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İÇİNDEKİLER/CONTENTS

Araştırma Makalesi/Original Article

1. Does Waiting Time for Hospitalization in the Emergency Department Increase Mortality in Patients with Febrile Neutropenia? – Retrospective Observational Research 99-102
Febril Nötropeni Hastalarında Acil Serviste Yatış İçin Bekleme Süresi Mortaliteyi Arttırır mı? – Retrospektif Gözlemsel Araştırma
Yunus Emre Özlüer, Fatma Dilan Güvenç

2. Does Intubation Affect Survival Among Patients Experiencing In-Hospital Cardiopulmonary Arrest? 103-108
Entübasyon Hastane İçi Kardiyopulmoner Arrest Hastalarında Sağkalımı Etkiliyor mu?
Metin Yadigaroğlu, Burak Katipoğlu, Olgun Aşık, Mustafa Sabak

3. The Predictive Value of Ultrasound, Alvarado Score, and C-Reactive Protein in Pediatric Appendectomy Outcomes 109-115
Ultrason, Alvarado Skoru ve C-Reaktif Proteinin Pediatrik Appendectomilerdeki Prediktör Değeri
Ali Çelik, Mehmet Altuntaş

4. Evaluations of Risk Factors Related to Covid-19 Disease in Healthcare Professionals 116-123
Sağlık Çalışanlarında Covid-19 Hastalığına Bağlı Risk Faktörlerinin Değerlendirilmesi
Funda Çoktaş, Fatma Sarı Doğan, Tuba Cimilli Öztürk, Fatma Şimşek Ceviz

5. Retrospective Analysis of Patients with Emergency Hemodialysis Indication in the Emergency Department 124-127
Acil Serviste Acil Hemodiyaliz Endikasyonu Konulan Hastaların Retrospektif Analizi
Çiğdem Özpolat, Erhan Altunbaş

6. Evaluation of Brain Oxygenation by Near Infrared Spectroscopy in Healthcare Professionals Using Surgical and FFP2/N95 Masks 128-132
Cerrahi ve FFP2/N95Maske Kullanan Acil Servis Çalışanlarında Near İnfrared Spectroscopy (NIRS) ile Beyin Oksijenizasyonunun Değerlendirilmesi
Öner Bozan, Şeref Emre Atiş, Bora Çekmen, Halit Karakısa, Edip Burak Karaaslan, Mehmet Esat Ferhatlar, Mehmet Muzaffer İslam, Asım Kalkan

7. Comparison of Inferior Vena Cava Collapsibility and Clinical Scales for the Assessment of Dehydration in Children With Diarrhea 133-138
İshalli Çocuklarda Dehidratasyonun Değerlendirilmesi için Inferior Vena Kava Kollapsibilite Indeksi ve Klinik Ölçeklerin Karşılaştırılması
Asım Enes Özbek, Onur Karakayalı

8. Evaluation of Pediatric Cases with Suspected Rabies Exposure in the Pediatric Emergency Department 139-144
Çocuk Acil Servise Kuduz Şüpheli Hayvan Teması İle Başvuran Pediatrik Olguların Değerlendirilmesi
Yalçın Kara, Mahmut Can Kızıl, Ömer Kılıç, Sabiha Şahin, Ener Çağrı Dinleyici

Olgu Sunumu/Case Report

An Unusual Presentation of Ruptured Abdominal Aortic Aneurysm: A Case Report 145-148
Rüptüre Abdominal Aort Anevrizmasının Olağandışı Bir Sunumu: Bir Olgu Sunumu
Fevzi Yılmaz, Fadime Kara, Esra Sönmez Üçkapı

Derleme/Review

Publication Ethics and Plagiarism 149-152
Yayın Etiği ve Plagiarizm
Özlem Güneysel

ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Does Waiting Time for Hospitalization in the Emergency Department Increase Mortality in Patients with Febrile Neutropenia? – Retrospective Observational Research

Febril Nötropeni Hastalarında Acil Serviste Yatış İçin Bekleme Süresi Mortaliteyi Arttırır mı? – Retrospektif Gözlemsel Araştırma

Yunus Emre Özlüer[1], Fatma Dilan Güvenç[1]

ABSTRACT

Aim: To determine whether there is any relationship between waiting time and in-hospital mortality and length of stay in febrile neutropenia patients waiting for hospitalization in the emergency department (ED).

Material and Methods: Demographic characteristics of patients diagnosed with febrile neutropenia, who presented to Aydın Adnan Menderes University Faculty of Medicine, Department of Emergency Medicine between 01.04.2015 and 01.08.2019, their leukocyte and neutrophil counts at the time of admission, whether antibiotics and colony stimulating factors (CSF) were administered in the ED, the waiting time for the patient for hospitalization, the department where the patients were hospitalized from the ED (wards/intensive care units), length of hospital stay and in-hospital mortality were recorded. The relationship of the obtained data between in regards to mortality and length of hospital stay was analyzed.

Results: The median age of 86 patients included in the study was 67 [IQR 17] and 52.3% (n=45) of the patients were male. The median waiting time for hospitalization in the ED was 6.7 [IQR 6.5] hours, the number of patients with solid organ malignancy was 44 (51.2%), and the number of patients admitted to the intensive care unit was 20 (23.3%). The number of patients treated with CSF was 36 (41.9%), and the number of patients who started antibiotic treatment in the ED was 65 (75.6%). The median leukocyte count at the time of admission to the ED was 725/mm3 [IQR 705], and the median neutrophil count was 135/mm3 [IQR 237.5]. No correlation was found between the duration of waiting in the emergency room and in-hospital mortality and hospital stay (p=0.480, p=0.768, respectively).

Conclusion: The waiting period for hospitalization does not affect in-hospital mortality and length of stay in the emergency departments in patients with febrile neutropenia when appropriate isolation conditions and necessary health care standards are provided.

Keywords: Febrile neutropenia, emergency room, mortality, waiting times

ÖZ

Amaç: Acil serviste yatış için bekleyen febril nötropeni hastalarında, bekleme süresi ile hastane içi mortalite ve hastanede yatış süresi arasında herhangi bir ilişki olup olmadığını saptamak.

Gereç ve Yöntemler: Aydın Adnan Menderes Üniversitesi Tıp Fakültesi Acil Tıp Ana Bilim Dalı'na 01.04.2015-01.08.2019 arasında başvuran febril nötropeni tanısı almış hastaların demografik özellikleri ile başvuru sırasındaki lökosit ve nötrofil değerleri, acil serviste antibiyotik ve koloni stimülan faktör uygulanıp uygulanmadığı, acil serviste yatış için bekleme süresi, hastaların acil servisten yatışının yapıldığı bölüm (servis/yoğun bakım), hastanede kalış süreleri ve hastane içi mortalite durumları kaydedildi. Elde edilen verilerin mortalite ile hastanede kalış süresi arasındaki ilişkisi analiz edildi.

Bulgular: Çalışmaya dahil edilen 86 hastanın medyan yaşı 67 [IQR 17] ve erkek hasta oranı %52,3 (n=45) idi. Hastaların acil serviste yatış bekleme süresi medyan 6,7 [IQR 6,5] saat, solid organ malignitesi olan hasta sayısı 44 (%51,2), yoğun bakım yatışı yapılan hasta sayısı 20 (%23,3) olarak tespit edildi. Koloni stimülan faktör (CSF) uygulanan hasta sayısının 36 (%41,9), acil serviste antibiyotik tedavisi başlanan hasta sayısının 65 (%75,6) olduğu görüldü. Hastaların acil servise başvuru anındaki medyan lökosit sayısı 725/mm3 [IQR 705], medyan nötrofil sayısı ise 135/mm3 [IQR 237,5] olarak tespit edildi. Yapılan korelasyon analizinde acil serviste bekleyiş süresi ile hastane içi mortalite ve hastanede kalış süresi arasında bir korelasyon saptanmadı (sırasıyla p=0,480, p=0,768).

Sonuç: Febril nötropeni hastaları için acil servislerde uygun izolasyon koşulları ve gerekli sağlık bakım standartlarının sağlanması halinde yatış için bekleme süresi hastane içi mortalite ve hastanede kalış süresini etkilememektedir.

Anahtar Kelimeler: Febril nötropeni, acil servis, mortalite, bekleme süresi

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Giriş

Febril nötropeni (FN), antineoplastik kemoterapötik tedavilerin sık görülen ve hayatı tehdit edebilen bir komplikasyonudur (1). Meydana gelen immün yetmezlik nedeniyle FN gelişen hastalar enfeksiyon etkenlerine açık hale gelmektedirler. Bu nedenle FN saptanan bir hastaya ivedilikle geniş spektrumlu antibiyotiklerin başlanması ve hastanın bulaş riski nedeniyle izole edilmesi tedavide önem arz etmektedir (2,3).

Ülkemizdeki hastanelerin yoğunluğu nedeniyle bu hastalar hızlıca izolasyonlarının yapılabileceği kliniklere yatışı gecikebilmekte ve bu hastalar acil serviste uygun yatağın açılmasını beklemek durumunda kalabilmektedirler. Acil servisler, birçok hastanın bir arada bulunabildiği ve çoğu zaman da kalabalık olabilen birimlerdir. Dolayısıyla, acil serviste FN tespit edilen hastaların izolasyon sorunu ortaya çıkabilmektedir.

Literatür incelendiğinde, FN hastalarının acil servislerdeki yönetimini inceleyen yeterli sayıda yayın bulunmamaktadır. Çalışmamızın amacı, acil serviste FN tanısı konan hastalarda mortalite üzerine etki eden faktörlerin ortaya konmasıdır. Bu faktörlerden biri olarak hastaların acil serviste bekleme süresinin hastane içi mortalite üzerine negatif etkisi olabileceğini düşünmekteyiz. Bildiğimiz kadarıyla, FN'de acil serviste yatış bekleme süresi ile mortalite ve hastanede kalış süresini inceleyen bir yayın bulunmamaktadır.

Gereç ve Yöntemler

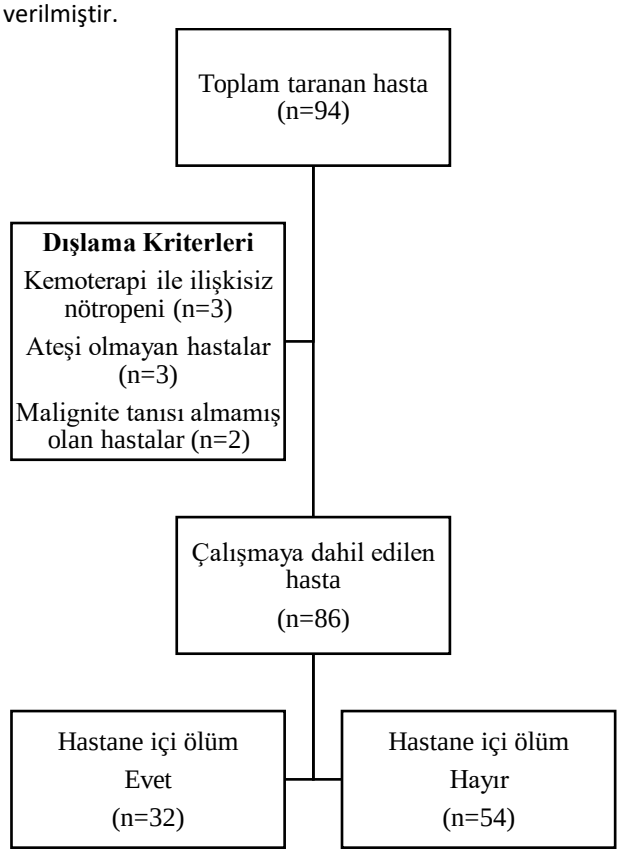
Çalışmamız retrospektif, gözlemsel bir çalışma niteliğinde olup, üçüncü basamak bir üniversite hastanesi acil servisi olarak bölgeye hizmet veren, yılda yaklaşık 72.000 hasta başvurusu olan, bir Acil Tıp kliniğinde yürütüldü. Çalışma protokolü Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) kılavuzuna uygun olarak yürütüldü ve yerel etik kurul onayı alındı (2020/116).

Acil servise 01.04.2015 – 01.08.2019 tarihleri arasında başvuran tüm hastalar arasından D70.4 (Nötropeni) ICD-10 kodu girilen hastalar hastane bilgi işlem sisteminden taranarak çalışmaya dahil edildi. Dışlama kriterleri olarak kemoterapi ile ilişkisiz nötropeni, ateş şikayetinin olmaması ve henüz doku tanısı ile malignite tanısı doğrulanmamış olması belirlendi ve bu kriterleri karşılayan hastalar çalışmadan çıkarıldı (Şekil-1). Hastaların yaş ve cinsiyet gibi demografik özelliklerinin yanı sıra, acil servise başvuru sırasındaki lökosit ve nötrofil değerleri, acil serviste antibiyotik ve koloni stimülan faktör uygulanıp uygulanmadığı, acil serviste yatış için bekleme süresi, hastaların acil servisten yatışı yapıldığı bölüm (servis/yoğun bakım), hastanede kalış süreleri ve hastane içi mortalite durumları kaydedildi.

Elde edilen veriler SPSS 20 for Windows (SPSS Inc., Chicago, IL, USA) kullanılarak analiz edildi. Çalışmamızda elde edilen sayısal değişkenlerin hiçbiri normal dağılıma uyum göstermediği için sayısal değişkenler medyan [IQR], kategorik değişkenler sayı (%) olarak gösterildi. Gruplar arası kıyaslamalarda Mann-Whitney-U, Ki-kare ile Spearman korelasyon testi kullanıldı. Analizlerin yorumlanmasında $p<0,05$ değeri anlamlı olarak kabul edildi.

Bulgular

Çalışma süresinde acil serviste 94 hastaya nötropeni (D70.4) tanısı girildiği görüldü. Bu hastalardan 8'i dışlama kriterleri uyarınca çalışma dışı bırakıldı ve çalışmamıza toplam 86 hasta dahil edildi. Çalışmanın akış şeması Şekil 1'de verilmiştir.



Şekil 1. Çalışmanın akış diyagramı

Tablo 1'de çalışmaya dahil edilen hastaların demografik ve klinik özellikleri sunuldu. Buna göre hastalarımızın medyan yaşı 67 [IQR 17] ve erkek hasta oranı %52,3 (n=45) olduğu gözlendi. Hastaların acil serviste yatış bekleme süresi medyan 6,7 [IQR 6,5] saat, solid organ malignitesi olan hasta sayısı 44 (%51,2), yoğun bakım yatış oranı %23,3 (n=20), koloni stimülan faktör (CSF) uygulama oranı %41,9 ve acil serviste antibiyotik tedavisi başlama oranının %75,6 olduğu görüldü. En sık tercih edilen antibiyotik piperasilin-tazobaktam idi (n=64, %85,3). Hastaların acil servise başvuru anındaki medyan lökosit sayısı 725/mm3 [IQR 705], medyan nötrofil sayısı ise 135/mm3 [IQR 237,5] olarak tespit edildi.

Çalışmamızda hastane içi mortalite oranı %37,2 olarak tespit edildi. Yapılan karşılaştırmada yoğun bakım yatışı ve hastanede yatış süresi dışındaki parametrelerin mortalite açısından anlamlı farklılık göstermediği saptandı. Hastane içi ölüm görülen hastalarda yoğun bakım yatış oranı anlamlı olarak daha yüksekken, hastanede yatış süresi anlamlı olarak daha düşüktü (Tablo 1). Çalışmamızda hastaların acil serviste medyan bekleyiş süresi 6,7 [IQR 6,5] saat, medyan hastanede yatış süresinin ise 7,4 [IQR 9,3] gün olduğu tespit edildi. Yapılan korelasyon analizinde acil serviste bekleyiş süresi ile hastanede kalış süresi arasında bir korelasyon saptanmadı ($p=0,768$).

		Hastane içi Ölüm		
	Toplam (n=86)	**Evet (n=32)**	**Hayır (n=54)**	**p**
Yaş (yıl)	67 [17]	68,5 [17]	67 [17]	0,678
Cinsiyet (kadın/erkek) (%)	41/45 (47,6/52,3)	13/19 (40,6/59,4)	28/26 (51,9/48,1)	0,314
Kanser tipi (solid/hematolojik) (%)	44/42 (51,2/48,8)	12/20 (37,5/62,5)	32/22 (59,3/40,7)	0,051
Acil serviste yatış bekleme süresi (saat)	6,7 [6,5]	7 [5,5]	7 [9]	0,480
Acil servisten yatış yapılan birim (servis/yoğun bakım) (%)	66/20 (76,7/23,3)	17/15 (53,1/46,9)	49/5 (90,7/9,3)	<0,001
Ampirik antibiyotik uygulanan hasta (n) (%)	65 (75,6)	26 (81,2)	39 (72,2)	0,346
CSF uygulanan hasta (n) (%)	36 (41,9)	14 (43,8)	22 (40,7)	0,785
Ampirik antibiyotik ve CSF uygulanan hasta sayısı (n) (%)	32 (37,2)	14 (43,8)	18 (33,3)	0,334
Başvuru anındaki lökosit sayısı	725 [705]	700 [520]	770 [795]	0,159
Başvuru anındaki nötrofil sayısı	135 [237,5]	105 [292,5]	150 [220]	0,439
Hastanede kalış süresi (gün)	7,4 [9,3]	4 [9,5]	8,5 [7,25]	0,005

Tablo 1. Çalışmaya dahil edilen hastaların mortalite açısından demografik, klinik ve laboratuvar verileri

Tartışma

Çalışmamızda, acil serviste kemoterapötik tedaviye bağlı FN tanısı alan hastalarda acil serviste yatış için bekleme süresi ile hastanede kalış süresi ve mortalite arasında bir ilişki saptayamadık. Literatürde bu ilişkiyi inceleyen bir çalışma olmamakla birlikte FN'de mortalite oranları %2,6 ila %50,6 oranında bildirilmektedir (4,5). Çalışmamızda tespit edilen %37,2'lik mortalite oranı literatür ile uyumludur ve sonuçlarımızın genellenmesi açısından önemlidir. FN tanısı alan hastalarda acil serviste yatış için bekleme süresi ile hastanede kalış süresi ve mortalite arasında negatif bir korelasyon olabileceği düşüncesindeydik fakat çalışmamızın sonuçlarının bu hipotezi doğrulamadığını gördük. Bunun en önemli sebebinin acil servisimizde FN gibi izolasyon gerektiren hastalıklar için ayrılmış olan bir izolasyon odası bulunması olarak tahmin ediyoruz. Ayrıca çalışmanın yapıldığı merkezin 3. Basamak bir acil servis olması, hastaların sürekli olarak Acil Tıp uzmanı hekimler tarafından takip ediliyor olmasının hastalarda gerekli tedavinin daha hızlı başlanmasına olanak sağladığı kabul edilirse çalışmamızın sonuçlarını etkileyebileceği düşüncesindeyiz.

Acil servislerin yoğunluğu özellikle ülkemizde gün geçtikçe artmaktadır. Bu yoğunluk hastane genelinde de gözlenmekte ve çoğu zaman hastalar acil serviste servis ya da yoğun bakım yataklarının boşalmasını beklemektedirler. Febril nötropeni gibi immün yetmezliğe yol açan durumların varlığında hastaların ivedilikle acil servis gibi kalabalık bir ortamdan uzak tutularak uygun yataklara yatırılması ve risk sınıflaması için önerilen modeller mevcuttur (6,7).

Bununla birlikte FN hastalarının acil servislerde yatış için bekleme süreleri ile mortalite ya da hastanede kalış süresi arasındaki ilişkiyi inceleyen bir yayına rastlamadık. Bu açıdan çalışmamız bir ilk olma özelliğini göstermektedir.

Febril nötropeni tedavisinde piperasilin-tazobaktam gibi antipsödomonal etkinliği de olan geniş spektrumlu antibiyotiklerin ampirik olarak uygulanması gereklidir (8). Amerika Birleşik Devletleri'nde 2020 yılında yapılan bir retrospektif çalışmada FN yönetiminde kılavuz önerilerine uyum oranı %96,8 olarak bildirilmiştir (9). Çalışmamızdaki acil serviste ampirik antibiyotik uygulanma oranı %75,6'dır. Acil servisimize başvuran FN tanılı hastalar öncelikle izolasyon odasına alınmakta ve uygulanması gereken ampirik antibiyoterapi ve CSF gibi tedavilere hastanın takip edildiği klinik ve Enfeksiyon Hastalıkları kliniklerinden hekimlerin katılımı ile acil serviste Acil Tıp uzmanı gözetiminde başlanmaktadır. Ülkemizde piperasilin-tazobaktam gibi antibiyotiklerin başlama yetkisi Enfeksiyon Hastalıkları uzmanlık dalında bulunduğu için bu orana çalışmanın yazarlarının herhangi bir doğrudan etkisi olmadı.

Çalışmamızdan elde edilen verilerin ışığında acil serviste ampirik antibiyoterapinin hastane içi mortalite üzerine herhangi bir etkisi gösterilemedi. Febril nötropeni yönetiminde ampirik antibiyotiklerin ilk 1 saat içinde başlanması önerilmektedir (10). Bunun yanında, Daniels ve ark. yaptıkları çalışmada FN hastalarında 3 saate kadar olan antibiyotik uygulanmasının hastane içi mortalite ve hastanede kalış süresi üzerinde bir etkisi olmadığı gösterilmiştir (11). Benzer şekilde Peyrony ve ark. yaptıkları prospektif çalışmada acil serviste antibiyotik başlama süresi ile mortalite arasında bir ilişki bulunamamıştır (12). Her ne kadar çalışmamızın retrospektif dizaynı nedeniyle kapı-antibiyotik süresinin belirlenmesi mümkün değilse de antibiyoterapinin geciktirilmemesi acil servisimizde FN yönetiminin ana komponentini oluşturmaktadır.

Antibiyoterapiye benzer şekilde FN tanısı konan hastalarda gelişebilecek enfeksiyonları engellemek amacıyla antibiyoterapiye ek olarak CSF uygulanmasının nötropeniden çıkış ve hastanede kalış süresinin kısalması ile ilişkili olduğu gösterilmişse de mortalite üzerine olan etkisi ortaya konamamıştır (13). Ek olarak, 2015 yılında yayımlanan bir Cochrane sistematik derlemesinde antibiyotiklere kıyasla CSF uygulanmasının FN'de enfeksiyonların ortaya çıkmasını önleme açısından herhangi bir yarar ya da zararının gösterilemediği vurgulanmıştır (14). Literatüre paralel şekilde antibiyoterapiye ek olarak uygulanan CSF tedavisinin mortalite ve hastanede kalış süresi ile bir ilişkisini saptayamadık.

Nötrofiller, enfeksiyöz patojenlere karşı ilk sırada işlev gören, immünitenin en önemli hücrelerinden biridir. Özellikle nötrofil sayısının 500/mm^3 düzeyinin altına düşmesi ciddi enfeksiyonların ortaya çıkma olasılığını ve dolayısıyla mortalite riskini belirgin olarak artırmaktadır (15). Çalışmamızda ölen hastaların başvuru lökosit ve nötrofil değerleri, her ne kadar istatistiksel olarak anlamlılığa ulaşmamış olsa da, ölen hasta grubunda daha düşüktür. Bizim verilerimize paralel şekilde Hatamabadi ve ark. FN hastalarında yaptıkları çok merkezli çalışmada düşük başvuru lökosit değerlerinin belirgin olarak mortalite ile ilişkili olduğunu ortaya koymuşlardır (16). Çalışmamızın sınırlı örneklem büyüklüğünün, ölen hasta grubundaki lökosit ve nötrofil değerlerinin düşüklüğünün istatistiksel olarak anlamlılık düzeyine ulaşmamış olmasında etken olabileceğini düşünmekteyiz.

Çalışmamızda mortalite görülen olgularda yoğun bakım yatış oranı anlamlı seviyede yüksek saptanmıştır. Aagard ve ark. Danimarka'da yaptıkları çalışmada FN gelişen kanser hastalarında FN gelişmeyenlere göre yoğun bakıma yatış ve mortalite insidansı belirgin olarak yüksek bulunmuştur (17). Bununla birlikte, çalışmamızın retrospektif tabiatı nedeniyle bu noktada bir sebep-sonuç ilişkisinden çok klinik durumu daha ağır olan hastaların yoğun bakıma yatırılmış olması olasılığının yüksek olması nedeniyle bu anlamlı farkın ortaya çıkmış olabileceğini düşünmekteyiz.

Kısıtlılıklar

Çalışmamızın retrospektif şekilde dizayn edilmesi nedeniyle veriler bilgisayar girdilerinin taranması ile elde edilebildi. Bu nedenle hastaların hastalık derecesinin objektif olarak belirlenmesini sağlayan APACHE II ya da SOFA gibi skorlamalar yapılamadı. İkinci kısıtlılık olarak yine çalışmamızın retrospektif doğası nedeniyle hastalarda kapı-antibiyotik ve kapı-CSF uygulama süreleri saptanamadı. Yatışı yapılan hastaların ilerleyen dönemde birimler arası yaptığı geçişler çalışmamıza dahil edilmedi, sadece hastaların acil servisten hangi birime yatışının yapıldığı kaydedildi.

Sonuç

Febril nötropeni hastaları için acil servislerde uygun izolasyon koşulları ve gerekli sağlık bakım standartlarının sağlanması halinde yatış için bekleme süresi hastane içi mortalite ve hastanede kalış süresini etkilememektedir.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Does Intubation Affect Survival Among Patients Experiencing In-Hospital Cardiopulmonary Arrest?

Entübasyon Hastane İçi Kardiyopulmoner Arrest Hastalarında Sağkalımı Etkiliyor mu?

Metin Yadigaroğlu[1], Burak Katipoğlu[2], Olgun Aşık[3], Mustafa Sabak[4]

ABSTRACT

Aim: Cardiopulmonary arrest is an important public health problem that contributes substantially to in-hospital morbidity and mortality. The present study aimed to determine the factors that affect in-hospital mortality and determine whether intubation contributes to survival among patients experiencing in-hospital cardiopulmonary arrest.

Material and Methods: This retrospective, cross-sectional study was conducted by examining the event notification forms of all patients with a "Code Blue" call between January 1, 2014, and December 31, 2018. Patients who died and those who did not die after intervention were compared concerning age, sex, location and time of the call, and interventions implemented. Patients who received cardiopulmonary resuscitation alone and those who received cardiopulmonary resuscitation + intubation were compared concerning in-hospital mortality; p-values < 0.05 were considered statistically significant.

Results: In total, 924 patients were included in the present study. The most frequent calls were made from the wards in the hospital, at a rate of 64.4%. The in-hospital mortality rate was 42.4%. In-hospital mortality rates were significantly higher in the elderly, in those who were given overtime and service calls, and in those who received cardiopulmonary resuscitation or cardiopulmonary resuscitation + intubation. Among patients who received CPR, intubation did not affect survival. Sex, age, time of call, and intervention were significant predictors of in-hospital mortality.

Conclusion: Code blue calls occurred primarily in the hospital wards outside of working hours, and improper call rates were high. Moreover, age, location and time of call, and interventions were independent risk factors for in-hospital mortality; intubation did not contribute to survival among patients experiencing in-hospital cardiopulmonary arrest.

Keywords: Cardiopulmonary arrest, cardiopulmonary resuscitation, intubation, survival, in-hospital mortality

ÖZ

Amaç: Kardiyopulmoner arrest, hastane içi morbidite ve mortaliteye anlamlı katkı sağlayan önemli bir halk sağlığı sorunudur. Bu çalışma, hastane mortalitesini etkileyen faktörleri belirlemeyi ve hastane içi kardiyopulmoner arrest geçiren hastalarda entübasyonun sağkalıma katkı sağlayıp sağlamadığını belirlemeyi amaçladı.

