyal yaşam kalitesi skorlarının belirgin derecede daha yüksek olduğu rapor edilmiştir [18]. Fenestre kanül kullanan hastaların %76'sında toplam yaşam kalitesi skoru "düşük" kategorideyken, konuşma valfi kullanan hastalarda bu oran yalnızca %4,7 olarak bulunmuştur [18]. Literatürdeki bu bulgular, çalışmamızdaki konuşma valfi sonrası yaşam kalitesindeki artışları doğrular niteliktedir. Özellikle iletişim kurabilme, sosyal etkileşim ve duygu durumundaki iyileşmenin, yaşam kalitesinin psikososyal boyutlarını güçlendirdiği anlaşılmaktadır. Bununla birlikte, genel sağlık ve çevresel alanlar gibi boyutlarda iyileşmenin sınırlı olabileceği de göz önünde bulundurulmalıdır.

Çalışmamızda solunum yetmezliği veya nörolojik nedenle trakeostomili hastaların bakıcılarında, konuşma valfi uygulanması sonrasında ZBYÖ puanlarında anlamlı azalma gözlendi. Türkiye'de yapılan bir kesitsel çalışmada trakeostomiyle yaşamını sürdüren hastaların aile bakım verenlerinde ortalama ZBYÖ skorunun ~42 (orta-yüksek düzey) olduğu rapor edilmiştir [19]. Bu değer, geliştirilmiş ülkelerde felç gibi kronik hastalığı olanların bakıcılarında bildirilen ortalama yük skorlarından (örneğin, inme hastalarında yaklaşık 25 puandır) belirgin derecede yüksektir [20, 21]. Trakeostomi bakımının zorluğu – ki bu zorluklar arasında hastayla iletişim kurma güçlüğü de bulunmaktadır – bakıcı yükünü artıran temel faktörlerdendir. Bakıcılar, trakeostomili hastayla

iletişim kurabilmek, aspirasyon ve kanül bakımı yapmak gibi konularda özel bilgi ve beceriye ihtiyaç duyar. Trakeostomi bakımı hakkında eğitim verilen bakıcılar eğitim sonrası bilgi seviyelerinde artış ve bakım yüklerinde azalma gözlemlendiği bildirilmiştir [22]. Ayrıca, konuşma valfi takılarak hastanın kendini ifade edebilmesinin, bakım verenin omuzlarındaki yükü hafifletmesi beklenen bir sonuçtur. Literatürde doğrudan konuşma valfi uygulaması sonrası bakıcı yükündeki değişimi inceleyen sınırlı sayıda çalışma vardır. Ancak, dolaylı kanıtlar, iletişim güçlüğünün giderilmesinin bakım verende stres ve tükenmişliği azaltabileceğine işaret etmektedir. Örneğin, trakeostomili çocukların ailelerinde yapılan araştırmalarda da bakım verenlerin yaşam kalitesinin düşük, bakım yükünün yüksek olduğu vurgulanmıştır [23]. Bizim bulgularımız, hastanın iletişim bağımlılığının azalmasıyla ve yaşam kalitesinin artması ile birlikte bakıcı yükünün de azalabileceğini göstermiştir. Bu, bakım verenlerin psikososyal durumunu iyileştiren önemli bir kazanımdır ve literatürdeki genel eğilimle uyumludur.

Bu çalışmanın bazı kısıtlılıkları bulunmaktadır. İlk olarak, çalışmanın retrospektif doğası, neden-sonuç ilişkisini net bir şekilde ortaya koymayı zorlaştırmaktadır. İkincisi, ek bir sağlık merkezinde gerçekleştirilmiş olması ve katılımcı sayısının sınırlı olması, elde edilen sonuçların genellenebilirliğini kısıtlamaktadır. Üçüncüsü, konuşma valfi uygulamasının hastaların psikososyal durumu üzerindeki etkileri detaylı psikolojik testlerle değerlendirilmemiştir. Son olarak, çalışmada hastaların uzun dönem sonuçları değerlendirilmemiştir. Konuşma valfi kullanımının uzun vadede yaşam kalitesi üzerindeki etkilerini inceleyen takip çalışmaları faydalı olacaktır. Bu limitasyonları göz önünde bulundurarak, gelecekte yapılacak daha geniş çaplı, çok merkezli ve prospektif çalışmalar, konuşma valfi kullanımının trakeostomili hastalar üzerindeki uzun vadeli etkilerini daha kapsamlı bir şekilde ortaya koyabilir.

Sonuç

Bu çalışma, trakeostomili hastalarda konuşma valfi uygulamasının yaşam kalitesini anlamlı ölçüde artırdığını ve bakım verenlerin yükünü azalttığını göstermektedir. Konuşma valfi kullanımı, hastaların iletişim yetilerini geri kazanmalarına olanak tanıyarak psikososyal iyilik hallerini iyileştirmekte ve bakım süreçlerini daha yönetilebilir hale getirmektedir.

Maddi destek ve çıkar ilişkisi

Çalışmayı maddi olarak destekleyen kişi/kuruluş yoktur ve yazarların herhangi bir çıkar dayalı ilişkisi yoktur

Etik Onayı

Çalışma Helsinki Bildirgesi'ne uygun olarak gerçekleştirilmiş ve İstanbul Atlas Üniversitesi Tıp Fakültesi Etik Kurulu tarafından onaylanmıştır (Onay Tarihi: 19.11.2024, Karar No: E-22686390-050.99-54939).

Bilgilendirilmiş Onam

Retrospektif tasarım nedeniyle Yerel Etik Kurulu'nun onayıyla bilgilendirilmiş onam gerekliliğinden feragat edilmiştir.

Veri ve Materyallerin Kullanılabilirliği

Bu çalışmanın bulgularını destekleyen veriler ilgili yazardan talep üzerine temin edilebilir.

Yazarların katkısı

Kavramsallaştırma – D.A., Tasarım – D.A., Veri düzenleme – D.A., B.M., M.S., A.Ş., H.P. ve S.B., Doğrulama – D.A., Biçimsel analiz – D.A., B.M., M.S., A.Ş., H.P. ve S.B., Kaynaklar – D.A., B.M., M.S., A.Ş., H.P. ve S.B., Yazım – D.A., Eleştirel inceleme – B.M., M.S., A.Ş., H.P. ve S.B. Tüm yazarlar makalenin son halini okuyup onaylamıştır.

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Research Article

Evaluation of the frequency of hard tissue augmentation material usage in dental implant surgery based on different specialties

Farklı uzmanlık alanlarına göre dental implant cerrahisinde sert doku ogmentasyon materyallerinin kullanım sıklığının değerlendirilmesi

Doğan Göral*[1], Nebi Cansın Karakan[2]

[1]Department of Periodontology, Afyonkarahisar Health Sciences University Faculty Of Dentistry, Afyonkarahisar, Turkey

[2]Department of Internal Medicine, University of Health Sciences, Konya City Hospital, Konya, Turkey

Abstract

Aim: This study aimed to investigate the preference profiles of periodontists and oral, dental and maxillofacial (ODM) surgeons regarding graft and membrane biomaterials used in sinus augmentation and horizontal/vertical augmentation procedures.

Material and Methods: This cross-sectional study included 180 specialists in ODM Surgery (n = 90) and Periodontology (n = 90) who were employed in state institutions or the private sector between February 2021 and August 2021. The surveys collected demographic data and information on various factors, including specialty, years of experience as a specialist, the number of implants placed in the past year, the proportion of patients requiring hard tissue augmentation, and the types of biomaterials and barrier membranes used in sinus and horizontal/vertical augmentation procedures.

Results: Periodontists reported more frequent use of xenograft and combined grafts in sinus augmentation procedures, whereas ODM surgeons tended to use these materials occasionally ($p < 0.05$). Xenografts were widely used by both groups, with no significant difference in sinus augmentation. In horizontal augmentation, periodontists favored resorbable collagen membranes, while ODM surgeons more often used non-resorbable barriers. In vertical augmentation, both specialties commonly employed combined grafts and non-resorbable membranes, but periodontists showed a higher preference for xenograft-based combinations.

Conclusion: This study highlights that xenografts and resorbable membranes are the most widely used materials in clinical practice, with preference patterns differing based on the clinician's specialty

Keywords: Augmentation, Barrier membranes, Dental implant, Graft

Corresponding Author*: Doğan Göral, Department of Periodontology, Afyonkarahisar Health Sciences University Faculty Of Dentistry, Afyonkarahisar, Turkey

E-mail: doangoral@gmail.com

Orcid: 0009-0001-7048-5520

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Öz

Amaç: Bu çalışmanın amacı periodontistlerin ve ağız, diş ve çene (ADÇ) cerrahlarının sinüs artırma ve yatay/dikey artırma prosedürlerinde kullanılan greft ve membran biyomalzemelerine ilişkin tercih profillerini araştırmaktır.

Gereç ve Yöntemler: Bu kesitsel çalışmaya Şubat ve Ağustos 2021 tarihleri arasında devlet kurumlarında veya özel sektörde çalışan ADÇ cerrahisi (n = 90) ve Periodontoloji (n = 90) alanında uzman 180 kişi katılmıştır. Anketler aracılığıyla demografik verileri ve uzmanlık alanı, uzman olarak deneyim yılları, geçen yıl yerleştirilen implant sayısı, sert doku artırma gerektiren hasta oranı ve sinüs ve yatay/dikey artırma prosedürlerinde kullanılan biyomalzeme ve bariyer membran türleri dahil olmak üzere çeşitli faktörlere ilişkin bilgiler toplanmıştır.

Sonuçlar: Periodontistler sinüs ogmentasyon prosedürlerinde xenograft ve kombine greftleri daha sık kullandıklarını bildirirken, ODM cerrahları bu materyalleri ara sıra kullanma eğilimindeydi ($p<0,05$). Ksenogreftler her iki grup tarafından yaygın olarak kullanıldı ve sinüs ogmentasyonunda anlamlı bir fark yoktu. Yatay ogmentasyonda periodontistler rezorbe olabilen kollajen membranları tercih ederken, ODM cerrahları daha sık rezorbe olmayan bariyerleri kullandı. Dikey ogmentasyonda, her iki uzmanlık dalı da genellikle kombine greftler ve rezorbe olmayan membranlar kullandı, ancak periodontistler ksenogreft bazlı kombinasyonlara daha fazla tercih gösterdi.

Sonuç: Bu çalışma, ksenograftların ve emilebilir membranların klinik uygulamada en yaygın kullanılan materyaller olduğunu ve tercih kalıplarının klinisyenin uzmanlık alanına göre farklılık gösterdiğini vurgulamaktadır.

