Acta Medica Alanya

e-ISSN: 2587-0319

Volume 7 Issue 3
Sep-Dec 2023

Cilt 7 Sayı 3
Eylül-Aralık
2023

http://dergipark.gov.tr/medalanya

actamedica@alanya.edu.tr

e-ISSN: 2587-0319

DERGİNİN KÜNYESİ/ *JOURNAL INFO*:

Derginin Adı/ *Journal Name*: Acta Medica Alanya

Kısa Adı/ *Short Name*: Acta Med. Alanya

e-ISSN: 2587-0319

doi prefix: 10.30565/medalanya.

Yayın Dili/ *Publication Language* : İngilizce /*English*

Yayın peryodu/ *Publication period*: Yılda üç kez (Nisan, Ağustos ve Aralık) /
Three times a year (April, August and December)

Sahibi/ *Owner*: Prof.Dr. Kenan Ahmet Türkdoğan (Rektör/ *Rector*)

Sorumlu Yazı İşleri Müdürü ve Başeditör/*Publishing Manager and Editor in Chef*: Prof.Dr. Ahmet Aslan

Kuruluş/ *Establishment*: Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi bilimsel yayım organı olarak, Üniversitemiz Senatosunun 2016-95 sayılı kararıyla kurulmuştur. Yasal prosedürleri tamamlanmış ve Ekim 2016 tarihinde TÜBİTAK ULAKBİM Dergipark sistemine kabul edilerek online (çevrimiçi) olarak yayım hayatına başlamıştır. / *The scientific publishing journal of the Faculty of Medicine of Alanya Alaaddin Keykubat University. It was founded by the decision of the University Senate of 2016-95. The legal procedures have been completed and on October, 2016, on TÜBİTAK ULAKBİM Dergipark system was accepted and started publishing online.*

Dizinler ve Platformlar/ *İndexing and Platforms*: TUBITAK-ULAKBİM TR Dizin, Türkiye Atıf Dizini , Sobiad ,Türk Medline, DOAJ, CAS Source Index, J-Gate, Index Copernicus, EuroPub, Ulrich's ProQuest, CrossRef, Google Scholar, ResearchBib, Scilit, NCBI NLM Catalog ID: 101778132

Web Adresi/ *Web address* : http://dergipark.gov.tr/medalanya

Yayınlayan Kuruluş/ *Publisher* : Alanya Alaaddin Keykubat Üniversitesi http://www.alanya.edu.tr/

Makale gönderim ve takip sistemi/ *Article submission and tracking system*: ULAKBİM DergiSistemleri http://dergipark.gov.tr/

Web barındırma ve teknik destek/ *Web hosting and technical support*: DergiparkAkademik http://dergipark.gov.tr/

İletişim/ *Contact*: Alanya Alaaddin Keykubat Üniversitesi Tıp Fakültesi Temel Tıp Bilimleri BinasıKestel Kampüsü, Alanya / Antalya. mail: actamedica@alanya.edu.tr Tel/Phone: +905056462411

EDİTORİAL PUBLİSHİNG BOARD/ *EDİTÖRYAL YAYIN KURULU:*

Dean of Medicine Faculty/ *Tıp Fakültesi Dekanı :* Prof. Dr. Arife Uslu Gökceoğlu,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fak. Çocuk Sağlığı ve Hast. AD. Alanya /Türkiye
arife.gokceoglu@alanya.edu.tr https://orcid.org/0000-0002-5331-0315

Editor in Chef/ *Baş Editör:* Prof. Dr. Ahmet Aslan,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Ortopedi ve Travmatoloji AD. Alanya/Türkiye
ahmet.aslan@alanya.edu.tr http://orcid.org/0000-0001-5797-1287

Associate Editor/ *Editör Yardımcısı:* Prof.Dr. Şakir Özgür Keşkek,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Dahiliye AD. Alanya/Türkiye
drkeskek@yahoo.com https://orcid.org/0000-0001-5888-3123

Surgical Medicine Science Editor/ *Cerrahi Tıp Bilimleri Editörü:* Doç. Dr. Yılmaz Güler,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fak. Genel Cerrahi AD. Alanya /Türkiye,
yilmaz.guler@alanya.edu.tr https://orcid.org/0000000232256348

Internal Medicine Science Editor/ *Dahili Tıp Bilimleri Editörü:* Doç. Dr. Tayfun Kara,
Alanya Alaaddin Keykubat Ün, Tıp Fakültesi, Çocuk ve Ergen Ruh Sağlığı ve Hastalıkları AD. Alanya /Türkiye,
tayfun.kara@alanya.edu.tr https://orcid.org/0000-0002-2156-3457

Basic Medicine Science Editor/ *Temel Bilimler Editörü:* Doç. Dr. İ. Suat Övey,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Fizyoloji AD. Alanya /Türkiye,
suat.ovey@alanya.edu.tr https://orcid.org/0000-0002-0392-4386

İngilizce Dil Editörü/ English Language Editor: Doç. Dr. Can Ramazan Öncel,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Kardiyoloji AD. Alanya /Türkiye,
can.oncel@alanya.edu.tr https://orcid.org/0000-0001-5422-6847

Etik ve Biyoistatistik Editörü/ Ethic and Statistics Editor: Dr.Öğr.Üye. Erkan Maytalman,
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Farmakoloji AD. Alanya/Türkiye,
erkanmaytalman@gmail.com https://orcid.org/0000-0001-5284-7439

Bilimsel Sekreterya, İndexler ve Deneysel Araştırmalar/Web page, Indexes and Experimental Study Editor:
Prof. Dr. Ahmet Aslan, ALKÜ, Tıp Fakültesi, Ortopedi ve Travmatoloji Alanya/Türkiye,
ahmet.aslan@alanya.edu.tr http://orcid.org/0000-0001-5797-1287

EDİTÖRYAL DANIŞMA KURULU

TEMEL TIP BİLİMLERİ (Alfabetik sırayla, Güncelleme: 27.03.2022)

Ahmet Asan, Prof.Dr. ahmetasan84@gmail.com
Trakya Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, Edirne/Türkiye

Ayşegül Özalan, Prof.Dr, aysegul.gozalan@alanya.edu.tr
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Tıbbi Mikrobiyoloji AD, Alanya /Türkiye