Gereç ve Yöntemler: Bu retrospektif, kesitsel çalışma, 1 Ocak 2014 ile 31 Aralık 2018 tarihleri arasında "Mavi Kod" çağrısı olan tüm hastaların olay bildirim formları incelenerek yapılmıştır. Müdahale sonrası ölen ve ölmeyen hastalar yaş, cinsiyet, çağrının yeri, zamanı ve yapılan müdahaleler açısından karşılaştırıldı. Tek başına kardiyopulmoner resüsitasyon uygulanan hastalar ile kardiyopulmoner resüsitasyon + entübasyon yapılan hastalar hastane içi mortalite açısından karşılaştırıldı; p değerleri <0,05 istatistiksel olarak anlamlı kabul edildi.

Bulgular: Bu çalışmaya toplam 924 hasta dahil edildi. En sık arama %64,4 oranıyla hastanenin servislerinden yapıldı. Hastane içi ölüm oranı %42,4 idi. Hastane içi ölüm oranları yaşlılarda, fazla mesai ve servis çağrılarında, kardiyopulmoner resüsitasyon veya kardiyopulmoner resüsitasyon + entübasyon uygulananlarda anlamlı olarak daha yüksekti. CPR yapılan hastalarda entübasyon sağkalımı etkilemedi. Cinsiyet, yaş, arama zamanı ve müdahale, hastane içi mortalitenin önemli belirleyicileriydi.

Sonuç: Mavi Kod aramaları öncelikle hastane servislerinden mesai saatleri dışında yapılıyordu ve uygunsuz arama oranları yüksekti. Ayrıca yaş, yer ve çağrı zamanı ve müdahaleler hastane içi mortalite için bağımsız risk faktörleriydi; entübasyon, hastane içi kardiyopulmoner arrest geçiren hastalarda sağkalıma katkıda bulunmadı.

Anahtar Kelimeler: Kardiyopulmoner arrest, kardiyopulmoner resüsitasyon, entübasyon, sağkalım, hastane içi mortalite

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Introduction

Hospital emergency codes are emergency call and guidance systems that aim to mobilize hospital staff to respond to various emergencies to minimize in-hospital mortality and are applied by using the same colors worldwide (1). Cardiopulmonary arrest contributes substantially to in-hospital morbidity and mortality (2). Although there are various definitions for cardiopulmonary arrest, the most commonly used description comprises the discontinuation of cardiac mechanical activity, as confirmed by the absence of a detectable rhythm, unresponsiveness, and apnea. A cardiopulmonary arrest occurs in the hospital in patients with a rhythm during admission, known as an in-hospital cardiopulmonary arrest; its incidence is 3–4/1000 in adult patients (3,4). Because of the low survival rate among such patients, in-hospital cardiopulmonary arrest is an important public health problem. The main reasons for the low survival rate include age, the presence of multiple additional diseases, late detection of cardiopulmonary arrest, low level of knowledge (among hospital staff) of basic life support algorithms, defective equipment (e.g., monitors, defibrillators, and resuscitation cards), lack of qualified resuscitation teams, and lack of organization (5). The "Code Blue" serves to provide patients with rapid intervention during in-hospital cardiopulmonary arrest; it focuses on recovery and the maintenance of basic life support in the shortest possible time (0–5 min) (6). It has been reported that improved training, training of field staff, creation of resuscitation teams, and improved organization might improve survival rates (5,7). Establishing the leader and intra-team roles is the most critical factor in the success of the resuscitation team (8). Establishing code blue teams, ensuring that each member has a clear understanding of their role during training and exercises, and critiquing the resuscitation after each code blue event will increase survival and team success (9). Current guidelines for primary cardiopulmonary arrest recommend continuing circulation with chest compressions before airway and ventilation intervention; if necessary, defibrillation can then be applied (10). Some emergency services recommend high-quality, uninterrupted chest compressions together with oxygenation using an oropharyngeal airway or simple oxygen mask, as well as passive oxygenation; with a shockable rhythm, up to 600 chest compressions may delay advanced airway intervention during instances of out-of-hospital cardiopulmonary arrest with witnesses (11). European guidelines permit a pause in chest compression for not more than 5 seconds for tracheal intubation (12). Comparisons between airway interventions are difficult because of the use of multiple airway procedures during cardiopulmonary resuscitation (CPR), the importance of rescuer experience in the selection of the airway intervention technique, as well as patient status (e.g., obesity, location of cardiopulmonary arrest, and other interventions), and the need for advanced airway intervention in early returning patients (13). During resuscitation, the interventions and success rates are affected by many factors, including patient factors, rescuer experience, and resuscitation stage (10). The recommendations for optimal interventions are unclear, as the evidence to support recommendations in both in-hospital and out-of-hospital cardiopulmonary arrest consists entirely of observational studies (14).

This study aimed to identify factors that affect in-hospital mortality rates by evaluating code blue events and determining whether intubation for patients experiencing in-hospital cardiopulmonary arrest contributed to increased survival.

Material and Methods

This retrospective cross-sectional study was conducted by examining the event notification forms of all patients for whom a "code blue" was called at Trabzon Kanuni Training and Research Hospital, during the period from January 1, 2014, to December 31, 2018. All necessary permits were obtained from the Health Directorate before the study, and the Ethics Committee of Trabzon Kanuni Training and Research Hospital Clinical Researches Ethical Committee approved the study (Date: 17.09.2020, Decision No: 2020/42). Age, sex, location and time of cardiopulmonary arrest, source of cardiopulmonary arrest (cardiac or non-cardiac), interventions (aspiration, CPR, intubation, non-CPR call, or non-intervention), and results (death, hospitalization, intensive care follow-up, emergency room referral, or discharge) were recorded. Calls made by the hospital emergency department, calls for drills, accidental code blue calls, and calls for the patients below 18 years old were excluded from the study. Patients who died and did not die after intervention were compared concerning age, sex, location and time of call, and interventions implemented. In addition, patients who received CPR alone and those who received CPR + intubation were compared concerning in-hospital mortality.

Statistical analysis

Data was recorded and compared using SPSS software (version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics for continuous variables (characteristics) are presented as medians, while those for categorical variables are presented as counts and percentages. The chi-squared test was used to compare categorical data. Univariate and multivariate logistic regression analyses were used to identify independent risk factors for in-hospital mortality. Parameters with a p-value < 0.1 in univariate analysis were included in the multivariate model; odds ratios and 95%

confidence intervals were calculated; p-values < 0.05 were considered statistically significant.

Results

In total, 924 patients were included in this study; 464 (50.1%) were women, with a mean age of 71.4 years (range: 45.2–82.6 years). The remaining 460 patients (49.9%) were men, with a mean age of 68.7 years (56.7–77.5 years). Most calls were made from the wards (n = 596, 64.4%), followed by the intensive care unit (18.6%), clinics (14.1%), and other locations (2.9%) (e.g., hospital garden or cafeteria).

Concerning patients' final statuses after code blue calls, 393 (42.4%) died; 223 (24.1%) continued hospitalization in the intensive care unit or the wards (no change in location); 140 (15.1%) were admitted to the intensive care unit, and 168 (18.1%) were discharged after intervention or following emergency service observation. Table 1 shows the results of interventions during each year of the study period concerning sex, call time, location of the call, and intervention distribution.

Regarding interventions implemented after code blue calls, patients were divided into two groups: those who experienced in-hospital mortality (42.4%) and those who did not (57.6%). Table 2 shows differences between the groups in terms of the year, age, time of call (during working or non-working hours), location of the call, and intervention. In-hospital mortality rates were significantly higher in patients with an older age (73.7 years versus 66.2 years; p < 0.001), in calls made during non-working hours (p < 0.001), in patients with service hospitalization (p < 0.001), and in patients who received CPR or CPR + intubation (p < 0.001).

The present study also evaluated whether the in-hospital mortality rate differed between patients who received CPR alone and those who received CPR + intubation. Notably, there was no change in survival when intubation was performed in combination with CPR (p = 0.431) (Table 3).

Table 4 shows the results of univariate and multivariate logistic regression analyses performed to determine independent risk factors for in-hospital mortality. Multivariate regression analysis showed that sex, age, time of call, and intervention were significant predictors of in-hospital mortality (p = 0.008, p = 0.001, p < 0.001, and p < 0.001, respectively).

Discussion

One of the most important findings of the present study is that intubation did not affect in-hospital mortality in CPR patients. In a prior study of adult and pediatric patients who received CPR in the emergency department, survival rates were reportedly significantly increased in patients who did not also receive advanced airway intervention (15). In addition, advanced airway intervention during CPR allegedly did not result in improved survival or 28-day neurological functionality, compared with balloon mask ventilation (16,17).

Guidelines for in-hospital cardiopulmonary arrest indicate that intubation performed in the first 15 minutes of the cardiopulmonary arrest event reduces survival compared with no intubation (18).

	2014, % (n:234)	2015, % (n:233)	2016, % (n:174)	2017, % (n:137)	2018, % (n:146)
Result, % (n)					
Exitus	47.9 (112)	47.6 (111)	44.3 (77)	35.0 (48)	30,8 (45)
Continue hospitalization	25.2 (59)	23.6 (55)	22.9 (40)	23.4 (32)	25,3 (37)
Intensive Care	14.1 (33)	10.3 (24)	11.5 (20)	26.3 (36)	18,5 (27)
Other	12.8 (30)	18.5 (43)	22.4 (39)	15.3 (21)	24,0 (35)
Gender, % (n)					
Female	51.7 (121)	48.5 (113)	49.4 (86)	54.0 (74)	46.6 (68)
Male	48.3 (113)	51.5 (120)	50.6 (88)	63 (46.0)	53.4 (78)
Call Time, % (n)					
In-office hours	43.6 (102)	42.5 (99)	50.6 (88)	52.6 (72)	47.9 (70)
Out-of-the-office hours	56.4 (132)	57.5 (134)	49.4 (86)	47.4 (65)	52.1 (76)
Place of call, % (n)					
Clinic	9.4 (22)	17.6 (41)	16.1 (28)	14.6 (20)	13.7 (20)
Service	57.3 (134)	51.9 (121)	77.0 (134)	72.3 (99)	74.0 (108)
Intensive Care	30.3 (71)	29.2 (68)	2.9 (5)	10.2 (14)	9.6 (14)
Other	3.0 (7)	1.3 (3)	4.0 (7)	2.9 (4)	2.7 (4)
Intervention, % (n)					
CPR	45.3 (106)	35.6 (83)	27.6 (48)	29.9 (41)	30.1 (44)
CPR + Intubation	28.6 (67)	32.2 (75)	43.1 (75)	40.1 (55)	13.0 (19)
Intubation	2.1 (5)	5.6 (13)	1.1 (2)	0.0 (0)	4.8 (7)
Call place + Other	23.9 (56)	26.6 (62)	28.2 (49)	29.9 (41)	52.1 (76)

Table 1. Distribution of the patients in terms of the result after the intervention, gender, time and place of the call, and the intervention by years.

	Group 1 (n:393)	Group 2 (n:531)	p value
Age, median (IQR)	73.7 (20.5)	66.2 (35.5)	<0.001
Call time, % (n)			
In-office hours	30.8 (121)	58.4 (310)	<0.001
Outside office hours	69.2 (272)	41.6 (221)	
Call place, % (n)			
Clinic	1.0 (4)	23.9 (127)	
Service	78.1 (307)	54.4 (289)	
Intensive Care	20.1 (79)	17.5 (93)	<0.001
Other	0.8 (3)	4.1 (22)	
Intervention, % (n)			
CPR	50.1 (197)	23.5 (125)	
CPR + Intubation	47.6 (187)	19.6 (104)	
Intubation	0.3 (1)	4.9 (26)	<0.001
Treatment + Other	2.0 (8)	52.0 (276)	

Table 2. Significance levels of the statistical differences between the groups in terms of a year, time and place of the call, and intervention between those with incident mortality and those without incident mortality.

According to the American Heart Association, it is critical to minimize the pause between compressions for advanced airway intervention in the patients with cardiopulmonary arrest (19). The most common reasons for cardiopulmonary arrest in adult patients are cardiac-related. Consequently, the present study shows that non-invasive ventilation was adequate for these adult patients because of the cardiac origin of the arrest. Due to the study's retrospective nature, it is unclear whether the non-intubated patients received any airway intervention. This is a limitation of the study. In addition, in-hospital mortality did not increase in patients who did not receive intubation, potentially because compression was not paused to enable advanced airway intervention. Because of the above uncertainties in the literature, we believe that the results of our study represent a substantial contribution.

	CPR (n:322)	CPR + Intubation (n:291)	p value
Group 1	61.2 (197)	64.3 (187)	0.431
Group 2	38.8 (125)	35.7 (104)	

Table 3. The effect of intubation on in-hospital event mortality in patients who receive CPR.

Although the rate of true and false code blue status was not regarded as a formal outcome in our study, the rate of improper code blue calls was 31%, assuming that all patients with true code blue status had received CPR. An excessive number of foul calls results in labor losses, and measures that may be taken to reduce such calls have frequently been discussed in the literature; improper calls occurred in 11–74% of cases and varied widely among studies. Differences among improper call rates may reflect the attitudes of the code blue teams in the hospitals where the studies were conducted. Only completing a form for the actual code blue may reduce recorded improper call rates. At the hospital where the study was conducted, a form is completed for each code blue call notification; thus, the rates may be relatively higher.

In a study that examined code blue data from a secondary state hospital in 2017, the most frequent code blue calls were reportedly made from the wards (20). Similarly, Bayramoğlu et al. found that the most frequent call sites were the wards (21). Conversely, Eroğlu et al. found that the most frequent code blue calls were from the phlebotomy unit (22). Çiçekçi et al. included intensive care calls in their study and found that 80.8% of the calls were made from intensive care units (23). Notably, the hospital where the present study was conducted is a tertiary hospital; in addition to the general intensive care unit, many departments have separate intensive care units (e.g., chest, cardiology, and neurology departments). Because there is an anesthesiologist in the general intensive care unit, calls from that unit were not included in the present study; however, other intensive care calls were included. It is reasonable that calls were most frequently made from intensive care units, as critical patients are hospitalized in such units. Because of the number of beds in various hospital wards, the calls are likely to be made most frequently from the wards when intensive care units are not included. In the study, although calls made from intensive care units were included in the research, the most frequent calls were made from wards; this is because there was a doctor in charge in each intensive care unit and when the medical state of the patients deteriorates, interventions can be made before a cardiopulmonary arrest occurs. The code blue call in intensive care units was made after this stage.

The rate of calls during non-working hours was 69.2% in the present study. In the literature, many studies have reported significantly higher nighttime cardiopulmonary arrest rates compared to rates during working hours (24,25), as follows: nighttime rates, 53–64%; weekday rates, 24–26%; and weekend rates, 26–28% (26,27). This difference is possible because cardiopulmonary arrest in adults is frequently of cardiac origin, and heart attacks occur more often in the early morning due to increased beta-adrenergic activity, hypercoagulability, and platelet hyperreactivity (28). Çiçekçi et al. reported the rate of cardiopulmonary arrest during non-working hours as 77.4%.

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	P	OR	95% CI	P
Gender (female vs. male)	0.560	0.430-0.729	<0.001	1.641	1.136-2.370	0.008
Age	0.978	0.971-0.986	<0.001	0.983	0.973-0. 993	0.001
Call time	3.153	2.395-4.151	<0.001	0.417	0.287-0.607	< 0.001
Call place	0.640	0.521-0.786	<0.001	1.082	0.769-1.523	0.651
Intervention	3.821	3.146-4.642	<0.001	3.446	2.695-4.408	< 0.001

Table 4: Determining the independent risk factors for in-hospital incidence mortality with the Univariate and Multivariate Logistic Regression Analysis.

Similarly, Murat et al. reported that the rate of cardiopulmonary arrest during non-working hours was greater (56%) than during working hours; therefore, the authors proposed a 24-h readily availablecode blue team because it corresponded to the period when fewer professional health personnel were present in the hospital (23,29).

With respect to instant discharge rates following code blue calls, the present study demonstrated a rate of 18.1%. This rate is similar to the 22% recently reported by Kaykasız et al. in an analysis of a secondary hospital (20). Another study showed a rate of instant discharge of 15–20%, whereas long-term discharge rates have been reported as approximately 30% (21,30). Among patients who are followed-up in intensive care units following successful resuscitation, discharge rates are expected to be high. In addition, age, additional disease, single-center or multicenter study design, and resuscitation team characteristics can affect discharge rates. The results of our study are consistent with the literature.

Our study has some limitations. False or fake calls were not excluded from the study. In addition, the form of airway interventions other than intubation could not be determined clearly.

Conclusion

In the present study, code blue calls occurred at the greatest frequency in wards during non-working hours; moreover, the improper call rate was high. Age, time, and location of calls and interventions were independent risk factors for in-hospital mortality; intubation did not contribute to survival in patients experiencing in-hospital cardiopulmonary arrest. In the future, multicenter, prospective studies with larger patient groups are needed to support the findings of this investigation.

Conflict of Interest: The authors declare no conflict of interest regarding this study.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

The Predictive Value of Ultrasound, Alvarado Score, and C-Reactive Protein in Pediatric Appendectomy Outcomes

Ultrason, Alvarado Skoru ve C-Reaktif Proteinin Pediatrik Appendektomilerdeki Prediktör Değeri

Ali Çelik[1], Mehmet Altuntaş[1]

ABSTRACT

Aim: This retrospective study aimed to investigate the combined accuracy of appendix diameter, C reactive protein, and Alvarado score in classifying patients with negative appendectomy and acute appendicitis.

Material and Methods: This descriptive observational cohort study research was conducted at the Emergency Department of a Training and Research Hospital between November 2017 and April 2019. We included the data of appendicitis cases aged under 18 years in this retrospective study and gathered data on patients` demographics, preoperative laboratory values, signs, symptoms, and final pathological diagnosis, retrospectively. Then, cases were divided into acute appendicitis or negative appendectomy groups according to formal pathology reports.

Results: The final study population consisted of 60 patients; the negative appendectomy rate was 25%. The diagnostic accuracy of the multivariate model`s involving CRP, Alvarado score, and appendix diameter was 93.3%, with a sensitivity and specificity of 93.3% for identifying acute appendicitis (+LR: 14 and -LR: 0.07). Applying the model could have prevented 93.3% of negative appendectomy cases (25% to 1.7%) from undergoing unnecessary surgery in our cohort.

Conclusion: In conclusion, CRP, Alvarado score, or appendix diameter should not be used individually to diagnose AA in children. However, combining these variables can increase the accuracy of acute appendicitis diagnosis and may provide a significant reduction in negative appendectomy rates.

Keywords: Appendicitis, Alvarado score, appendix diameter, C-reactive protein, lymphoid hyperplasia, negative appendectomy

ÖZ

Amaç: Bu retrospektif çalışma, negatif apendektomili ve akut apandisitli hastaları sınıflandırmada apendiks çapı, C reaktif protein ve Alvarado skorunun birleşik doğruluğunu araştırmayı amaçladı.

Gereç ve Yöntemler: Bu tanımlayıcı gözlemsel kohort çalışması, Kasım 2017 ile Nisan 2019 tarihleri arasında bir Eğitim ve Araştırma Hastanesi Acil Servisinde yürütülmüştür. Çalışmaya 18 yaş altı apandisit olguları dahil edilmiş ve hastaların demografik özellikleri, laboratuvar ölçümleri, semptom, bulgu ve nihai patoloji raporlarına ilişkin veriler retrospektif olarak toplanmıştır. Daha sonra olgular resmi patoloji raporlarına göre akut apandisit veya negatif apendektomi gruplarına ayrılmıştır.

Bulgular: Nihai çalışma popülasyonu 60 hastadan oluşuyordu ve negatif apendektomi oranı %25 idi. CRP, Alvarado skoru ve apendiks çapı verilerini içeren çok değişkenli modelin tanısal doğruluğu %93.3, akut apandisit tanımlamada duyarlılık ve özgüllüğü %93.3 idi (+LR: 14 ve -LR: 0.07). Modeli uygulamanın, kohortumuzdaki negatif apendektomi vakalarının %93,3'ünü (%25 ila %1,7) gereksiz cerrahiden kurtarabileceği görülmüştür.

Sonuç: Sonuç olarak, CRP, Alvarado skoru veya apendiks çapı çocuklarda AA tanısında tek başına kullanılmamalıdır. Ancak bu değişkenlerin birlikte kullanımı apandisit tanısının doğruluğunu artırabilir ve negatif apendektomi oranlarında önemli bir azalma sağlayabilir.

Anahtar Kelimeler: Akut apandisit, Alvarado skoru, apandiks çapı, C-reaktif protein, lenfoid hiperplazi, negatif apendektomi

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Introduction

Acute appendicitis (AA) remains one of the most common surgical emergencies of all ages. The expected lifetime risk of appendicitis is stated to be about 8% (1). In most cases, the ideal treatment option is an appendectomy, which places a significant burden on healthcare systems. With the progress in diagnosis, severe complications have decreased. Despite pre-surgical diagnostic imaging tools, negative appendectomy (NA) cases, mostly lymphoid hyperplasia (LH), has grown as a novel dilemma at a rate of up to 25% (2). In this regard, conservative treatment (CT) with antibiotics has become a better approach for uncomplicated cases. However, antibiotics are still preferred in limited circumstances, due to the high recurrence rate of up to 40% and potential institutional disparities (3).

Many diagnostic tools exist for identifying appendicitis, such as clinical decision rules (CDRs) settled by laboratory parameters, physical examination findings, and patients` symptoms. Leucocyte counts and C-reactive protein (CRP) measures are widely used but non-specific laboratory markers of acute appendicitis. The Alvarado Score (AS) and Pediatric Appendicitis Score (PAS) are extensively utilized CDRs with adequate sensitivity for appendicitis but lack specificity. Ultrasonography (US) is a useful imaging modality for suspected pediatric appendicitis without radiation exposure. The American College of Radiology (ACR) positioned the US as the initial imaging for children with suspected appendicitis (4). In the sonographic examination, a fluid-filled, non-compressible appendix with a diameter of 6 mm is recognized as AA. However, US also lacks sufficient specificity, and viewing the appendix is not feasible in all cases.

This study hypothesized that the combination of CRP, CDRs (AS or PAS), and appendix diameter (AD) would provide more reliable diagnostic accuracy regardless of the severity of appendicitis. Consequently, the study aimed to investigate the predictive performance of CRP, CDRs, and appendix diameter (AD), both independently and mutually.

Material and Methods

Design, location, and study period

This retrospective observational study was performed after obtaining approval from the hospital authorities, and the patients` consents were waived (Date: 06.01.2021 Number: E-64247179-799). This study was conducted at an academic ED between November 2017 and April 2019. The total volume of patients under 18 years at the ED during the study period was 16029.

Patient selection and data collection

The patients diagnosed with acute appendicitis under the age of 18 years old who presented to the ED were included in our study. The patients who underwent elective surgery and other surgical procedures or were transported to another hospital before surgery, those treated without surgical intervention, and those who had inconclusive pathology reports were excluded from the study. We gathered data on patient demographics, preoperative laboratory values, signs and symptoms in ED, and final pathological diagnosis. After collecting the data needed, AS and PAS were calculated according to defined previously in the literature (5).

Statistical analysis

The summary statistics were reported as median with interquartile range (IQR) and percentages (%), as appropriate. The Shapiro-Wilk test and histograms were conducted to identify the distribution patterns of continuous variables. Mann-Whitney U test was used to compare continuous variables, and Pearson's chi-square test was performed for categorical variables. Odds ratios (OR) of univariate analyses with 95% confidence intervals (CI) and Wald test statistics were recorded. Then, the goodness-of-fit measures of regression models and collinearity issues between variables were examined for multivariate analysis. The correlation coefficient value > 0.6, tolerance value < 0.1, and variance inflation factor (*VIF*) > 10 for a variable resulted in it being removed from the regression model. Then, the receiver operating characteristic (ROC) curve analysis was performed to identify cut-offs for true AA compared to a normal appendix. Contingency tables were used for the fitted regression model`s diagnostic utility metrics following. In all tests, $p < 0.05$ was accepted as the statistically significant cut-off value. We performed statistical analysis using Jamovi software (version 1.1.5.0; https://jamovi.org) and Statistical Package for Social Sciences (SPSS version 26). *The STARD 2015 guidelines for reporting diagnostic accuracy studies* were used as a reference while preparing for this report (7).

Results

During the study period, a total number of 87 patients were diagnosed with acute appendicitis, and 27 cases were excluded (16; treated conservatively, 5; transferred to another hospital, 6; without enough data). Finally, 60 patients were included in the statistical analysis. 45 (75%) patients had pathologically confirmed AA (**Figure 1**).

The patients` median age was 13 (IQR: 5), and 39 patients (65%) were male. No statistically significant difference was found between groups concerning age or sex. ($X^2_{(1)} = 1.20$, *p=0.27*; $U_{(15, 45)} = 334.5$, *p= 0.96, respectively*). CRP and WCC levels were significantly higher in AA cases than among the lymphoid hyperplasia (LH) group ($U_{(15, 45)} = 148.5$, ***p = 0.001***; $U_{(15, 45)} = 195$, ***p < 0.01***; respectively). The patients of the AA group had higher AS, PAS, and AD than in the LH group ($U_{(15, 45)} = 148.5$, ***p= 0.001***; $U_{(15, 45)} = 188.5$, ***p<0.01***; $U_{(15, 45)} = 100.5$, ***p<0.001***; respectively) (**Table 1**).

	Appendicitis –	Appendicitis +		Univariate regression analysis OR (95 % CI) *		Multivariate regression analysis OR (95 %CI) *	
	n = 15	n = 45				Model 1	Model 2
Male, n (%)	8 (53.3 %)	31 (68.9 %)	p=0.27	1.97 (0.59-6.40) NS	p=0.28	0.39 (0.04-4.43) NS	removed
CRP$^{\geq 0.8}$, n (%)	4 (26.7 %)	38 (84.4 %)	**p< 0.001**	14.9 (3.68-60.50) ***	**p< 0.001**	13.74 (1.31-151.1) *	8.58 (1.28-57.4) *
Age, median (IQR)	12 (11-15)	13 (9-15)	p=0.965	0.97 (0.83-1.13) NS	p=0.73	1.04 (0.71-1.43) NS	removed
AS, median (IQR)	5 (4- 5.5)	7 (6- 8)	**p= 0.001**	1.90 (1.22-2.96) **	**p= 0.001**	6.16 (1.35-27.03) *	2.27 (1.24-4.17) **
PAS, median (IQR)	6 (5- 7)	7 (6- 8)	**p= 0.009**	1.42 (1.01-2.01) *	**p= 0.036**	0.39 (0.11-1.35) NS	removed
AD, median (IQR)	6.5 (6.1- 6.9)	8.1 (7.9- 10)	**p< 0.001**	3.18 (1.54-6.50) **	**p< 0.001**	4.53 (1.46-14.73) **	4.36 (1.50-12.6) **

CRP: C- reactive protein, AD: appendix diameter, AS: Alvarado Score, PAS: Pediatric Appendicitis Score,CRP$^{\geq 0.8}$: dichotomous data of CRP according to 0.8 mg/dl cut off, IQR: interquartile range, P value: by Mann-Whitney U and Pearson's X^2 test, NS: nonsignificant (p>0.05), OR: Odds ratio, CI: Confidence interval, LR test: Omnibus Likelihood ratio test statistics and p value, *: p value (*: p<0.05, **: p<0.01, ***: p<0.001) of Wald test statistics of logistic regression analysis

Table 1: Baseline characteristics of variables

In this study, it is evaluated whether these four variables (CRP, AD, and CDRs (AS or PAS)) together create a new predictive score to find out AA. CRP values were transformed into a dichotomous version according to the 0.8 mg/dl cut-off calculated with ROC analysis to get an easily calculatable score. 38 (84.4%) cases in the AA group showed positive CRP values and 4 patients (26.7%) in the LH group with respect to the new cut-off value, indicating a statistically significant difference. We also performed univariate regression analyses that revealed significant predictive abilities for CRP, AS, PAS and AD to discriminate AA cases from LH cases (**Table 2)**.