Anahtar Kelimeler: Ogmentasyon, Bariyer membranlar, Diş implantı, Greft

Introduction

Dental implant surgeries are of high importance in the dental care of patients with complete or partial edentulism in their alveolar crests. These interventions restore masticatory functions while addressing aesthetic concerns (1). Among various implant-supported prosthetic treatments, dental implants are widely accepted, particularly for managing total edentulism. However, one of the most common challenges encountered during implant rehabilitation is the insufficient height and thickness of the alveolar bone, often necessitating bone augmentation procedures (2).

The success of augmentation largely depends on the choice of bone graft materials, which include autogenous grafts, xenografts, allografts, alloplastic grafts, or combinations of these materials (3, 4). Various augmentation techniques can be performed either before or simultaneously with implant placement to enhance bone volume and quality. These techniques include inlay or onlay bone augmentation, directed bone regeneration, ridge splitting, alveolar distraction, maxillary sinus floor elevation, sandwich osteotomy (interpositional grafting), and inferior alveolar nerve repositioning (5, 6).

Periodontists and oral, dental and maxillofacial (ODM) surgeons are the two crucial specialists involved in implant surgery and augmentation procedures (7). Differences in training, clinical experience, and working environments contribute to significant variations in augmentation approaches, including the selection of graft materials and barrier membranes (7). While some studies have explored the impact of these factors on implant success, limited data exist regarding specialists' biomaterial preferences and the factors influencing these choices (8, 9). Moreover, there is a limited number of survey-based studies analyzing the clinical practices of specialists regarding biomaterial selection and the factors influencing their decisions (7, 10).

This study aimed to analyze survey data from periodontists and ODM surgeons in Turkey to identify their preferences for graft and membrane biomaterials used in sinus and horizontal/vertical augmentation procedures. Additionally, it examined the potential influence of specialty experience on these preferences.

Material And Methods

This cross-sectional study was carried out at the Department of Periodontology in XXX Health Sciences University between February 2021 to August 2021, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the XXX Health Sciences University Clinical Research Ethics Committee (Date: 04.12.2020, Decision No: 2020/545).

Study Population

Due to the absence of a comprehensive system covering both the private and public sectors, it was impossible to reliably determine the number of oral and maxillofacial surgeons and periodontists working in Turkey. As such, the number of physicians to be included in our study was determined with reference to similar survey studies conducted (7, 10). The required sample size was determined using the G*Power 3.1 program. When effect size was taken as 0.30, based on an alpha level of 0.05 and power of 80%, the targeted sample size was 167 (11).

Participants, including ODM surgeons and periodontists from both state institutions and private sector, were evaluated for study eligibility. The participants were selected based on their professional backgrounds showing experience with these procedures / interventions. Individuals with missing or incomplete responses to any of the survey questions were excluded from the analyses. The analyses included 90 ODM surgery and 90 periodontist specialists who fully completed the survey.

Data Collection

The surveys were created in 'Google Forms' and distributed to specialist dentists via the internet and institutional communication opportunities (emails, social media, affiliations) over a period of approximately 5 months from the beginning of February 2021. The number of participants targeted at study inception was reached by August 2021.

Participants were categorized based on their specialty experience into two groups: 0–5 years and ≥6 years. Additionally, they were classified according to the proportion of patients who underwent hard tissue augmentation in the past year, with the following groups: 0–10%, 11–20%, and >21%.

Survey creation and considerations

The questionnaire created for the purpose of the study includes queries related to demographics (age and sex), specialty (periodontology or oral and maxillofacial surgery), duration of employment as a specialist, number of implants performed within the prior year (12 months at time of survey response), the percentage of patients that required hard tissue augmentation during the same period, and the use of biomaterials, their types, barrier membranes etc. during sinus and vertical/horizontal augmentation procedures.

The questions we planned to direct to physicians working in two different specialties were prepared with two different methods. The questions included in the first group were included in the survey questions with reference to previous survey studies, while the second group, which constitutes the majority, was prepared using the 'Lawshe' technique. This technique is based on content validity studies. In the preparation of such scales, it is critical to determine whether the items in the scale are sufficient to cover and collect data that is factual while ensuring that recalled information is reliable, which is accomplished by assessing expert opinions. Content validity studies based on expert opinions are qualitative studies by nature (12). Therefore, the data obtained should be converted into quantitative data as accurately as possible by calculating content validity ratios (CVR) and content validity index (CVI). The appropriateness of the survey question contents was assessed with these metrics during the creation of the survey. The brief procedural steps employed for this process are listed below: (1) formation of the specialty group (periodontists or oral and maxillofacial surgeons); (2) preparation of the candidate scale form and receipt of specialist opinions; (3) data analysis which involves calculation of CVR and CVI; (4) deciding whether each item should be included in the scale according to the CVR and CVI criteria.

The expertise, background and the number of experts (between 5-40) are of great importance in obtaining objective metrics used to assess content validity. While preparing the survey questions, we collected opinions from 7 specialists who were defined as experts in the field. In the Lawshe (1975) technique, expert opinions for each item are graded in three categories as "the item measures the targeted construct", "the item is related to the construct but unnecessary" and "the item does not measure the targeted construct". However, the ratings of expert opinions in Lawshe (1975) technique were rearranged as "Appropriate", "Appropriate but should be corrected" and "Should be removed" (13). In the current study, in order to determine the content validity of the items to be included in the scale, the qualitative data obtained in line with specialist opinions were transformed into quantitative data by calculating the CVR and CVI. In summary, after the necessary scoring was done, the sub-headings, questions, and multiple-choice responses provided for each question were determined with this technique.

Statistical Analysis

The Kolmogorov-Smirnov test was used to examine the conformity of the variables to normal distribution. Descriptive statistics were presented by using mean, standard deviation, median, minimum, maximum for continuous variables, while frequency and percentage were used for categorical variables. Continuous variables were analyzed by using the Mann-Whitney U or Kruskal-Wallis tests, depending on the number of groups being compared. Categorical variables were analyzed

by using appropriate chi-square tests (Pearson, Yate's continuity correction) or the Freeman-Halton extension of the Fisher's Exact test. Pairwise comparisons were adjusted by using Bonferroni correction. We defined $p < 0.05$ as demonstrating statistical significance. IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis.

Results

Demographic characteristics of the participants

The mean age of participants was 33.7 ± 6.3 years (minimum: 25.00; maximum: 53.00) and 55.6% were male. In terms of experience 38.9% of the participants reported 6 years or more. Hard tissue augmentation groups showed that 69 participants (38.3%) had performed augmentation in 0-10% of their patients, 55 (30.6%) in 11-20%, and 56 (31.1%) in >21%. The median number of implants in the last year was 180.0 (range: 0 – 3000). Median number of implantations in the last year was higher in the ODM surgery group compared to periodontist group (250 vs. 65; $p < 0.001$, respectively) (Table 1).

Table 1. Demographic characteristics of the participants and their findings regarding implant applications.

Variables	All population n = 180
Age	33.7 ± 6.3
Gender, n (%)	
Male	100 (55.6)
Female	80 (44.4)
Specialty, n (%)	
Periodontology	90 (50.0)
Oral and Maxillofacial Surgery	90 (50.0)
Duration of work as a specialist, n (%)	
0-5 years	110 (61.1)
≥6 years	70 (38.9)
Percentage of patients who underwent hard tissue augmentation in the prior year, n (%)	
0-10	69 (38.3)
11-20	55 (30.6)
>21	56 (31.1)
Number of implants in the last year	180.0 (0.0 - 3000.0)
Specialty	
Periodontology	65.0 (0.0 - 1100.0)
Oral and Maxillofacial Surgery*	250.00 (0.0 - 3000.0)

Data are mean±standard deviation or median (IQR), or number (%).*p<0.05 indicates statistical significance.

Sinus augmentation

The occasional ("sometimes") use of autogenous grafts was reported more frequently by ODM surgeons than by periodontists (38.9% vs. 24.4%, $p = 0.006$). However, the proportion of participants reporting frequent ("often" or "always") use of autogenous grafts was higher in the periodontist group compared to the ODM surgeon group (40.0% vs. 26.7%, $p < 0.05$). The frequency of xenograft use did not differ significantly between periodontists and ODM surgeons. Occasional use of combined grafts was more frequently reported by ODM surgeons than by periodontists (42.2% vs. 15.6%, $p < 0.001$). However, the proportion of participants reporting frequent ("often" or "always") use of combined grafts was higher among periodontists than ODM surgeons (58.9% vs. 33.3%, $p < 0.05$). The frequency of resorbable membrane use did not differ significantly between periodontists and ODM surgeons. The proportion of participants who never used non-resorbable membranes was higher in the ODM surgeon group than the periodontist group (53.3% vs. 28.9%, $p = 0.005$). However, the proportion of participants reporting frequent ("often" or "always") use of non-resorbable membranes was higher in the periodontist group than the ODM surgeon group (18.9% vs. 5.6%, $p < 0.05$) (Table 2).

Lateral (horizontal) hard tissue augmentation

The frequency of autogenous grafts and non-resorbable titanium mesh membranes use did not differ significantly between periodontists and ODM surgeons. The proportion of participants reporting frequent ("often" or "always") use of xenograft was lower in the ODM surgeon group compared to the periodontist group (23.3% vs. 55.6%, $p < 0.05$). The occasional ("sometimes") use of combined grafts was reported more frequently by ODM surgeons than by periodontists (23.3% vs. 12.2%, $p = 0.001$). Also, the "often" use of combined grafts was reported by 45.6% of periodontists and 60% of ODM surgeons. Nonetheless, the proportion of participants who reported "always" using combined grafts was greater among periodontists (24.4% vs. 6.7%; $p = 0.001$). The frequency of resorbable membrane use was higher in the periodontist group compared to the ODM surgeon group (71.1% vs. 37.8%, $p < 0.05$). The proportion of participants reporting frequent ("often" or "always") use of non-resorbable membranes (d-PTFE, e-PTFE, titanium-reinforced) was higher in the ODM surgeon group compared to the periodontist group (44.4% vs. 25.5%, $p < 0.05$) (Table 3).

Vertical Hard Tissue Augmentation

The occasionnal ("sometimes") use of autogenous graft was reported more frequently by ODM surgeons than by periodontists (37.8% vs. 15.6%, $p = 0.001$). The occasionnal

Table 2. Comparison of graft and membrane biomaterial usage frequency in sinus augmentation based on specialty.