Ahmet Koçak, Dr.Öğretim Üyesi, dr.ahmet@gmail.com
Kütahya Sağlık Bilimleri Üniversitesi, Tıp Fakültesi, Histoloji ve Embriyoloji AD, Kütahya /Türkiye

Ramazan Güneşaçar, Prof.Dr. ramazan.gunesacar@alanya.edu.tr
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Tıbbi Biyoloji AD, Alanya /Türkiye

Gülden Z. Omurtag, Prof.Dr. gzomurtag@medipol.edu.tr
Medipol Üniversitesi, Eczacılık Fakültesi, Farmasötik Toksikoloji, AD, İstanbul/Türkiye

Gökhan Cesur, Prof.Dr. gokhancesur@hotmail.com
Adnan Menderes Üniversitesi, Tıp Fakültesi, Fizyoloji AD, Aydın/Türkiye

Mehmet Ali Malas, Prof.Dr. mamalas@hotmail.com
Katip Çelebi Üniversitesi, Tıp Fakültesi, Anatomi AD, İzmir/Türkiye

Mehmet Fatih Bozkurt, Dr.Öğr.Üyesi, fbozkurt@gmail.com
Afyon Kocatepe Üniversitesi, Patoloji ve Deneysel Hayvan Çalışmaları, Afyonkarahisar/Türkiye

Osman Gürdal, Dr.Öğr.Üyesi, ogurdal@hotmail.com
Süleyman Demirel Üniversitesi, Tıp Fakültesi, Biyoistatistik ve Tıbbi Bilişim AD, Isparta /Türkiye

S.Sırrı Bilge, Doç.Dr. ssbilge@gmail.com
Ondokuz Mayıs Üniversitesi ,Tıp Fakültesi, Tıbbi Farmakoloji AD, Samsun/Türkiye

Mustafa Nazıroğlu, Prof.Dr. mustafanaziroglu@sdu.edu.tr
Süleyman Demirel Üniversitesi, Tıp Fakültesi, Biyofizik AD, Isparta /Türkiye

Fatih Gültekin, Prof.Dr. drfatih2000@gmail.com
Sağlık Bilimleri Üniversitesi, Uluslararası Tıp Fakültesi, Biyokimya AD. İstanbul/Türkiye

Yasemin Toçak Sezgin, Doç.Dr. yasemin_tocak@hotmail.com
Baskent Universitesi, Dişhekimliği Fakültesi, Periodontoloji AD.Ankara/Türkiye

DAHİLİ TIP BİLİMLERİ (Alfabetik sırayla, Güncelleme: 27.03.2022)

Afşin İbiş, Doç.Dr. avsinibis@yahoo.com
Sağlık Bakanlığı, Afyonkarahisar Devlet Hastanesi, Nefroloji Kliniği, Afyonkarahisar/Türkiye

Zehra Eren, Prof. Dr. zehra.eren@alanya.edu.tr
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, İç Hastalıkları AD. Alanya/Türkiye.

Bayram Ünver, Prof.Dr. unverbay@gmail.com
Dokuz Eylül Üniversitesi, Fizik Tedavi ve Rehabilitasyon Yüksek Okulu, Fizyoterapi Bölümü, İzmir/Türkiye

Davran Çicek, Prof.Dr. davrancicek@gmail.com
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Kardiyoloi AD, Alanya/Türkiye

Doğa Türkkahraman, Doç.Dr. drdoga@hotmail.com
Sağlık Bilimleri Üniversitesi, Antalya Eğitim ve Araştırma Hastanesi, Çocuk Endokrinoloji Kliniği, Antalya/Türkiye

Ersin Günay, Doç.Dr. ersingunay@gmail.com
Afyon Sağlık Bilimleri Üniversitesi, Tıp Fakültesi, Göğüs hastalıkları ve Tbc AD, Afyonkarahisar /Türkiye

Güven Yılmaz, Uzman Dr, cesus20@gmail.com
Sağlık Bilimleri Üniversitesi, Kartal Eğitim ve Araştırma Hastanesi, Hematoloji Kliniği, İstanbul/Türkiye

Hakan Gür, Prof.Dr. hakangur2001@gmail.com
Uludağ Üniversitesi, Tıp Fakültesi, Spor Hekimliği AD, Bursa/Türkiye

Hacer Erdem Tilki, Prof. Dr. hacererdem@gmail.com
Ondokuz Mayıs Üniversitesi, Tıp Fakültesi, Klinik Nörofizyoloji BD. Samsun/ Türkiye

Ersin Sayar, Dr. Öğr. Üyesi, ersin.sayar@alanya.edu.tr
ALKÜ, Tıp Fakültesi, Çocuk Sağlığı ve Hastalıkları/ Çocuk Gastroenteroloji BD. Alanya/Türkiye

İnci Meltem Atay, Doç.Dr. incimeltem@gmail.com
Süeyman Demirel Üniversitesi, Tıp Fakültesi, Psikiatri AD, Isparta /Türkiye

Murat Baykara, Dr.Öğr.Üyesi, mbaykara@hotmail.com Fırat Üniversitesi, Tıp Fakültesi, Radyoloji AD, Elazığ/Türkiye

Mustafa Öztürk, Prof.Dr. muozturk32@gmail.com
Karabük Üniversitesi, Tıp fakültesi, Halk Sağlığı AD, Karabük/Türkiye

Mustafa Adlı, Prof.Dr. madli@hotmail.com
Marmara Üniversitesi, Tıp Fakültesi, Radyasyon Onkolojisi AD. İstanbul/ Türkiye

Mustafa Sait Gönen, Prof.Dr. gonen.sait@gmail.com
İ.Ü. Cerrahpaşa Tıp Fakültesi ,İç Hastalıkları AD, Endokrinoloji ve Metabolizma BD, İstanbul/Türkiye

Neşe Demirtürk, Doç.Dr. nesed60@hotmail.com
Afyon Sağlık Bilimleri Üniversitesi, Tıp Fakültesi, Enfeksiyon Hastalıkları AD, Afyonkarahisar /Türkiye

Nilay Şahin, Doç.Dr. dincernilay@yahoo.com
Balıkesir Üniversitesi, Tıp Fakültesi, Fizik tedavi ve Rehabiliatasyon AD, Balıkesir /Türkiye

Tayfun Kara, Dr. Öğr. Üyesi, tayfun.kara@alanya.edu.tr
ALKÜ, Tıp Fakültesi, Çocuk ve Ergen Ruh Sağlığı ve Hastalıkları AD. Alanya/Türkiye