Following the univariate regression analyses, correlation analyses were performed to prevent multi-correlation and no significant correlation was detected between variables except for AS and PAS. A strong correlation existed between AS and PAS (Spearman ***r: 0.87***, ***p < 0.0001***). Moreover, PAS revealed no meaningful predictive performance to differentiate AA in the multivariate logistic regression model including AS, CRP, and AD (OR: 0.39 (CI95%: 0.11-1.35), *p= 0.13*) or within the model excluding AS (OR: 1.63 (CI 95%: 0.96-2.77), *p= 0.07*). Consequently, PAS was removed from the final multivariate model. As a result, the multivariate logistic regression model including all variables minus PAS was able to differentiate the AA cases from the LH cases ($X2_{(5)} = 37.5$, ***p < 0.0001***). However, the backward procedures involving the removal of age and sex did not cause a significant change in pseudo R^2 (Nagelkerke's R^2: 0.688 to 0.688; McFadden's: 0.556 to 0.555) and provided a decrease in Bayesian Information Criterion (BIC; 54.5 to 46.4) and Akaike Information Criteria (AIC: 41.9 to 38.0). These results pointed out no difference between the two models in terms of predictive ability. Therefore, the final model was formed by CRP, AS, and AD parameters. According to the regression analysis, the patients with positive CRP (≥ 0.8 mg/dl) were 8.5 times more likely to have AA than negative ones. The model also showed that each one-mm increase in appendix diameter cause a 436 % increase in the likelihood of appendicitis.

Metrics	Value	95% CI		Appendicitis +	Appendicitis -	Total
Sensitivity	93.3%	81.7 – 98.6		42	1	
Specificity	93.3%	68.1 – 98.8	**Predicted +**	(RT: 95.6%)	(RT: 4.4%)	43
+ LR	14	2.1 – 93.15		(CT: 95.6%)	(CT: 13.3%)	(CT: %75)
- LR	0.07	0.02 – 0.2		3	14	
+PV	97.7%	86.3 – 99.6	**Predicted -**	(RT:13.3%)	(RT: 86.7%)	17
-PV	82.35%	60.8 – 93.4		(CT: 4.4%)	(CT: 86.7%)	(CT: %25)
Accuracy	93.3%	83.8 – 98.2	Total	45 (RT: 75%)	15 (RT: 25%)	60

+ LR: Positive Likelihood Ratio, - LR: Negative Likelihood Ratio, +PV: Positive Predictive Value, -PV: Negative Predictive Value, RT: Raw Total, CT: Column Total.

Table 2: Diagnostic metrics of final multivariate logistic regression model and 2x2 classification table of patients

In addition, one point increase in Alvarado Score provides a 227% rise in the likelihood of appendicitis. As a result, the final model accurately labeled 93.3 % of cases in our study. The final model equation was formed as below:

$$P = \frac{1}{1+e(-16.099 + (0.820 \times \mathbf{AS}) + (1.471 \times \mathbf{AD}) + (2.149 \times [0 \text{ if } CRP<0.8\ mg/dl,\ \ 1 \text{ if } \geq 0.8 \text{mg/dl}])}$$

According to final model equation of multivariate analysis, a simplified score was generated as: **[AS + (2 × AD) + (4 × {0; if CRP<0.8, 1 if ≥0.8}]**. Then, the diagnostic accuracy metrics for variables and the final model distinguishing AA were figured out with the use of the optimal cut-off values calculated through ROC analysis. The predictive performance of the final model (cut off ≥ 22.8) expressed a sensitivity of 93.3%, a specificity of 93.3%, a positive likelihood ratio (+LR) of 14, a negative likelihood ratio (-LR) of 0.07 and the area under the curve (AUC) was 0.942 (**Table 2-3)**. To predict acute appendicitis, AD had a slightly better diagnostic performance with an AUC of 0.851 compared to AS (0.780) and CRP (0.780). According to the data, both AS and PAS showed similar specificity (93.3%) and respective PPV of 92.9% and 94.1% at the cut-off point of 7. Also, based on the original ruling out cut-offs, AS had a sensitivity of 77.8%, an NPP of 52.4% and PAS had a sensitivity of 88.9%, an NPP of 28.6%. AS had statistically insignificant but slightly better predictive performance compared to PAS (AUC difference: 6%, (95% CI: -0.08% to 13%); Delongs' test, *p=0.084*). The predictive performance of variables and final model were summarised in **Table 3**, and ROC curve analysis comparisons of the final model, and variables were shown in **Figure 2.**

Discussion

This report studied a multivariate model including a combination of CDRs (AS and PAS), radiological, and laboratory findings to predict AA. The final multivariate model including these variables showed a diagnostic accuracy of 93.3% with a sensitivity of 93.3% and a specificity of 93.3%. Depending on a -LR of 0.07, a +LR of 14, low false negative (6.7%), and low false-positive rate (6.7%), we could recommend the model to rule in or out for acute appendicitis in children.

Previous studies showed that AS and PAS have high sensitivity but low specificity, limiting their use (7). In literature, various optimal cut-offs for these scores were reported in the diagnosis of AA (8, 9). In the prospective cohort study of Wu et al., AUCs of Alvarado score were observed higher than PAS (10). Systematic reviews and meta-analysis suggested that the typical AS is valuable in children to rule out AA (AS< 5; -LR: 0.04- and sensitivity: 0.99) (5, 11). Nevertheless, one of these concluded that the standard PAS cut-offs were inaccurate in distinguishing AA (PAS≥ 8; +LR: 8.1, PAS< 4; -LR: 0.13) (5). In our cohort, AS (≥5) and PAS (≥6) could not show acceptable diagnostic performance based on the best cut-off points calculated by ROC analysis. At the cut-off point of 8, the maximum +LR for AS and PAS were observed (+LR: 4.3, +LR: 5.3; respectively). The patients with an AS <3 or a PAS<4, both have a -LR of 0.16. These results are partially correlated with the current literature. AS and PAS appeared as only mediocre tests; they are not accurate enough for ruling in or out AA in children.

Metric	Model prediction	Appendix diameter	Alvarado score	PAS	C-reactive protein
AUC ±SE	0.942 ± 0.037	0.851 ± 0.061	0.780 ± 0.073	0.721 ± 0.076	0.780 ± 0.076
(95% CI)	(0.871- 1.000)	(0.731- 0.971)	(0.636- 0.924)	(0.571- 0.870)	(0.633- 0.927)
Cut off value	22.8	7.1 mm	5	6	0.8 mg/dl
Sensitivity (%)	93.3	88.9	88.9	86.7	84.4
Specificity (%)	93.3	80	46.7	33.3	73.3
+ PV (%)	97.7	93	83.3	79.6	90.5
- PV (%)	82.4	70.6	58.3	45.5	61.1
+ LR	14	4.44	1.6	1.3	3.2
- LR	0.07	0.13	0.23	0.4	0.21
P value	p< 0.0001***	p< 0.0001***	p= 0.0001**	p= 0.0018**	p= 0.0001**

SE: standard error, PAS: Pediatric Appendicitis Score, AUC: Area Under Curve, +PV: Positive predictive value, -PV: Negative predictive value, + LR: Positive likelihood ratio

Table 3: *Area under the curve measures and cut off values of receiver operating characteristic curve for prediction pathologically positive appendicitis*

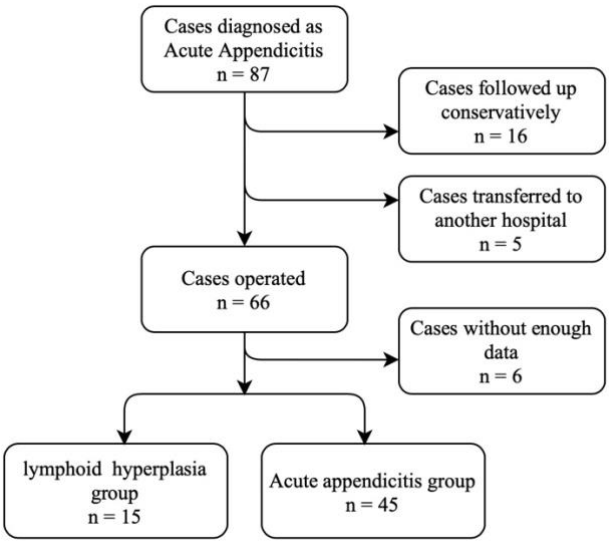

Figure 1: Flow chart of patients` selection and outcome.

C-reactive protein, leukocytes, and neutrophils are widely investigated laboratory markers in AA. They have been reported as predictors of appendicitis; however, they are not accurate for diagnosing or ruling out AA on their own (12-14). According to a recent meta-analysis, only a combination of CRP (≥ 3 mg/dl) and WCC (≥ 12000) achieved a +LR of 4.36. In the same report, WCC < 10000 showed the best value of -LR (0.21) but not enough to rule out AA (5). Another recent study that included 1391 patients reported that a combination of CRP, WCC, and leucocytosis has a strong discrimination ability (14). This study analyzed only CRP as a predictor of AA as the Alvarado score included the others. We observed a +LR of 3.2 for CRP (≥ 0.8 mg/dl) which is consistent with current literature (15). Therefore, CRP was not precise enough to rule in AA.

In the modern era, presurgical radiologic imaging is now routine in most circumstances. US is positioned as a first-line imaging tool for suspicion of AA in children; however, the accuracy of US is strongly related to operator experience and patients` body status (4). In this regard, several studies reported different results of the diagnostic metrics for the diagnosis of acute appendicitis (8, 15-22). Also, it was reported that repeated US protocols, US plus PAS or AS, and US in selected patient groups were able to reach the sensitivity up to 100% (7, 8, 15, 18, 20, 22-24). It is a known fact that larger appendix diameters (non-compressible, greater than 6 mm) increase the likelihood of appendicitis (15, 20, 23). However, Wu et al. suggested that lymphoid hyperplasia might be observed in cases that have a non-compressible appendix 6-8 mm in diameter (19). In our cohort, appendix diameter less than 6 mm significantly rule out appendicitis (-LR:0.0, NPV:100%, sensitivity: 100%) but not specific enough to differentiate NAs alone (specificity: 20%, PPV: 79%). According to ROC analysis, AD greater than 7.1 mm is the best cut-off with limited diagnostic accuracy (+LR:4.4, -LR:0.13). Multivariate analysis showed that each 1 mm increase in AD raises the likelihood of AA by 4.36 times (OR: 4.36) and a 1 mm decrease provides a 78% reduction to harbor appendicitis (OR: 0.22) which is compatible with current literature (16). Several reports have suggested that using CT over US could minimize the number of negative appendectomies (1, 7, 20, 24). However, US first protocols using CDRs are extensively favored in many centers to avoid radiation exposure (1, 7, 17, 21, 25). In this work, we established that PAS, AS, AD, and CRP, individually, and AS, AD, and CRP in combination, are valuable predictors of appendicitis.

In our cohort, applying the model that included these variables could have saved 14 (93.3% of NA group) cases from avoidable surgeries and the negative appendectomy rate (NAR) would have been significantly reduced (25% to 1.7%).

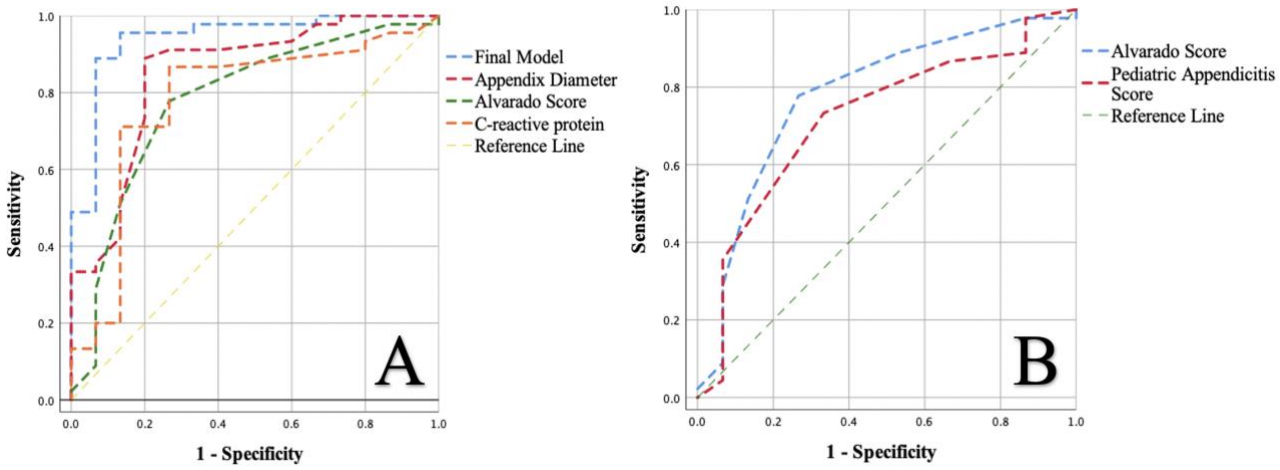

Figure 2: Receiver operating characteristic curve of multivariate regression model prediction, CRP, AD, and AS for acute appendicitis: A. Comparison of ROC curves between AS- PAS: B.

Moreover, none of the three false-negative cases had signs of complicated or even suppurative appendicitis. Therefore, we could suggest using the model in the decision-making of the treatment strategy.

Limitations

This study's first and foremost limitation was its retrospective nature, which may result in bias, especially in collecting data. The lack of an external or internal validation cohort because of the small sample size is the second most mattering limitation that might cause optimism about our findings. As such, the results should be validated in larger cohorts before accepting them globally. Third, this study's NAR was slightly higher than the rate in the current literature. However, this is thought to not be an actual limitation for this study, as cases of lymphoid hyperplasia have been accepted as negative appendicitis and several studies have reported similar or even higher NARs (normal appendix and lymphoid hyperplasia) (1, 7, 23). Meanwhile, the post-ultrasound NAR is known to be higher than the post-CT NAR (17). Furthermore, a conservative follow-up is also an important factor in decreasing NAR, but this may not be feasible in settings with limited resources. There were only two paediatric surgeons in the study's institute and the related region during the study period. Hence, surgical treatment was selected as a safer and more definitive choice in most cases.

Conclusion

In conclusion, C-Reactive Protein, AS, PAS, or appendix diameter should not be used individually to diagnose AA in children. However, using them together can aid the diagnosis or exclusion of acute appendicitis and may provide a significant reduction in the negative appendectomy rate.

Conflict of Interest: The authors declare no conflict of interest regarding this study.

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Authors' Contribution: Contributions of authors were listed in brackets following the associated sections of the study: Literature search (AÇ), study design (AÇ, MA), supervision and quality control (AÇ), data collection (MA), statistical analyses (AÇ), drafting the manuscript (AÇ). All authors were concerned in the writing and crucial revision of the manuscript and approved the last version. AÇ and MA take the whole responsibility for the paper.

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Ethical Statement: Approval was obtained from Rize Scientific Research Review Commission (Date: 06.01.2021 Number: E-64247179-799). All authors declared that they follow the rules of Research and Publication Ethics.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Evaluations of Risk Factors Related to Covid-19 Disease in Healthcare Professionals

Sağlık Çalışanlarında Covid-19 Hastalığına Bağlı Risk Faktörlerinin Değerlendirilmesi

Funda Çoktaş[1], Fatma Sarı Doğan[2], Tuba Cimilli Öztürk[2], Fatma Şimşek Ceviz[3]

ABSTRACT

Aim: The most prominent victims of the Covid-19 pandemic are healthcare workers. The increasing workload in hospitals and daily exposure to a disease factor threaten the health of healthcare professionals and the community. With this study, we aimed to investigate the risk factors in terms of infection of healthcare workers who are exposed to the disease during the health service delivery to Covid-19 patients, and whether current infection control measures are effective.

Materials and Methods: A case-control study was conducted with a questionnaire for healthcare workers diagnosed with Covid-19 and non-infected healthcare workers working in a Fatih Sultan Mehmet Training and Research Hospital in Istanbul in Istanbul.

Results: In the study in which 127 healthcare workers participated, the average duration of experience in the profession was found to be higher in cases compared to controls (p = 0.011). The rate of taking prophylactic drugs after high-risk exposure to Covid-19 patients was significantly higher in the case group compared to controls (p=0,001).

Conclusion: Healthcare workers with more experience in the profession appear to be at greater risk of Covid-19 infection and high-risk unprotected exposure may be associated with higher infection rates. Three days of prophylactic hydroxychloroquine after high-risk contact with a Covid-19 patient is not effective in preventing the disease.

Keywords: Covid-19, healthcare workers, risk factors, infection control, personal protective equipment

ÖZ

Amaç: Covid-19 pandemisinin en belirgin mağdurları sağlık çalışanlarıdır. Hastanelerde artan iş yükü ve her gün bir hastalık etkenine maruz kalmak, sağlık çalışanlarının ve toplumun sağlığını tehdit etmektedir. Bu çalışma ile Covid-19 hastalarına sağlık hizmeti sunumu sırasında hastalığa maruz kalan sağlık çalışanlarının enfeksiyon açısından risk faktörlerini ve mevcut enfeksiyon kontrol önlemlerinin etkili olup olmadığını araştırmayı amaçladık.

Gereç ve Yöntemler: İstanbul Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi'nde çalışan Covid-19 tanılı sağlık çalışanlarına ve enfekte olmayan sağlık çalışanlarına anket ile vaka kontrol çalışması yapılmıştır.

Bulgular: Çalışmaya 127 sağlık çalışanı katıldı. Meslekte ortalama deneyim süresi vaka grubunda daha yüksek bulundu (p = 0.011). Covid-19 hastalarına yüksek riskli maruziyet sonrası profilaktik ilaç alma oranı kontrollere göre vaka grubunda anlamlı olarak daha yüksekti (p=0,001).

Sonuç: Meslekte daha fazla deneyime sahip sağlık çalışanları, Covid-19 enfeksiyonu riski altında görünmektedir ve yüksek riskli korunmasız maruziyet, daha yüksek enfeksiyon oranları ile ilişkili olabilir. Covid-19 hastasıyla yüksek riskli temastan sonra üç günlük profilaktik hidroksiklorokin, hastalığı önlemede etkili değildir.

Anahtar Kelimeler: Covid-19, sağlık çalışanları, risk faktörleri, enfeksiyon kontrolü, kişisel koruyucu ekipman

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Introduction

The new type of coronavirus, which emerged in Wuhan, China, in December 2019, spread worldwide. In March 2020, World Health Organization (WHO) declared a pandemic, and the disease was named “Covid-19” disease (1). It is thought to be transmitted by fluids, through contaminated surfaces, or with direct contact (2,3). It is important to evaluate the risk factors for Covid-19 disease of healthcare workers (HCW) who come into contact with Covid-19 patients and are exposed to the disease agent, to detect the transmission method of the virus and to prevent future infections of healthcare workers and hospital-acquired virus spread (4). It is supported by studies that, the use of personal protective equipment (PPE) and education on infection control measures reduce the infection spread and certain types of exposure (endotracheal intubation, aspiration, etc.) increase the risk of infection 5. Demographic characteristics of HCW, working conditions at workplaces, training, and practices regarding infection control measures, and pre-existing diseases are potential risk factors.

In this study, we aim to evaluate the risk factors for transmission of infection among HCWs who come into contact with Covid-19 patients and are exposed to the virus. In addition, the effectiveness of current infection control measures as a secondary goal was examined.

Material and Methods

Our study was conducted as a single-center, case-control study comparing healthcare workers exposed to Covid-19 patients with and without a diagnosis of Covid-19 disease, in the form of a survey study. During the Covid-19 pandemic period, between March-July 2020, healthcare workers in the İstanbul Fatih Sultan Mehmet Training and Research Hospital, who were exposed to Covid-19 patients and to surfaces contaminated by patients' secretions and diagnosed with Covid-19 disease and agreed to be volunteers were included in the study. The number of cases was determined according to the number of HCWs diagnosed with Covid-19 during the study period. The number of controls was determined according to WHO's case-control study protocol. It was targeted to include at least two controls for each number of cases 4. The control group was formed by a random matching method from HCW who worked under the same conditions and status as the case group and who did not have an infection in the specified period.

Contact with a suspected or confirmed Covid-19 patient for more than 15 minutes or contact with their belongings is defined as “exposure”. The case group consisted of HCWs who were working in the Fatih Sultan Mehmet Training and Research Hospital during the study period and were involved in the treatment of pandemic patients. In our study, cases with positive Covid-19 PCR test results or cases diagnosed as Covid-19 with lung imaging findings and clinical symptoms are included in the scope of confirmed Covid-19 cases. The control group consisted of HCW who were actively working in the same hospital during the pandemic period and in contact with the same group of patients who did not have Covid-19 disease. Those who did not give consent to participate in the study and those who had missing data were excluded from the study. Those who were determined as a case in the study and described a close contact with a confirmed Covid 19 outside of work within 14 days were also excluded from the study. To be used in our study, a unique questionnaire was prepared again, based on the questionnaire questions in the WHO's case-control study protocol (4).

NCSS (Number Cruncher Statistical System) program was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage, minimum, maximum) were used while evaluating the study data. The conformity of the quantitative data to the normal distribution was made using the Shapiro-Wilk test and graphical examinations. Student-t-test was used to compare two groups of normally distributed quantitative variables, and Mann-Whitney U was used to compare two groups of non-normally distributed quantitative variables. Pearson chi-square test, Fisher's exact test, and Fisher-Freeman-Halton exact test were used to compare qualitative data. Statistical significance was accepted as $p<0.05$.

Approval for the study was obtained with the permission of the Ministry of Health Covid-19 Scientific Research Platform with the number x-2020-06-18T16_35_47.xml and the permission of the Clinical Research Ethics Committee of Fatih Sultan Mehmet Training and Research Hospital, numbered 2020/13.

Results

The study was conducted between 10 July and 30 August 2020 in Fatih Sultan Mehmet Training and Research hospital with 127 participants. Of these, 43 were cases diagnosed with Covid-19, and 84 were healthy participants. Eight of the participants, identified as cases, were excluded from the study because Covid-19 was detected in one of the households 14 days before the diagnosis of the disease. The final total number of cases was 35 and the number of controls was 84.

The distribution of the descriptive characteristics of the participants is shown in Table 1. Of the 119 participants, 62% (n=74) were female and 38% (n=45) were male. The mean age of the HCW participating in the study was 31.78±7.66 years. There was no statistically significant difference

between the age and gender distributions of the cases according to the groups (p>0.05).

			Groups		
		Total	Cases (n=35)	Control (n=84)	P value
Age	*Min-Max (Median)*	20-54 (30)	20-52 (34)	20-54 (29)	[a]***0,055***
	Mean±Sd	31,78±7,66	33,91±7,88	30,89±7,43	
	<35 Age	80 (67,2%)	19 (54,3%)	61 (72,6%)	[b]***0,052***
	≥35 Age	39 (32,8%)	16 (45,7%)	23 (27,4%)	
Gender	**Female**	74 (62,2%)	24 (68,6%)	50 (59,5%)	[b]***0,354***
	Male	45 (37,8%)	11 (31,4%)	34 (40,5%)	
Educational level	**Primary**	15 (12,6%)	7 (20,0%)	8 (9,5%)	[b]***0,291***
	High school	19 (16,0%)	5 (14,3%)	14 (16,7%)	
	University	85 (71,4%)	23 (65,7%)	62 (73,8%)	
Job in hospital	**Physician**	32 (26,9%)	7 (20,0%)	25 (29,8%)	[b]***0,477***
	Nurse	47 (39,5%)	14 (40,0%)	33 (39,3%)	
	Other	40 (33,6%)	14 (40,0%)	26 (31,0%)	
Hospital unit	**Emergency&Surgical**	91 (76,5%)	28 (80,0%)	63 (75,0%)	[b]***0,558***
	Internal Medicine&Others	28 (23,5%)	7 (20,0%)	21 (25,0%)	
Hospital unit	**Emergency Medicine**	51 (42,9%)	16 (45,7%)	35 (41,7%)	[b]***0,684***
	All other units	68 (57,1%)	19 (54,3%)	49 (58,3%)	
Length of employment in profession	*Min-Max (Median)*	0,25-30 (5)	0,5-30(6,5)	0,25-29 (4)	[d]***0,011****
	Mean±Sd	7,16±6,38	8,79±6,39	6,48±6,28	
Length of employment in the hospital	*Min-Max (Median)*	0,1-25 (3)	0,5-20 (5)	0,1-25 (3)	[d]***0,053***
	Mean±Sd	4,78±4,35	5,44±3,92	4,51±4,51	
Daily working time	**≤12 hours**	72 (60,5%)	23 (65,7%)	49 (58,3%)	[b]***0,453***
	>12 hours	47 (39,5%)	12 (34,3%)	35 (41,7%)	
Monthly working hours during the pandemic	**≤160 hours**	37 (31,1%)	10 (28,6%)	27 (32,1%)	[c]***0,673***
	160-200 hours	57 (47,9%)	16 (45,7%)	41 (48,8%)	
	≥200 hours	25 (21,0%)	9 (25,7%)	16 (19,0%)	
Special education on health care for Covid-19 patients	**Yes**	56 (47,1%)	15 (42,9%)	41 (48,8%)	[b]***0,553***
	No	63 (52,9%)	20 (57,1%)	43 (51,2%)	
Education on infection control measures	**Yes**	84 (70,6%)	24 (68,6%)	60 (71,4%)	[b]***0,755***
	No	35 (29,4%)	11 (31,4%)	24 (28,6%)	
Training on the use of personal protective equipment	**Yes**	105(88,2%)	30 (85,7%)	75 (89,3%)	[e]***0,550***
	No	14 (11,8%)	5 (14,3%)	9 (10,7%)	
Type of training received on the use of personal protective equipment	**Narrative**	71 (67,0%)	18 (60,0%)	53 (69,7%)	[b]***0,337***
	Training with video	56 (52,8%)	16 (53,3%)	40 (52,6%)	[b]***0,948***
	Practical training	25 (23,6%)	5 (16,7%)	20 (26,3%)	[b]***0,292***

[a]*Student-t Test* [b]*Pearson Chi-Square Test* [c]*Fisher Freeman Halton Test*
[d]*Mann Whitney U Test* [e]*Fisher's Exact Test *p<0,05*

Table 1. *Distribution of descriptive characteristics of the groups*

While the average professional experience period of the group was 8.79 years in the case group, it was determined as 6.48 years in the control group. The total working time of the case group was higher than the control group, and a statistically significant difference was found (p=0.011; p<0.05). In the case group, the working duration at the hospital of the cases was also higher (although not statistically significant) compared to the participants in the control group (5.44 years in the case group, 4.51 years in the control group; p=0.053; p>0.05). The comparisons of the questions in which the rate of compliance with the practices related to infection control measures are shown in Table 2. There was no statistical difference between the participants in terms of applying infection control measures and using PPE when necessary (p>0.05). The comparison of the case and control groups in terms of exposure and contact characteristics of Covid-19 patients is shown in Table 3. There was no statistical difference between the case and control groups in terms of compliance with the precautions related to infection control (p values are given in Table 3). Participants were compared in terms of chronic disease, continuous drug use, smoking, and prophylactic drug use after exposure to Covid-19 patients. 83% of the participants did not have any chronic disease and 84% of the participants did not use any medication. Twentyseven people stated that they had a chronic disease. Of them, 7 had asthma, and 7 had hypertension or heart disease. 23% of the case group and14% of the control group had a chronic disease. However, there is no significant difference between the groups (p:0.255). While the rate of continuous use of any drug was 26% in the case group, it was 12% in the control group, but it was not found to be statistically significant (p:0.061). The rate of cigarette or other tobacco products used was 32% in total, and there was no difference between the case and control groups (p>0.05). 34% of the patients declared that they had used prophylactic drugs (Hydroxychloroquine was advised by the Turkish Ministry of

Health guidelines at that time) after exposure to Covid-19 patients in the case group.