Variables	Specialty		p
	Periodontology n = 90	ODM Surgery n = 90	
Use of autogenous graft biomaterials			
Never	18 (20.0)	6 (6.7)	0.006*
Rare	14 (15.6)	25 (27.8)	
Sometimes	22 (24.4)	35 (38.9)	
Often	29 (32.2)	19 (21.1)	
Always	7 (7.8)	5 (5.6)	
Use of xenograft biomaterials			
Never	9 (10.0)	8 (8.9)	0.115
Rare	7 (7.8)	12 (13.3)	
Sometimes	17 (18.9)	10 (11.1)	
Often	46 (51.1)	56 (62.2)	
Always	11 (12.2)	4 (4.4)	
Use of combined graft biomaterials			
Never	12 (13.3)	7 (7.8)	<0.001*
Rare	11 (12.2)	15 (16.7)	
Sometimes	14 (15.6)	38 (42.2)	
Often	39 (43.3)	26 (28.9)	
Always	14 (15.6)	4 (4.4)	
Use of resorbable membrane biomaterials			
Never	3 (3.3)	5 (5.6)	0.087
Rare	5 (5.6)	5 (5.6)	
Sometimes	11 (12.2)	13 (14.4)	
Often	49 (54.4)	59 (65.6)	
Always	22 (24.4)	8 (8.9)	
Use of non-resorbable d-PTFE, e-PTFE, titanium-reinforced membrane biomaterials			
Never	26 (28.9)	48 (53.3)	0.005*
Rare	28 (31.1)	19 (21.1)	
Sometimes	19 (21.1)	18 (20.0)	
Often	16 (17.8)	5 (5.6)	
Always	1 (1.1)	0	

Data are number (%).*p<0.05 indicates statistical significance. d-PTFE: High-density polytetrafluoroethylene, e-PTFE: Expanded polytetrafluoroethylene

("sometimes") use of xenograft was reported more frequently by ODM surgeons than by periodontists (54.4% vs. 26.7%, p < 0.001). However, the proportion of participants reporting frequent ("often" or "always") use of xenograft was higher in the periodontist group compared to the ODM surgeon group (43.4% vs. 14.4%, p < 0.001). The proportion of participants who reported "often" using combined grafts was higher in the ODM surgeon group compared to the periodontist group (60.0% vs. 42.2%; p = 0.001). However, the proportion of participants who reported "always" using combined grafts was higher in the periodontist group compared to the ODM surgeon group (27.8% vs. 4.4%; p = 0.001). The proportion of participants reporting frequent ("often" or "always") use of resorbable membrane biomaterials was higher in the periodontist group compared to ODM surgeon group (56.6% vs. 28.9%, p < 0.05). The frequency of non-resorbable membranes (d-PTFE, e-PTFE, titanium-reinforced) use did not differ significantly between periodontists and ODM surgeons. The frequent of participants who reported "often or always" using non-resorbable titanium mesh membranes was higher in the periodontist group compared to the ODM surgeon group (31.1% vs. 11.1%, p < 0.05) (Table 4).

Table 3. Comparison of graft and membrane biomaterial usage frequency in lateral (horizontal) hard tissue augmentation based on specialty.

Variables	Specialty		p
	Periodontology n = 90	ODM Surgery n = 90	
Use of autogenous graft biomaterials			
Never	5 (5.6)	3 (3.3)	0.101
Rare	15 (16.7)	5 (5.6)	
Sometimes	24 (26.7)	32 (35.6)	
Often	35 (38.9)	42 (46.7)	
Always	11 (12.2)	8 (8.9)	
Use of xenograft biomaterials			
Never	8 (8.9)	8 (8.9)	<0.001*
Rare	11 (12.2)	20 (22.2)	
Sometimes	21 (23.3)	41 (45.6)	
Often	42 (46.7)	21 (23.3)	
Always	8 (8.9)	0	
Use of combined graft biomaterials			
Never	4 (4.4)	6 (6.7)	0.001*
Rare	12 (13.3)	3 (3.3)	
Sometimes	11 (12.2)	21 (23.3)	
Often	41 (45.6)	54 (60.0)	
Always	22 (24.4)	6 (6.7)	
Use of resorbable membrane biomaterials			
Never	3 (3.3)	5 (5.6)	<0.001*
Rare	6 (6.7)	20 (22.2)	
Sometimes	17 (18.9)	31 (34.4)	
Often	51 (56.7)	26 (28.9)	
Always	13 (14.4)	8 (8.9)	
Use of non-resorbable d-PTFE, e-PTFE, titanium-reinforced membranes biomaterials			
Never	10 (11.1)	15 (16.7)	0.003*
Rare	19 (21.1)	17 (18.9)	
Sometimes	38 (42.2)	18 (20.0)	
Often	21 (23.3)	40 (44.4)	
Always	2 (2.2)	0	
Use of non-resorbable titanium mesh membranes biomaterials			
Never	26 (28.9)	23 (25.6)	0.614
Rare	19 (21.1)	21 (23.3)	
Sometimes	33 (36.7)	39 (43.3)	
Often	11 (12.2)	7 (7.8)	
Always	1 (1.1)	0	

Data are number (%).*p<0.05 indicates statistical significance. d-PTFE: High-density polytetrafluoroethylene, e-PTFE: Expanded polytetrafluoroethylene

Table 4. Comparison of graft and membrane biomaterial usage frequency in vertical hard tissue augmentation based on specialty.

Variables	Specialty		p
	Periodontology n = 90	ODM Surgery n = 90	
Use of autogenous graft biomaterials			
Never	5 (5.6)	3 (3.3)	0.001*
Rare	15 (16.7)	3 (3.3)	
Sometimes	14 (15.6)	34 (37.8)	
Often	44 (48.9)	36 (40.0)	
Always	12 (13.3)	14 (15.6)	
Use of xenograft biomaterials			
Never	8 (8.9)	13 (14.4)	<0.001*
Rare	19 (21.1)	15 (16.7)	
Sometimes	24 (26.7)	49 (54.4)	
Often	33 (36.7)	11 (12.2)	
Always	6 (6.7)	2 (2.2)	
Use of combined graft biomaterials			
Never	6 (6.7)	11 (12.2)	0.001*
Rare	7 (7.8)	5 (5.6)	
Sometimes	14 (15.6)	16 (17.8)	
Often	38 (42.2)	54 (60.0)	
Always	25 (27.8)	4 (4.4)	
Use of resorbable membrane biomaterials			
Never	7 (7.8)	6 (6.7)	0.002*
Rare	11 (12.2)	27 (30.0)	
Sometimes	21 (23.3)	31 (34.4)	
Often	40 (44.4)	21 (23.3)	
Always	11 (12.2)	5 (5.6)	
Use of non-resorbable d-PTFE, e-PTFE, titanium-reinforced membranes biomaterials			
Never	11 (12.2)	14 (15.6)	0.091
Rare	12 (13.3)	14 (15.6)	
Sometimes	23 (25.6)	13 (14.4)	
Often	38 (42.2)	48 (53.3)	
Always	6 (6.7)	1 (1.1)	
Use of non-resorbable titanium mesh membranes biomaterials			
Never	19 (21.1)	19 (21.1)	0.010*
Rare	17 (18.9)	19 (21.1)	
Sometimes	26 (28.9)	42 (46.7)	
Often	25 (27.8)	10 (11.1)	
Always	3 (3.3)	0	

Data are number (%).*p<0.05 indicates statistical significance. d-PTFE: High-density polytetrafluoroethylene, e-PTFE: Expanded polytetrafluoroethylene.

Discussion

This study represents one of the few comparative analyses of periodontists and ODM surgeons and revealed significant differences in their preferences for hard tissue augmentation materials in implant procedures. In sinus augmentation, periodontists reported more frequent use of autogenous and combined grafts as well as non-resorbable membranes, whereas ODM surgeons tended to use these materials occasionally. In hard tissue augmentation, periodontists consistently favored xenografts, resorbable membranes, and non-resorbable titanium mesh membranes, while ODM surgeons showed greater reliance on non-resorbable membranes and more variable use of autogenous materials.

In sinus augmentation procedures, our findings showed that both periodontists and ODM surgeons commonly utilized xenograft bone substitutes and resorbable collagen membranes, with no significant difference in their frequency of use. This aligns with the established clinical preference for xenografts in sinus grafting due to their osteoconductive properties and ability to maintain long-term volume stability, as well as the routine application of resorbable membranes to prevent soft tissue invasion and support graft protection (14, 15). However, a notable distinction emerged in the use of autogenous and combined grafts. Periodontists reported significantly more frequent use of both, which may reflect their stronger emphasis on biologically oriented regeneration. Autogenous bone, known for its osteogenic, osteoinductive, and osteoconductive capabilities, remains the gold standard in bone augmentation procedures, offering viable cells and growth factors for new bone formation (16). Despite its superior biological potential, autogenous bone is subject to donor site morbidity and higher resorption rates over time, particularly in sinus grafts (17). These limitations have led many clinicians—especially periodontists—to favor combining autogenous bone with xenografts, leveraging the early bone-forming capacity of the former with the volumetric stability of the latter (18). Conversely, ODM surgeons, who often manage large-scale or full-arch implant cases, may prioritize procedural efficiency and reduced morbidity. The use of xenografts alone with resorbable membranes eliminates the need for a second surgical site, aligning well with their broader surgical workflow (19, 20). Although non-resorbable membranes offer superior structural stability—particularly in large sinus windows—periodontists appeared more inclined to accept the additional surgical step required for their removal, possibly due to their focus on maximizing regenerative outcomes in localized defects (19, 21).

In horizontal ridge augmentation, periodontists demonstrated a significantly higher frequency of xenograft use compared to ODM surgeons. This preference aligns with existing data showing that xenografts—particularly of bovine origin—can achieve predictable horizontal bone gains with high implant survival rates, making them a reliable alternative to autografts in many clinical situations (22-25). A systematic review reported that xenogenous grafts can achieve substantial horizontal bone gains (~4–5 mm on average) with high implant success rates, validating xenografts as a feasible alternative to autograft in many cases (26). Periodontists also reported more frequent use of resorbable collagen membranes, a trend supported by studies indicating that up to 80% of periodontal specialists routinely apply collagen membranes in guided bone regeneration (GBR) procedures (25). These membranes are favored in periodontal practice for their ease of use, soft-tissue compatibility, and elimination of the need for a second surgical procedure for removal (19). ODM surgeons, on the other hand, showed a higher tendency to use non-resorbable polymer-based membranes, such as d-PTFE or titanium-reinforced barriers. These membranes provide superior space maintenance and structural rigidity, which are often required in extensive horizontal defects. Their usage is consistent with the training and surgical orientation of ODM surgeons, who commonly treat complex cases and may follow staged protocols that accommodate membrane retrieval procedures. While non-resorbable membranes carry risks such as exposure or infection, ODM surgeons are generally equipped to manage these complications due to their operative background. Ultimately, membrane selection in horizontal augmentation appears to reflect each specialty's clinical priorities. Periodontists tend to prioritize minimally invasive protocols with emphasis on soft-tissue healing and ease of handling, whereas ODM surgeons favor structural predictability and mechanical stability in larger or more complex cases.