Süleyman Kutluhan, Prof.Dr. skutluhan@hotmail.com
Süeyman Demirel Üniversitesi, Tıp Fakültesi, Nöroloji AD, Isparta /Türkiye

Hatice Lakadamyalı, Prof.Dr. hatice.lakadamyali@alanya.edu.tr
Alanya Alaaddin Keykubat Üniversitesi, Tıp Fakültesi, Radyoloji AD. Alanya/Türkiye

CERRAHİ TIP BİLİMLERİ (Alfabetik sırayla, Güncelleme: 27.03.2022)

Adalet Demir, Prof.Dr. dradalet@hotmail.com
Özel Medical Park Bahçeşehir Hastanesi, Göğüs Cerrahisi Kliniği, İstanbul/Türkiye

Altuğ Tuncel, Prof.Dr. tuncelaltug@yahoo.com
Sağlık Bilimleri Üniversitesi, Ankara Numune Eğitim ve Araştırma Hastanesi, Üroloji Kliniği, Ankara/Türkiye

Atilla Sezgin, Prof.Dr. asezgin@baskent.edu.tr
Başkent Üniversitesi, Tıp Fakültesi, Kalp-Damar Cerrahisi AD, Çocuk Kalp Damar Cerrahisi BD. Ankara/Türkiye

Cemil Ertürk, Doç.Dr. erturkc@yahoo.com
SBU, İstanbul Kanuni Sultan Süleyman SUAM, Ortopedi ve Travmatoloji Kliniği , İstanbul, Türkiye

Fevzi Yılmaz, Doç.Dr. fevzi_yilmaz2002@yahoo.com
Sağlık Bilimleri Üniversitesi, Antalya Eğitim ve Araştırma Hastanesi, Acil Tıp Kliniği. Antalya/Türkiye

Hakan Kaya, Prof.Dr. drhakankaya2002@yahoo.com
Özel Isparta Hastanesi, Kadın Hastalıkları ve Doğum Kliniği, Isparta/Türkiye

Hasan Kamil Sucu, Doç.Dr. hksucu@gmail.com
İzmir Katip Çelebi Üniversitesi, Atatürk Eğitim ve Araştırma Hastanesi, Nöroşurji Kliniği, İzmir/Türkiye

Müberra Seğmen Yılmaz, Uzm.Dr. muberraseg@gmail.com
Sağlık Bilimleri Üniversitesi, Ümraniye Eğitim ve Araştırma Hastanesi, Patoloji Kliniği, İstanbul /Türkiye

N. Cenk Sayın, Prof.Dr. ncsayin@trakya.edu.tr
Trakya Üniversitesi Tıp Fakültesi, Kadın Hastalıkları ve Doğum AD, Perinatoloji BD. Edirne/Türkiye

Ömer Faruk Recep, Doç.Dr. omerfarukrecep@yahoo.com
Özel Ortadoğu 19 Mayıs Hastanesi, Göz Hastalıkları Kliniği, Ankara/Türkiye

Ömer Karahan, Prof.Dr. omer.karahan@usak.edu.tr
Uşak Üniversitesi, Tıp Fakültesi, Genel Cerrahi AD, Uşak/Türkiye

Pakize Kırdemir, Prof.Dr. pkirdemir@gmail.com
Süeyman Demirel Üniversitesi, Tıp Fakültesi, Anestezi ve Reanimasyon AD, Isparta /Türkiye

Serdar Nazif Nasır, Doç.Dr. snasir72@gmail.com
Hacettepe Üniversitesi ,Tıp Fakültesi, Plastik Rekonstrüktif ve Estetik Cerrahi AD, Ankara/Türkiye

Yavuz Uyar, Prof.Dr. yavuzuyar@mail.com
Sağlık Bilimleri Üniversitesi, Okmeydanı Eğitim ve Araştırma Hastanesi, KBB Kliniği, İstanbul/Türkiye

ULUSLARARASI DANIŞMA KURULU (Alfabetik sırayla, Güncelleme: 31.03.2020)

Abdelsalam Hegazy, Assist. Prof of Clinical Orthopedics at Qatar Weill Cornell Medical School, Pediatric Orthopedic Surgeon at Hamad General Hospital, Doha, Qatar. ahegazy@hamad.qa

Bahare Fazeli, MD , PhD. Assist.Prof. of Immunology, Mashhad University of Medical Sciences, Vascular Inflammation Research Center, Clinical Immunology, Iran. bahar.fazeli@gmail.com

Bilgen Basgut, Assoc.Prof. Near East University, Faculty of Pharmacy, Department of Clinical Pharmacy. Nicosia, Turkish Republic of Northern Cyprus. bilgenbasgut@gmail.com

Burak Yuluğ, Prof. Dr. Alanya Alaaddin Keykubat University, Medicine Faculty, Department of Neurology, Alanya, Turkey. burak.yulug@alanya.edu.tr

Edin Husarić, Dr. Pediatric Surgery, University of Tuzla, Pediatric Clinic, Tuzla, Bosnia and Herzegovina. edin.husaric@ukctuzla.ba

Caner Süsal, Prof.Dr. MD, Department of Transplantation Immunology, Heidelberg University, Heidelberg, Germany. caner.suesal@med.uni-heidelberg.de

Ivan Cvjetko, MD, PhD Cardiovasculary Surgery, University Hospital Merkur, Zajceva 19, 10 000 Zagreb, Croatia. ivancvjetko@yahoo.com

Lut Tamam, Prof.Dr, MD, Çukurova University, Medicine Faculty, Department of Psychiatry, Balcalı, Adana, Turkey. ltamam@gmail.com

Nguyen Giang Son, MD. General Surgery, Hi-Tect Department, National Hospital of Endocrinology, Hanoi, Vietnam. sonngan82@gmail.com

N.A.Uvais, MD, Iqraa International Hospital and Research Centre, Department of Psychiatry, Calicut, India. druvaisna@gmail.com

O. Şahap Atik, Prof.Dr. MD, Turkish Joint Diseases Foundation, Editor-in-Chief of Joint Diseases and Related Surgery, Ankara, Turkey. satikmd@gmail.com

Peter Lansber, MD, PhD, Department of Pediatrics, Section Molecular Genetics,
University Medical Center Groningen 9713 AV Groningen, The Netherlands. lansberg@gmail.com