		Total	Group		P value
			Cases (n=35)	Control (n=84)	
		n (%)	n (%)	n (%)	
Performing hand hygiene when necessary	Every time	92 (77,3)	28 (80,0)	64 (76,2)	[b]0,651
	Frequently	27 (22,7)	7 (20,0)	20 (23,8)	
Method of performing hand hygiene before touching the patient	Alcohol-based disinfectant	42 (35,3)	9 (25,7)	33 (39,3)	[b]0,158
	Using non-sterile gloves	56 (47,1)	15 (42,9)	41 (48,8)	[b]0,553
	Washing with soap and water	67 (56,3)	20 (57,1)	47 (56,0)	[b]0,905
Method of performing hand hygiene after touching the patient	Alcohol-based disinfectant	47 (39,5)	10 (28,6)	37 (44,0)	[b]0,116
	Changing gloves	38 (31,9)	10 (28,6)	28 (33,3)	[b]0,612
	Washing with soap and water	88 (73,9)	27 (77,1)	61 (72,6)	[b]0,608
Availability of hand sanitizer in the work area	Yes	109 (91,6)	31 (88,6)	78 (92,9)	[e]0,478
	No	10 (8,4)	4 (11,4)	6 (7,1)	
Whether or not standard infection control measures are taken in contact with each patient	Yes, always	78 (65,5)	26 (74,3)	52 (61,9)	[c]0,161
	Frequently	34 (28,6)	6 (17,1)	28 (33,3)	
	Rarely	4 (3,4)	1 (2,9)	3 (3,6)	
	Never	1 (0,8)	1 (2,9)	0 (0,0)	
	No idea	2 (1,7)	1 (2,9)	1 (1,2)	
Using personal protective equipment when necessary	Yes, always	80 (67,2)	26 (74,3)	54 (64,3)	[b]0,290
	Frequently	39 (32,8)	9 (25,7)	30 (35,7)	
Availability of adequate personal protective equipment in the hospital	Yes	91 (76,5)	26 (74,3)	65 (77,4)	[b]0,866
	No	11 (9,2)	4 (11,4)	7 (8,3)	
	No idea	17 (14,3)	5 (14,3)	12 (14,3)	
Insufficient equipment	Medical face mask	12 (24,5)	2 (14,3)	10 (28,6)	[e]0,466
	Face shield	19 (38,8)	3 (21,4)	16 (45,7)	[b]0,115
	Respirator mask	25 (51,0)	7 (50,0)	18 (51,4)	[b]0,928
	Protective clothing	37 (75,5)	9 (64,3)	28 (80,0)	[e]0,285

[b]Pearson Chi-Square Test [c]Fisher Freeman Halton Test [e]Fisher's Exact Test

Table 2. Comparison of compliance with infection control measures

This rate was 3.6% in the control group and the difference between the two groups was statistically significant (p=0.001; p<0, 01). The most common symptoms related to the disease are, respectively; anorexia (71%), taste disturbance (66%), and fatigue (60%) were recorded. The incidence of symptoms is given in Figure 1.

Discussion

In this study, we aimed to show that various demographic characteristics, experience and working conditions of employees, infection control measures, and medical background are effective in the occurrence of Covid-19 disease in HCW who are heavily exposed to viral agents during the delivery of healthcare services to Covid-19 patients. In this study, we have seen that there is no significant difference between age, gender, education level, duty and unit in the hospital, working hours, infection control measures, and training in the use of personal protective equipment among HCW in terms of the risk of Covid-19 infection. In addition, no factor would create a significant difference between cases and controls in compliance with infection control measures. On the contrary, the period of experience in the profession was longer in the case group and the difference was found statistically significant. In terms of PPE (personal protective equipment) usage during exposure to Covid-19 patients, we did not detect a factor that would significantly increase the risk of infection. We found that prophylactic drug use was higher in the case group. In the literature, there are different results from the studies investigating the risk factors of HCW for Covid-19 disease. In a systematic review, it was stated that the use of PPE and infection control precautions education reduced the risk of infection, while some exposures such as intubation, which were in direct contact with the patient or their secretions, increased this risk. In a survey study, it was concluded that the unit worked, occupational group, gender, and age made a significant difference. They found that the infection rate was higher in nurses younger than 45 years of age who are working in units other than the frontline clinics, compared to doctors older than 45 years of age working in "frontline" clinics (6). In this study, we did not find a significant difference between those under 35 years of age and those over 35 years of age. Due to the low number of participants above the age of 45 (8.4%) in our study, we performed the statistical analysis of the age factor by comparing those under 35 years of age and above, therefore the result may be different. The majority of the cases in our study were female. In our literature research on the subject, we found that the number of female cases was higher in some studies, and on the other hand, in some studies, the male case number was higher or that there was no distributional difference in both genders (7-10). This may be due to the difference in gender distribution of HCW who were employed in different countries and different health

			Group		
		Total n (%)	Cases n (%)	Control n (%)	P-value
Number of exposures to Covid 19 patients	≤50 people	37 (35,9)	14 (43,8)	23 (32,4)	[b]**0,539**
	51-500 people	44 (42,7)	12 (37,5)	32 (45,1)	
	>500 people	22 (21,4)	6 (18,8)	16 (22,5)	
Close contact with patients	Frequently	78 (65,5)	23 (65,7)	55 (65,5)	[c]**0,971**
	Occasionally	19 (16,0)	5 (14,3)	14 (16,7)	
	Rarely	14 (11,8)	5 (14,3)	9 (10,7)	
	Never	8 (6,7)	2 (5,7)	6 (7,1)	
Duration of close contact with patients	<5 minutes	46 (41,1)	11 (32,4)	35 (44,9)	[b]**0,285**
	5-15 minutes	34 (30,4)	10 (29,4)	24 (30,8)	
	>15 minutes	32 (28,6)	13 (38,2)	19 (24,4)	
Personal protective equipment used during contact with patients	Medical face mask	91 (81,3)	29 (87,9)	62 (78,5)	[b]**0,245**
	Face shield	84 (75,0)	25 (75,8)	59 (74,7)	[b]**0,905**
	Respirator mask	79 (70,5)	25 (75,8)	54 (68,4)	[b]**0,433**
	Protective clothing	103(92,0)	32 (97,0)	71 (89,9)	[e]**0,278**
Masks used during close contact with patients	Medical face mask	25 (22,1)	9 (27,3)	16 (20,0)	[c]**0,644**
	Respirator mask	55 (48,7)	17 (51,5)	38 (47,5)	
	Medical face mask & Respirator mask	32 (28,3)	7 (21,2)	25 (31,3)	
	Not sure	1 (0,9)	0 (0,0)	1 (1,3)	
If gloves are worn, post-contact removal	Yes	110(96,5)	31 (93,9)	79 (97,5)	[c]**0,328**
	No	2 (1,8)	1 (3,0)	1 (1,2)	
	Not sure	2 (1,8)	1 (3,0)	1 (1,2)	
Hand hygiene <u>before</u> contact with the patient	Every time	73 (62,4)	25 (73,5)	48 (57,8)	[c]**0,203**
	Frequently	35 (29,9)	6 (17,6)	29 (34,9)	
	Rarely	8 (6,8)	3 (8,8)	5 (6,0)	
	Never	1 (0,9)	0 (0,0)	1 (1,2)	
If hand hygiene was performed <u>before</u> contact with the patient, which method was preferred?	Alcohol-based disinfectant	39 (34,2)	11 (32,4)	28 (35,0)	[b]**0,768**
	Washing with soap and water	48 (42,1)	16 (47,1)	32 (40,0)	
	Both of them	27 (23,7)	7 (20,6)	20 (25,0)	
Hand hygiene <u>after</u> contact with the patient	Every time	94 (80,3)	29 (85,3)	65 (78,3)	[c]**0,604**
	Frequently	20 (17,1)	4 (11,8)	16 (19,3)	
	Rarely	3 (2,6)	1 (2,9)	2 (2,4)	
If hand hygiene was performed <u>after</u> contact with the patient, which method was preferred?	Alcohol-based disinfectant	28 (23,9)	7 (20,6)	21 (25,3)	[b]**0,707**
	Washing with soap and water	55 (47,0)	18 (52,9)	37 (44,6)	
	Both of them	34 (29,1)	9 (26,5)	25 (30,1)	
Whether or not any procedure that generates aerosols is performed	Yes	63 (52,9)	16 (45,7)	47 (56,0)	[b]**0,594**
	No	47 (39,5)	16 (45,7)	31 (36,9)	
	Not sure	9 (7,6)	3 (8,6)	6 (7,1)	
The state of being in the environment while performing any procedure that generates aerosols	Yes	90 (75,6)	26 (74,3)	64 (76,2)	[c]**1,000**
	No	23 (19,3)	7 (20,0)	16 (19,0)	
	Not sure	6 (5,0)	2 (5,7)	4 (4,8)	
Use of personal protective equipment by those in the environment while performing an aerosol-generating procedure	Medical face mask	75 (77,3)	22 (81,5)	53 (75,7)	[b]**0,543**
	Face shield	83 (85,6)	24 (88,9)	59 (84,3)	[e]**0,751**
	Respirator mask	82 (84,5)	20 (74,1)	62 (88,6)	[e]**0,114**
	Protective clothing	91 (93,8)	25 (92,6)	66 (94,3)	[e]**0,669**

[b]Pearson Chi-Square Test [c]Fisher Freeman Halton Test [e]Fisher's Exact Test

Table 3. Exposure and contact characteristics of Covid-19 patients

facilities. There are different results in the literature regarding the risk posed by the unit in terms of Covid-19. In a study in which employees were examined as "frontline" and "non-frontline", it was reported that "non-frontline" employees had a higher risk of Covid19 (6). Ran et al. reported that those working in high-risk departments such as chest diseases, infectious diseases, and intensive care were infected more than in other low-risk departments(11). Zheng et al. found that employees in emergency and acute care clinics were infected more compared to intensive care and operating room personnel(12).

In our study, the units worked were categorized as emergency services, internal medicine units, surgical units, and other units. 43% of the cases in our study were employees of the emergency department, but there was no significant difference between cases and controls in terms of units worked. During the pandemic period, most of the

healthcare professionals in our hospital worked alternately in the Covid-19 polyclinic and services, so this may have been affected by the change of place of duty. In different studies evaluating the risk factors of Covid-19 in HCW, it has been stated that the most frequently affected group of HCW is

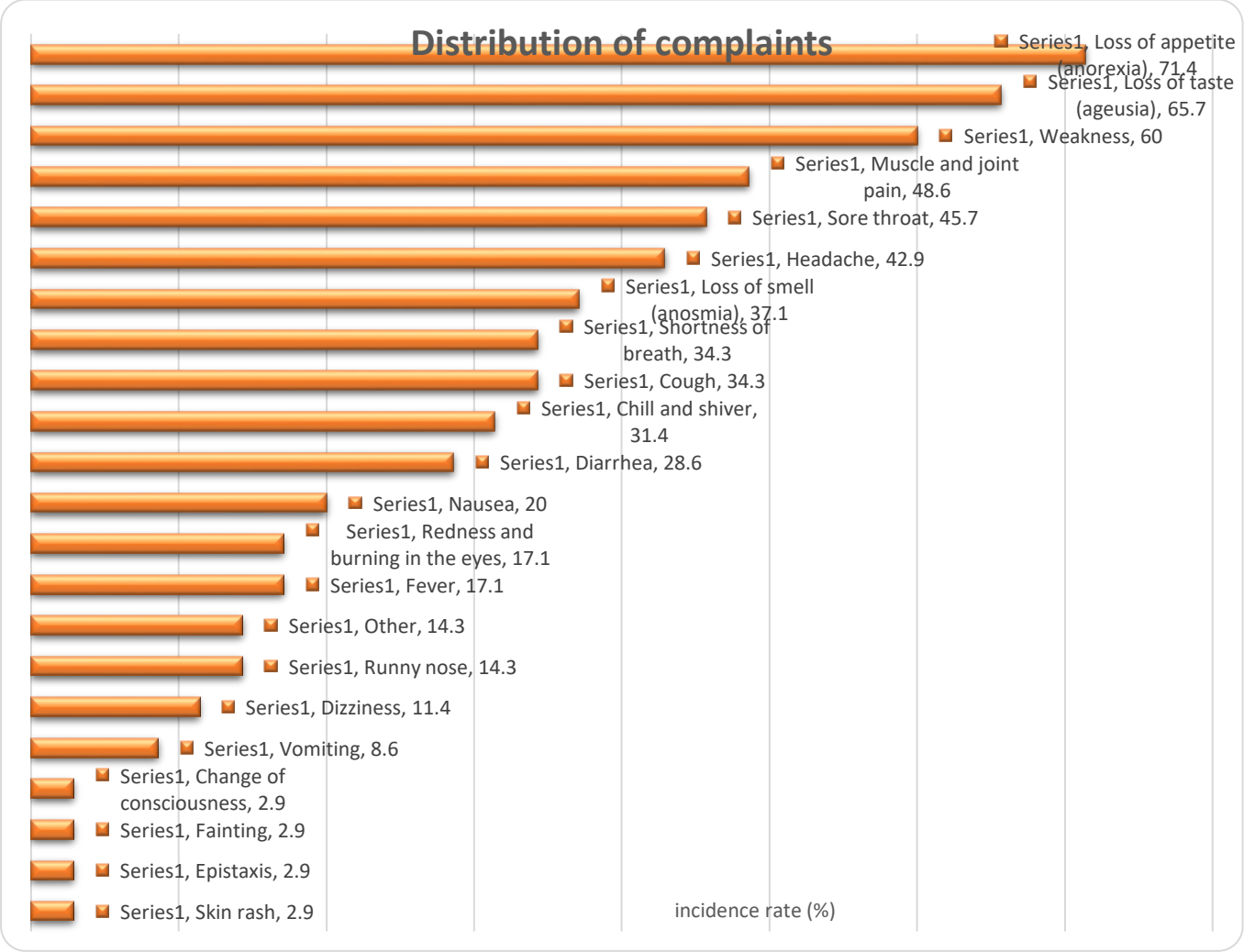

Figure 1. Symptoms in healthcare workers diagnosed with Covid-19

nurses (6, 8, 13, 14). In our study, 40% of the cases were nurses, 20% were doctors, 40% were other HCW and no statistically significant difference was observed between occupational groups.

We thought that there is a higher risk of infection for nurses because they have longer and more intense contact with the patient during patient care and treatment. Zhang et al. determined that 89% of the HCW who participated in the survey had sufficient knowledge about Covid-19 and 89.7% of them followed the correct practices for Covid-19. It has been seen that there is a significant relationship between the level of knowledge and attitudes, and it has been determined that those with higher levels of knowledge have higher self-confidence in combating the virus(15). While a positive relationship was found between careful removal of PPE and education level,

there was a negative relationship with the median work experience period. Similarly, in the study of Chatterjee et al., the risk of Covid-19 was found to be higher in those who worked for more than 1 year compared to those who worked for less than 1 year (odds ratio 2.5 p: <0.001) (10). In this

study, the professional experience period was higher in the case group. One of the reasons may be that experienced professionals are less careful about the use of PPE, as the result of this study indicates. Again, in this study, the rate of stating that they felt tired was lower in HCW with 5-9 years of experience compared to those with less than 5 years of experience, and this was attributed to the fact that those with more professional experience were experienced in coping with extraordinary situations. Those with more professional experience may have taken more roles in the frontline in the fight against the pandemic, and this may have increased the risk of infection. It has been reported in

the literature that close contact with the patients and not using appropriate PPE during contact are among the most

important factors in the transmission of infection in HCW who have had Covid-19. In our study, we did not detect any difference between groups related to not using any of the PPEs. While the proportion of patients in the case group stating that they wore a respirator mask while performing aerosol-generating procedures was 74%, it was 88.6% in the control group, but there was no statistically significant difference (p: 0.114). Considering the transmission dynamics of respiratory tract infections and previous studies, the importance of PPE and infection control measures is an indisputable fact. The fact that there was no significant difference between case and control groups regarding infection control measures and the use of PPE in our study may be due to the subjective data of the survey study. The rate of participants who stated that they did not comply with the rules regarding infection control measures and the use of PPE was very low. It is possible that the participants did not honestly answer the questions on this subject. Algorithms were created by the Ministry of Health to combat the pandemic in our country. These algorithms were updated frequently in light of current studies. According to the "Management Algorithm" published by the Ministry of Health, Risk Categories for Covid-19 Contact Health Workers, which were also applied in our hospital, were determined. Employees who fit the description were given hydroxychloroquine prophylactically for 3 days at that time. Those who were given preventive medication were those who had “high-risk contact” with a suspected COVID-19 patient; that is, when HCW who were in intense contact with the patient without wearing a medical mask or N95 mask, and the Covid-19 patient they met, also did not wear a medical mask (19). In this study, due to the post-exposure prophylactic drug use of healthcare professionals, in line with the algorithm, the rate of using protective drugs after exposure to Covid-19 patients was higher in the case group (34%) than in the control group (3.6%). This result supports that the use of 3 days of prophylactic hydroxychloroquine is not effective in preventing the disease.

Limitations

One of the most important limitations of our study is that it is single-centered and the data obtained cannot be generalized to the entire population of HCW. The small number of cases makes a statistical analysis of some parameters impossible, it is possible to study with a multicenter and larger sample to give better results. Since the symptoms of HCW were questioned only in the case group, statistical analysis could not be performed for the control group. A study can be planned to determine which symptoms better indicate the likelihood of Covid-19 infection in HCW, who were exposed to Covid-19 patients with various symptoms, but Covid-19 was not detected in comparison with Covid-19 was detected. Due to the low sensitivity of the Covid-19 diagnostic test in the early stages of the disease, patients diagnosed with tomography were also included in the study, which is one of the limitations of the study. The fact that it is a survey study and therefore the data obtained are subjective information stated by the participants by their self-evaluation limits the reliability of the results, especially regarding the use of PPE and compliance with infection control measures, most of the participants stated that they always followed the rules and no meaningful results could be obtained.

Conclusion

In this cross-sectional study, in which we investigated the risk of infection transmission after exposure to COVID-19 patients in HCW, our findings were that the working time of the employees in the profession increased the probability of infection. We did not detect any difference in other demographic characteristics indicating increased risk. HCWs who are more experienced in the profession seem to be at higher risk of Covid-19 infection. In addition, high-risk unprotected exposure may be associated with higher infection rates in HCW. Three days of prophylactic hydroxychloroquine after high-risk contact with Covid-19 patients were not effective in preventing the disease.

Conflict of Interest: The authors declare no conflict of interest regarding this study.

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Authors’ Contribution: TCÖ and FSD designed and carried out the research, coordinated the study, participated in all of the research. FÇ, FSD, FCŞ collected the data and prepared the manuscript. FSD and TCÖ assisted in designing and conducting the research. FÇ, FDS, and FCŞ participated in manuscript preparation and performed the statistical analysis. TCÖ and FSD corrected the English manuscript and revised further statistical data. All authors have read and approved the content of the manuscript.

Ethical Statement: Approval for the study was obtained with the permission of the Ministry of Health Covid-19 Scientific Research Platform with the number x-2020-06-18T16_35_47.xml and the permission of the Clinical Research Ethics Committee of Fatih Sultan Mehmet Training and Research Hospital, numbered 2020/13. All authors declared that they follow the rules of Research and Publication Ethics.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Retrospective Analysis of Patients with Emergency Hemodialysis Indication in the Emergency Department

Acil Serviste Acil Hemodiyaliz Endikasyonu Konulan Hastaların Retrospektif Analizi

Çiğdem Özpolat[1], Erhan Altunbaş[1]

ABSTRACT

Aim: Emergency hemodialysis is a life-saving treatment. There is a limited number of descriptive studies in the literature on patients who applied to the emergency department due to chronic renal failure or acute renal failure and then received hemodialysis with the need for urgent hemodialysis. In this study, it was aimed to determine the demographic characteristics, clinical and laboratory findings of the patients who applied to the Marmara University Faculty of Medicine Emergency Medicine Clinic with various complaints and were given an indication for emergency dialysis as a result of the tests.

Material and Methods: Patients who applied to the emergency department of our hospital and received hemodialysis after consultation after emergency medicine physician evaluation were included in this study. Demographic, clinical and laboratory data of the patients, dialysis indications and subsequent processes were collected retrospectively. The data were analyzed with the SPSS 22.0 program.

Results: A total of 380 patients were included in our study. 56.6% of the patients were male and their mean age was 63.3±17.3 years. 71.7% of the patients have known chronic renal failure and 67% of them enter the routine hemodialysis program. The most common presenting complaint is shortness of breath. 75% of the patients received hemodialysis within the first 12 hours. An emergency catheterization was required in 54.2% of the patients. Most of the patients required hospitalization in the service or intensive care unit, and 3 patients died.

Conclusion: Most of the patients who need emergency hemodialysis require hospitalization and these patients constitute the critical patient group. Larger descriptive studies are needed to better recognize these patients and to control their diseases before the emergency service process.

Keywords: Hemodialysis, chronic renal failure, acute renal failure

ÖZ

Amaç: Acil hemodiyaliz hayat kurtarıcı bir tedavidir. Literatürde kronik böbrek yetmezliği ya da akut böbrek yetmezliği nedeniyle acil servise başvuran ve sonrasında acil hemodiyaliz ihtiyacı ile hemodiyalize alınan hastalarla ilgili tanımlayıcı çalışma sınırlı sayıdadır. Bu çalışmada Marmara Üniversitesi Tıp Fakültesi Acil Tıp Kliniğine çeşitli şikâyetlerle başvuran ve yapılan tetkikleri neticesinde acil diyaliz endikasyonu konulan hastaların demografik özellikleri, klinik ve laboratuvar bulgularının belirlenmesi amaçlandı.

Gereç ve Yöntemler: Bu çalışmaya hastanemiz acil servisine başvuran, acil tıp hekimi değerlendirmesinin ardından konsültasyon sonrası hemodiyalize alınan hastalar dahil edildi. Hastaların demografik, klinik ve laboratuvar verileri, diyaliz endikasyonları ve sonraki süreçleri retrospektif olarak toplandı. Veriler SPSS 22.0 programı ile analiz edildi.

Bulgular: Çalışmamıza toplam 380 hasta alınmıştır. Hastaların %56,6'sı erkek olup yaş ortalamaları 63,3±17,3'dir. Hastaların %71,7'sinin bilinen kronik böbrek yetmezliği olup %67'si rutin hemodiyaliz programına girmektedir. En sık başvuru şikayeti nefes darlığıdır. Hastaların %75'i ilk 12 saat içinde hemodiyalize alınmıştır. %54,2 hastaya acil kateter takılması gerekmiştir. Hastaların büyük çoğunluğuna servis ya da yoğun bakım yatışı gerekmiş olup 3 hasta exitus olmuştur.

Sonuç: Acil hemodiyalize alınması gereken hastaların çoğunluğuna yatış gerekmekte olup bu hastalar kritik hasta grubunu oluşturmaktadır. Bu hastaların daha iyi tanınması ve acil servis süreci öncesi hastalıklarının kontrol altına alınması için daha geniş tanımlayıcı çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Hemodiyaliz, kronik böbrek yetmezliği, akut böbrek yetmezliği

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Giriş:

Acil servisler, akut böbrek hasarı (ABH) olan hastaların en sık tedavi edildiği yerlerin başında gelir. Kronik böbrek yetmezliği ve onunla ilgili hastalıklar önemli bir halk sağlığı problemidir. Renal Replasman Tedavisi (RRT) yöntemlerine bakıldığında %85 hemodiyaliz, %10 periton diyalizi, %5 böbrek nakli olduğu görülür. Hemodiyaliz(HD) programında olan ve acil medikal tedavi gerektiren hastalarda mortalite oranları belirgin oranda yüksektir (yaklaşık %50) (1). Rutin diyaliz programında olmayan takipli kronik böbrek yetmezliği hastalarının acil diyaliz ihtiyaçları ve akut böbrek yetmezliği gelişen hasta grubunun acil servis başvurularında saptanan acil hemodiyaliz ihtiyacı da katıldığında acil servisin önemli ve kritik bir hasta grubunu bu hastalar oluşturmaktadır. Bu da acil servislerde ek hasta birikimine sebep olmaktadır (2-5).

Bu konuda mevcut sınırlı çalışmadan anlaşıldığı kadarıyla bu hasta grubunun acil serviste yoğun tıbbi kaynak kullanımı ve bunun sonucunda da yüksek maliyetlere sebep olduğu anlaşılmaktadır. Bu durumu azaltmak için bu hasta grubunun acil servis başvuru kliniklerini anlamak ve başvuru öncesinde nasıl önlemler alınabileceğini belirlemek gereklidir.

Bu çalışmada Marmara Üniversitesi Tıp Fakültesi Acil Tıp Kliniğine çeşitli şikâyetlerle başvuran ve yapılan tetkikleri neticesinde acil diyaliz endikasyonu konulan hastaların demografik özellikleri, klinik ve laboratuvar bulgularının belirlenmesi ve sonlanımlarının tespiti amaçlanmıştır. Literatürde akut böbrek yetmezliği ya da kronik böbrek yetmezliği olan hastaların akut alevlenmeleri sonucu acil hemodiyaliz ihtiyacı oluşması, bunun sonucunda acil servise başvurmaları ile ilgili tanımlayıcı çalışma sayısı sınırlıdır. Bu çalışmamızda, bu hasta grubunun tanımlayıcı verilerinin sunulması amaçlanmıştır.

Gereç ve Yöntemler:

Çalışmamız, Marmara Üniversitesi Pendik Eğitim Araştırma Hastanesi Acil Tıp Anabilim Dalında Mart 2020-Mart 2021 tarihleri arasında acil servise başvuran ve nefroloji uzmanı tarafından değerlendirilerek acil hemodiyaliz endikasyonu konulan hastaların demografik ve klinik özelliklerini incelemek amaçlı retrospektif olarak tasarlanmıştır. Marmara Üniversitesi Etik Komitesi'nden etik kurul onayı (Etik Onay Tarih/ No: 01.04.2002.612) alınmıştır.

Hastanemiz üçüncü basamak bir araştırma hastanesi olup, acil servise yılda yaklaşık 500.000 hasta başvurmaktadır. Başvuran tüm hastalar Acil Tıp Kliniği hekimlerince değerlendirilmekte ve Acil Tıp uzmanlarının gerekli gördüğü hastalara ilgili dal hekimlerinden konsültasyon istenmektedir. Hastanemizde 24 saat hemodiyaliz merkezi açık bulunup, yoğun bakım ünitelerinde de yatak başı hemodiyaliz yapılabilmektedir.

Çalışmaya acil servise belirtilen süreler içinde başvuran, acil tıp hekimleri tarafından hemodiyaliz ihtiyacı olduğu düşünülüp nefroloji konsültasyonu istenen, nefroloji uzmanı tarafından acil hemodiyaliz endikasyonu konulan ve/veya acil servisteki takipleri sırasında hemodiyalize alınan, 18 yaş üstü hastalar çalışmaya dahil edilmiştir. Yeterli klinik bilgiye ulaşılamayan hastalar çalışma dışı bırakılmıştır.

Çalışma verileri olarak hastaların demografik özellikleri, komorbid hastalıkları, başvuru şikâyetleri, başvuru laboratuvar verileri, acil hemodiyaliz endikasyonu, acil serviste diyaliz kateteri takılıp takılmadığı ve hastaların sonlanımları kayıt altına alınmıştır. Veriler hastane bilgi işlem sistemi taranarak kaydedilmiştir. Acil hemodiyaliz endikasyonları metabolik asidoz, hipervolemi, ciddi üremik bulgular, elektrolit bozukluğu ve diğer nedenler olarak gruplanmıştır. Acil servis başvurusundan sonraki 12 saat içinde hemodiyaliz ünitesine alınan hastalar acil hemodiyaliz hastaları olarak tanımlanmıştır. Takipleri sırasında hemodiyaliz ihtiyacı doğup, 12 saat sonra diyalize alınan hastalar ayrı bir grup olarak kaydedilmiştir. Hastaların sonlanımı acil servisten taburcu, servise yatış ve yoğun bakım ünitesine yatış olarak tanımlanmıştır.