Vertical ridge augmentation remains one of the most technically demanding procedures in implant dentistry, often requiring the use of autogenous bone due to its superior regenerative capacity. In our study, over half of the participants in both specialties reported using autogenous grafts in vertical augmentation, a finding that aligns with current recommendations favoring at least 50% autogenous content in such procedures to ensure sufficient osteogenic stimulation (27). Nevertheless, periodontists demonstrated a higher

frequency of xenograft use compared to ODM surgeons. This may reflect a preference for volume-stable grafts with slower resorption profiles, particularly when aiming to preserve ridge dimensions while minimizing the need for extensive harvesting (28). The frequent use of combined grafts—mixing autogenous and xenograft materials—by both groups underscores a shared clinical strategy aimed at balancing biological activity and volumetric stability. This approach is also supported by systematic reviews reporting enhanced outcomes in vertical augmentation when composite grafts are used in conjunction with barrier membranes (29). Regarding membrane selection, both resorbable and non-resorbable options were used. While non-resorbable membranes such as d-PTFE, e-PTFE, and titanium-reinforced barriers were more frequently applied in vertical augmentation, we found no significant difference between the two specialties in the use of titanium mesh. Prior studies have shown that titanium mesh, when used alongside collagen membranes and combined grafts, can yield predictable vertical bone gains (29-31). These results reinforce the trend observed in our data: both specialties adopt a combined biomaterial approach in vertical augmentation, tailoring graft and membrane selection to the complexity and dimensional needs of the defect.

This study has several limitations that should be acknowledged. First, as a survey-based investigation, it is subject to potential sampling bias, which may affect the representativeness and generalizability of the findings. The voluntary and anonymous nature of participation, while protecting confidentiality, may have allowed for variability in response accuracy. Recall bias is another concern, as participants were asked to report their clinical preferences retrospectively, which may not always reflect actual behavior. Additionally, there is a possibility that some participants accessed literature data to fine-tune their responses to accommodate for clinical practice guidelines (despite anonymous participation). The cross-sectional design also limits temporal interpretation, as responses represent a single time frame. Variations in biomaterial availability, institutional protocols, and evolving clinical technologies across different centers and regions may have influenced participant responses. Furthermore, the significant differences in the number of implants placed annually among respondents could have introduced confounding effects on material preference patterns. Finally, the scarcity of comparable studies in the literature posed challenges for direct comparison and contextualization of the results.

Conclusion

This study indicate that specialty significantly influences clinical decision-making regarding graft and membrane selection. Periodontists were more likely to utilize autogenous and combined grafts, particularly in sinus and vertical augmentation, and showed a preference for resorbable membranes aligned with guided bone regeneration protocols. In contrast, ODM surgeons demonstrated more variable use of graft types and a higher tendency toward non-resorbable membranes, particularly in complex cases requiring extensive reconstruction. These differences reflect not only procedural preferences but also distinct educational philosophies and clinical workflows between the two specialties. Understanding such variations is essential for promoting interdisciplinary collaboration, optimizing treatment planning, and developing evidence-based guidelines for material selection in implant dentistry.

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Conflicts of Interest

The authors declare they have no conflicts of interest.

Ethics Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (Date: 04.12.2020, Decision No: 2020/545).

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author.

Authors' contribution

Conceptualization – D.G., Design – N.B.K., Data curation – D.G. and N.B.K., Validation – N.B.K., Formal analysis – .G. and N.B.K., Resources – .G. and N.B.K., Writing – D.G., Critical review – N.B.K. All authors read and approved the final version of the manuscript.

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Araştırma Makalesi

Diagnostic performance of urinary biomarkers and self-monitoring blood glucose in estimating microvascular complications in elderly patients with diabetes mellitus

Yaşlı diyabetli hastalarda mikrovasküler komplikasyonları tahmin etmede idrar biyobelirteçlerinin ve kendi kendine kan glikozu izlemenin tanısal performansı

Muzaffer Serdar Deniz*[1], Fatih Karataş [2]

[1]Endocrinologist, Department of Endocrinology, Karabük University Education and Research Hospital, Karabük, Turkey

[2]Oncologist, Department of Medical Oncology, Karabük University Education and Research Hospital, Karabük, Turkey

Abstract

Aim: In elderly patients, detection of diabetes mellitus (DM)-associated complications is crucial to improve quality of life and prevent serious pathologies. This study aimed to evaluate the diagnostic performance of urine microalbumin-creatinine ratio (uMCR), urine protein-creatinine ratio (uPCR), and self-monitoring blood glucose (SMBG) in estimating microvascular complications, neuropathy, retinopathy, and nephropathy in older adults with DM.

Material and Methods: In this diagnostic methodological study, DM patients (n=99) older than 64 years were followed in the endocrinology clinic parameters; serum hemoglobin A1c (HbA1c), serum triglyceride-glucose index (TyG index), the difference between self-measured peak glucose level and nadir level (SMBGdiff), and the ratio of the SMBGdiff to the highest SMBG level (SMNGratio), uMCR and uPCR were evaluated by ROC analysis and their cut-off values and specificity were determined to evaluate the diagnostic power for microvascular complications.

Results: Our findings showed that 70% of the patients were male, 48.5% had neuropathy, 25.3% had retinopathy and 25.3% had nephropathy. Although lipid metabolism and liver-related indicators were within the normal range, patients were vitamin D deficient. ROC analysis revealed that uMCR and uPCR levels were independently associated with nephropathy ($p<0.001$), with strong specificity and moderate sensitivity. SMBGdiff was associated with both retinopathy and neuropathy ($p=0.049$ and $p=0.040$), and both specificity and sensitivity were poor.

Conclusion: In elderly patients with DM uMCR and uPCR are strong indicators of nephropathy. However, other diabetes-associated biomarkers showed poor correlations emphasizing the age-related complexities in diabetic patients and an urgent need for further research.

Keywords: Type 2 diabetes, retinopathy, neuropathy, nephropathy, urine microalbumin-creatinine ratio, protein-creatinine ratio

Corresponding Author*: Muzaffer Serdar Deniz, Endocrinologist, Department of Endocrinology, Karabük University Education and Research Hospital, Karabük, Turkey

E-mail: serdardeniz86@hotmail.com

Orcid: 0000-0002-8905-3955

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Öz

Amaç: Yaşlı hastalarda yaşam kalitesini artırmak ve ciddi patolojileri önlemek için diabetes mellitus (DM) ile ilişkili komplikasyonların saptanması çok önemlidir. Bu çalışmanın amacı, DM'li yaşlı erişkinlerde üriner mikroalbümin-kreatinin oranı (uMCR), üriner protein-kreatinin oranı (uPCR) ve kendi kendine kan şekeri takibinin (SMBG) nöropati, retinopati ve nefropatiyi gibi mikrovasküler komplikasyonları tahmin etmedeki tanısal performansını değerlendirmektir.

Gereç ve Yöntemler: Bu tanısal metodolojik çalışmada, endokrinoloji kliniğinde takip edilen 64 yaş üstü DM hastalarının (n=99) serum hemoglobin A1c (HbA1c), serum trigliserid-glukoz indeksi (TyG indeksi), SMBG ile ölçülen en yüksek ve en düşük kan şekeri düzeyleri farkı (SMBGfarkı) ve SMBGfarkı ile en yüksek SMBG düzeyinin oranı (SMBGoranı), uMCR ve uPCR değerleri, mikrovasküler komplikasyonları tahmin etmedeki tanısal güçleri ROC analiziyle değerlendirildi. Tanısal performansa sahip olanların kesim değerleri ve sensitivite ve spesifiteleri hesaplanmıştır.

Bulgular: DM hastalarının %70'inin erkek olduğunu, %48,5'inde nöropati, %25,3'ünde retinopati ve %25,3'ünde nefropati olduğunu göstermiştir. Lipid metabolizması ve karaciğerle ilgili göstergeler normal aralıkta olmasına rağmen, hastalarda D vitamini eksikliği görülmüştür. ROC analizi, uMCR ve uPCR düzeylerinin bağımsız olarak nefropati ile ilişkili olduğunu ($p<0.001$), güçlü spesifisite ve orta düzeyde duyarlılık gösterdiğini ortaya koymuştur. SMBGfarkı hem retinopati hem de nöropati açısından istatistiksel olarak anlamlı tanısal performansa sahip ($p=0.049$, $p=0.040$), ancak hem spesifite hem de sensitivite düzeyleri düşüktür.

Sonuçlar: DM'lu yaşlı hastalarda uMCR ve uPCR nefropatinin güçlü göstergeleridir. Bununla birlikte, diyabetle ilişkili diğer biyobelirteçler zayıf korelasyon göstermiştir; bu da diyabetik hastalarda yaşa bağlı sorunları ve araştırmaya duyulan ihtiyacı vurgulamaktadır.

Anahtar Kelimeler: Tip 2 diyabet, retinopati, nöropati, nefropati, idrar mikroalbümin-kreatinin oranı, protein-kreatinin oranı

Introduction

Type 2 diabetes mellitus (T2DM) is a growing global health concern, affecting over 500 million people worldwide and projected to rise further with an aging population [1]. The burden is especially high in older adults; for example, in Turkey nearly one-third of individuals over 65 have diabetes [2]. Chronic hyperglycemia in T2DM leads to widespread microvascular damage, giving rise to complications such as diabetic retinopathy (DR), nephropathy, and neuropathy [3]. These microvascular complications contribute substantially to morbidity, and their prevalence is striking – roughly one-third of T2DM patients develop DR, about one-quarter develop nephropathy, and nearly half develop neuropathy over time [1]. Elderly patients are particularly vulnerable to such complications due to longer disease duration and coexisting comorbidities, making early detection and prevention a clinical priority [4, 5].

One key approach to early detection of microvascular damage is monitoring urinary protein excretion. The urine albumin-to-creatinine ratio (ACR) is a simple and sensitive test for detecting microalbuminuria and early diabetic kidney disease, and guidelines recommend annual ACR screening in T2DM patients [6]. Recent studies have demonstrated that higher ACR correlates with increased risk of diabetic retinopathy and peripheral neuropathy [7, 8]. Similarly, the urine protein-to-creatinine ratio (PCR), which measures total proteinuria, is widely used to quantify renal involvement in diabetes; emerging evidence suggests that higher PCR values are linked to greater severity of diabetic retinopathy [9]. These findings underscore that albuminuria and proteinuria may serve as accessible markers reflecting systemic microvascular injury in diabetes.