Sandeep Raj Pandey, Dr. MBBS,MS,FVES,EVES, Consultant Vascular & Endovascular Specialist Annapunra hospital, Norvic Hospital ,Kathmandu, Nepal. sandeeprajpandey@gmail.com

Acta Medica Alanya 2023;7(3):
Contents/ İçindekiler

EDITORIAL / EDİTÖRYAL

RESEARCH ARTICLE/ ARAŞTIRMA MAKALESİ

Acta Medica Alanya

Editorial

Editöryal

Acta Medica Alanya 2023;7(3): 210-212
Doi: 10.30565/medalanya.1412356

Management in Disasters: An Overview

Afetlerde Yönetim: Genel Bir Bakış

Kenan Ahmet Türkdoğan[1], Ahmet Aslan[2]

[1] Rector of Alanya Alaaddin Keykubat University, Alanya, Antalya, Türkiye

[2] Department of Orthopedics and Traumatology, Medical School of Alaaddin Keykubat University, Alanya, Türkiye

ABSTRACT

In this article, current knowledge on the management of natural and man-made disasters is briefly reviewed.

Key Words: Earthquake, Disaster, Management, Emergency health

ÖZ

Bu yazıda, doğal ve insan kaynaklı afetlerln yönetimiyle ilgili mevcut bilgiler kısaca gözden geçirilmiştir.

Anahtar Kelimeler: Deprem, Afet, Yönetim, Acil sağlık

Disaster is a term that refers to large-scale disasters usually caused by natural events. However, it may also occur due to human-induced problems. Disaster is defined by the World Health Organization (WHO, 2002) as "an event that disrupts normal conditions of existence and causes suffering at a level that exceeds the adaptive capacity of the affected society".[1] Disasters can be caused by natural events such as earthquakes, floods, fires, tsunamis, hurricanes and volcanic eruptions. These events can often cause serious damage and loss to human-inhabited areas.[2]

Disasters can occur due to a combination of various factors. For example, earthquakes occur as a result of the movement of tectonic plates in the earth's crust. Floods caused by high water levels are usually due to meteorological factors such as excessive rainfall, snowmelt or tropical cyclones. Volcanic eruptions occur as a result of underground magma rising to the surface. The impacts of disasters can be large in environmental, economic and social dimensions.[2] Problems such as loss of human life, homelessness, damage to basic infrastructures, and destruction of agricultural lands may arise. Therefore, disaster management and preparedness are important to minimize the effects of disasters and protect society. Disaster management includes various strategies such as emergency planning, education, early warning systems and post-disaster assistance.[3]

Natural and man-made disasters can be classified based on various factors. Two basic classifications are made according to the effects caused by disasters and according to their source of occurrence.[4] These classifications are used to understand the variation among types of disasters. Disaster management takes these classifications into account in order to develop and implement effective measures against disasters of a particular type. Disaster types according to these two basic classifications are listed in Table 1.

Disaster management is a process that includes a set of strategies and measures planned and implemented in order to minimize the effects of disasters and ensure a rapid recovery after the disaster. Disaster management generally includes the stages of preparedness, response, recovery and sustainability.[5] The basic stages of the disaster management process are shown in Table 2 below.

Health services management in disaster situations includes directing health resources quickly and effectively and planning and implementing emergency medical interventions. This process may vary depending on the type of disaster, its size and the areas it affects.[6]

Recieved Date: 30.12.2023 / **Accepted Date:** 31.12.2023 / **Published (Online) Date:** 29.10.2023

Corresponding author: Ahmet Aslan, MD, Medical School of Alaaddin Keykubat University, Department of Orthopedics and Traumatology, Alanya/Antalya, Türkiye

Phone: 05056462411 / **mail:** ahmet.aslan@alanya.edu.tr

ORCID: 0000-0001-5797-1287

To cited: Türkdoğan KA, Aslan A, Management in Disasters: An Overview. Acta Med. Alanya 2023;7(3): 210-212 doi: 10.30565/medalanya.1412356

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 210-212
Doi: 10.30565/medalanya.1412356

Table 1. Classification of Disasters

Classification by Effects			**Classification According to Formation Sources**	
Natural Disasters	**Technological Disasters**	**Biological Disasters**	**Natural Disasters**	**Man-made Disasters**
Earthquake	Nuclear Accident	Pandemics	Geological Disasters	Technological Disasters
Flood	Industrial Accidents		Meteorological Disasters	Social Disasters
Fire			Hydrological Disasters	
Hurricane/ Typhoon				
Volcanic Eruption				
Tsunami				

Table 2. Basic stages of the disaster management process:

Risk Assessment and Planning	Risk Analysis	Planning	
Preparation Phase	Education and Awareness	Infrastructure Preparations	
Intervention Phase	Rescue Operations	Logistics and Communication	Public Safety
Improvement Phase	Rehabilitation	Psychosocial Support	Social Healing
Sustainability	Post-Disaster Assessment	Learning and Improvement	

Below is a general framework covering key issues for healthcare management in disasters:

A. Risk Assessment and Planning:

- Conducting pre-disaster risk analysis.
- Needs analysis of health services and determination of resources.
- Developing and updating emergency plans.

B. Preparation Phase:

- Training of medical personnel and other emergency teams.
- Storage and preparation of human resources, medicines, medical equipment and other materials.
- Creating communication plans.

C. Intervention Phase:

- Coordination of units providing health services.
- Planning and implementation of emergency medical intervention and rescue operations.
- Preparation of patient transfer and evacuation plans.

D. Communication and Coordination:

- Ensuring effective communication between health units.
- Coordination with other emergency teams, local government and national health organizations.

E. Logistics and Resource Management:

- Effective distribution of health supplies and resources.
- Storage and replenishment of emergency medical supplies.

F. Raising Community Awareness:

- Education and awareness programs for the society to be prepared before disaster.

Widely known emergency numbers

G. Psychosocial Support:

- Providing psychosocial support services to disaster victims.
- Psychosocial support programs for medical personnel and rescue teams.

H. Healing Phase:

- Assessing the damage and creating recovery plans.
- Managing the process of society's return to normal health services.