Verilerin analizinde SPSS 22.0 (SSPSS Inc., Chicago, IL, USA) programları kullanılmıştır. Sürekli değişkenler medyan değeri ve çeyrekler dilimi aralığı (İKA) ile kategorik değişkenler ise frekans ve yüzde olarak raporlanmıştır.

Bulgular

Çalışmamıza % 43,4'ü (n:165) kadın olmak üzere toplamda 380 hasta dahil edilmiştir. Hastaların yaşları 18,5 ile 97,0 arasında değişmekte olup, ortalama 63,3±17,3 yıldır.

Hastaların komorbiditelerine baktığımızda 181'inin (%47,6) diyabetes mellitus (DM), 252'sinin (%66,3) hipertansiyon (HT), 39'unun (%10,3) geçirilmiş serebrovasküler olay (SVO), 141'inin (%37,1) koroner arter hastalığı(KAH), 47'sinin (%12,4) kronik obstrüktif akciğer hastalığı(KOAH) ve 45'inin (%11,8) malignite hikayesi olduğu saptanmıştır.

Hastaların başvuru laboratuvar değerleri Tablo 1'deki gibidir. Hastaların 270'inin (%71,7) bilinen kronik böbrek yetmezliği (KBY)'si mevcut olup, bu hastaların 89'unun hemodiyaliz öyküsü bulunmamaktadır.

	Medyan	Minimum	Maksimum
pH	7,29	6,890	7,59
BE(mmol/L)	-6,70	-27,80	9,50
BUN(mg/dl)	73,50	7	332
HCO3(mmol/L)	18,50	3,20	79,50
Laktat(mmol/L)	1,80	0,40	14,80
Kreatinin(mg/dl)	6,23	0,790	18,98
Potasyum(mEq/L)	5,35	2,60	8,90
Hemoglobin(g/dl)	9,70	4,10	18,90
MCV(fl)	90,35	19,30	113,40

*BE: Base excess, BUN: Blood Urea Nitrogen, HCO3: Bicarbonate

Tablo 1. Başvuru Laboratuvar Değerleri

Hastaların başvuru şikayetlerine bakıldığında 139'u (%36,6) nefes darlığı, 70'i (%18,4) kusma, 35'i (%9,2) bilinç bulanıklığı, 29'u (%7,6) idrarda azalma, 17'si (%4,4) ateş, 20'si (5,3'ü) rutin diyalizine girememe şikayetiyle başvurmuştur.

Hastaların 285'ine (%75'i) acile başvurularının ilk 12 saatinde acil diyaliz endikasyonları konulup hemodiyalize alınmıştır.

Bu hastaların 94'ünün (94/285) acildeki takipleri sırasında tekrar diyalize alınmaları gerekmiştir. Acile başvuruda ilk 12 saatte diyaliz endikasyonu konulmayıp acil servisteki takiplerinde diyaliz ihtiyacı gelişen 95 (%25) hasta vardır.

206 (%54,2) hastaya acil serviste kateter katılması gerekmiştir. Bu hastaların 168'i ilk 12 saatte acil diyaliz ihtiyacı gelişen hastalar idiler. Bu 206 hastanın 99'unun KBY hikayesi varken 107'sinin bulunmamaktadır. Acil serviste kateter takılmayan hastaların 3'üne diyaliz ünitesinde kateter takılmıştır.

Hastaların 221'inin (%58,2) servise, 66'sının (%17,4) yoğun bakım ünitesine (YBÜ) yatışı yapılmıştır. 90 (%23,7) hasta hemodiyaliz sonrası acil servisten taburcu edilirken 3 hasta (%0,8) exitus olmuştur.

Tüm hastaların acil hemodiyaliz endikasyonları değerlendirildiğine metabolik asidoz 28 (%7,4), ciddi üremik bulgular 111 (%29,2), hipervolemi 86 (%22,6), elektrolit bozuklukları 56 (%14,7), rutin 83 (%21,8), diğer nedenler 16 (%4,2) olarak kaydedilmiştir. Acil hemodiyaliz endikasyonlarının ayrıntılı dağılımı Tablo 2'dedir.

	KBY hikayesi (-) (n=110)	KBY hikayesi (+) (n=270)	KBY (+) rutin diyaliz (-) (n= 89)	KBY (+) rutin diyaliz (+) (n= 181)
Metabolik Asidoz, n (%)	14 (12,7)	14 (5,2)	10 (11,2)	4 (2,2)
Ciddi Üremik Bulgular, n (%)	52 (47,3)	59 (21,8)	45 (50,6)	14 (7,7)
Hipervolemi, n (%)	11 (10)	75 (27,8)	23 (25,9)	52 (28,7)
Elektrolit bozuklukları, n (%)	18 (16,4)	38 (14,1)	10 (11,2)	28 (15,5)
Rutin, n (%)	0 (0)	83 (30,7)	0 (0)	83 (45,9)
Diğer Nedenler, n (%)	15 (13,6)	1(0,4)	1 (1,1)	0 (0)

KBY: Kronik Böbrek Yetmezliği

Tablo 2. Acil Hemodiyaliz Endikasyonları Dağılımı

Tartışma

Çalışmamızda acil servise başvurup acil servisteki takipleri sırasında hemodiyalize alınan hastalar incelenmiştir. Retrospektif olarak verileri alınan akut böbrek yetmezliği, kronik böbrek yetmezliği ya da kronik böbrek yetmezliğinin alevlenmesi sonucu gelişen akut olaylar sonucu acil hemodiyaliz kararı verilen ya da acil serviste başka bir şikayet nedeniyle izlemi devam ederken hemodiyaliz endikasyonu konulan hastalar çalışma grubunu oluşturmuştur.

Çalışmamız sonucunda acil servisten hemodiyalize alınan hastalarda erkeklerin daha fazla olduğu saptanmıştır. Bu sonuç Aktepe ve arkadaşlarının Türkiye'den yaptıkları acil hemodiyalize alınan hastaların incelendiği çalışma ile benzerdir (6). Yine çalışmamızdaki yaş aralığı ve ortalama yaş verileri de bu çalışma ile benzerdir. Benzer cinsiyet ve yaş dağılımı yine Türkiye'den rutin hemodiyalize alınan hastaların acil hemodiyaliz endikasyonlarını inceleyen Gülle ve arkadaşlarının çalışmasıyla da örtüşmektedir (7).

Hastalarımızın %47.6'sında altta yatan DM hastalığı mevcut olup bu sonuç da hemodiyaliz hastalarının acil servis başvurularını ve hastane yatışlarını inceleyen Zhang ve arkadaşlarının çalışması ile aynıdır (8). Ama bizim çalışmamızda daha fazla hastanın altta yatan HT hastalığı olduğu saptanmıştır. Bu oran da Gülle ve arkadaşlarının çalışmasıyla benzerdir. Yine bu hasta grubunda sık altta yatan hastalıklar olan KAH, SVO, KOAH gibi hastalıklar da mevcut diğer çalışmalarla benzerlik göstermektedir (6-9).

Hasta grubumuzdaki 380 hastanın 270'inin bilinen KBY'si olup 110 hastaya acil serviste hemodiyaliz endikasyonu konmasına rağmen bilinen böbrek yetmezliği nedeniyle takibi olmayan hastalardı. Bu oran yaklaşık %28.94 olup Aktepe ve arkadaşlarının Türkiye'den yaptıkları çalışma ile de uyumludur. Çalışmamız retrospektif dizaynda olup daha önceki kan ya da poliklinik takipleri hastalardan öğrenilemediğinden bu 110 hastanın kaçının akut gelişen bir böbrek yetmezliği kaçının kronik böbrek yetmezliği zemininde gelişen akut bir olay olduğuna dair elimizde net veriler bulunmamaktadır. 2016 Yılı Ulusal Nefroloji, Diyaliz ve Transplantasyon Kayıt Sistemi Raporuna göre, ülkemizde hemodiyalize başlanan hastaların %66.44'ü acil olarak hemodiyalize alınmıştır. Bu hastalarda en sık diyalize başlama sebepleri hipervolemi (%40) ve hiperpotasemidir (%25) (10). Acil servise takibi hiç yapılmamış acil hemodiyaliz endikasyonu konan hasta oranının toplamın yaklaşık ⅓'ü olması hastaların düzenli sağlık takiplerini yeterince yaptırmadıkları şeklinde yorumlanabilir.

Çalışmamızda hastaların acil servise başvuru şikayetleri incelendiğinde en sık şikayetin nefes darlığı olduğu saptanmıştır. Bazı çalışmalarda en sık görülen şikayet bulantı ve kusma olsa da hastaların sık başvuru şikayetleri olan nefes darlığı, bulantı ve kusma, bilinç bulanıklığı, ateş, diyalizine girememe çoğu çalışmada ortaktır (6,7,11). Bu noktada KBY'si bilinen ve rutin hemodiyaliz programında olan hastalarda da benzer şikayetlerin olması yetersiz diyaliz alımları konusunda uyarıcı olabilir.

Çalışmamızda hastaların %54.2'sine acil serviste diyaliz kateteri takılması gerekmiştir. Böyle bir veri değerlendirmesine diğer çalışmalarda rastlanmamıştır. Bu yüksek oran acil servisin yoğunluğu için de ek bir yük oluşturmaktadır. Ayrıca acil hemodiyaliz kateteri takılmasındaki komplikasyonlar hazırlıklı sürece ve elektif şartlara göre her zaman daha yüksektir (12). Bu nedenle hemodiyalize alınması muhtemel hastaların daha iyi planlamasının yapılması bu komplikasyonların önüne geçecektir.

Hastaların hemodiyaliz sonrası süreçleri incelendiğinde büyük oranda hastane yatışı gerektirdiği çalışmamızda saptanmıştır. Bu hasta grubunun altta yatan çoğul hastalıklarının olması ve tedavi sürecinin daha uzun bir dönem için tekrar düzenlenmesi gerekmesi bu durumun altta yatan nedenlerindendir. Çalışmamızda 3 hasta exitus olmuştur. Acil hemodiyalize alınan hastalarda mortalite elektif şartlara göre çalışmalarda yüksek bulunmuştur (13).

Çalışmamıza katılan ve bilinen KBY'si olmayan hastaların acil hemodiyaliz endikasyonları daha çok üremik bulgular iken, bilinen KBY'si olan grupta hipervolemi daha fazla endikasyon teşkil etmiştir. Bektaş ve arkadaşlarının Türkiye'den yaptığı acil serviste akut böbrek yetmezliği(ABY) tanısı alan hastaların incelendiği çalışmada ABY hasta grubundaki acil diyaliz endikasyonları metabolik asidoz ve elektrolit bozuklukları olarak saptanmıştır (11). Bu konuda literatürde yeterli çalışma bulunmamaktadır.

Çalışmamızın en önemli kısıtlılığı, geriye dönük bir çalışma olması ve verilerin hastane veri tabanından alınmasıdır. Bu

nedenle daha detaylı bir inceleme yapılamamıştır. Şu anki merkezi ölüm bildirim sistemi(ÖBYS) hasta veri tabanı incelemelerinde hastaların mortalite tarihlerine de ulaşılamadığından uzun dönem mortalite sonuçları da çalışma sonuçlarına eklenememiştir. Çalışmamızın görece küçük bir hasta popülasyonunda yapılması nedeni ile sonuçlar ile genelleme yapılması zor görülmektedir.

Sonuç

Sonuç olarak acil servise başvuran ve acil hemodiyaliz endikasyonu konan önemli miktarda hasta bulunmaktadır. Bu hastaların hemodiyalize alınmaları için kateter takılması dahil olmak üzere takipleri acil servisin yoğunluğu içinde yapılmaktadır. Acil hemodiyalize alınması gereken hastaların çoğunluğuna yatış gerekmekte olup bu hastalar kritik hasta grubunu oluşturmaktadır. Bu hastaların daha iyi tanınması ve acil servis süreci öncesi hastalıklarının kontrol altına alınması için daha geniş tanımlayıcı çalışmalara ihtiyaç vardır.

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Yazar Katkısı: ÇÖ, EA çalışmanın tasarımı, EA, ÇÖ verilerin toplanması, EA, ÇÖ verilerin yorumlanması, ÇÖ metnin yazılması, ÇÖ, EA kritik revizyonun yapılması konusunda ana katkı sağlamış ayrıca her yazar tüm aşamalarda belirli miktarda katkıda bulunmuştur.

Etik Onayı: Araştırma protokolü, Marmara Üniversitesi, Tıp Fakültesi Dekanlığı, Bilimsel Araştırmalar Etik Kurulu tarafından incelenip onaylanmıştır (Etik Onay Tarih/ No: 01.04.2002.612).
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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Evaluation of Brain Oxygenation by Near Infrared Spectroscopy in Healthcare Professionals Using Surgical and FFP2/N95 Masks

Cerrahi ve FFP2/N95Maske Kullanan Acil Servis Çalışanlarında Near Infrared Spectroscopy ile Beyin Oksijenizasyonunun Değerlendirilmesi

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ABSTRACT

Aim: The present study aimed to detect changes in brain oxygenation associated with the use of surgical and FFP2/N95 masks using the near infrared spectroscopy (NIRS) method.

Material and Methods: Volunteers wearing surgical masks were asked to sit upright for 30 minutes. Cerebral oxygen saturation values were measured at the 1st, 5th, and 30th minutes (group 1). The mask wearers were requested to return at the same time on the day following this procedure. In group 2, serial cerebral oxygen saturation values (SpO2) were obtained at the same time intervals as in group 1, but while the subjects were wearing FFP2/N95 masks.

Results: A statistically significant difference was found between the groups in the comparison of the values measured using NIRS at the 1st, 5th, and 30th minutes in group 1. According to the post-hoc analysis, this difference was due to discrepancies in NIRS measurements at the 1st minute and 30th minute and at the 5th minute and 30th minute. No statistically significant difference was found between the groups in the comparison of the values measured using NIRS at the 1st, 5th, and 30th minutes in group 2.

Conclusion: Neither surgical nor FFP2/N95 masks caused a clinically significant negative difference in brain oxygenation.

Keywords: Mask, oxygenation, near infrared spectroscopy, oxygen saturation, volunteers

ÖZ

Amaç: Bu çalışma, Near infrared spektroskopi (NIRS) yöntemini kullanarak cerrahi ve FFP2/N95 maskelerinin kullanımıyla ilişkili beyin oksijenasyonundaki değişiklikleri tespit etmeyi amaçladı.

Gereç ve Yöntemler: Cerrahi maske takan gönüllülerden 30 dakika dik oturmaları istendi. 1., 5. ve 30. dakikalarda (grup 1) serebral oksijen satürasyonu değerleri ölçüldü. Maske takanların bu işlemin ertesi günü aynı saatte gelmeleri istendi. Grup 2'de seri serebral oksijen satürasyonu değerleri (SpO2) grup 1 ile aynı zaman aralıklarında ancak denekler FFP2/N95 maskesi takarken elde edildi.

Bulgular: Grup 1'de 1., 5. ve 30. dakikalarda NIRS ile ölçülen değerlerin karşılaştırılmasında gruplar arasında istatistiksel olarak anlamlı fark bulundu. Post-hoc analize göre bu fark, 1. dakika ve 30. dakika ve 5. dakika ve 30. dakikada. Grup 2'de 1., 5. ve 30. dakikalarda NIRS ile ölçülen değerlerin karşılaştırılmasında gruplar arasında istatistiksel olarak anlamlı fark bulunmadı.

Sonuç: Ne cerrahi ne de FFP2/N95 maskeleri, beyin oksijenasyonunda klinik olarak anlamlı bir negatif farklılığa neden olmadı.

Anahtar Kelimeler: Maske, oksijenasyon, near infrared spectroscopy, oksijen saturasyonu, gönüllüler

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Introduction

In the face of a life-threatening pandemic, the mask has become the leading personal protective equipment to stop the spread of SARS-CoV-2 and to ensure the safety of patients and healthcare workers (1). Patients and healthcare professionals perform their daily activities with a mask for prolonged time periods (2). Medical masks have a negative impact on cardiopulmonary capacity, which significantly interferes with strenuous and physical activities. In addition, medical masks significantly impair the quality of life of the wearer (3). Masks are generally considered uncomfortable for regular use and may result discomfort due to not being worn properly (4, 5). However, when FFP2/N95 masks and surgical masks are compared, there is no significant difference in terms of the risk of not being worn at the workplace (6). In addition, adequate personal protective equipment is considered as the key to reducing the risk of adverse psychological consequences (7).

Near-infrared spectroscopy (NIRS) is a non-invasive technology that continuously monitors tissue oxygenation, especially that of the brain (8). The mechanism of NIRS (NIR: near-infrared; wavelength: 700-1100 nm) includes measurement of the amount of near-infrared light absorption by chromophore molecules (9). Cerebral NIRS has been reported to demonstrate silent periods of cerebral ischemia, thus playing an important role in maintaining brain function (10). Although NIRS has primarily been used for measurement of cerebral oxygenation during carotid endarterectomy and perioperative surgery, it can be used in case of shock and acute brain injury, and especially cardiopulmonary resuscitation (CPR) in emergency department. There is evidence to suggest that it can be helpful in detecting the return of spontaneous circulation during CPR (11).

Pulse oximetry measurement has limitations in hypoxic state. It is difficult to use in the presence of anemia, light interference, skin pigmentation, venous pulsations and low perfusion. Unlike peripheral oxygen saturation (SpO2), pulsatile flow measurement is also not required during NIRS measurement. It has also been shown that NIRS measurement provides earlier alert than pulse oximetry in hypoxic state (12, 13).

Although we struggle to control this pandemic and maintain an adequate supply of personal protective equipment, it is important to evaluate the effect of personal protective equipment on humans. Our study aimed to detect the changes in brain oxygenation associated with the use of surgical and FFP2/N95 masks using the NIRS method. To our knowledge, our study is the first of its kind to evaluate the effect of surgical and FFP2/N95 masks on brain oxygenation.

Material and Methods

This study was conducted in the emergency department of a training and research hospital between November 2020 and February 2021. Ethics committee approval was obtained from the hospital's ethics committee for the study, (ethics committee approval number: 18/1/2021-221426) and informed consent was obtained from all volunteers before the procedures.

Participants

Forty healthy emergency medicine staff between the ages of 18 and 42 years were included in the study. Volunteers who had chronic diseases or were pregnant were excluded from the study.

Study Protocol

We aimed to eliminate the demographic differences between the two groups by designing the study with the same volunteers. Hence, the same volunteers were included in the surgical mask group (group 1) and the FFP2/N95 mask group (group 2). All volunteers were asked to sleep at least 8 hours the night before the study and to arrive at the same time in the morning on the study day. Demographic data (age, gender, height, and weight) of the volunteers were recorded. On the first day, the volunteers wore a surgical mask and were asked to sit upright on a hospital stretcher for 30 min. Data on cerebral oxygen saturation, arterial tension, fingertip oxygen saturation, and heart rate measurements of volunteers wearing surgical masks were recorded at the 1st, 5th, and 30th min. The volunteers were asked to arrive at the same time on the following day to minimize any possible daily biological rhythm changes. At this second visit, the volunteers put on a FFP2/N95 mask. Cerebral oxygen saturation, arterial tension, fingertip oxygen saturation, and heart rate measurements were obtained at the same time intervals as that during the procedure in group 1. The typical and widely used disposable FFP2/N95 protective face masks (Era®, Korfez Is Güvenlik Malzemeleri San. Ve Tic Ltd Sti., Istanbul, Turkey) and surgical masks (Evony®, Hayat Kimya San. A.S. Istanbul, Turkey) with ear loops, were used in this study.

Cerebral Oxygen Saturation Measurement

A low frequency emitting source, such as a light emitting diode or a continuous intensity laser, and a detection device that can detect these low frequencies are used in NIRS measurements. During these measurements, data on fractional tissue oxygen extraction, which measures the balance between oxygen distribution and consumption in the tissue, is obtained. An INVOS 5100C cerebral/somatic oximeter (Covidien) with a near infrared cerebral oximetry system was used for cerebral oxygen saturation measurements using this measurement method. The

measurements were made with electrodes attached to the forehead and recorded continuously.

Statistical Analysis

Data obtained were analyzed with SPSS version 26.0. (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp). The normality of the data distribution was tested by Shapiro–Wilk test, histogram, and Q–Q Plot. Normally distributed continuous data were expressed as mean (± standard deviation), non-normally distributed continuous data as median (25%–75% interquartile range), and categorical data as frequency (%).

The dependent multiple group comparisons were made using repeated measures analysis of variance (ANOVA) for variables that met ANOVA conditions, and Friedman test for variables that did not meet ANOVA conditions. Bonferroni and Wilcoxon tests were used for post-hoc analysis, respectively, followed by application of Bonferroni correction.

A difference greater than 5% between the groups was considered clinically significant for NIRS measurements (14).

Results

A total of 40 volunteers were included in the study. Of these, 16 (40%) were women. The mean age of the volunteers was 28 years (± 5), their mean height was 172 cm (± 8), and their median weight was 69 kg (55–80). The basic descriptive characteristics of the volunteers are summarized in Table 1.

	Mean (SD) / n (%)	Median [%25-75 IQR]
Age	28.2 (5)	28.0 [25.0-30.0]
Sex (Female)	16 (40)	
Length (cm)	171.7(8)	
Weight (kg)		69.0 [55.25-79.75]
Body-Mass Index	23.4(3.9)	
Surgical mask group, vital values before intervention		
Systolic TA (mmHg)	118(11)	
Diastolic TA (mmHg)		75 [69-81]
Heart rate (beats per minute)	83(10)	
SpO_2		98 [97-99]
FFP2/N95 mask group, vital values before intervention		
Systolic TA (mmHg)	118(12)	
Diastolic TA (mmHg)		70 [65-76]
Heart rate (beats per minute)	81(11)	
SpO_2		98 [97-99]

Descriptive statistics were expressed as mean standard deviation and median (IQR) for metric variables. Categorical variables were presented as number (%). IQR: Interquartile range, TA: arterial tension

Table 1. Basic descriptive characteristics of volunteers

The mean NIRS measurements of group 1 at the 1st, 5th, and 30th min were 70 (± 9), 70 (± 8), and 68 (± 8), respectively, and those of group 2 were 70 (± 8), 69 (± 7), and 68 (± 8), respectively.

When the NIRS measurement values of group 1 at 1, 5, and 30 min were compared, a statistically significant difference was found (p = 0.001, repeated measures ANOVA). In the post-hoc analysis, it was observed that the difference was due to the difference between NIRS measurements at 1 min and 30 min and at 5 min and 30 min (p = 0.016 and p = 0.001, respectively, with Bonferroni correction applied).

When the 1st, 5th, and 30th min NIRS measurement values of group 2 were compared, no statistically significant difference was observed (p = 0.136, Repeated Measures ANOVA).

The primary outcome measures were summarized in Table 2.

	NIRS 1st minute Mean (SD)	NIRS 5th minute Mean (SD)	NIRS 30th minute Mean±SD	P value
Surgical Mask	70(9)	70(8)	68(8)	**.001***
FFP2/N95 Mask	70(8)	69(7)	68(8)	.136

Descriptive statistics were expressed as mean±standard deviation. P-values written in bold are statistically significant (P<.05).

* In the post-hoc analysis, it was seen that the difference was due to the NIRS measurements at 1st minute to 30th minute and from 5th to 30th minutes. (P=.016, P=.001 respectively, Bonferroni correction was applied).

Table 2. NIRS measurement values of surgical mask and FFP2 / N95 mask groups at 1st, 5th and 30th minutes

In group 1, the median oxygen saturation (SpO2) values for measurements made at 1, 5, and 30 min were 98 (97–99), 98 (97–98), and 98 (97–98), respectively, and those of group 2 were 98 (97-99), 98 (97-99), and 98 (97-99), respectively. No statistically significant difference was found among the within group SpO2 measurements of group 1 and 2 at the 1st, 5th, and 30th min (p = 0.279, p = 0.166, respectively) (Table 3).

	SpO_2 1st minute Median [%25-75 IQR]	SpO_2 5th minute Median [%25-75 IQR]	SpO_2 30th minute Median [%25-75 IQR]	P value*
Surgical Mask	98 [97-99]	98 [97-98]	98 [97-98]	.279
FFP2/N95 Mask	98 [97-99]	98 [97-99]	98 [97-99]	.166

Descriptive statistics were expressed as median [IQR]. IQR: Interquartile range

* Friedman test was used.

Table 3. SpO_2 measurement values of surgical mask and FFP2 / N95 mask groups at 1st, 5th and 30th minutes

The difference between before-the-intervention sPO2 and 30th minute sPO2 measurements was named ΔsPO2. The median ΔsPO2 of the surgical mask group was 0 (-1 to 1), and the median ΔsPO2 of the FFP2 mask group was 0 (0 to 1).

The mean heart rates of group 1 at the 1st, 5th, and 30th min were 83 bpm (79–88), 82 bpm (76–92), and 79 bpm (72–88), respectively, and those in group 2 were 80 bpm (73–88), 80

bpm (73–90), and 78 bpm (71–89), respectively. When the heart rates of group 1 at 1, 5, and 30 minutes were compared, a statistically significant difference was found (p = 0.048, Friedman test). However, in the post-hoc analysis performed for the heart rate differences between the 1st and 5th min, 1st and 30th min, and 5th and 30th min, no statistically significant difference was found after applying the Bonferroni correction (p = 1, p= 0.174, and p = 0.072, respectively, Wilcoxon test, with Bonferroni correction applied).

When the measured heart rate values of group 2 at the 1st, 5th and 30th minutes were compared, a statistically significant difference was found (p = 0.031, Friedman). However, in the post-hoc analysis performed for the heart rate differences between the 1st and 5th min, the 1st and 30th min, and 5th and 30th min, no statistically significant difference was found between the groups after applying Bonferroni correction (p = 1, p = 0.264, p = 0.090, respectively, Wilcoxon test, with Bonferroni correction applied) (Table 4).

	Heart rate 1st minute Median (%25-75 IQR)	Heart rate 5th minute Median (%25-75 IQR)	Heart rate 30th minute Median (%25-75 IQR)	P value
Surgical Mask	83 [79-88]	82 [76-92]	79 [72-88]	**.048***
FFP2/N95 Mask	80 [73-88]	80 [73-90]	78 [71-89]	**.031***

IQR: Interquartile range

* Although a significant difference was detected in the Omnibus test, no statistically significant difference was found in post hoc analyzes (Wilcoxon test was used.)

Table 4. Heart rate measurement values of surgical mask and FFP2 / N95 mask groups at 1st, 5th and 30th minutes

Discussion

NIRS is used for early and noninvasive detection of cerebral hypoperfusion. Particularly in patients with carotid artery stenosis, close monitoring is provided, and technical and medical interventions can be performed by using NIRS (15). Unlike other oximetric measurements, the NIRS oximeter does not require pulsatile or non-pulsatile blood flow (16). Measurements obtained during NIRS are expressed as %, and brain regional cerebral oxygen saturation (rSo2) median values in adult patients were found to be 66% (IQR 61-71) (17). The NIRS value falls and brain perfusion decreases with age, especially in individuals with cardiovascular diseases (18). In our study, the mean NIRS values of group 1 at the 1st, 5th, and 30th min were 70 (± 9), 70 (± 8), and 68 (± 8), respectively, and that of group 2 were 70 (± 8), 69 (± 7), and 68 (± 8), respectively. Although there was no statistically significant difference in the 1st, 5th, and 30th minute NIRS values of group 2, a statistically significant difference was found in these values in group 1. Even though the difference was statistically significant, it was not clinically significant (14). An experimental study conducted in healthy individuals, which was similar to our study, showed no decrease in brain oxygenation despite decreased oxygen supply and carbon dioxide elimination (19). Accordingly, we believe that neither the surgical mask nor the FFP2/N95 mask impairs brain perfusion within a short period of time.