Tight glycemic control remains fundamental in limiting microvascular complications. Landmark evidence indicates that each 1% reduction in hemoglobin A1c (HbA1c) can reduce the risk of microvascular complications by approximately 37% [10, 11]. Self-monitoring of blood glucose (SMBG) is an important tool for achieving and maintaining glycemic targets; frequent SMBG enables patients to adjust therapy and has been strongly associated with improved glycemic control [12]. Improved glycemic management in turn is known to slow the progression of complications such as DR, nephropathy, and neuropathy. However, in older adults, maintaining optimal glycemic control can be challenging, underscoring the need for reliable predictors and close monitoring of complications in this high-risk group.

Given the potential of these indicators, we hypothesize that elevated urinary ACR and PCR, as well as patterns of SMBG (reflecting glycemic control), are associated with the presence of microvascular complications in elderly T2DM patients. The aim of this study was to evaluate and compare the diagnostic performance of ACR, PCR, and SMBG in predicting diabetic retinopathy, nephropathy, and neuropathy in an elderly patient population.

Material and Methods

Ethics

This retrospective study was carried out at the Endocrinology and Metabolic Diseases Polyclinic in Karabük University between October 2021 to August 2023, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the Non-Interventional Clinical Research Ethics Committee at Karabük University (Date: 10.09.2024, Decision No: 1876). Given the retrospective nature of the study, the Local Ethics Committee waived the requirement for informed consent.

Study Population

A total of 121 patients aged 65 or older and diagnosed with type 2 diabetes mellitus were retrospectively reviewed for eligibility during their outpatient clinic visits throughout the study period. The diagnosis and treatment of DM were carried out following American Diabetes Association (ADA) guidelines [13]. Exclusion criteria included severe cognitive or psychiatric conditions, absence of consistent clinical documentation, and end-stage renal failure unrelated to diabetes. After applying the exclusion criteria, 99 patients were included in the final analysis (Figure 1).

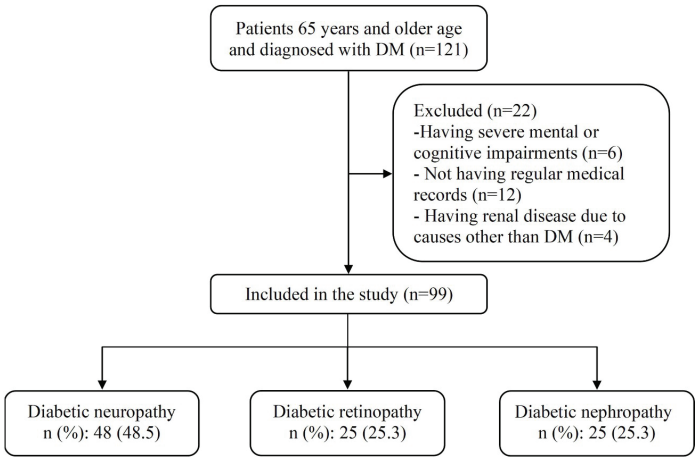

Figure 1. Flow diagram of the study

Data Collection

Demographic, clinical, anthropometric, and laboratory data were retrospectively obtained from electronic medical records. Body mass index (BMI) was calculated using recorded weight and height measurements. Waist and hip circumferences, as well as waist-to-hip ratio (WHR), were documented when available. Metabolic risk classifications based on waist circumference and WHR were defined according to the World Health Organization criteria [14]. For men, waist circumference greater than 94 cm waist circumference greater than 102 cm, and a waist-to-hip ratio equal to or greater than 0.90 had a substantial risk of metabolic complications. For women, a waist circumference greater than 80 cm showed an increased risk, while a waist circumference greater than 88 cm and waist-to-hip ratio equal to or greater than 0.85 had a significantly increased risk of metabolic complications.

Self-monitoring blood glucose (SMBG) values recorded by patients over the previous three months were retrospectively reviewed. The highest and lowest reported SMBG values were noted, and the difference between them (SMBGdiff), as well as the ratio of this difference to the highest value (SMBGratio), were calculated.

Biochemical parameters were obtained from patient records based on venous blood samples collected at the time of admission and were obtained from electronic medical records. Fasting glucose and triglyceride values were derived from serum samples, while urinary parameters were based on spot urine tests. Fasting samples were generally collected in the morning after at least 8 hours of fasting, as documented. The triglyceride glucose index (TyG) was calculated as: TyG = Ln (Fasting triglycerides [mg/dL] x Fasting blood glucose [mg/dL]/2). The urinary microalbumin-to-creatinine ratio (uMCR) and protein-to-creatinine ratio (uPCR) were calculated from recorded morning spot urine samples. Microalbuminuria was defined as having at least 2 out of 3 elevated uMCR values over a 3–6-month period, and the average of abnormal values was used for analysis. The averages of the abnormal values were calculated as: uMCR = Urinary microalbumin / Creatinine; uPCR = Urinary protein / Creatinine.

The presence of microvascular complications—diabetic neuropathy, retinopathy, and nephropathy—was determined based on clinical diagnoses documented in patient records. Each condition was defined according to established diagnostic guidelines [6].

Statistical analysis

Statistical analyses were performed using SPSS version 23 (IBM Corp. in Armonk, NY) and Medcalc version 16 (MedCalc Software Ltd, Ostend, Belgium). Numerical variables were assessed for normality using the Kolmogorov–Smirnov test. Those with normal distribution are presented as mean ± standard deviation, and those with non-normal distribution as median

[interquartile range (IQR): 25th–75th percentile]. Student's t-test was used for normally distributed data, while the Mann–Whitney U test was used for non-normally distributed data. Categorical data are expressed as numbers and percentages, with group comparisons conducted via Chi-square or Fisher's exact test. ROC curve analysis was used to assess diagnostic performance, with threshold values determined via the Youden index method. AUC curves were compared using a nonparametric approach, employing the generalized U-statistics method to estimate the covariance matrix, as previously described by DeLong et al. [15]. Significance was accepted at $P < 0.05$ (*) for all statistical analyses.

Results

Patients had a mean age of 71.2 ± 4.9 years, with the vast majority being male. The majority of the patients were males (n= 70, 70.7%) and were overweight (32.29±6.87). All patients were in the WC high-risk group, whereas only 33.3% presented a high risk for WHR. The treatment regimens were diverse; 56.6% were using a combination of an oral antidiabetic drug (OAD) and insulin, 23.3% only OAD, 13.1% only insulin, 4% were under combined treatment of GLP-1 agonist, OAD and insulin, 2% were using GLP-1 agonist and OAD, 1% were using GLP-1 agonist and insulin. The median peak self-monitored blood glucose (SMBG) level was 280 mg/dL (IQR: 200.0–398.0), while the median nadir glucose level was 110 mg/dL (IQR: 82.0–150.0). Hypertension was present in 73.7% of patients, and 55.6% had hyperlipidemia. The demographic characteristics of the patients are presented in detail in Table 1.

The laboratory characteristics of the patients are presented in Table 2. The median fasting and postprandial plasma glucose levels, as well as HbA1c values, were above reference ranges, indicating suboptimal glycemic control among the patients. The LDL cholesterol and triglyceride levels were also elevated in many cases. The mean TyG index was 5.1 (IQR: 4.82–5.22). Urinary markers showed a median MCR of 5.2 mg/g (IQR: 1.8–13.6) and PCR of 15.0 mg/g (IQR: 8.4–44.6). Additionally, vitamin D levels were low.

The diagnostic performance of the parameters is presented in Table 3 and Table 4. Among all parameters, only SMBGdiff was statistically significant in relation to neuropathy prediction; nevertheless, its diagnostic value was poor (AUC = 0.617, p = 0.040). SMBG difference and SMBG ratio were both statistically significant predictors of retinopathy (AUC = 0.625, p = 0.049; AUC = 0.656, p = 0.019), yet there was no meaningful difference in their diagnostic performance. In the prediction of retinopathy, both uMCR and uPCR ratios demonstrated statistical significance (AUC = 0.881, $p < 0.001$; AUC = 0.872, $p < 0.001$); nonetheless, their diagnostic accuracy was comparable (Table 3 and Figure 2). As presented in Table 4, an SMBG difference of >110.0 mg/dL was associated with a sensitivity of 79.2% and specificity of 51.0% for detecting diabetic neuropathy. For diabetic retinopathy, the optimal cut-off for SMBG difference was >123.0 mg/dL, yielding 84.0% sensitivity and 48.7% specificity. An SMBG ratio >0.61 showed lower diagnostic performance for retinopathy, with 60.0% sensitivity and 68.9% specificity. Regarding diabetic nephropathy, an uMCR cut-off of >10.3 mg/g demonstrated 76.0% sensitivity and 91.9% specificity. For uPCR, the cut-off value of >26.0 mg/g showed a sensitivity of 64.0% and specificity of 82.4% (Table 4).

Table 1. Demographics and clinical features of the patients.

Variables	All population n = 99
Age, years	71.2 ± 4.9
Gender, n (%)	
Female	29 (29,3)
Male	70 (70,7)
BMI, kg/m2	32.0 ± 6.3
WC, cm	
Female	121.2 ± 6.5
Male	110.4 ± 5.2
WC risk group, n (%)	
Normal	0
High	99 (100.0)
WHR	
Female	0.81 ± 0.02
Male	1.00 ± 0.02
WHR risk group, n (%)	
Normal	66 (66.7)
High	33 (33.3)
Duration of disease, years	13.0 (10.0-20.0)
Treatment regimen, n (%)	
OAD	23 (23.3)
Insulin	13 (13.1)
OAD and insulin	56 (56.6)
GLP-1 agonist and OAD	2 (2.0)
GLP-1 agonist and insulin	1 (1.0)
GLP-1 agonist, OAD and insulin	4 (4.0)
SMBG levelsa, mg/dL	
Lowest	110.0 (82.0-150.0)
Highest	280.0 (200.0-398.0)
Hypertension, n (%)	73 (73.7)
Hyperlipidemia, n (%)	55 (55.6)
Complications, n (%)	
Neuropathy	48 (48.5)
Retinopathy	25 (25.3)
Nephropathy	25 (25.3)

The data are expressed as the mean ± SD, median (IQR), or frequency (%). a Over the last three months. BMI: Body mass index, DM: Diabetes Mellitus, GLP-1: Glucagon-Like Peptide-1, OAD: Oral antidiabetic drug, SMBG: Self-monitoring of blood glucose, WC: Waist circumference, WHR: Waist-to-hip ratio.

Table 2. Laboratory findings of the patients.