Türkiye is a country where many types of disasters occur with significant frequency. In recent years, our country

has faced major disasters such as earthquakes, forest fires, floods and pandemics.[7] The Kahramanmaraş-centered earthquake disasters we experienced this year unfortunately showed that we are still not sufficiently prepared for disasters.[8,9] In disaster situations, healthcare management often requires effective engagement of multiple stakeholders (hospitals, healthcare personnel, emergency teams, local and national health authorities). Good coordination, rapid response and effective communication are critical in healthcare management.

Conflict of Interest: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this article received no financial support.

ORCID and Author contribution: *K.A.T.(0000-0003-4850-5094):* Concept, literature search, writing, *A.A (0000- 0001-5797-1287):* Literature search, writing, critical review, editing.

References

1. Su Y, Wu XV, Ogawa N, Yuki M, Hu Y, Yang Y. Nursing skills required across natural and man-made disasters: A scoping review. J Adv Nurs. 2022;78(10):3141-3158. doi: 10.1111/jan.15337.
2. Gönen ÖF, Çavuşoğlu T, Kurnaz E. Medical rescue team's experiences in disaster response to individuals with special needs: The case of Türkiye. Nat Hazards (2023). https://doi.org/10.1007/s11069-023-06273-7
3. Usta G, Torpuş K, Küçük U. (2017). Afetlerde START Triaj Skalası. Doğal Afetler Ve Çevre Dergisi, 2017;3(2):70-76. https://doi.org/10.21324/dacd.320067
4. Işık Ö, Aydınlıoğlu HM, Koç S, Gündoğdu O, Korkmaz G, Ay A. Afet Yönetimi ve Afet Odaklı Sağlık Hizmetleri.Okmeydanı Tıp Dergisi 28 (Ek sayı 2):82-123, 2012 doi:10.5222/otd.supp2.2012.082
5. Lee AC, Booth A, Challen K, Gardois P, Goodacre S. Disaster management in low- and middle-income countries: scoping review of the evidence base. Emerg Med J. 2014 Oct;31(e1):e78-83. doi: 10.1136/emermed-2013-203298.
6. Şahin Ş. Türkiye'de Afet Yönetimi ve 2023 Hedefleri. Türk Deprem Araştırma Dergisi, 2019;1(2):180-196. doi: 10.46464/tdad.600455
7. https://www.afad.gov.tr/kurumlar/afad.gov.tr/35429/xfiles/turkiye_de_afetler.pdf erişim: 30.12.2023
8. Aslan A, Balta O, Coşkun HS. Evaluation of the Orthopedic Traumas in the Earliest Days of the 2023 Kahramanmaraş Earthquakes In Türkiye. Acta Med.Alanya 2023;7(1): 1-4 doi: 1303749
9. Aslan A, Zengin Ç, Büyükceran İ. What we learned in the short term from the 2023 Kahramanmaraş Earthquakes in terms of Orthopedic Trauma: A brief literature review. Acta Med. Alanya 2023;7(2): 105-107 doi: 10.30565/medalanya.1376079

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 213-218
Doi: 10.30565/medalanya.1291772

Comparison of the Relationship Between Inflammatory Markers and Saphenous Vein Graft Disease in Patients With Stable Angina Pectoris

Stabil Anjina Pektorisli Hastalarda İnflamatuvar Belirteçler ile Safen Damar Grefti Hastalığı Arasındaki İlişkinin Karşılaştırılması

Çağrı Zorlu[1], Sefa Erdi Ömür[1], Samet Yılmaz[2]

[1] Tokat Gaziosmanpaşa University, Medicine Faculty, Department of Cardiology, Tokat, Turkey

[2] Ömer Halisdemir University,Training and Research Hospital,Department of Cardiology, Niğde, Turkey

ABSTRACT

Aim: Coronary artery bypass graft surgery is one of the most commonly used strategies to revascularization of occlusive coronary atherosclerotic lesions. Atherosclerosis is known to be a chronic inflammatory process. Many inflammatory cells and mechanisms are active in this process. Markers such as mean platelet volume-to-lymphocyte ratio (MPVLR) and C-reactive protein-to-albumin (CAR) which may be associated with the severity of inflammation. In this study, it was aimed to determine the relationship between these parameters and saphenous vein graft (SVG) diseases.

Methods: In this retrospective study, 314 patients SVG disease with stable angina pectoris were included. Patients were divided into two groups according to the severity of SVG disease. We compared 159 patients who had severe stenosis in SVG and 156 patients who did not,in terms of CAR, NLR, PLR, MPVLR.

Results: Patients who ≥50% stenosis in SVG had significantly higher CAR, MPVLR, NLR, and PLR (respectively 9.1 (4.2-16.8) p<0.001, 4.5)0.68) p<0.001, 2.4 (0.69) p=0.002, 153)6) p=0.048). In line with these data, CAR and MPVLR values were also higher in the group with ≥50% stenosis in SVG, which was highly statistically significant (respectively 3.2 (0.9-4.4) vs 9.1 (4.2-16.8); p<0.001 and 3.64)0.43) vs 4.53)0.68); p<0.001).

Conclusion: C-reactive protein-to-albumin and MPVLR can be a useful and easily accessible markers to predict severity SVG stenosis.

Key Words: C-reactive protein-to-albumin ratio, mean platelet volume-to-lymphocytes ratio, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, saphenous vein graft diseases.

ÖZET

Amaç: Koroner arter baypas greft cerrahisi, tıkayıcı koroner aterosklerotik lezyonların revaskülarizasyonu için en sık kullanılan stratejilerden biridir. Aterosklerozun kronik bir inflamatuar süreç olduğu bilinmektedir. Bu süreçte birçok enflamatuar hücre ve mekanizma aktiftir. Enflamasyonun ciddiyeti ile ilişkili olabilecek biyobelirteçler; ortalama trombosit hacmi-lenfosit oranı (MPVLR) ve C-reaktif protein-albümin (CAR), nötrofil-lenfosit oranı (NLR) ve platelet-lenfosit oranı (PLR)'dir. Bu çalışmada bu parametreler ile safen ven grefti (SVG) hastalıkları arasındaki ilişkinin belirlenmesi amaçlanmıştır.

Yöntem: Bu retrospektif çalışmaya stabil anjina pektorisli SVG hastalığı olan 314 hasta dahil edildi. Hastalar SVG hastalığının şiddetine göre iki gruba ayrıldı. SVG'de ciddi darlık olan 159 hasta ile darlık olmayan 156 hastayı CAR, NLR, PLR, MPVLR açısından karşılaştırdık.