No statistically significant difference was found in the SpO2 measurements within groups 1 as well as 2. In a study, although the use of masks in healthy young male volunteers caused a minimal decrease in SpO2 during an aerobic exercise for 75 min, the decrease was not found to be statistically significant (20). In another study conducted on 14 volunteers, no difference in SpO2 and an increased heart rate was observed among the no mask, surgical mask, and FFP2/N95 mask groups after exercise at a mean age of 59 years. The use of a mask was recommended even during exercise (21). In a study without a control group, the saturation levels of 25 oral surgeons were measured while they wore masks and performed surgeries, and the measurements were taken throughout the surgery, which lasted 20 min. The effects of underlying medical conditions, age, and gender were not evaluated, and the saturation levels were found to be 97.5% before the surgery and 94% after the surgery (22). In a study conducted on patients with chronic obstructive pulmonary disease, a significant decrease in SpO2 was observed even while walking with the FFP2/N95 mask (23).

The mean heart rates of the group 1 at the 1st, 5th, and 30th min were 83 bpm (79–88), 82 bpm (76–92), and 79 bpm (72–88), respectively, and that of group 2 were 80 bpm (73–88), 80 bpm (73–90), and 78 bpm (71–89), respectively. No statistically significant difference was found in either group. In similar studies, it has been determined that both types of masks had a minimal effect on heart rate, which was not statistically significant in healthy volunteers (20, 21). In particular, breathing resistance, temperature, tension, and general discomfort are the factors that have the greatest impact on subjective perception. These factors can increase the heart rate relatively (3). A study comparing FFP2/N95 and surgical masks in 5 male and 5 female volunteers found that a small physiological effect became detectable during moderate to high intensity exercise in FFP2/N95 mask wearers (24, 25). Although there are studies reporting that there may be increases in heart rate, especially in those with comorbidities, the findings suggest that the widespread use of masks may be reasonable even for those with underlying heart disease, lung disease, and other comorbidities (22, 23, 25).

Limitations

The most important limitation of the study was that it was performed in healthy and young volunteers. Therefore, it may be difficult to generalize our results to elderly patients with comorbidities, particularly those with respiratory and

cardiovascular diseases. In this research, we evaluated wearing mask for the first 30 minutes. The effect of longer duration of wearing mask and wearing mask with movement was not investigated in this article.

Conclusion

Neither surgical masks nor FFP2/N95 masks caused a clinically significant negative difference in brain oxygenation according to our measurements. There was no clinically significant difference between the surgical mask and the FFP2/N95 mask in terms of SpO2 reduction and heart rate increase. Further studies are needed on the long-term use of these masks and in populations at risk for impaired cerebral perfusion (e.g., underlying lung disease, cardiac disease, or cerebrovascular disease).

Conflict of Interest: The authors declare no conflict of interest regarding this study.

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Authors' Contribution: designing the study, ÖB, ŞEA, BÇ, EBK; interpretation of data, EBK, AK, MMİ, MEF, HK; writing the manuscript, ÖB, ŞEA; performing critical revision AK, BÇ, ŞEA, ÖB

Ethical Statement: Approval was obtained from Karabuk University Non-invasive Clinic Researchs Ethics Committee (Number:2021/426). All authors declared that they follow the rules of Research and Publication Ethics.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Comparison of Inferior Vena Cava Collapsibility and Clinical Scales for the Assessment of Dehydration in Children With Diarrhea

İshalli Çocuklarda Dehidratasyonun Değerlendirilmesi için Inferior Vena Kava Kollapsibilite Indeksi ve Klinik Ölçeklerin Karşılaştırılması

Asım Enes Özbek[1], Onur Karakayalı[2]

ABSTRACT

Aim: There is no fair predictor to determine the dehydration level in children. The objective of the study was to investigate the efficacy and reliability of the inferior vena cava collapsibility index by the use of ultrasonography to assess volume status for pediatric patients with acute gastroenteritis.

Material and Methods: This prospective study was conducted in a tertiary care hospital between December 2016 and October 2017. Patients were assessed with clinical dehydration scores and their inferior vena cava collapsibility indices were measured. The weights of the children were measured prior to treatment and one week after the improvement of symptoms. The correlation between the dehydration percentage seven days after symptom relief and inferior vena cava collapsibility index and also the correlation between clinical dehydration scale results and dehydration percentage seven days after symptom relief were determined.

Results: 190 patients enrolled in the study. 130 (68.4%) patients were found to be mildly dehydrated while 60 (31.6%) patients' dehydration levels remained moderate to severe, and of these 18 (9.4%) were severely dehydrated. The area under the curve for the caval index was determined as 0.985 (95% CI; 0.959-1). The IVCCI cutoff of >58 produced 98.3% sensitivity, 88.5% specificity, 0.79 PPV, 0.99 NPV, 1.2 +LR, and 1.01 -LR. The AUC for moderate-to-severe dehydration was 0.778 (CI 95%: 0.703-0.854) according to the CDC and 0.764 (95% CI:0.669-0.889) for the Gorelick scale.

Conclusion: USG-guided IVC index measurement is an effective and reliable method for determining the dehydration severity in pediatric patients present with acute gastroenteritis.

Keywords: Acute gastroenteritis, inferior vena cava collapsibility index, pediatrics

ÖZ

Amaç: Çocuklarda dehidratasyon düzeyini belirlemek için objektif öngörücü değerlendirme testleri ile ilgili çalışmala sınırlıdır.Çalışmanın amacı, akut gastroenteritli pediatrik hastalarda volüm durumunu değerlendirmek için ultrasonografi kullanılarak inferior vena kava kollapsibilite indeksinin etkinliğini ve güvenilirliğini araştırmaktı.

Gereç ve Yöntemler: Bu prospektif çalışma, Aralık 2016 ile Ekim 2017 tarihleri arasında üçüncü basamak bir hastanede yürütülmüştür. Hastalar klinik dehidratasyon skorları ile değerlendirildi ve sonografik inferior vena kava kollapsibilite indeksi ölçüldü. Çocukların ağırlıkları tedaviden önce ve semptomların düzelmesinden bir hafta sonra ölçüldü. Semptomların düzelmesinden yedi gün sonra dehidratasyon yüzdesi ile vena kava inferior kollapsibilite indeksi arasındaki korelasyon ve ayrıca klinik dehidratasyon skalası sonuçları ile semptomların iyileşmesinden yedi gün sonra dehidratasyon yüzdesi arasındaki korelasyon belirlendi.

Bulgular: Çalışmaya 190 hasta alındı. 130 (%68,4) hastanın hafif dehidrate olduğu, 60 (%31,6) hastanın dehidratasyon düzeylerinin orta-şiddetli düzeyde kaldığı ve bunların 18'inin (%9,4) ciddi dehidrate olduğu tespit edildi. Kaval indeks için eğri altında kalan alan 0,985 (%95 GA; 0.959-1) olarak belirlendi. >58 IVCCI kesme değeri %98,3 duyarlılık, %88,5 özgüllük, 0,79 PPV, 0,99 NPV, 1,2 +LR ve 1,01 -LR üretti. Orta-şiddetli dehidratasyon için EAA, CDC'ye göre 0,778 (CI %95: 0,703-0,854) ve Gorelick ölçeği için 0,764 (%95 GA:0,669-0,889) olmuştur.

Sonuç: Akut gastroenterit ile başvuran pediatrik hastalarda dehidratasyon şiddetini belirlemede USG eşliğinde IVC indeks ölçümü etkili ve güvenilir bir yöntemdir.

Anahtar Kelimeler: Akut gastroenterit, inferior vena cava kollapsibilite indeksi, pediyatri

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Introduction

Diarrhea-related dehydration is a common problem in children. Delayed administration of treatment for dehydration may lead to severe fluid and electrolyte imbalance, acute renal failure, and even death (1). Diarrhea complicated by dehydration is the second leading cause of death among children under 5 years old (2). Determining the degree of dehydration is a key step in the prevention of mortality, as the severity of diarrhea is directly proportional to fluid loss (2). By contrast, misdiagnosis of dehydration in normovolemic or mildly dehydrated patients may lead to unnecessary hospitalizations (3). Therefore, the most important question that should be asked to ensure efficient and appropriate management of pediatric patients with acute diarrhea is ''Is this child dehydrated?''.

Alteration in weight percentage is regarded as the "gold standard" method for determining the level of dehydration; however, this method is inappropriate for use in the emergency department (ED) due to the 1 week later the measurement of body weights is not possible in the emergency room (4). The Clinical Dehydration Scale (CDS) and the Gorelick Scale are the most commonly used clinical dehydration scales (5). However, they are subjective scoring systems that may be influenced by the clinician's experience and may often be inadequate for accurately determining dehydration severity (6). Furthermore, these classification scales are not equally sensitive for all pediatric age groups. While they are recommended for patients in their first years of life, data concerning their use for older pediatric age groups are limited. Therefore, a rapid, non-invasive, dynamic measurement method that will enable the clinician to make the optimal decision is required.

Evaluation of inferior vena cava collapsibility through ultrasonography is a method that is frequently used in adults (7). However, the method of inferior vena cava collapsibility index for the assessment of volume status in children with acute diarrhea is limited.

We hypothesize that the evaluation of inferior vena cava collapsibility index through ultrasonography is a reliable method for the assessment of volume status, due to its non-invasive, rapid, and dynamic properties. The study's objectives were to investigate the efficacy and reliability of the inferior vena cava collapsibility index by the use of ultrasonography to assess volume status, and to compare these results with the most widely used clinical dehydration scales in pediatric patients admitted to the ED due to acute diarrhea.

Material and Methods

Study design

This single-center, prospective, observational study was conducted at a tertiary care center that receives around 350,000 ED visits annually, with pediatric patients accounting for approximately 25% of all admissions. The study was approved by the local ethics committee (KOU KAEK-2016/278). Written informed consent was obtained from all parents and from the patient him/herself if he/she was literate.

Participants

The study was conducted at the emergency department (ED) of a tertiary care training and research hospital from December 2016 to October 2017. Enrollment occurred on weekdays between 08:00 to 17:00. Patients aged between 6 months and 17 years, who had experienced at least 3 watery defecations during the last 24 hours were included in the study if the researcher who would perform ultrasonography examination was available at the time of their admission to the ED. Patients who did not consent to participation, those who had chronic liver failure, renal or cardiac failure, those who were intubated, and trauma patients were excluded from the study.

Study protocol

Written informed consent was obtained from all participants included in the study. The patients were evaluated by an emergency medicine specialist who had at least two years of experience in the emergency department. Demographic data, vital signs, physical examination findings, clinical dehydration scores, and weight were recorded, and then the principal investigator was called. Complete blood counts, blood urea nitrogen (BUN), creatinine, and venous blood gas analyses were obtained for all participants. The clinical dehydration scales were used to assess the dehydration severity of the patients by the attending physician, and the dehydration status of the patients were classified as mild, moderate, or severe. Clinical assessment of hydration status was not disclosed to the researcher who would perform the ultrasonography. The basal body weight of the patients was measured minus clothing prior to treatment. The body weights of children under 2 years old were measured using a digital baby weighing scale (Weewell Digital Baby Scale, China), while children over 2 years old were weighed using an electronic weighing scale (Tess Electronic Scale, RP LCD-300, Turkey). The first and second weights were measured using the same instruments. Ultrasonography was performed with the patient in the supine position prior to treatment. Treatment was administered in accordance with the guidelines as per the decision of the attending physician who had performed the initial evaluation. The decision to hospitalize or discharge each patient was made on the basis of the clinical and laboratory findings, dehydration severity, and tolerance of oral intake. Patients admitted to the hospital according to the recommendation of Centers of Disease Control and Prevention guideline: If caregivers

cannot provide adequate care at home; substantial difficulties exist in administering oral rehydration therapy; concern exists for other possible illnesses as metabolic disorders or immune compromise complicating the clinical course; oral rehydration therapy fails; severe dehydration exists; social or logistical concerns exists; such factor as young age, unusual irritability or drowsiness, progressive course of symptoms, inpatient care was indicated. Weight loss percentage could not be estimated without knowledge of the patient's initial weight; hence, the alteration in weight one week after recovery was considered to be the optimal point of reference, based on previous literature (8). One week after their first visit, patients were contacted by phone to schedule appointments for the repeated weight evaluation and were asked to return one week after resolution of the symptoms. The weight loss percentage after one week was calculated using the formula: (last weight-first weight)/ last weight x100. Patients whose weight loss was less than 5% were classified as "mildly dehydrated" and patients whose weight loss was in excess of 5% were classified as "moderately-to-severely dehydrated". Patients who experienced weight loss between 5 and 10% were classified as "moderately dehydrated" and patients whose weight loss exceeded 10% were classified as "severely dehydrated". All data were recorded in the patients' record forms.

Ultrasonography examination

A single emergency medicine specialist, who had 5 years of experience and held basic and advanced ultrasonography education certificates awarded by the Turkish Association of Emergency Medicine, performed ultrasonography examinations for all patients. The patients who had been admitted to the hospital between 8 a.m. and 5 p.m. were included in the study as the investigator was working during these hours. Ultrasonography scans were carried out using the Sonoace R5 (USS-SAR5N20/WR, Samsung Medison, Hampshire, UK) device. The CN2-8 MHz convex probe was used and adjusted for each patient. The probe was placed in the subxiphoid region with the marker directed toward the patient's right side. When the subxiphoid image of the heart had been obtained, the probe was rotated 90 degrees so that the marker was directed toward the patient's head. Ultrasound scans were obtained in the longitudinal plane at 2 cm before the inferior vena cava (IVC) merges with the right atrium. Minimum and maximum inspiratory and expiratory diameters of the IVC were measured on the motion mode (M-mode) image. The IVC collapsibility index was measured using the following formula: (IVC expiratory diameter-IVC inspiratory diameter) / IVC expiratory diameter x 100. Measurements and calculations were recorded on patients' record forms.

Outcome measures

The primary outcome measures were defined as the correlation between the inferior vena cava collapsibility index (IVCCI) score and the dehydration percentage seven days after symptom relief. The secondary outcome measures were defined as the correlation between the clinical dehydration scale results and dehydration percentage seven days after symptom relief and the correlation between the IVCCI score and the clinical dehydration scale results.

The sample size was determined using a software application (G-Power 3.1.3, Franz Faul, Universität Kiel, Kiel, Germany). The clinically acceptable IVC collapsibility index difference between the groups was determined as 20± 10% for this study. The required sample size was determined as 102 for effect size: 0.5, alpha: 0.05, and power: 0.80.

Statistical analysis

Statistical analyses were performed using the SPSS version 21.0 for Windows (SPSS Inc. Chicago, USA) statistical package program. The socio-demographic and clinical characteristics of the patients were presented as mean ± standard deviation, median, interquartile range (IQL), 95% confidence interval (CI) and percent (%). The Student's t-test or the Mann-Whitney U-test was used to compare the continuous variables, and the chi-squared test was used to compare the intermittent variables. The diagnostic value of the IVCCI for the prediction of moderate-to-severe dehydration was evaluated using receiver operating characteristic (ROC) curve analysis. Sensitivity, specificity, negative predictive values (NPV), and likelihood ratios (LR) were estimated within the 95% CI and compared.

Results

A total of 212 pediatric patients were admitted with acute diarrhea during the study period. 22 patients who met the exclusion criteria or who were lost to follow-up were excluded from the study, and, consequently, the study proceeded with 190 participants. The patients' mean age was 52.34 months (SD± 40.8) and 97 (51.05%) were male. Age, gender, vital signs on admission, and the laboratory values are presented in Table 1.

When the patients were evaluated according to weight alteration one week after recovery, 130 (68.4%) patients were found to be mildly dehydrated while 60 (31.6%) patients' dehydration levels remained moderate to severe, and, of these, 18 (9.4%) were severely dehydrated. Although moderate to severe dehydration was determined in 27 patients by using the CDC scale, according to the alteration in weight percentage these patients were mildly dehydrated. However, 23 patients with mild dehydration were determined as moderate to severely dehydrated by using Gorelick scale. Both the CDC and Gorelick scales assessed 16 patients as moderate to severely dehydrated but, according

	All Patients	Mild Dehydration	Moderate-Severe Dehydration	p
Age	52.34	54.11	48.48	0.178
m (± SD)	(± 40.8)	(± 40.53)	(± 41.44)	
Sex M	97	69	28	0.413
n (%)	(%51)	(%53.1)	(%46.7)	
Temperature	36.83	36.88	36.72	0.321
m (± SD)	(± 1.69)	(± 1.58)	(± 1.9)	
Pulse Rate m	110.99	107.35	118.9	0.002
(± SD)	(± 22.1)	(± 20.79)	(± 22.95)	
Respiratory Rate	14.78	14.51	15.37	0.141
m (± SD)	(± 3.53)	(± 3.47)	(± 3.61)	
SBP	99.72	103.12	92.35	0.000
m (SD)	(± 14.47)	(± 12.63)	(± 15.51)	
DBP	62.6	65.15	57.07	0.000
m (± SD)	(± 10.83)	(± 9.74)	(± 10.99)	
BUN/Creatinine	26.2	24.89	29.02	0.009
m (± SD)	(± 10.41)	(± 9.45)	(± 11.82)	
pH	7.39	7.4	7.37	0.000
m (± SD)	(± 0.05)	(± 0.04)	(± 0.67)	
PCO2	31.62	32.47	29.76	0.05
m (± SD)	(± 6.26)	(± 6.23)	(± 5.97)	
HCO3 m (± SD)	19.5 (± 3.7)	20.12 (± 3.28)	18.12 (± 4.18)	0.022

m: Mean, M: Male , SBP: Systolic Blood Pressure, DBP :Diastolic Blood Pressure, BUN: Blood Urea Nitrogen

Table 1. Baseline demographics, vital signs and laboratory findings of study groups.

to the alteration in weight percentage, these patients were mildly dehydrated.

While moderate to severe dehydration was found in 60 patients by using the alteration in weight percentage, of these 44 had moderate to severe dehydration according to both the CDC and Gorelick scales. The degree of the dehydration in different age groups is shown in Table 2.

The ROC curve of the IVCCI's predictive value for dehydration severity is presented in Figure 1. The area under the curve (AUC) for the IVCCI was determined as 0.985 (95% CI; 0.959-1). The IVCCI cutoff of>58 produced 98.3% sensitivity, 88.5% specificity, 0.79 PPV, 0.99 NPV, 1.2 +LR, and 1.01 -LR. The diagnostic value of the CDS and the Gorelick Scale are presented in Table 3. The AUC for moderate-to-severe dehydration was 0.778 (CI 95%: 0.703-0.854) according to the CDS and 0.764 (95% CI: 0.669-0.889) for the Gorelick Scale (Figure 2 and Figure 3).

Discussion

The present study has revealed that the CDS and the Gorelick Scale are subjective tests, with low sensitivity and specificity levels, that are susceptible to being influenced by the clinician's experience and are inadequate for determining the degree of dehydration.

	Mild dehydration	Moderate dehydration	Severe dehydration	Total
< 2 years old n (%)	33 (17.4%)	12 (6.3%)	8 (4.2%)	53 (27.9%)
2-5 years old n (%)	52 (27.4%)	17 (8.9%)	7 (3.7%)	76 (40%)
> 5 years old n (%)	45 (23.7%)	13 (6.8%)	3 (%1.6)	61 (32.1%)

Table 2. Severity of the symptoms according to the age.

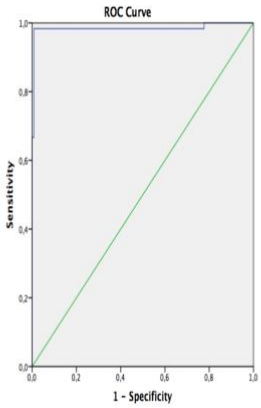

Figure 1. Inferior vena cava collapsibility index >58 predicting significant dehydration 5 % body weight change. AUC (Area under curve) : 0.985 (95% CI; 0.959-1)

However, measurement of the IVCCI by ultrasonography offers superior sensitivity and specificity for determining the degree of dehydration.

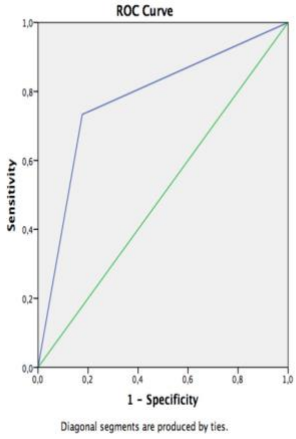

Figure 2. Clinical Dehydration Scale predicting significant dehydration 5 % body weight change. AUC (Area under curve) : 0.778 (CI 95%: 0.703-0.854)

Accurate assessment of hydration status enables clinicians to correctly determine whether there is a need for hospital admission and to assess whether a patient needs immediate intravenous fluid therapy. There is no definitive assessment method for hydration status in patients presenting with acute diarrhea in the ED. Urinary output might be difficult to measure in children experiencing frequent watery diarrhea. Laboratory tests are invasive and have limited utility for assessing hydration status (6). Clinical decision-making for the management of pediatric patients with acute gastroenteritis is a commonly used method; however, a meta-analysis including 13 studies has revealed that no signs or symptoms can securely define a child's degree of dehydration. This meta-analysis also reported that laboratory tests are unreliable indicators of hydration status (6).

	Sensitivity %	Specificity %	PPV %	NPV %	LR +	LR -
IVCCI ≥ 58	98.3	88.5	0.79	0.99	8.16	0.22
CDS ≥ 1	65.7	87	0.73	0.82	5	1.14
Gorelick Scale ≥ 8	77.13	54.4	0.77	0.82	1.6	0.42

CDS: Clinical dehydration scale, PPV: Positive predictive value NPV: Negative predictive value, LR: Likelihood ratio, IVCCI: inferior vena cava collapsibility index

Table 3. Test characteristics of clinical scales and IVCCI for predicting the ≥5% dehydration with the best cutoff points.

The Gorelick Scale and the CDS are the most commonly used clinical scoring systems. While Gorelick et al. reported their scale to have a sensitivity of 82% and a specificity of 90% for determining dehydration severity when applied by emergency nurses, Vega et al. reported lower percentages (70% sensitivity, 84% specificity) when the test was applied by emergency physicians (9). It has been reported that the sensitivity and specificity of the CDS were similar to those of the Gorelick Scale for determining moderate-to-severe dehydration (10). However, it has been reported that the CDS was effective in predicting the duration of hospital stay, the requirement for intravenous fluid replacement, and determining the need for hospital admission (11,12).

In the present study, patients were evaluated using the Gorelick Scale and the CDS. The sensitivity and specificity of the Gorelick Scale in determining hydration status were consistent with those observed in previous studies; by contrast, the sensitivity and specificity of the CDS were lower than those observed in previous studies (13). It has been suggested that the difference between our findings and those of previous studies may be attributed to the subjectivity of the clinical scoring systems.

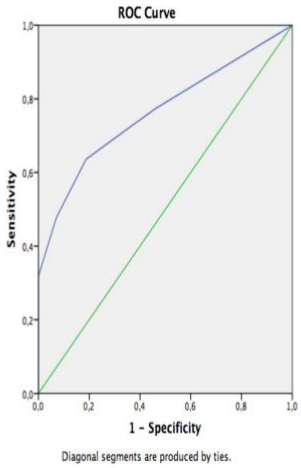

Figure 3. Gorelick 3-point scale predicting significant dehihydration 5 body weight change under 5 years old. AUC (Area under curve) : 0,764 (95% CI:0,669-0,889)

The IVCCI is a reliable method for detecting and measuring dehydration in adult patients (7). There are few studies in the literature investigating the use of IVCCI to determine hydration status in pediatric patients. Chen et al. reported a negative correlation between IVC diameter and the degree of dehydration in pediatric dehydrated patients (8). Levine et al. evaluated IVC collapsibility in 52 children presenting with diarrhea and/or vomiting and reported that when a 27% cutoff was used, the IVCCI had a sensitivity of 93% and a specificity of 35% (14). The most significant limitation of this study was its small sample size. However, our research is nonetheless important, having involved the largest study population to participate in a study of pediatric dehydration hitherto.

However, the measurement of IVC collapsibility using ultrasonography was investigated in a limited number of studies, and the small sample sizes were the major limitation for these studies. The absence of valid cutoff points for dehydration severity leads to difficulties with patient management in the ED. The present study revealed that when a > 58 cutoff was used, the hydration status of the patients were determined using the IVCCI with a sensitivity of 98.3% and specificity of 88.5%. In the light of these results, the IVCCI is a practical, effective, and reliable method suitable for use in daily practice. Ultrasonography is a useful diagnostic tool for the diagnosis of dehydration, but there are some limitations to using ultrasonography. Ultrasound equipment is expensive; on the other hand, it is less expensive than most other imaging equipment. According to the World Health Organization, the use of diagnostic ultrasound should be encouraged where there is a likelihood of clinical benefit. On the other hand, the use of diagnostic ultrasound by individuals without proper training and experience adds to the likelihood of unnecessary examinations and misdiagnosis. This renders

ultrasonography dependent on the skill and experience of the physician, and its usage is limited to physicians.

Limitations

Our study has several limitations. Since it was conducted in a single emergency department, the results cannot be generalized. To eliminate the experience gap between the users and to improve the reliability of the results, one researcher performed the ultrasonography for all patients. Enrollment only occurred during working hours, and thus selection bias may have been present and loss of study subjects may have occurred. The study included more patients than the planned sample size to minimize the study's limitations. Ten patients were lost to follow-up. Intention-to-treat analysis was not performed because the number of patients lost to follow-up constituted 5.6% of the entire study group. The optimal method for calculating weight loss percentage is based on the alteration between pre-illness and post-illness weight. However, pre-illness weights were unavailable, so weight measurement one week after resolution of symptoms was accepted as the patient's actual weight. Hospitalized patients may receive more fluid than discharged patients, so it is likely that the final weight values were greater in hospitalized patients. However, this patient group's mean IVCCI values were 92.48% (± 7.72), so dehydration degrees were severe, and for this reason, it is likely that the amount of fluid received did not significantly affect the study results.

Conclusion

Clinical scoring systems used to determine dehydration severity in pediatric patients are subjective and susceptible to being influenced by clinicians' experiences. We consider the ultrasonography-guided IVCCI method to be non-invasive, easily applicable, effective, and reliable in determining dehydration severity and reducing the number of unnecessary hospitalizations in pediatric patients presenting with acute diarrhea.

Conflict of Interest: The authors declare no conflict of interest regarding this study.

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Authors' Contribution: Study design (AEÖ,OK), case sonographer (AEÖ,OK), writing the manuscript (AEÖ,OK), statistical evaluation (OK)

Ethical Statement: Approval was obtained from Kocaeli University Non-invasive Clinic Researchs Ethics Committee (Number: KOU KAEK-2016/278). All authors declared that they follow the rules of Research and Publication Ethics.

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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Evaluation of Pediatric Cases with Suspected Rabies Exposure in the Pediatric Emergency Department

Çocuk Acil Servise Kuduz Şüpheli Hayvan Teması İle Başvuran Pediatrik Olguların Değerlendirilmesi

Yalçın Kara[1], Mahmut Can Kızıl[1], Ömer Kılıç[1], Sabiha Şahin[2], Ener Çağrı Dinleyici[3]

ABSTRACT

Aim: Rabies is a public health problem that can be prevented by vaccination and prophylaxis practices both in our country and in the world. It has a high risk of death if it cannot be prevented. In this study, we aimed to investigate the clinical and epidemiological characteristics of children admitted to the pediatric emergency department of our hospital with the suspicion of rabies.

Material and Methods: In this study, patients who applied to the Pediatric Emergency Department of Eskişehir Osmangazi University Faculty of Medicine between January 2013 and June 2021 with contact with an animal with an animal at risk of rabies were evaluated retrospectively. Epidemiological and clinical features of 746 pediatric cases included in the study were evaluated.