Variables	Reference	Mean±SD or Median	IQR
Fasting plasma glucose, mg/dL	74.0-106.0	150.0	118.0-199.0
Postprandial plasma glucose, mg/dL	-	234.0	167.0-307.0
HbA1c, %	4.0-6.0	8.2 ± 1.8	7.0-9.1
Serum creatinine, mg/dL	0.50-1.30	0.95	0.74-1.20
GFR, mL/min/1.73 m^2		67.8 ± 23.3	52.0-88.0
AST, U/L	5.0-34.0	17.0	15.0-22.0
ALT, U/L	10.0-49.0	16.0	13.0-23.0
LDL cholesterol, mg/dL	60.0-140.0	93.8	74.0-125.0
HDL cholesterol, mg/dL	33.0-90.0	52.2 ± 14.4	42.0-58.8
Triglyceride, mg/dL	0.0-250.0	157.0	114.0-217.0
TyG index	-	5.1 ± 0.4	4.82-5.28
MCR, mg/g	-	5.52	2.90-12.39
PCR, mg/g	-	15.40	8.44-44.50
Uric acid, mg/dL	3.1-9.2	5.8 ± 1.8	4.5-6.6
TSH, uIU/mL	0.35-5.50	1.89	1.09-3.07
Vitamin B12, pg/mL	211.0-911.0	389.0	293.0-493.0
Vitamin D, ng/mL	30.0-100.0	16.6	10.8-23.1

The data are expressed as the mean ± SD, median (IQR).ALT: Alanine transaminase, AST: Aspartate transaminase, FIB-4 score: Fibrosis-4 score, GFR: Glomerular filtration rate, HbA1c: Hemoglobin A1c, HDL: High-density lipoprotein, IQR: Interquartile range, LDL: Low-density lipoprotein, MCR: Microalbumin-to-creatinine ratio, PCR: Protein-to-creatinine ratio, TSH: Thyroid-stimulating hormone, TyG index: Triglyceride-glucose index.

Table 3. ROC analysis results of HbA1c, TyG index, uMCR, uPCR, SMBG difference and SMBG ratio in estimating neuropathy, retinopathy and nephropathy.

	Neuropathy		Retinopathy		Nephropathy	
	AUC (95% CI)	p	AUC (95% CI)	p	AUC (95% CI)	p
HbA1c (%)	0.523 (0.421-0.625)	0.692	0.549 (0.446-0.649)	0.468	0.512 (0.409-0.614)	0.874
TyG index	0.597 (0.493-0.694)	0.091	0.536 (0.433-0.637)	0.601	0.540 (0.437-0.641)	0.570
uMCR	0.549 (0.445-0.649)	0.414	0.539 (0.436-0.640)	0.600	0.881 (0.801-0.938)	<0.001
uPCR	0.573 (0.469-0.672)	0.218	0.515 (0.413-0.617)	0.818	0.872 (0.790-0.931)	<0.001
SMBG difference	0.617 (0.514-0.713)	0.040	0.625 (0.522-0.721)	0.049	0.541 (0.438-0.642)	0.554
SMBG ratio	0.601 (0.497-0.698)	0.079	0.656 (0.554-0.749)	0.019	0.536 (0.433-0.637)	0.591

AUC: Area under the curve, CAD: Coronary artery disease, CI: Confidence interval, HbA1c: Hemoglobin A1c, SMBG: Self-monitoring of blood glucose, TyG index: Triglyceride-glucose index, uMCR: Urinary microalbumin-to-creatinine ratio, uPCR: Urinary protein-to-creatinine ratio.

Table 4. Associated cut-off values, sensitivity and specificity of uMCR, uPCR, SMBG difference and SMBG ratio in estimating diabetic neuropathy, retinopathy and nephropathy.

Variables	Cut-off	Sensitivity (95% CI)	Specificity (95% CI)
Neuropathy			
SMBG difference, mg/dL	>110.0	79.2 (65.0-89.5)	51.0 (36.6-65.2)
Retinopathy			
SMBG difference, mg/dL	>123.0	84.0 (63.9-95.5)	48.7 (36.9-60.6)
SMBG ratio	>0.61	60.0 (38.7-78.9)	68.9 (57.1-79.2)
Nephropathy			
uMCR, mg/g	>10.3	76.0 (54.9-90.6)	91.9 (83.2-97.0)
uPCR, mg/g	>26.0	84.0 (63.9-95.5)	82.4 (71.8-90.3)

CI: Confidence interval, SMBG: Self-monitoring of blood glucose, uMCR: Urinary microalbumin-to-creatinine ratio, uPCR: Urinary protein-to-creatinine ratio.

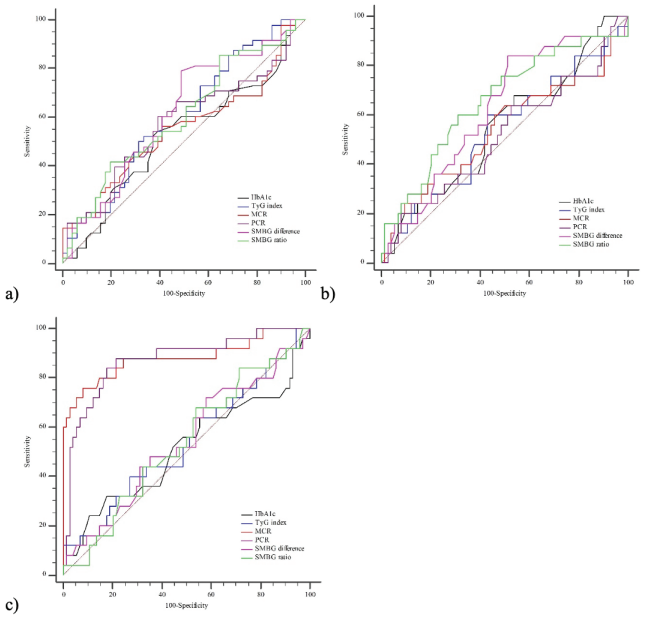

Figure 2. ROC curves of HbA1c, TyG index, uMCR, uPCR, SMBG difference and SMBG ratio in estimating (a) neuropathy, (b) retinopathy, and (c) nephropathy

Discussion

Our findings revealed a prevalence of 25% for retinopathy, 25% for nephropathy, and 48% for neuropathy among elderly diabetic patients—figures that closely mirror those reported in large-scale epidemiological studies. According to NHANES data, diabetic retinopathy affects 29–30% of individuals aged 65 and older [16], neuropathy is seen in 40–50% [17], and nephropathy prevalence ranges between 10–60% [16]. These high complication rates underscore the importance of identifying reliable predictive parameters for the early detection of microvascular complications in elderly patients with T2DM.

HbA1c is the established gold standard for evaluating long-term glycemic control and is commonly used in both diagnosis and complication risk assessment. While studies have demonstrated its predictive value for retinopathy and nephropathy in younger T1DM populations [18], and renal protection in older T2DM with lower HbA1c levels [19], our findings align with a Turkish cohort [20], showing no significant correlation between HbA1c and any microvascular complication.

The TyG index has emerged as a reliable surrogate marker for insulin resistance, a key pathophysiological component in the development of T2DM and its associated complications. Increasing evidence suggests that a higher TyG index is significantly associated with a greater risk of diabetic neuropathy [21], nephropathy [22, 23], and retinopathy [23], positioning it as a potential early indicator of microvascular dysfunction. Despite its growing recognition in the literature, our study did not find a statistically significant association between the TyG index and the presence of microvascular complications in elderly patients with T2DM. One possible explanation for this discrepancy is the older age profile of our cohort compared to previous studies, which often involved younger or mixed-age populations. Aging is associated with increased comorbidity burden, altered metabolic responses, and a higher likelihood of preexisting overlapping complications, all of which may confound the independent predictive value of the TyG index.

Studies have shown age-related differences in microvascular complications in T2DM patients [24]. Urinary biomarkers, uMCR, and uPCR are non-invasive markers that reflect renal function and early kidney damage. Our results confirm that uMCR is a highly sensitive indicator for diabetic nephropathy in elderly patients, detecting renal microvascular damage often before overt clinical symptoms. This is in agreement with current guidelines, which prefer uMCR for early diabetic kidney disease screening due to its superior sensitivity at low levels of proteinuria [25]. Also, Our findings align with the current literature, studies from Italy [25] and Brazil [26] comprised of T2DM patients with kidney disease showed elevated albuminuria in those older than 75 years. In fact, the cumulative incidence of ESRD climbs steeply as one moves from mild to heavy albuminuria [27]. The uPCR, which captures total protein excretion, similarly tracked nephropathy severity in our study. Elevated uPCR levels were associated with nephropathy, which is consistent with literature noting that uPCR rises in parallel with declining glomerular filtration and can serve as a convenient marker of kidney damage [25].

Self-monitoring of blood glucose metrics, reflecting glycemic control, also showed expected trends: our patients with DR had higher blood glucose profiles, mirroring the well-established relationship between chronic hyperglycemia and retinopathy [28]. Our findings concur with a longitudinal study in older adults where regular SMBG use was linked to ~50% reduced incidence of DR [29], suggesting that intensive self-monitoring (and presumably better glucose management) can translate into lower retinopathy risk. Also, Tight glycemic control remains the only proven strategy to prevent or delay

diabetic neuropathy [30]. Recent studies have expanded this understanding by implicating glycemic variability as well—high glucose oscillations correlate with painful neuropathy and reduced nerve function [31]. Our data did hint at this, as individuals with stable SMBG trends tended to report less neuropathic pain, aligning with emerging literature on variability's role. However, the diagnostic performance of the SMBGratio, as indicated by its moderate to low area under the ROC curve, implies that while it provides valuable information, its ability to serve as an independent predictor is limited. The poor reliability and discriminatory power in the clinical setting were in line with the current literature [32].

Limitations

The study has several limitations. The cross-sectional design of the study limits our ability to determine causality or temporal relationships between diagnostic factors and the development of complications. Our sample size was small, which may limit the statistical power to detect associations between complications and biomarkers, especially for those with modest effects. The presence of multiple coexisting complications and comorbidities in the elderly may have confounded the observed relationships, masking potential associations between traditional biomarkers (e.g., HbA1c, TyG index) and microvascular damage. The reliance on single measurements for some biomarkers may not fully capture the dynamic nature of glycemic control and its impact on the development of complications. Future longitudinal studies with larger cohorts are needed to further elucidate these relationships and refine screening strategies, ultimately improving clinical outcomes in this vulnerable population.

Conclusion

Our results suggest that in elderly patients with type 2 diabetes, urinary biomarkers such as uMCR and uPCR provide strong diagnostic accuracy for nephropathy compared to traditional glycemic markers and insulin resistance indices. While SMBGratio shows promise in detecting retinopathy, its stand-alone predictive performance is limited. These findings highlight the need for a tailored, multi-marker approach to assessing microvascular complications in the elderly, taking into account the unique pathophysiological changes associated with aging.