Bulgular: SVG'de ≥%50 darlığı olan hastalarda CAR, MPVLR, NLR ve PLR anlamlı olarak daha yüksekti (sırasıyla 9.1 (4.2-16.8) p<0.001, 4.5(0.68) p<0.001, 2.4 (0.69) p=0.002, 153 (6) p=0.048). Bu veriler doğrultusunda SVG'de ≥%50 darlık olan grupta CAR ve MPVLR değerleri de istatistiksel olarak anlamlıydı (sırasıyla 3,2 (0,9-4,4) ve 9,1 (4,2-16,8); p<0,001 ve 3,64 (0,43) - 4,53(0,68); p<0.001)

Sonuç: C-reaktif protein-albümin ve MPVLR, SVG stenozunun ciddiyetini tahmin etmek için yararlı ve kolay erişilebilir bir belirteç olabilir.

Anahtar Kelimeler: C-reactive protein-albumin oranı, ortalama platelet hacmi- lenfosit oranı, nötrofil-lenfosit oranı, platelet-lenfosit oranı, safen ven greft hastalığı

Recieved Date: 03.05.2023 / **Accepted Date:** 17.10.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Sefa Erdi Ömür. Department of Cardiology, Tokat Gaziosmanpaşa University, Medicine Faculty, Tokat, Türkiye

Phone: +9005301806188 / **mail:** sefaerdi61@gmail.com

ORCID: 0000-0002-6209-1732

To cited: Zorlu Ç, Ömür SE, Yılmaz S. Comparison Of The Relationship Between Inflammatory Markers And Saphenous Vein Graft Disease In Patients With Stable Angina Pectoris Acta Med. Alanya 2023;7(3): 213-218 doi: 10.30565/medalanya.1291772

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Saphenous vein grafts (SVG) degenerate more than arterial grafts over time. Despite this, they are still used in coronary artery bypass surgery[1]. SVG degeneration negatively affects long-term outcomes in CABGs. In SVG stenosis < 1 month period, thrombosis is seen as the leading cause. In the period of 1-12 months, neointimal hyperplasia may be the cause of stenosis. Atherosclerosis occurs in SVG stenosis after 12 months.[2-4]

It is known that inflammatory conditions predispose to vascular thrombosis. The neutrophil-to-lymphocyte ratio (NLR), whose association with atherosclerosis has recently been frequently investigated, is a marker of inflammation.[5] The platelet-to-lymphocyte ratio (PLR) is used as a biomarker in atherosclerosis.[6] Also, platelets play a leading role in thrombosis, and increased mean platelet volume (MPV) has been found to be associated with negative consequences in cardiovascular diseases. Mean platelet volume-to-lymphocyte ratio (MPVLR), a relatively newer inflammatory biomarker than others, has also been investigated in some studies and has been shown to predict adverse cardiovascular outcomes.[7,8] In addition, high C-reactive protein (CRP) levels and low albumin levels are inflammatory biomarkers and CRP-to- albumin ratio (CAR) is a valuable prognostic marker of heart disease.[9,10]

Previous studies have investigated the importance of NLR, PLR or CAR in SVG diseases, but no study has yet been conducted that compares and evaluates all these markers simultaneously. In this study, the relationship between NLR, PLR, MPVLR and CAR and the development of SVG disease was investigated.

Patients and Method

Study Population: Between January 2017-September 2020 who underwent coronary angiography due to stable angina patient data were collected. Three hundred and fourteen patients who had CABG operation involving SVG were enrolled in the study. Coronary angiography indication was made according to the presence of typical angina despite maximal anti-ischemic and antianginal medical therapy or positive non-invasive screening tests for myocardial ischemia. Coronary angiography images were evaluated by 3 different cardiologists. Patients were divided into two according to whether there was ≥50% stenosis in SVG. The criteria for not receiving the study were as follows: inflammatory disease, active infection, hematologic disorders, malignancy, connective tissue disease, advanced liver disease, receiving dialysis and thyroid diseases. Transthoracic echocardiography were performed in all patients. The patients and their laboratory data were evaluated separately with their anamnesis and physical examination. The ethics committee approval of the study was obtained from the local university board with the application dated 28.01.2021 and numbered 21-KAEK-007.

Demographic and laboratory data: Routine biochemical datas were calculated and evaluated with the Coulter LH-780 Hematology Analyzer (Beckman Coulter, Inc, California). Hemogram panel (white blood cell, neutrophil, platelet, MPV etc.) and albumin, CRP were measured at the time before the elective coronary angiography. The PLR was defined as the ratio of the platelet count to the lymphocyte count, the NLR was defined as the ratio of the neutrophil count to the lymphocyte count, and the MPVLR was evaluated as the ratio of the MPV to the lymphocyte count, in CAR calculation, the method of ratio of CRP (mg/dL) to albumin (g/dL) and then multiplying the result by 100 was used. The other biochemical parameters were performed using appropriate methods. Hypercholesterolemia is defined as a previous diagnosis of hypercholesterolemia and being under statin treatment or having an LDL value above 130 mg/dL. Diabetes mellitus and hypertension were defined as receiving appropriate medical therapy for the treatment of these diseases. Also, a fasting blood glucose ≥126 mg/dL in a few consecutive values or >200 mg/dL in any time period was considered as diabetes mellitus. The presence of hypertension was accepted in patients whose repetitive blood pressure ≥ 140/90 mmHg. The patient was defined as being a smoker at the time of admission or smoking in the previous 6 months.

Echocardiographic Examination: All echocardiographic examinations (EPIQ 7, Amsterdam, Philips, Netherlands) were performed using a 2.5-3.5 MHz transducer with all participants. Evaluations were made in the presence of at least two cardiologists, in accordance with the criteria of the American Society of Echocardiography. Left ventricular ejection fraction (LVEF) was evaluated by Simpson method.[11]

Angiographic Evaluation: Coronary angiography (General Electric Optima; Wisconsin, ABD) was performed via the radial/femoral route using the standard Judkins technique and was examined by two experienced angiographers. All images were calibrated with a guide catheter (6-7 french). SVGs were evaluated from at least 2 different angles following contrast material injection. Thus, the patients included in the study; those with less than 50% stenosis in the SVG and those without less than 50% stenosis were divided into 2 groups.