Results: 55% of 746 patients included in the study were male and the mean age was 102 months (4 months-216 months). 94% of the cases reside in the city and 6% reside in the countryside. There was cat contact in 54% and dog contact in 46% of the cases. Of the contact animals, 84% were stray and 89% were unvaccinated. While 82% of suspected rabies contacts were in category 2, 60% had upper extremity contact, and 21% had lower extremity contact. While wound cleaning was performed in all cases, rabies vaccine was administered to 99%, rabies immunoglobulin to 10%, tetanus prophylaxis to 32%, and antibiotic treatment to 21%. Immunoglobulin, antibiotics, tetanus prophylaxis, suturing and hospitalization were higher in the dog contact group than in the cat contact group. Compliance with the rabies vaccination schedule was high in both groups.

Conclusion: Our study shows that the contact cases with suspected rabies are mostly with stray and unvaccinated animals, and precautions such as vaccination and housing of stray animals should be increased. Rabies, which is still a deadly public health problem for the whole world and for our country, can be prevented by vaccination, post-exposure prophylaxis practices, and community education.

Keywords: Rabies, pediatric,emergency, exposure

ÖZ

Amaç: Kuduz hem ülkemizde hem de dünyada aşı ve profilaksi uygulamaları ile önlenebilen, önlenemediği takdirde ölüm riski yüksek bir halk sağlığı sorunudur. Bu çalışmada hastanemiz çocuk acil servisine kuduz teması şüphesiyle başvuran çocukların klinik ve epidemiyolojik özelliklerini araştırmayı amaçladık.

Gereç ve Yöntemler: Çalışmamızda Ocak 2013-Haziran 2021 tarihleri arasında Eskişehir Osmangazi Üniversitesi Tıp Fakültesi Çocuk Acil Servisi'ne kuduz riski taşıyan bir hayvanla temas ile başvuran çocuk hastalar retrospektif olarak değerlendirildi. Çalışmaya dahil edilen 746 pediatrik olgunun epidemiyolojik ve klinik özellikleri değerlendirildi.

Bulgular: Çalışmaya alınan 746 olgunun %55'i erkekti ve yaş ortalaması 102 ay (4 ay-216 ay) idi. Vakaların %94'ü şehirde, %6'sı kırsalda ikamet etmektedir. Vakaların %54'ünde kedi, %46'sında köpek teması vardı. Temaslı hayvanların %84'ü sahipsizdi ve %89'u aşısızdı. Şüpheli kuduz temaslılarının %82'si kategori-2'de iken, %60'ında üst ekstremite teması ve %21'inde alt ekstremite teması vardı. Tüm olgularda yara temizliği yapılırken, %99'una kuduz aşısı, %10'una kuduz immünoglobulin, %32'sine tetanoz profilaksisi ve %21'ine antibiyotik tedavisi uygulandı. İmmünoglobulin, antibiyotik, tetanoz profilaksisi, dikiş atma ve hastaneye yatış, köpek temas grubunda kedi temas grubuna göre daha yüksekti. Her iki grupta da kuduz aşı takvimine uyum yüksekti.

Sonuç: Çalışmamız, kuduz şüphesi olan temas vakalarının çoğunlukla sahipsiz ve aşısız hayvanlarla olması, sokak hayvanlarının aşılanması ve barındırılması gibi önlemlerin artırılması gerektiğini göstermektedir. Tüm dünya ve ülkemiz için halen ölümcül bir halk sağlığı sorunu olan kuduz, aşılama, temas sonrası korunma uygulamaları ve toplum eğitimi ile önlenebilir.

Anahtar Kelimeler: Kuduz, çocuk, acil servis, temas

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Introduction

Rabies is acute, progressive encephalitis caused by the *Lyssavirus* of the *Rhabdoviridae* family. Rabies is a disease that does not have an effective treatment after its clinical manifestations start to be seen (1). And results in the highest death rate among infectious diseases, but is preventable by immunization. It is one of the important causes of death especially in underdeveloped and developing countries. The most common cause of rabies in the world is pets, and dogs are the most common among them (2). Apart from dogs, rabies transmission is also possible from pets such as cats, cattle, sheep, goats, horses, donkeys, and wild animals such as wolves, foxes, jackals, pigs, bears, martens, skunks, and weasels. Animals are not equally susceptible to the rabies virus. Wolf, fox, and coyote contact is the highest risk, while dog contact is considered a medium risk for rabies, but also is the most common cause of transmission in developing countries. Contacts with mice, rats, squirrels, hamsters, guinea pigs, gerbils, rabbits, and hares have not been shown to transmit rabies and do not need post-exposure prophylaxis (3).

Rabies is a global public health problem with a high mortality rate and social impacts, as well as a significant socio-economic burden. It is recognized as a neglected disease worldwide by the World Health Organization (WHO). According to WHO data, 59,000 people die every year in more than 150 countries due to rabies. 59% of these deaths occur in Asia, and 36% in Africa, and it is seen that children under the age of 15 account for approximately half of these deaths. An estimated 35,000 people die each year in Asia due to canine-mediated rabies, with India taking the lead. Turkey is still an endemic region for rabies (4). In Turkey, approximately 180,000 risky rabies contact reports are made annually and most of these cases are included in the vaccination program to prevent rabies, but an average of 1-2 rabies cases are seen per year. Throughout the world, dogs are responsible for 92%, cats 2%, other pets 3%, bats 2%, and other wild animals less than 1%. It is seen that 93% of rabid animals in our country are pets and among them dogs take the first place with 59%. According to the data from the Turkish Government Ministry of Health, 15 rabies cases occurred in Turkey in the 10 years between 2008-2017. The clinical course of the disease is incubation period, prodrome period, acute neurological period, coma, and death (3,5-7). Prophylaxis applied in contact with suspected rabies animals in our country is carried out within the framework of the principles specified in the Rabies Prophylaxis Guide updated in 2019 by the Republic of Turkey Ministry of Health General Directorate of Public Health. It is mainly divided into two as pre-exposure protection and post-exposure prophylaxis (3). The contact with suspected rabid animals is divided into 4 categories in the guideline according to the nature of the contact and prophylaxis is planned according to these categories (Table 1). Postexposure prophylaxis is an emergency medical intervention and should be done as soon as possible. Wound care includes active immunization with rabies vaccine and passive immunization with rabies immunoglobulin. After contact with rabies risk, rabies protection can be provided at rates close to 100% with a timely and correct application. The primary step in contact with a suspected rabid animal is wound care. The wound site should be washed with plenty of soapy water and povidone-iodine can be applied. Rabies vaccination and rabies immunoglobulin form the basis of post-exposure prophylaxis (8-10).

Anyone admitted with rabies risky contact should also be evaluated for tetanus prophylaxis and antibiotic prophylaxis against potential wound pathogens (3). In addition, all applications should be evaluated in terms of tetanus vaccine, tetanus immunoglobulin and antibiotic prophylaxis according to wound site and vaccination status (Table-2) (11). For the prevention of rabies cases, the correct administration and knowledge of the approach to rabies risky contact cases are essential for all healthcare professionals. In this study, we aimed to retrospectively evaluate the general characteristics and prophylaxis approaches of pediatric patients who applied to the emergency department of our hospital with rabies risky contact.

Material and Methods

In our study, pediatric patients who were admitted to Eskişehir Osmangazi University Faculty of Medicine Pediatric Emergency Department between January 2013 and June 2021 with contact with animals at risk for rabies were evaluated retrospectively. The study was started after the approval of Eskişehir Osmangazi University Ethics Committee (Date:28.09.2021 Number:06). Patient data were obtained from the hospital information management system. 1059 rabies risky animal contact pediatric cases were identified, and the information of 746 of these patients was fully accessed. Patients over the age of 18 and cases with missing data entry were not included in the study. Among the cases included in the study, parameters such as age, sex, date, location, type of animal, vaccination status, category of contact, anatomical location, wound cleaning performed in post-exposure prophylaxis, antibiotherapy, vaccine, immunoglobulin and tetanus prophylaxis administration, side effects, treatment compliance were investigated. The classification and post-exposure prophylaxis practices of the cases included in the study were organized within the framework of the principles specified in the Rabies Prophylaxis Guide updated in 2019 by the World Health Organization (WHO) and the Republic of Turkey Ministry of

Health, General Directorate of Public Health. Rabies risky contact cases were divided into 4 categories according to the nature of the contact animal and the wound site (Table 1). Post-exposure vaccination is were divided into 3 groups as 4-dose vaccination schedule (0, 3, 7, 14-28), 5-dose vaccination schedule (0, 3, 7, 14, 28), and 3-dose vaccine scheme (in animals with owners, 0, 3, 7). Tetanus prophylaxis approach was classified according to tetanus vaccine and tetanus immunoglobulin administration, previous tetanus vaccination status, and the characteristics of the wound site (Table 2).

Statistical analysis

While evaluating the findings obtained in this study, SPSS (Statistical Package for Social Sciences) 21.0 for Windows program was used for statistical analysis. While evaluating the study data, Pearson Chi-Square test was used to compare qualitative data, and T test was used to evaluate single samples and independent samples. While descriptive data were expressed with frequency and percentage (%), a value of $p<0.05$ was considered statistically significant.

Results

In our study, 1059 pediatric patients who were admitted to Eskişehir Osmangazi University Faculty of Medicine Pediatric Emergency Service between January 2013 and June 2021 with risky animal contact for rabies were included. The data of 194 of these 1059 cases could not be accessed from the hospital automation system. Out of 865 cases whose data were accessed, 119 of them were excluded from the study because there was some missing data.

Of the 746 cases included in the study, 408 (55%) were male and 338 (45%) were female. The mean age was 102 months (4 months-216 months). Of the cases, 701 (94%) were urban and 45 (6%) resided in the countryside. Of 746 cases, 403 (54%) were contacted with cats and 343 (46%) were contacted with dogs. While 624 (84%) were stray, 122 (16%) were pets, 668 (89%) were not vaccinated against rabies, 78 (11%) were vaccinated. 612 (82%) of rabies suspected animal contacts were in category 2, 132 (7.8%) were in category 3, 2 (0.2%) were in category 1. There were upper extremity contact in 444 (60%) cases, lower extremity in 159 (21%), trunk in 38 (5%), face and head in 80 (%10), and multiple anatomical location contact in 25 (3.3%) cases. 43 (6%) of patients admitted in the first 1-7 days and only 1 patient admitted to hospital after 7 days. While rabies vaccine was administered to 745 (99%) suspected rabies contact cases (632 (85%) had 4 doses, 69 (9%) had 5 doses, 44 (6%) had 3 doses), 73 (10%) of them were given rabies immunoglobulin, 238 (32%) tetanus vaccine, 124 (17%) oral antibiotics, and 26 (3.4%) of them had parenteral antibiotics. In 4 cases (0.5%) some side effects (fever, vomiting, rash) developed after vaccination and immunoglobulin administration. While compliance with the vaccination schedule was 99%, 2 cases refused to be vaccinated. 41 (5%) patients were sutured and 23 (3%) were admitted to the inpatient service and followed up (Table 3).

1	-Touching/feeding the animal -Intact skin exposure to animal's saliva			No intervention warranted
2	-Slight scratching of skin (injuries not extending to subcutaneous tissue)	If the exposed animal was vaccinated within the last year		Wound care Evaluation for tetanus prophylaxis Observation of animal for 10 days
	-Minor injuries without bleeding	If the exposed animal was not vaccinated within the last year or vaccination status is unknown	If the animal is healthy and can be observed properly	Wound care Evaluation for tetanus prophylaxis Observation of animal for 10 days
			If the animal cannot be observed	Wound care Evaluation for tetanus prophylaxis Initiation of rabies vaccination
3	-Bites/scratches penetrating the skin	If the exposed animal was vaccinated within the last year		Wound care Evaluation for tetanus prophylaxis
	-Exposure of open wounds/mucosa to animal's saliva			Observation of animal for 10 days
	-Lesions localised to head, fingertips (areas of dense innervation)	If the exposed animal was not vaccinated within the last year or vaccination status is unknown	If the animal is healthy and can be observed properly	Wound care Ovaluation for tetanus prophylaxis Commencement of rabies vaccination Observation of animal for 10 days Administration of anti-rabies Ig
			If the animal cannot be observed	Wound care Ovaluation for tetanus prophylaxis Commencement of rabies vaccination Administration of anti-rabies Ig
4	Exposure to wild animals with a risk of rabies			Wound care Ovaluation for tetanus prophylaxis Commencement of rabies vaccination Administration of anti-rabies Ig5

Table 1: Categories of Rabies Risk Animal Exposures (T.R. Ministry of Health, National Rabies Field Guide)

History of Tetanus ımmunization	Category-2 Rabies Risk Animal Exposure[1]		Category-3,4 Rabies Risk Animal Exposure	
	Td	TIG	Td	TIG
Uncertain or < 3 doses	Yes	No	Yes	No
>3 doses	No/unless> 10 years since last dose	No	No/ unless > 5 years since last dose	No

Table 2. Indications for Tetanus Prophylaxis Rabies Risk Animal Exposure

The risk of rabies contact with a dog was more common in boys, and contact with a cat was more common in girls (p<0.001). Immunoglobulin, antibiotics, suturing administrations and hospitalization rates were higher in cases with rabies risky contact with dogs compared to contact with cats (p<0.001). Although the vaccination rate was higher in canine contact, there was no difference between the cats and dogs (p=0.05). Category 3 contact was higher in cases with dog contact (p<0.001). There was more lower extremity contact in cases contacted with dogs, and more upper extremity contact in cases contacted with cats (p<0.001).

	Total (n) (%)	Cat (403)	Dog (343)	P
Age (month)	102 (4-216)	92 (4-216)	113(6-216)	0,40
Boy	408 (54)	194 (49)	214 (62)	**<0,001**
Girl	338 (46)	209 (51)	129 (38)	
City	701 (93)	391 (97)	310 (90)	**<0,001**
Rural	45 (7)	12 (3)	33 (10)	
Owned	122 (17)	57 (14)	65 (20)	**0,04**
Derelict	624 (83)	346 (86)	278 (80)	
Vaccinated	78 (11)	35 (8)	43 (12)	0,05
Unvaccinated	674 (89)	368 (92)	300 (88)	
Category 2	612 (81)	375 (93)	237 (69)	**<0,001**
Category 3	132 (19)	28 (7)	104 (30)	
Category 4	2 (0,3)	0 (0)	2 (0,2)	
Anatomy				**<0,001**
Lower Exstremity	159 (21)	43 (11)	116 (34)	
Upper Extremity	444 (59)	304 (75)	140 (41)	
Head-Face	80 (9,5)	5 (1,2)	33 (9,6)	
Body	38 (8)	39 (9,7)	41 (12)	
Multiple	25 (3,3)	12 (3)	13 (3,8)	
< 24 hour	704 (94)	372 (92)	332 (97)	
24-72 hour	41 (6)	30 (8)	11 (3)	
>1 week	1 (0,2)	1 (0,2)	0 (0)	**0,018**
Rabies Vaccine	745 (99)	402 (99)	343 (100)	
3 doses	44 (6)	31 (7,7)	13 (3,8)	0,07
4 doses	632 (84)	336 (84)	296 (86)	
5 doses	69 (5)	35 (8,7)	34 (10)	
Immunglobulin	73 (10)	18 (4,5)	55 (16)	**<0,001**
Antibiotic	150 (21)	55 (14)	95 (28)	**<0,001**
Oral	124 (17)	54 (13)	70 (20)	
Parenteral	26 (3,4)	1 (0,2)	25 (7,3)	
Vaccine Compliance	744 (99)	401 (99)	343 (100)	0,2
Suture	41 (5)	1 (0,2)	40 (5)	**<0,001**
Hospitalization	23 (3)	1 (0,2)	22 (6,4)	**<0,001**

Table-3: Characteristics of Rabies Risk Animal Exposure Cases

Discussion

Rabies is a preventable disease however, it is a public health problem that maintains its importance in the world and in our country, as it is a fatal disease after the disease begins. The high risk of death after getting rabies, the inadequacies in treatment, and the fact that it can be prevented by vaccination and protection precautions increase the importance of prophylaxis after exposure to rabies risk. In a study conducted by Söğüt et al. in our country, it was shown that in cases of suspected rabies risky contact, the applications made from the city center were higher than the applications made from the rural areas. In our study, in parallel with the literature, the rate of applications from the city center was higher than those from the rural areas (12). This can be explained by the high number of stray animals in the city center and the high level of perception and knowledge about rabies vaccination.

In many studies, dogs are the most common pet encountered in rabies risky contact worldwide. In the studies conducted by Yılmaz et al. and also by Söğüt et al. in our country, the most frequent contact with rabies risk is dogs (12-13). In our study, on the contrary to the literature, contact with cats was more frequent. In the study of Şengöz et al., while 70% of contacts with animals at risk of rabies were stray, only 6% of animals were vaccinated (14). Similarly, in the study of Gülaçtı et al., more than half of the cases had contact with stray animals (15). In our study, 84% of contacts with animals at risk of rabies were with stray animals, while only 11% of animals were vaccinated. Cases of contact with suspected rabies can be reduced by adopting stray animals, increasing shelters, and regularly vaccinating both stray animals and pets.

In the study of Kocabaş et al., 61% of rabies risky animal contact cases were category III and 39% were category II, and the anatomical region where contact was most common was the upper extremity (5). In our study, while the rate of category 2 cases was higher, the most common contact area was the upper extremity. This can be explained by the higher

incidence of cat contact cases in our study, and more scratching in risky contact with cats and more bites in contact with dogs. In our study, almost all of the rabies risky contact cases were treated with wound cleaning and vaccination, while rabies immunoglobulin was administered to only 10%. In a study conducted in the United States of America, the rate of rabies vaccination in contact with rabies risk was determined as 6.7%. In the same study, while the rate of rabies immunoglobulin administration together with the vaccine was found to be high, it was shown that the rate of rabies vaccine was higher in less developed countries and the administration of immunoglobulin together with the vaccine was lower (16,17). The high rate of rabies vaccination in our study can be explained by the high rate of contact with stray and unvaccinated animals. The low administration rates of rabies immunoglobulin can be explained by the fact that scratching and superficial category 2 animal contact are higher than biting and deep category 3 animal contact. Similarly, rabies immunoglobulin applications were higher in the cases with rabies risky contact with the dog than the contact with the cat. This can be explained by the fact that the contact with the cat is more scratching and superficial injury, and the contact with the dog is more biting and deep injury. In our study, in parallel with the literature, the rates of antibiotic use, tetanus prophylaxis, suturing and hospitalization were higher in cases of contact with dogs at risk of rabies than in contact with cats. This can be explained by the fact that contact with dogs at risk for rabies causes both multiple anatomical regions and deeper injuries compared to contact with cats.

In the study of Ramezankhani et al., the rate of local side effects after rabies vaccine and immunoglobulin applications after exposure to rabies risk was found to be 4%, and the rate of systemic side effects such as fever was 2.5% (18). In the study conducted by Kocabaş et al. in our country, it was observed that side effects such as local swelling and redness were 4.9%, and systemic side effects such as fever were 12% (5). In our study, in parallel with the literature, the rate of side effects was very low which is 0.5%. This has shown again that rabies vaccines and immunoglobulin administrations are very safe when applied with the right technique.

While the rate of compliance with the vaccination program and continuation of vaccination after exposure to rabies risk was close to 100% in previous studies conducted in Europe and our country, it was much lower in studies conducted in countries such as Thailand and the Ivory Coast (19,20). In our study, full compliance with the rabies vaccine schedule was 99%. This can be attributed to the socio-cultural level, the difficulty of accessing health services, and the low level of knowledge of the society about rabies in these countries. It emphasizes the importance of raising awareness of the society, increasing the level of knowledge and providing education to the society about rabies, which is a disease that can be prevented by post-exposure prophylaxis and vaccination.

Limitations

The main limitations of our study are that it is retrospective and the information about some rabies-risk contact cases cannot be accessed.

Conclusion

As a result, our study shows that the cases of suspected rabies contact should be mostly with stray and unvaccinated animals, and precautions such as vaccinating and sheltering stray animals should be increased. The low rate of vaccination in owned pets showed that the knowledge level of the society about animal vaccination and vaccination opportunities should be increased. Rabies, which is still a deadly public health problem for the whole world and for our country, can be prevented by vaccination, post-exposure prophylaxis practices and community education.

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CASE REPORT / OLGU SUNUMU

An Unusual Presentation of Ruptured Abdominal Aortic Aneurysm: A Case Report

Rüptüre Abdominal Aort Anevrizmasının Olağandışı Bir Başvurusu: Olgu Sunumu

Fevzi Yılmaz[1], Fadime Kara[1], Esra Sönmez Üçkapı[1]

ABSTRACT

Aim: Ruptured abdominal aortic aneurysm (AAA) is among the surgical emergencies with highest mortality, generally causes death in 90% of cases. Most AAA ruptures open into the retroperitoneal space, and are recognized by the classical triad of pain, hypotension, and a pulsatile mass. Unfortunately, only 25% to 50% of patients present with this triad; thus, many patients with ruptured AAA either remain undiagnosed or are falsely diagnosed with other diseases.

Case: A 75-year-old man presented to the emergency department (ED) with sudden-onset dyspnea, nausea, and left pelvic pain. Imaging studies revealed aneurysmal dilation of abdominal aorta, inferior to the origin of the renal artery, and intraabdominal free fluid. The patient was consulted with the department of cardiovascular surgery and urgently taken to operating room with the preliminary diagnosis of an AAA rupture.

Conclusion: Our report presents an unusually rare presentation of a life-threatening disorder. Early diagnosis, referral to vascular surgery, and possible open or endovascular repair are key to limiting AAA-related morbidity and mortality.

Keywords: Abdominal aorta aneurysm, retroperitoneal hematoma, mortality

ÖZ

Amaç: Rüptüre abdominal aort anevrizması (AAA) mortalitesi en yüksek cerrahi aciller arasındadır ve vakaların %90'ında ölüme neden olur. Çoğu AAA rüptürü retroperitoneal boşluğa açılır ve klasik bulguları olan ağrı, hipotansiyon ve pulsatil kitle üçlüsü ile tanınır. Ne yazık ki, hastaların sadece %25 ile %50'si bu üçlü ile başvurur; bu nedenle, AAA rüptürü olan birçok hasta ya teşhis edilmeden kalır ya da başka hastalıklarla yanlış teşhis konur.

Olgu: 75 yaşında erkek hasta ani başlayan nefes darlığı, bulantı ve sol pelvik ağrı şikayetleri ile acil servise (AS) başvurdu. Görüntüleme yöntemleri, renal arterin çıktığı yerin altında yer alan abdominal aortun anevrizmal dilatasyonunu ve intraabdominal serbest sıvıyı ortaya çıkardı. Hasta kalp damar cerrahisi bölümü ile konsülte edildi ve AAA rüptürü ön tanısı ile acilen ameliyathaneye alındı.

Sonuç: Bu vakamız, yaşamı tehdit eden bir bozukluğun alışılmadık derecede nadir görülen bir presentasyonunu gösteriyor. Erken tanı, vasküler cerrahiye sevk ve olası açık veya endovasküler onarım, AAA ile ilişkili morbidite ve mortaliteyi sınırlamanın temel anahtarıdır.

Anahtar Kelimeler: Abdominal aort anevrizması, retroperitoneal hematom, mortalite

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Introduction

Abdominal aortic aneurysm (AAA) refers to an abnormal focal increase in the diameter of the abdominal aorta, which affects a substantial number of patients and is a potentially important cause of significant morbidity and mortality. It is seen in 5–9% of people older than 65 years of age. It more commonly affects males who smoke, as well as those who have a family history of for this condition (1).

While the majority of patients with AAA have no symptoms, they are diagnosed upon the detection of a pulsatile mass by a physician during physical examination, by abdominal imaging studies performed for other indications, or during ultrasonographic screening of AAA (2). The most common symptoms are abdominal, back, or flank pain (3). Symptomatic aneurysms are more likely to rupture and cause a significant rate of death (4).

An AAA is usually diagnosed on the basis of imaging studies, mainly abdominal ultrasonography, which show the presence of an aneurysm. On the other hand, computerized tomography (CT) reveals important information, including the rupture status, expansion rate of an aneurysm in symptomatic patients. It also aid in elucidating the origin of symptoms, that is if they are likely aneurysm-related or caused by other conditions found in the abdominal cavity (2-4).

In this paper, we present a patient with abdominal aortic aneurysm rupture that clinically manifested with sudden-onset dyspnea, nausea, and left pelvic pain.

Case Report

A 75-year-old man presented to the ED with sudden-onset dyspnea, nausea, and left pelvic pain. His past medical history was notable for a previous coronary artery bypass (CABG) surgery, chronic renal failure (CRF), a surgical procedure for left femur fracture 5 months ago and and It was learned that he used antilipid, aspirin and alpha-blockers.

On admission, the patient's general condition was moderately well; he was conscious and oriented. His vital signs were as follows: BP 99/55 mmHg, pulse rate 100 bpm, respiratory rate 22/minute, spo2 97 %, and body temperature 36 C. On physical examination, first and second heart sounds were normal, and no extra sounds or murmurs were heard. He had normal breath sounds over both lung fields, and no rales or ronchi were heard; both hemithoraces equally participated in the respiratory effort. His abdominal examination revealed tenderness in the left lower quadrant and at the left costovertebral angle. He had no abdominal guarding, rebound tenderness, or palpable pulsatile mass. There were bilaterally symmetrical radial and femoral pulses of good volume. The patient had normal findings in the examination of the other systems. laboratory values; BUN 47 mg/dl, kreatinin 2,2 mg/dl, WBC 12200, HB 10,7, HCT 34,6, D Dimer 1116 ug/dl (0-242), High sensitive troponin T 41 ng/L (0-14).

A chest X-Ray was taken to detect possible critical diagnoses as the etiology of dyspnea and hypotension, but no meaningful sign was found. While Abdominal aortic diameter was found to be normal at T12 level in Non-contrast thoracic CT upper abdominal cross-sections, an appearance-irregularity that belong to a hematoma of approximately 35 mm surrounding the peripheral wall calcification of the abdominal aorta was detected below the origin of the renal arteries (Figure 1A, 1B).

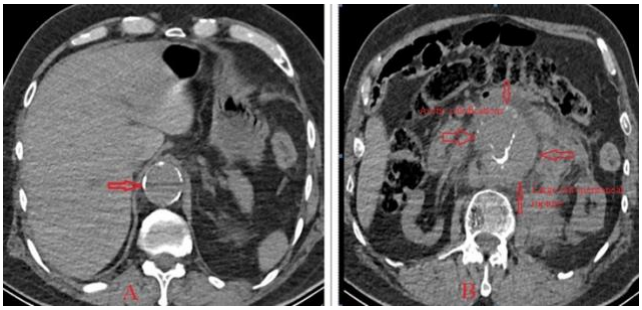

Figure 1A. Abdominal aortic diameter was found to be normal at T12 level in non-contrast thoracic CT upper abdominal cross-sections.

Figure 1B. an appearance-irregularity that may belong to a hematoma of approximately 35 mm surrounding the peripheral wall calcification of the infrarenal abdominal aorta.

As the patient had hypotension and tachycardia on admission, an abdominal CT angiography (CTA) with intravenous contrast was planned to diagnose a possible AAA rupture. Abdominal CTA showed irregularity in the infrarenal abdominal aorta and the appearance of a hemorrhagic collection extending into the left retroperitoneum. In addition, a retroperitoneal hematoma measuring 91x86 mm was detected in the paraaortic region, which was more prominent on the left side and was compatible with active bleeding (Figure 2A, 2B).