Ethics Committee Approval

The study was conducted with the permission of the Karabük University's Non-Interventional Clinical Research Ethics Committee (Date: 10.09.2024, Decision No: 1876).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Letter to the Editor

The Potential Role of GPT-4o in Interpreting Chest Computed Tomography for Thoracic Emergencies

Torasik Acillerde Toraks Bilgisayarlı Tomografi Yorumlamada GPT-4o'nun Potansiyel Rolü

Muhammed Said Beşler*

Department of Radiology, Kahramanmaraş Necip Fazıl City Hospital, Kahramanmaraş, Türkiye

Abstract

This study evaluated GPT-4o's performance in interpreting chest CT images for thoracic emergencies. In July 2024, open-access medical images were analyzed by GPT-4o via chatgpt.com with a query to identify and describe abnormalities, specifying the type and plane of imaging. GPT-4o consistently identified the imaging type and plane correctly. For instance, it accurately detected a right-sided pneumothorax with mediastinal shift, and a significant right pleural effusion with a smaller left effusion, although it misidentified minimal bilateral pneumothorax. It correctly identified pericardial effusion in the coronal plane in a cardiac tamponade case but failed to identify a saddle pulmonary embolism. While GPT-4o shows potential for diagnosing chest CT images in thoracic emergencies, it may still miss major abnormalities. Future large-scale studies should evaluate both common and rare pathologies using large language models.

Keywords: artificial intelligence; thorax; multidetector computed tomography

Öz

Bu çalışmada, torasik aciller için toraks BT görüntülerini yorumlamada GPT-4o'nun performansı değerlendirildi. Temmuz 2024'te, açık erişimli tıbbi görüntüler, chatgpt.com üzerinden GPT-4o'ya analiz ettirildi ve görüntü türü ve düzlemini belirterek anormallikleri tanımlaması istendi. GPT-4o, görüntü türünü ve düzlemini tutarlı bir şekilde doğru belirledi. Örneğin, sağ tarafta pnömotoraks ve mediastinal kaymayı doğru bir şekilde tespit etti ve sağda belirgin, solda daha az belirgin plevral efüzyonu doğru bir şekilde tanımladı, ancak minimal bilateral pnömotoraksı yanlış tespit etti. Kardiyak tamponad vakasında, koronal düzlemde perikardiyal efüzyonu doğru belirledi, ancak aksiyal düzlemde plevral effüzyon olarak yorumladı. Akut pulmoner emboli vakasında, sağ ventrikül ve pulmoner arterleri içeren aksiyal kesitlerde saddle pulmoner emboliyi tespit edemedi. GPT-4o, göğüs BT görüntülerinde önemli tanılar koyma potansiyeline sahip olsa da, hala büyük anormallikleri kaçırabilir. Gelecekteki büyük ölçekli çalışmalar, yaygın ve nadir patolojileri büyük dil modelleri kullanarak değerlendirmelidir.

Anahtar kelimeler: yapay zeka; toraks; çok kesitli bilgisayarlı tomografi

Corresponding Author*: Muhammed Said Beşler, Department of Radiology, Kahramanmaraş Necip Fazıl City Hospital, Kahramanmaraş, Türkiye
E-mail: msbesler@gmail.com
Orcid: 0000-0001-8316-7129
Doi: 10.18663/tjcl.1530324
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Dear Editor,

There is an increasing body of research exploring the application of large language models in medical imaging across various modalities [1, 2]. In this context, I would like to share the performance of generative pre-trained transformer (GPT)-4o, the latest version of ChatGPT, in interpreting chest computed tomography (CT) images for common thoracic emergencies.

For common thoracic emergencies, open-access medical images were captured. In July 2024, GPT-4o was prompted via chatgpt.com with the query: "Please evaluate the medical imaging of a patient presenting to the emergency department and describe any abnormalities. Specify the type and plane of the imaging as well." JPEG images were then uploaded. GPT-4o consistently identified the imaging type and plane correctly. The following are some examples:

- Axial CT with pneumothorax: GPT-4o correctly identified a right-sided pneumothorax and mediastinal shift to the left in the parenchymal window (https://radiopaedia.org/articles/pneumothorax).
- Axial CT with pleural effusion: GPT-4o accurately described a significant right pleural effusion and a smaller left pleural effusion. Notably, it also detailed the quantity of the effusion. However, it incorrectly identified bilateral minimal pneumothorax, possibly due to the use of the mediastinal window (https://radiopaedia.org/articles/haemothorax).
- Cardiac Tamponade: In a case of cardiac tamponade, GPT-4o interpreted the pericardial effusion as a pleural effusion in the axial plane and mediastinal window; however, correctly identified it in the coronal plane (https://radiopaedia.org/articles/cardiac-tamponade).
- Acute Pulmonary Embolism: For an acute pulmonary embolism case, axial slices involving the right ventricle and pulmonary arteries were uploaded. GPT-4o failed to identify a saddle pulmonary embolism (https://radiopaedia.org/articles/saddle-pulmonary-embolism).

GPT-4o has demonstrated the potential to make significant diagnoses in chest CT imaging for thoracic emergencies. However, it may still miss major abnormalities. Future large-scale studies could evaluate common and rare pathologies in chest CT using large language models.

Declarations

There was no financial support for the study, and the author has no conflicts of interest to declare.

Ethics Approval

Since publicly available and anonymized data were used in this study, ethical approval is not required.

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Letter to the Editor

Risk factors for invasive mechanical ventilation after thoracentesis

Torasentez sonrası invaziv mekanik ventilasyon için risk faktörleri

Korhan Kollu*

Department of Internal Medicine, Division of Intensive Care, University of Health Sciences, Konya City Hospital, Konya, Turkey

I read with interest the article by Dogancı et al. [1]. The article titled "Assessment of risk factors for the need of invasive mechanical ventilation in patients undergoing thoracentesis in tertiary care intensive care units" was published in the 2/2024 issue of the Turkish Journal of Clinics and Laboratory. Congratulations to the authors for this article.

Pleural effusions are common in intensive care units, with reported rates reaching 50–60% in various studies. Pleural fluid accumulation has been described as a "hidden" morbidity factor that can hinder weaning from mechanical ventilation [2]. A large database analysis found that pleural effusion in ICU patients is associated with increased mortality and prolonged ICU stay, independent of disease severity. The same study also reported a significantly higher need for mechanical ventilation in patients with pleural effusion (e.g., 63.1% vs. 55.7%) [3]. Therefore, predicting which patients will require invasive mechanical ventilation (IMV) despite thoracentesis is clinically crucial.

Doğancı et al. identified several factors associated with an increased need for IMV in these patients. In multivariate logistic regression, the use of vasopressor medication and prolonged ICU duration emerged as independent predictors of IMV requirement [1]. Patients requiring vasopressors or extended ICU care were more prone to deterioration, possibly due to hemodynamic shifts or re-expansion pulmonary edema after drainage. This aligns with findings that ICU patients with pleural effusions requiring vasopressors have worse outcomes, including higher mortality [4, 5]. Reducing ICU length of stay may mitigate IMV risk by preventing hospital-acquired infections. These insights highlight the need for close monitoring and early intervention after thoracentesis, particularly in hemodynamically unstable or long-term ICU patients.

The authors' study found that while the overall prevalence of comorbidities was similar between between patients requiring and not requiring IMV. However, the frequencies of specific comorbid conditions varied. Interestingly, certain comorbid conditions (like pulmonary thromboembolism and hypertension) were more common in patients who did not require IMV. These confounding factors could impact potential or independent risk factors for IMV requirement. Incorporating a standardized comorbidity assessment such as the Charlson Comorbidity Index (CCI) could enhance understanding of the patients' chronic health burdens and their impact on IMV risk. It has proven utility in critical care settings – for example, higher Charlson comorbidity scores have been shown to predict

Corresponding Author*: Korhan KOLLU, Department of Internal Medicine, Division of Intensive Care, University of Health Sciences, Konya City Hospital, Konya, Turkey

E-mail: korhankollu@gmail.com

Orcid: 0000-0002-0973-724X

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worse outcomes (including hospital mortality) in critically ill and mechanically ventilated patient populations [6].

In conclusion, a more detailed understanding of the risk profile in ICU patients undergoing thoracentesis will support clinicians in optimizing patient management. The observed increase in IMV and mortality risk in patients with pleural fluid drainage may stem from more severe underlying disease. Therefore, comprehensive risk assessment strategies incorporating comorbidities and overall disease severity are necessary for more accurate risk evaluation.

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Etik kurallar: Klinik araştırmaların protokolü etik komitesi tarafından onaylanmış olmalıdır. İnsanlar üzerinde yapılan tüm çalışmalarda, "Yöntem ve Gereçler" bölümünde çalışmanın ilgili komite tarafından onaylandığı veya çalışmanın Helsinki İlkeler Deklerasyonuna (www.wma.net/e/policy/b3.htm) uyularak gerçekleştirildiğine dair bir cümle yer almalıdır. Çalışmaya dahil edilen tüm insanların bilgilendirilmiş onam formunu imzaladığı metin içinde belirtilmelidir. Turkish Journal of Clinics and Laboratory gönderilen yazıların Helsinki Deklarasyonuna uygun olarak yapıldığını, kurumsal etik ve yasal izinlerin alındığını varsayacak ve bu konuda sorumluluk kabul etmeyecektir.

Çalışmada "Hayvan" öğesi kullanılmış ise yazarlar, makalenin Gereç ve Yöntemler bölümünde Guide for the Care and Use of Laboratory Animals (www.nap.edu/catalog/5140.html) prensipleri doğrultusunda çalışmalarında hayvan haklarını koruduklarını ve kurumlarının etik kurullarından onay aldıklarını belirtmek zorundadır.

Teşekkür yazısı: Varsa kaynaklardan sonra yazılmalıdır.

Maddi destek ve çıkar ilişkisi: Makale sonunda varsa çalışmayı maddi olarak destekleyen kişi ve kuruluşlar ve varsa bu kuruluşların yazarlarla olan çıkar ilişkileri belirtilmelidir. (Olmaması durumu da "Çalışmayı maddi olarak destekleyen kişi/kuruluş yoktur ve yazarların herhangi bir çıkar dayalı ilişkisi yoktur" şeklinde yazılmalıdır.

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Şekil ve tablo başlıkları: Başlıklar kaynaklardan sonra yazılmalıdır.

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Kaynak Yazım Örnekleri

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Tek yazar ve editörü olan kitaptan alıntı;

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Kılıç C. General Health Survey: A Study of Reliability and Validity. phD Thesis, Hacettepe University Faculty of Medicine, Department of Psychiatrics, Ankara; 1992.