Statistical Analysis: Statistical evalution of the data was done using the SPSS 21.0 (SPSS INC, Illinois, USA). The probability value of $p < 0.05$ was taken in the tests for statistical significance. Student-T test was used to evaluate parametric data and Mann-Whitney U test was used to evaluate nonparametric data. Categorical variables were evaluated by Chi-square test. The Kolmogorov-Smirnov test was used

Acta Medica Alanya 2023;7(3): 213-218
Doi: 10.30565/medalanya.1291772

to evaluate the normality of the data and was verified on all data. Receiver-operating characteristic (ROC) curves were estimated for NLR, PLR, MPVLR, and CAR. ROC analysis was used to determine the cut-off values of PLR, NLR, MPVLR, and CAR in predicting SVG disease.

Results

Three hundred fourteen patients presenting 'with stable angina pectoris were' included in this study. Mean age of the patients in the study was 64.1 (±9.5) years and 28.6% of patients were female. There was ≥50% stenosis in SVG in 159 of the patients in the study. Table 1 shows the clinical data and demographic information of the patients.

İn Table 2, laboratory data of the patients are given comparatively. In line with these data, CAR and MPVLR values were also higher in the group with ≥50% stenosis in SVG, which was highly statistically significant (respectively 3.2 (0.9-4.4) vs 9.1 (4.2-16.8); p<0.001 and 3.64 (0.43) vs 4.53(0.68); p<0.001).

Figure 1 shows MPVLR, CAR, PLR, NLR roc curves to foresee significant stenosis in SVG. The AUC of CAR was the highest of all parameters (0.864, p<0.001) in predicting significant stenosis in the SVG, with 82% sensitivity and 72% specificity. It was found that the AUC of MPVLR was significantly higher than both AUC of NLR (0.795 vs 0.680, p < 0.001) and PLR (0.795 vs 0.584, p<0.001) for predicting significant stenosis in SVG. According to the this data MPVLR value of >4.53 could be used as a predictor of >%50 stenosis in SVG with a sensitivity of %80 and a specificity of %66.

In univariate analyses (Table 3), ≥50% stenosis in SVG was positively and significantly correlated with lymphocyte count (p <0.001), hemoglobin (p <0.001), neutrophil count (p <0.001), MPVLR (p <0.001), and CAR (p <0.001). ≥50% stenosis in SVG was associated with CAR and MPVLR in univariate logistic regression analysis (table 3). When 'multivariate regression analysis results are evaluated, CAR and MPVLR were also identified as an independent predictor for ≥50% stenosis in SVG (OR 1.096, 95%CI 1.054 to 1.132 and OR 1.536, 95%CI 1.206-1.635) (Table 3).

Discussion

This study is the first study comparing NLR, PLR, MPVLR, and CAR that predict SVG disease in patients with CABG

Table 1. Baseline characteristics of the study groups

Variables	<50% stenosis in SVG n = 155	≥50% stenosis in SVG n =159	P Value
Age, years	63.5)9.31)	64.8)9.72)	0.068
Female, % (n)	30.30 (47)	27 (43)	0.210
BMI, kg/m2	27.50)4.8)	27.60)3.84)	0.804
Smokers, % (n)	41.29 (64)	45.91 (73)	0.389
Diabetes Mellitus, % (n)	45.80 (71)	61.63 (98)	<0.001
Hypertension, % (n)	66.45 (103)	76.10 (120)	0.005
Hyperlipidemia, % (n)	72.90 (113)	76.72 (122)	0.402
Time after CABG, months	64.40)37.42)	71.30)26.43)	0.192
LVEF, %	45.10)7.1)	54)5.8)	<0.001
Aspirin, % (n)	80 (124)	84.9 (135)	0.194
P2Y12 inhibitors, % (n)	32.25 (50)	28.93 (46)	0.508
Statins, % (n)	63.87 (99)	59.11 (94)	0.298
Beta-blockers, % (n)	83.87 (130)	86.79 (138)	0.405
ACEI/ARB, % (n)	70.96 (110)	74.84 (119)	0.309
CCB, % (n)	19.35 (30)	18.23 (29)	0.852
Nitrate, % (n)	16.12 (25)	26.41 (42)	0.001
Ranolazine, % (n)	18.70(29)	16.98 (27)	0.698
Trimetazidine, % (n)	23.87 (37)	25.78 (41)	0.452

ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; BMI, body mass index; CABG, coronary artery bypass graft;CCB, calcium channel blocker; LVEF, left ventricular ejection fraction; SVG, safen vein graft

Table 2. Laboratory Characteristics of the Study Patients

Variables	<50% stenosis in SVG n = 155	≥50% stenosis in SVG n =159	P Value
Glukose (mg/dL)	162)92)	170)104)	0.391
Creatinine (mg/dL)	1.11)0.29)	1.18 (0.32)	0.052
WBC (x 103/mm3)	7.7)1.6)	8.1)2)	0.118
Lymphocyte count (x109/L)	2 (0.4)	1.8)0.5)	<0.001
Neutrophil count (x109/L)	4.2)0.9)	4.4)1.1)	0.048
Hemoglobin (g/L)	14.4)1.5)	12.9)1.5)	<0.001
Platelet count (x103/mm3)	266)61)	296)60)	0.154
MPV (fL)	7.5)0.4)	8.4)0.7)	<0.001
CRP (mg/dL)	0.12 (0.06-0.2)	0.48 (0.3-0.7)	<0.001
Albumin (g/dL)	4)0.2)	3.9 (0.1)	0.05
NLR	2)0.32)	2.4)0.69)	0.002
PLR	129)54)	153)6)	0.048
MPVLR	3.64)0.43)	4.53)0.68)	<0.001
CAR X100	2.6 (0.9-4.5)	9.1 (4.2-16.8)	<0.001
Low-density lipoprotein cholesterol (mg/dL)	142)19)	144)22)	0.624
HDL (mg/dL)	42)6)	39)5)	0.213
Triglycerides (mg/dL)	228)65)	211)61)	0.595

CAR, C-reactive protein to albumin ratio; CRP, C-reactive protein; MPV, mean platelet volume; MPVLR, mean platelet volume to lymphocyte ratio; NLR, neutrophil to lymphocyte ratio; PLR, platelets to lymphocyte ratio WBC: White blood cell count, HDL: High-density lipoprotein cholesterol.