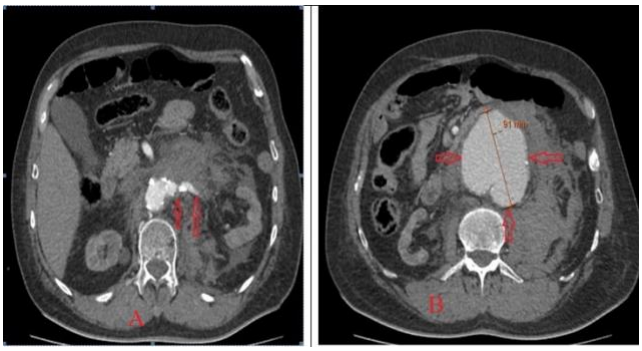

Figure 2A. Abdominal CTA showed irregularity in the infrarenal abdominal aorta and the appearance of a hemorrhagic collection extending into the left retroperitoneum.

Figure 2B. A retroperitoneal hematoma measuring 91x86 mm was detected in the paraaortic region, which was more prominent on the left side and was compatible with active bleeding

Abdominal CTA sagittal image of large AAA rupture and 3D reconstructed CT image of large AAA rupture shown in Figure 3A, 3B. A diagnosis of AAA rupture was made, and the patient was consulted with the department of

cardiovascular surgery and urgently taken to operating room.

Written informed consent was obtained from the patient for publication of this case report.

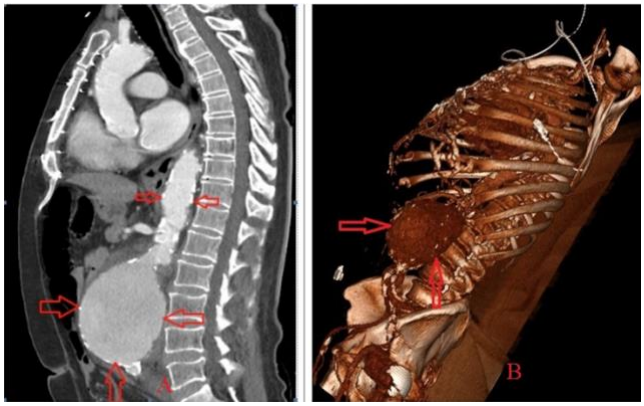

Figure 3A. Abdominal CTA sagittal image of large AAA rupture
Figure 3B. 3D reconstructed CT image of large AAA rupture

Discussion

Abdominal aortic aneurysm is aortic enlargement to a size of equal to or greater than 3 cm (3). Aneurysm formation refers to a segmental, full-thickness dilation process whereby a blood vessel is dilated to a size that is 50% greater than its original size (5). Despite the fact that normal aortic size depends on age, gender, and body size, infrarenal aorta is about 2.0 cm in diameter on average. A diameter that is considered normal is generally less than 3.0 cm; therefore, patients with an infrarenal aorta measuring equal to or greater than 3.0 cm are said to have AAA (3,6). Additionally, the risk of aneurysm rupture is proportional to the maximum transverse diameter of the aorta, with fusiform aneurysms measuring more than 54 mm are an indication for repair in patients without comorbidities (1). In our patient as well, the aortic diameter was found 9 cm in the infrarenal region, and a retroperitoneal hematoma was detected as a result of AAA rupture.

Several factors increasing the likeliness of predisposition to aneurysm development have been defined. These include smoking, male sex, advanced age, atherosclerosis, family history of AAA, other arterial aneurysms (e.g., iliac, femoral, popliteal, intracranial), connective tissue disorder (e.g., Marfan, Ehlers-Danlos, Loeys-Dietz syndromes) or family history, history of aortic dissection, and history of aortic surgery or instrumentation (7,8). Our patient was also a male of advanced age and had risk factors such as history of CRF, CABG, and surgery for femur fracture.

Different sites of rupture present with distinct clinical signs and symptoms. About one-fifth of patients have anterior rupture into the peritoneal space, which usually rapidly leads to profound blood loss and prehospital death. Rupture into abdominal veins or intestinal tissue is a rare occurrence. The majority of ruptures (approximately 80%) open into the retroperitoneal space; although this causes the hallmark triad of symptoms consisting of back pain, hypotension and a pulsatile mass, this triad is observed in only 25–50% of cases (1). Our patient similarly had bleeding into the retroperitoneal space; we believe that he was able to reach ED before he died because the hematoma partially limited itself.

Presence of risk factors and symptoms of AAA should prompt a search for clinical signs that support or refute the diagnosis during physical examination. Symptomatic patients may have normal vital signs or present with sinus tachycardia or hypotension of moderate or severe degree (9). Our patient also had hypotension and mild tachycardia on admission to the ED. We think that these signs were due to retroperitoneal bleeding. In addition, we think that our patient caused a moderate tachycardia response due to the cardiac drugs he used.

Abdominal pain is the most widely encountered sole presenting symptom of AAA; although it is reported by 80% of patients, it is relatively non-specific and also occurs in other abdominal disorders. Although AAA rupture into the retroperitoneal space can be buffered for a few hours, this can be maintained for days in only a few cases. Retroperitoneal hematoma formation and the compressive effects to the neighboring structures can give rise to various signs and symptoms which can misguide clinicians. It has been reported that symptoms resembling lumbar spondylitis, lower limb neuropathy, obstructive jaundice, testicular ecchymosis, or lower extremity edema (10). Likewise, our patient had dyspnea and left pelvic pain. We think that our patient developed dyspnea due to excessive abdominal distension due to AAA and diaphragmatic irritation caused by it. Since the upper abdominal cross-sections of a non-contrast enhanced chest CT study ordered to determine the cause of dyspnea revealed suggestive signs of AAA rupture, an abdominal CTA was taken, which showed a hematoma due to AAA rupture, which extended to the retroperitoneal space.

Conclusion

AAA rupture or symptomatic AAA are serious disorders not commonly encountered by emergency physicians. A rapid response and management of these conditions greatly increase patient outcomes. Advanced imaging techniques should be performed in atypical presentations suggestive of AAA rupture. Our report draws attention to a rare presentation of a disorder that may be potentially and rapidly fatal.

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REVIEW / DERLEME

Publication Ethics and Plagiarism

Yayın Etiği ve Plagiarizm

Özlem Güneysel[1]

ABSTRACT

Real knowledge is obtained through scientific research. The highest level of knowledge is the ability to discover/solve scientific problems. An important scientific work is also a team work and is a prerequisite for success. Scientific and professional work is primarily an educational tool and its content can be presented in different ways. Science is a connecting key in the education system, it reflects the culture of nations and the real source of knowledge of humanity. A scientist is a very hardworking, focused person in most situations. When a person enters the world of scientific work, it means that he has accepted to make extraordinary efforts and to compromise his daily life. Plagiarism; It is defined as "the use of other people's expressions, inventions or ideas in one's work as if they were his own without citing the source".

Keywords: Plagiarism, publication stealing, forgery

ÖZ

Gerçek bilgi, bilimsel araştırma ile elde edilir. Bilginin en üst düzeyi, bilimsel problemleri keşfetme/çözme becerisidir. Önemli bir bilimsel çalışma aynı zamanda bir takım çalışmasıdır ve başarının ön koşuludur. Bilimsel ve profesyonel çalışma öncelikle bir eğitim aracıdır ve içeriği farklı yollarla sunulabilir. Bilim, eğitim sisteminde bir bağlantı anahtarı, ulusların kültürü ve insanlığın gerçek bilgi kaynağını yansıtır. Bilim insanı birçok durumda oldukça çalışkan, ne yaptığına odaklanmış kişidir. Kişi bilimsel çalışma dünyasına girdiğinde sıra dışı efor harcamayı ve günlük yaşantısından ödün vermeyi kabul etmiş demektir. Plagiarizm; "bir kişinin eserinde başka kişilerin ifade, buluş veya düşüncelerini kaynak göstermeksizin kendisine aitmiş gibi kullanması" olarak tanımlanmaktadır. Türkçe'de tam karşılığı olmasa da "eser hırsızlığı", "intihal", "aşırma", "aşırmacılık", "bilgi hırsızlığı" gibi karşılıklarla anlamlandırılmaya çalışılmıştır.

Anahtar Kelimeler: Plagiarizm, intihal, sahtecilik

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Giriş

"Most people say that it is the intellect which makes a great scientist. They are wrong: it is character."
Albert Einstein

Gerçek bilgi, bilimsel araştırma ile elde edilir. Bilginin en üst düzeyi, bilimsel problemleri keşfetme/çözme becerisidir. Önemli bir bilimsel çalışma aynı zamanda bir takım çalışmasıdır ve başarının ön koşuludur. Bilimsel ve profesyonel çalışma öncelikle bir eğitim aracıdır ve içeriği farklı yollarla sunulabilir. Bilim, eğitim sisteminde bir bağlantı anahtarı, ulusların kültürü ve insanlığın gerçek bilgi kaynağını yansıtır. Bilim insanı birçok durumda oldukça çalışkan, ne yaptığına odaklanmış kişidir. Kişi bilimsel çalışma dünyasına girdiğinde sıra dışı efor harcamayı ve günlük yaşantısından ödün vermeyi kabul etmiş demektir (1).

Plagiarizm; "bir kişinin eserinde başka kişilerin ifade, buluş veya düşüncelerini kaynak göstermeksizin kendisine aitmiş gibi kullanması" olarak tanımlanmaktadır (2,3). Türkçe'de tam karşılığı olmasa da "eser hırsızlığı", "intihal", "aşırma", "aşırmacılık", "bilgi hırsızlığı" gibi karşılıklarla anlamlandırılmaya çalışılmıştır.

Etimolojik olarak sözcüğün kökeni Antik Roma'ya dayansa da, İngilizce'de yer bulması 17. yüzyıla kadar uzanmaktadır. Bu dönemden günümüze sadece sanatçı, yazar ya da üretim amaçlı konularda değerlendirilmiş olsa da; "toplumsal ahlak" ve "etik değerler" çerçevesinde ele alınmış bir olgudur (4).

Plagiarizm ve suistimalin benzer formları bilimsel araştırmalarda giderek artan bir problem olarak karşımıza çıkmaktadır. Son 20 yılda yayınlanan makalelerin artışı düşünüldüğünde, geri çekilen yazı oranının 10 kat arttığı (aslında bu sayının yine de az olduğu) tahmin edilmektedir (5). Geri çekilen/yazara iade edilen bu yazıların bir kısmı plagiarizm ve duplikasyon nedeniyle olsa da; daha fazlası "self-plagiarizm", "sahtecilik", "intihal" ya da "fabrikasyon" nedenlidir. Etik olmayan araştırma/çalışma/yazılar özellikle tıp alanında ciddi sorunlara neden olmaktadır. Kaybedilen yalnızca para, zaman veya emek değil; daha vahim olarak bu durum toplumun tıbba ve tıbbi araştırmalara olan güvenini sarsmaktadır. En kötüsü de hastalar bazen etik olmayan araştırmaların verilerine dayanarak etkisiz ya da zararlı tedaviler alabilmektedir (1).

Özellikle internetin yaygınlaşmasıyla bilgiye erişim kolaylaşmaktadır, ancak bu durum sorunlu/sorgulanır yayınların sayısını/miktarını da artırmaktadır. Plagiarizmin artması, yayın kararı veren dergi editörleri kadar bu yayınlara güvenerek tedavilerini planlayan hekimler için de bir sorundur (6).

Bilimsel yazılar spesifik bilgi gerektiren yazılardır ve toplumun okuması için değil, spesifik bilgiye sahip olan insanlara özgü yazılardır. Bilimsel yazıda yazarın bilmesi gereken, bilim insanları arasındaki iletişim yolunun bu spesifik yazılar olduğudur. Yazının bölümlerinin açık, net ve anlaşılır olması gerekir. Bu nedenle yazılarda geleneksel olarak kabul edilmiş "bölümlendirmeler" kullanılmaktadır (1). Bu bölümlendirmeler günümüzde kısaca "Giriş, yöntem, bulgular ve tartışma/sonuç"tan oluşmaktadır. Yapılan sık hatalardan biri "Bir yazıdan yöntemin tamamen alıntılanması"na rağmen bu yazıya atıf yapılmamasıdır. Yaygın plagiarizm yöntemlerinden bir diğeri de yazı bölümlerinin tamamen kopyalanması ve kendine aitmiş gibi yazılmasıdır (Bu yol, internet plagiarizm tarama programları sayesinde kolayca saptanabilmektedir). Her ne kadar benzer konularda farklı ve tamamen yeni görüşler sunulamıyor olsa da; aynı konuda yazan yazarlar birbirlerinin görüşlerinden bahsederken "atıf" (veya "doğru atıf") yapmak durumundadırlar. Araştırmacılar/yazarlar çalışmalarını yazıya dökerken önceden bilinen doğru ya da yanlış bilgileri kendi yazılarına taşırlar. Bu taşıma sırasında "doğru atıf" yapmak önem kazanır. Yazarların uyması gereken etik, ahlaki ve yasal zorunluluklar vardır. Bu kurallara uyulduğu takdirde okuyucu hangi düşünce ya da bilginin kime ait olduğunu açıkça görebilir (7). Bir yazı içerik anlamında orijinal ise ve yazının zenginleştirilmesi için başka yazarların "sözlerine/yazdıklarına" ihtiyaç duyuyorsa; alıntının doğru yapılması halinde bu durumun sakıncası yoktur. Yazar, atıf yaparak kendi düşüncesini daha iyi ifade edebilir ve atıf ile diğer yazarlardan bir nevi yardım alır (8).

Bilimsel yazılarda suistimal ve sahteciliğin önlenmesi amacıyla ilk adımlar Amerika Birleşik Devletleri'nde (ABD) 1992 yılında atılmış ve Office of Research Integrity (ORI-Dürüst Araştırma Ofisi) kurulmuştur. Organizasyon bilimsel araştırmalarda izlenmesi gereken adımları belirleyip standardize ederken, sahteciliğin engellenmesi yönünde de ilkeler belirleyerek adımlar atmıştır (7,9). Bu yöndeki diğer önemli adım Committee on Publication Ethics (COPE, 1997-Yayın Etiği Komitesi) ile İngiltere'de hayata geçirilmiştir. COPE, dürüst ve etik bilimsel prensiplerin belirlenmesi konusunda farkındalık ve yayıncıların uyabileceği rehberlerin hazırlanmasına ön ayak olmuştur (7,10). Göreceli olarak yeni sayılabilecek bu tür girişimler ve olgu değerlendirmelerinin yazılı kronolojisine (1932-Günümüz) The Research Ethics Timeline internet sitesinden erişilebilir (11). Plagiarizmin katı ve müsamahasız tanımında World Association of Medical Editors (Dünya Tıp Editörleri Birliği), "6 ardışık sözcük" kopyalandığında ve/veya "7-11 sözcükte 30 harfin benzeşmesi/örtüşmesi" durumunda plagiarizmden bahsetmektedir (7,12).

Plagiarizm Türleri ve Atıf Sorunları

Plagiarizmin net sınırlarını çizmek ve siyah/beyaz ayrımını yapmak bugünkü koşullarda olası değildir. Bununla birlikte plagiarizm ve türlerini tanımlamak konusunda görüş birliği ve kabul gören bir "kaynak otorite" bulunmamaktadır. Yine de plagiarizm türlerini tanımlayan çeşitli organizasyonların tanımları kabul görmüş, çeşitli dergi ve yayıncılar bu uygulamaları halen geçerli kabul etmişlerdir. Aşağıda en sık rastlanılan plagiarizm türleri (Kavram kargaşasını önlemek adına İngilizce karşılıkları korunarak) yer almaktadır.

Replication *(Çoğaltma / Kopyalama / Replikasyon)*

Bir yazıyı birden fazla yerde basılmak üzere göndermek / kaydetmek.

Etik ihlali olarak kabul edilir. Yazarların sıklıkla yazılarının yayınlanma şansını artırmak amacıyla başvurdukları bir yoldur. Genellikle yazının birden fazla dergi tarafından kabul edilmesi ve yazarın herhangi birinden yazısını geri çekmesinden önce birden fazla dergide yayınlanmasıyla ortaya çıkar. Bu yolu engellemek amacıyla bir çok dergi yazardan "yazının başka bir dergiye değerlendirilmek üzere gönderilmemiş olduğunun beyanını" sunmasını istemektedir. Her ne kadar bir çok dergi editörü tarafından etik dışı davranış olarak kabul edilse de; bir çok yazar "yazıyı yayınlatma şansını artırmak için **masum** bir girişim" olduğunda ısrarcıdır.

Duplication / Recycle *(Kopyalama / Duplikasyon)*

Kişinin kendine ait önceki yazı ya da çalışmasını, atıfta bulunmadan tekrar kullanması.

Yazar aynı ya da benzer konuda daha önce yapmış olduğu çalışmanın bir bölümünü, yeni çalışmasında tekrar eder / kullanır. Bu tanımlamanın etik boyutu tartışmalıdır zira yazarın alıntı yaptığı kişi yine kendisidir; ancak yayın hakları yayınlayan dergide ise tartışmanın boyutu değişmektedir. Editörler, yapılan alıntı metodoloji ile sınırlı kalıyorsa sıklıkla hoşgörülü davransalar da; alıntılar "bulgular / sonuçlar" kısmını kapsadığında yazarla iletişime geçerek "doğru atıf" konusunda uyarıda bulunmaktadırlar. Bu konuda da yazarlar plagiarizm olmadığını, önceki çalışmanın kendilerine ait olması durumunda etik ihlali olmayacağı konusuna vurgu yapsalar da bu durum kurumlar tarafından **Self-plagiarism** (Kendi kendisinden intihal) olarak da tanımlanmaktadır.

Secondary Source Plagiarism *(İkincil Kaynak Plagiarizmi)*

İkincil kaynağın kullanılması, ancak yalnızca (ikincil kaynağı içeren) birincil kaynağa atıfta bulunmak.

Yazar çalışmasında bir kaynak kullanır ve alıntı yaptığı kaynak içerisinde yapılmış olan alıntıları da sanki birinci kaynağın bilgileriymiş gibi gösterir. Bu durumun uygun olmayan yanı; bilgi, düşünce ya da emeğin gerçek sahibinin kaynak olarak gösterilmemesi, dolayısıyla da atıf alamayarak atıfın getirilerinden mahrum kalmasıdır.

Editörlerin bu konuda tam bir uyum içinde davrandıkları söylenemez ise de, ahlaki açıdan sorunlu olduğu hala tartışmalı bir konudur.

Misleading Attribution *(Yanıltıcı Atıf)*

Belirgin katkısına rağmen yazar adının çıkarılması, hatalı ya da yetersiz yazar listesi yazmak.

Yazıların yayınlanmasından sonra üçüncü kişilerin başvurusu ile gündeme gelen bir konudur. Katkısı olan yazar ya da yazarların, yazıyı dergiye gönderen muhatap yazar tarafından yazar listesinden çıkarılması en sık karşılaşılan durumdur. Adı yazar listesinden çıkarılan kişinin hak ettiği atıfı alamaması ve emeğinin yok sayılmasıyla sonuçlanır. Editörler ya da dergilerin kendilerini, yazının kaydı sırasında istedikleri "Çıkar çatışması beyannamesi" ve "yazarların katkılarını gösterir beyanname" ile koruma altına almaları sorumluluğu muhatap yazara yüklemektedir. Henüz yasal yaptırımı olmasa da, etik ihlal olduğu herkesin hemfikir olduğu bir konudur.

Invalid Source / Error 404 *(Geçersiz Kaynak)*

Var olmayan ya da yanlış kaynağın referans gösterilmesi.

Bilinçli olarak kandırmaya çalışmaktan öte özensiz ya da yarım yamalak hazırlanmış çalışmalarda karşımıza çıkmaktadır. Yazarın kaynak listesini artırma ya da yetersiz olan çalışmayı maskeleme çabasıdır. Yazarın önermesini desteklemek amacıyla, ilgisiz kaynak göstermesidir.

Paraphrasing *(Açımlamak)*

Başkasının yazısını, sözcükleri değiştirerek kendi düşünce veya araştırması gibi sunmak.

Birkaç cümleden, tüm yazının değiştirilerek kullanılmasına kadar değişen bir yelpazesi vardır. Bazen tümüyle orijinal düşünce alınarak, yazının sözcükleri değiştirilir ve çalışma tamamen orijinalmiş gibi sunulabilir.

Repetitive Research *(Tekrarlanan Araştırma)*

Uygun atıfta bulunmadan, benzer metodolojiye sahip benzer bir çalışmanın yazı ya da verilerinin tekrarlanması.

Benzer konularda yapılan çalışmaların sonuçlarının benzer çıkması ve önceki çalışmaya uygun atıf yapılmaması şeklindedir. Yazar benzer çalışmayı yapan kaynağın bölüm ya da bölümlerini alarak aynen kullanır. Genellikle aynı metodolojinin kullanıldığı, aynı sonuçların bulunduğu ve farklı bir yorum yapılamayan durumlarda görülmektedir. Korunmak amacıyla önceki çalışmaya doğru atıfta bulunmak yeterlidir.

Unethical Collaboration *(Etik Dışı İşbirliği)*

Kazara ya da istemli olarak; uygun atıf yapılmadan (birlikte çalışan kişilerin) birbirlerinin yazılmış olan yazılarını kullanmaları.

Sıklıkla ortaklaşa çalışma yürütülen durumlarda görülmektedir. Kişiler birlikte çalıştıkları kişilerin düşünceleri de dahil olmak üzere yazı, şekil, görsel materyal gibi ürünlerini kullanabilirler. Bu kullanma kopyalama şeklinde olabileceği gibi izin almadan veya atıfta bulunmadan kullanma şeklinde de olabilmektedir. **Hayalet yazarlık** (herhangi bir katkı olmadan yazar listesine isim eklenmesi) bu kategoride değerlendirilmektedir.

Verbatim *(Aynen / Kelimesi Kelimesine)*

Bir başkasının çalışmasının bölümlerini ve sözcüklerini uygun atıf (imla ya da alıntı işareti) olmadan aynen / kelimesi kelimesine almak.

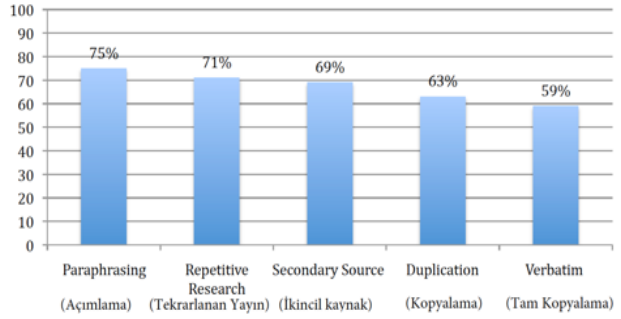
En sık karşılaşılan plagiarizm türüdür. İki formda değerlendirilir: 1. Yapılan alıntıya atıf belirtilir ancak sözcüklerin bire bir alındığından bahsedilmez. 2. Kaynak belirtilmez, alıntı yazarın kendi düşünce ve sözleriymiş gibi gösterilir. En sık olmakla birlikte ciddi ve en kolay belirlenebilen plagiarizm türüdür. Başka bir dilden yapılan çevirilerde (bu durumun saptanması zor olsa da) mutlaka doğru atıf yapılması sorunu ortadan kaldırır.

***Clone / Complete** (Klonlamak)*

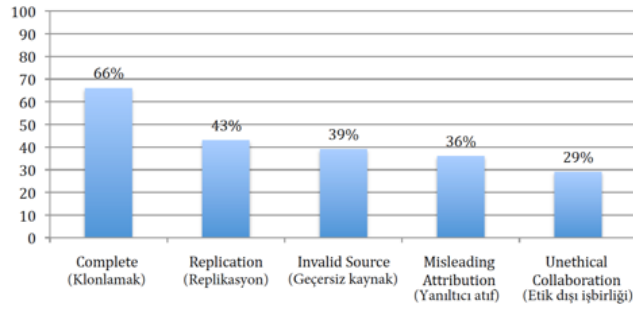
Bir başka araştırmacının yazısını kendi adıyla kaydetmek.

Oldukça nadir ancak en ciddi plagiarizm türüdür. Çalışmaların yasalar ile korunmasında adı geçen plagiarizm türüdür. Her ne kadar günümüz bilgi çağında imkansızmış gibi görünse de zaman zaman karşılaşılmakta ve telif davalarına konu olmaktadır.

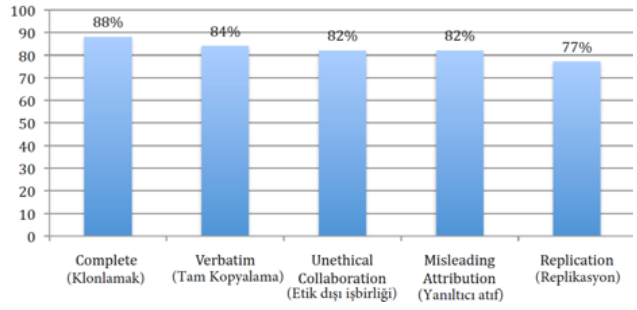
Plagiarizm tarama programı üreticilerinden bir şirket, 2013 yılında 50 ülkeden 334 araştırmacının katıldığı bir araştırma yaparak plagiarizm hakkında detaylı bir analiz yapmıştır. İnternet üzerinden katılımcılara plagiarizm tanımları hakkında standart bilgi vererek karşılaştıkları plagiarizm türleri, türlerin sıklığı ve ciddiyetini ölçmüş; araştırma ilginç sonuçlar vermiştir (13). Kuşkusuz bu araştırma, katılanların subjektif bilgi ve deneyimlerini yansıtıyor olsa da; aralarında dergi editörlerinin de olduğu popülasyonun deneyimlerini göstermesi açısından önemlidir. Bu sonuçlar plagiarizmin sanıldığından daha yaygın olduğunu ve araştırmacıların plagiarizm hakkında sınırlı bilgiye sahip olduğunu göstermektedir. Bazı araştırmacıların plagiarizmin bazı türlerini "plagiarizm olarak kabul etmediklerini", bazı türlerin de her şeye rağmen saptanamayacağı görüşünü bildirmişlerdir (Şekil 1-3).



Şekil 1. En sık karşılaşılan plagiarizm formları.



Şekil 2. Ez az karşılaşılan plagiarizm formları.



Şekil 3. En ciddi plagiarizm türleri

Plagiarizmden Korunmak

Tıbbi literatürde plagiarizmden sakınmak amacıyla çeşitli bilgisayar programları üretilmektedir. Her ne kadar bu lprogramlar henüz emekleme aşamasındaki bir çocuğa benzetilse de gerek yazarlar gerekse yayıncılar tarafından gün geçtikçe artan sıklıkta kullanılmaktadır. Günümüzde dergi yayıncıları ve editörlerin göz bebeği haline gelen yazılımlar internet veri tabanını tarayarak benzerlikleri saptamakta ve yapılan alıntıların kaynaklarını gösterebilmektedir. Plagiarizm, kişisel bir etik sorun değildir. Özellikle tıp araştırmalarının tüm toplumu ilgilendirdiği düşünüldüğünde konunun ne denli önemli olduğu ortaya çıkmaktadır. "Korunma, her zaman için tedaviden iyidir", bu nedenle etik davranışın genç araştırmacıların ilkeleri arasına yerleştirilmesi eğiticilerin ve akıl hocalarının görevi olmalıdır. Bilimsel ve akademik kurumlar, araştırma destekleri gibi bilimsel ürünlerini izleme, gözleme üniteleri/yapıları kurmalıdırlar. Bilim yalnızca "beyan" ile kabul edilemez. Plagiarizm ile ilgili olarak kriter, standart ve kuralların belirlenmesi; ulusal ve uluslararası yaptırımların uygulamaya konulması gerekmektedir (6,7). Her ne kadar dergi ve yayıncılar elektronik yazılımlar ile plagiarizmin önünü almaya çalışsalar da bu çaba yetersiz kalabilmektedir. Günümüzde halen kullanılmakta olan plagiarizm belirleyen yazılımların geliştirilmesi ve internet arama motorlarına benzer şekilde akademik kurumların ve araştırmacıların kullanımına sunulması uygun olacaktır.

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