Bir internet sitesinden alıntı;

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Joos S, Musselmann B, Szecsenyi J. Integration of Complementary and Alternative Medicine into Family Practice in Germany: Result of National Survey. Evid Based Complement Alternat Med 2011 (doi: 10.1093/ecam/nep019).

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Turkish Journal of Clinics and Laboratory - Türk Klinik ve Laboratuvar Dergisi

Tıp dergilerine gönderilecek makalelerin standart gereksinmeleri ile ilgili tüm bilgileri www.icmje.org internet adresinde bulabilirsiniz

Amaç ve kapsam: "Turkish Journal of Clinics and Laboratory", hakemli, açık erişimli ve periyodik olarak çıkan, DNT Ortadoğu Yayıncılık A.Ş. ye ait bir dergidir. Hedefimiz uluslararası bir tabanda hastalıkların teşhis ve tedavisinde yenilikler içeren yüksek kalitede bilimsel makaleler yayınlamaktır. Yılda dört kez çıkan bir bilimsel bir tıp dergisidir. Hakemli bir dergi olarak gelen yazılar konsültanlar tarafından, öncelikle, biyomedikal makalelere ait Uluslararası Tıp Dergileri Editörleri Komitesi (www.icmje.org adresinden ulaşılabilir) tarafından tanımlanan standart gereksinimler ile ilgili ortak kurallara uygunluğu açısından değerlendirilir. Tıbbın her dalı ile ilgili retrospektif/prospektif klinik ve laboratuar çalışmalar, ilginç olgu sunumları, davet üzerine yazılan derlemeler, editöre mektuplar, orijinal görüntüler, kısa raporlar ve cerrahi teknik yazılarıları yayımlayan bilimsel, uluslar arası hakemli bir dergidir. Başka bir dergide yayımlanmış veya değerlendirilmek üzere gönderilmiş yazılar veya dergi kurallarına göre hazırlanmamış yazılar değerlendirme için kabul edilmez.

On-line makale gönderimi: Tüm yazışmalar ve yazı gönderimleri dergipark üzerinden http://dergipark.gov.tr/tjcl yapılmalıdır. Yazı gönderimi için detaylı bilgi bu internet adresinden edinilebilir. Gönderilen her yazı için özel bir numara verilecek ve yazının alındığı e-posta yolu ile teyid edilecektir. Makalelerin "full-text" pdf formuna http://dergipark.gov.tr/tjcl linkinden ulaşılabilir.

Açık erişim politikası: Turkish Journal of Clinics and Laboratory açık erişimi olan bir dergidir. Kullanıcı lar yazıların tam metnine ulaşabilir, kaynak gösterilerek tüm makaleler bilimsel çalışmalarda kullanılabilir.

Aşağıdaki rehber dergiye gönderilen makalelerde aranan standartları göstermektedir. Bu uluslararası format, makale değerlendirme ve basım aşamalarının hızla yapılmasını sağlayacaktır.

Yazarlara Bilgi: Yazıların tüm bilimsel sorumluluğunu yazar(lar)a aittir. Editör, yardımcı editör ve yayıncı dergide yayınlanan yazılar için herhangi bir sorumluluk kabul etmez.

Dergi adının kısaltması: Turk J Clin Lab

Yazışma adresi: Yazılar e-mail yoluyla sorumlu yazar tarafından, Dergipark ta yer alan Turkish Journal of Clinics and Laboratory linkine girip kayıt olduktan sonra gönderilmelidir.

Makale dili: Makale dili Türkçe ve İngilizcedir. İngilizce makaleler gönderilmeden önce profesyonel bir dil uzmanı tarafından kontrol edilmelidir. Yazıdaki yazım ve gramer hataları içerik değişmeyecek şekilde İngilizce dil danışmanı tarafından düzeltilebilir. Türkçe yazılan yazılarda düzgün bir Türkçe kullanımı önemlidir. Bu amaçla, Türk Dil Kurumu Sözlük ve Yazım Kılavuzu yazım dilinde esas alınmalıdır.

Makalenin başka bir yerde yayımlanmamıştır ibaresi: Her yazar makalenin bir bölümünün veya tamamının başka bir yerde yayımlanmadığını ve aynı anda bir diğer dergide değerlendirilme sürecinde olmadığını, editöre sunum sayfasında belirtmelidirler. 400 kelimeden az özetler kapsam dışıdır. Kongrelerde sunulan sözlü veya poster bildirilerin, başlık sayfasında kongre adı, yer ve tarih verilerek belirtilmesi gereklidir. Dergide yayımlanan yazıların her türlü sorumluluğu (etik, bilimsel, yasal, vb.) yazarlara aittir.

Değerlendirme: Dergiye gönderilen yazılar format ve plagiarism açısından değerlendirilir. Formata uygun olmayan yazılar değerlendirilmeden sorumlu yazara geri gönderilir. Bu tarz bir zaman kaybının olmaması için yazım kuralları gözden geçirilmelidir. Basım için gönderilen tüm yazılar iki veya daha fazla yerli/yabancı hakem tarafından değerlendirilir. Makalelerin değerlendirilmesi, bilimsel önemi, orijinalliği göz önüne alınarak yapılır. Yayıma kabul edilen yazılar editörler kurulu tarafından içerik değiştirilmeden yazarlara haber verilerek yeniden düzenlenebilir. Makalenin dergiye gönderilmesi veya basıma kabul edilmesi sonrası isim sırası değiştirilemez, yazar ismi eklenip çıkartılamaz.

Basıma kabul edilmesi: Editör ve hakemlerin uygunluk vermesi sonrası makalenin gönderim tarihi esas alınarak basım sırasına alınır. Her yazı için bir doi numarası alınır.

Yayın hakları devri: http:/www.dergipark.ulakbim.gov.tr/tjclinlab adresi üzerinden online olarak gönderilmelidir. 1976 Copyright Act'e göre, yayımlanmak üzere kabul edilen yazıların her türlü yayın hakkı yayıncıya aittir.

Makale genel yazım kuralları: Yazılar Microsoft Word programı (7.0 ve üst versiyon) ile çift satır aralıklı ve 12 punto olarak, her sayfanın iki yanında ve alt ve üst kısmında 2,5 cm boşluk bırakılarak yazılmalıdır. Yazı stili Times New roman olmalıdır. "System International" (SI) unitler kullanılmalıdır. Şekil tablo ve grafikler metin içinde refere edilmelidir. Kısaltmalar, kelimenin ilk geçtiği yerde parantez içinde verilmelidir. Türkçe makalelerde %50 bitişik yazılmalı, aynı şekilde İngilizcelerde de 50% bitişik olmalıdır. Türkçede ondalık sayılarda virgül kullanılmalı (55,78) İngilizce yazılarda nokta (55.78) kullanılmalıdır. Derleme 4000, orijinal çalışma 2500, olgu sunumu 1200, editöre mektup 500 kelimeyi geçmemelidir. Özet sayfasından sonraki sayfalar numaralandırılmalıdır.

Yazının bölümleri

1. Sunum sayfası: Yazının Turkish Journal of Clinics and Laboratory 'de yayınlanmak üzere değerlendirilmesi isteğinin belirtildiği, makalenin sorumlu yazarı tarafından dergi editörüne hitaben gönderdiği yazıdır. Bu kısımda makalenin bir bölümünün veya tamamının başka bir yerde yayımlanmadığını ve aynı anda bir diğer dergide değerlendirilme sürecinde olmadığını, maddi destek ve çıkar ilişkisi durumu belirtmelidir.

2. Başlık sayfası: Sayfa başında gönderilen makalenin kategorisi belirtilmedir (Klinik analiz, orijinal çalışma, deneysel çalışma, olgu sunumu vs).

Başlık: Kısa ve net bir başlık olmalıdır. Kısaltma içermemelidir. Türkçe ve İngilizce yazılmalı ve kısa başlık (runing title) Türkçe ve İngilizce olarak eklenmelidir. Tüm yazarların ad ve soyadları yazıldıktan sonra üst simge ile 1'den itibaren numaralandırılıp, unvanları, çalıştıkları kurum, klinik ve şehir yazar isimleri altına eklenmelidir.

Bu sayfada "sorumlu yazar" belirtilmeli isim, açık adres, telefon ve e-posta bilgileri eklenmelidir.

Kongrelerde sunulan sözlü veya poster bildirilerin, başlık sayfasında kongre adı, yer ve tarih verilerek belirtilmesi gereklidir.

3. Makale dosyası: (Yazar ve kurum isimleri bulunmamalıdır)

Başlık: Kısa ve net bir başlık olmalıdır. Kısaltma içermemelidir. Türkçe ve İngilizce yazılmalı ve kısa başlık (runing title) Türkçe ve İngilizce olarak eklenmelidir.

Özet: Türkçe ve İngilizce yazılmalıdır. Orijinal çalışmalarda özetler, Amaç (Aim), Gereç ve Yöntemler (Material and Methods), Bulgular (Results) ve Sonuçlar (Conclusion) bölümlerine ayrılmalı ve 250 sözcüğü geçmemelidir. Olgu sunumları ve benzerlerinde özetler, kısa ve tek paragraflık olmalıdır (150 kelime), Derlemelerde 300 kelimeyi geçmemelidir.

Anahtar kelimeler: Türkçe ve İngilizce özetlerin sonlarında bulunmalıdır. En az 3 en fazla 6 adet yazılmalıdır. Kelimeler birbirlerinden noktalı virgül ile ayrılmalıdır. İngilizce anahtar kelimeler "Medical Subject Headings (MESH)" e uygun olarak verilmelidir. (www.nlm.nih.gov/mesh/MBrowser.html). Türkçe anahtar kelimeler "Türkiye Bilim Terimleri' ne uygun olarak verilmelidir (www.bilimterimleri.com). Bulunamaması durumunda birebir Türkçe tercümesi verilmelidir.

Metin bölümleri: Orijinal makaleler; Giriş, Gereç ve Yöntemler, Bulgular, Tartışma olarak düzenlenmelidir. Olgu sunumları; Giriş, Olgu sunumu, Tartışma olarak düzenlenmelidir. Şekil, fotoğraf, tablo ve grafiklerin metin içinde geçtiği yerler ilgili cümlenin sonunda belirtilmeli metin içine yerleştirilmemelidir. Kullanılan kısaltmalar altındaki açıklamada belirtilmelidir. Daha önce basılmış şekil, resim, tablo ve grafik kullanılmış ise yazılı izin alınmalıdır ve bu izin açıklama olarak şekil, resim, tablo ve grafik açıklamasında belirtilmelidir. Tablolar metin sonuna eklenmelidir. Resimler/fotoğraf kalitesi en az 300dpi olmalıdır.