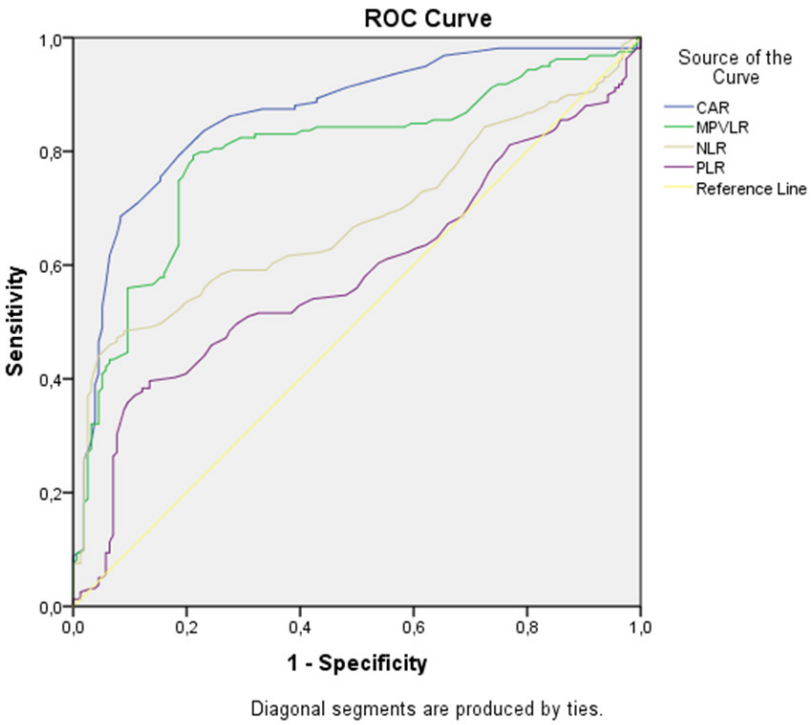


Figure 1. ROC curve of inflammatory parameters for predicting the presence of >50% stenosis in SVG.

Acta Medica Alanya 2023;7(3): 213-218
Doi: 10.30565/medalanya.1291772

Table 3. Univariate and Multivariate Predictors of ≥50% stenosis in SVG

Variables	Univariate	P value	Multivariate	P value
	OR, 95% CI		OR, 95% CI	
Hemoglobin	0.941 (0.923-0.959)	<0.001	0.949 (0.920-0.989)	0.007
Lymphocyte count	0.178 (0.136-0.236)	<0.001	0.317 (0.152-0.515)	<0.001
Neutrophil count	0.902 (0.886-0.962)	0.001	1.102(0.964-1.286)	0.064
Mean platelet volume	1.316 (1.118-1.1564)	<0.001	1.198 (0.954-1.339)	0.102
CAR	0.989 (0.942-1.036)	<0.001	1.096 (1.054-1.132)	<0.001
MPVLR	1.746 (1.488-1.920)	<0.001	1.536 (1.206-1.635)	<0.001
NLR	0.996 (0.958-1.210)	0.002	0.991(0.945-1.002	0.221
Female	0.802 (0.548-0.956)	0.008	0.903 (0.751-1.048)	0.003
Diabetes mellitus	0.928 (0.874-0.982)	0.001	0.938 (0.908-0.966)	0.006

CAR, C-reactive protein to albumin ratio; MPVLR, mean platelet volume to lymphocyte ratio; NLR, neutrophil to lymphocyte.

who underwent CAG due to stable angina. We found a more significant relationship between SVG with MPVLR and CAR than NLR and PLR in these patients. Saphenous vein graft diseases are a problem that negatively affects prognosis in patients with CABG. Therefore, it is important to identify inexpensive and easily detectable markers that predict SVG lesions. Many traditional risk factors for SVG lesions have taken place in the literature such as DM, HT. On the other hand, the relationship between inflammatory markers such as NLR, PLR, CRP, albumin with SVG has also been investigated in previous studies.[12,13] Determining which of these markers associated with the degree of SVG stenosis is more effective is important to eliminate time loss and confusion.

It is known that atherosclerosis is a chronic inflammatory process and therefore blood elements such as lymphocytes, neutrophils and platelets play a role in this process.[14] There are already numerous studies examining CRP in atherosclerosis and coronary artery disease.[15-16] The relationship between CAR and various coronary artery diseases has also been investigated in various studies and the relationship has been shown.[9,17]

Increased platelet activation has been shown to be associated with inflammation and therefore with atherosclerosis.[18] MPV is often used to evaluate immature platelets, and they are more prone to platelet aggregation and adhesion due to the substances they secrete.[19] Lymphocytes also play a major role in the inflammatory response, and lymphocyte count and activity affect and reflect the course of atherosclerosis and coronary artery disease.[20] PLR has been shown to be a useful marker in demonstrating systemic inflammatory response and in various forms of atherosclerosis and coronary artery disease.[21] In a previous meta analysis by Örnek et al., MPVLR was found to be associated with atherosclerosis and inflammation.[8] Increased NLR another systemic inflammatory is a marker and is associated with poor prognosis in coronary artery diseases.[22] CRP and albumin are also markers that have been shown to be associated with atherosclerosis, indicating a systemic inflammatory response.[23,24] CRP levels are expected to be high in inflammation, while plasma albumin levels are expected to be low.[25] Nutrition influences the state of inflammation and also some known infective parameters can be used as biomarkers for inflammation. Therefore, hypoalbuminemia may be a useful marker to indicate the severity of atherosclerosis. In addition, hypoalbuminemia leads to decreased antiplatelet activity, resulting in increased blood viscosity, leading to cardiovascular complications. studies have shown that serum albumin levels are inversely correlated with the severity of coronary artery stenosis in patients with myocardial infarction.[26] CAR has been shown in several studies to be a better marker than CRP and albumin in reflecting the severity of coronary artery stenosis and showing systemic inflammatory response.[27]

According to the results of this study, it was found that CAR and MPVLR reflect the severity of SVG stenosis better than PLR and NLR. Also found CAR to be the best indicator.

Limitations: Limitation of the study is that it is an observational, single-center study. Our research is multicenter and should be repeated with more participants. Another limitation of ours is that patients with acute coronary syndrome were not included in the study.

Conclusions: Patients who underwent CABG have major cardiovascular event risks in long-term follow-up. Identifying patients at the high risk of graft stenosis is challenging and also important in terms of future outcomes. In this context, inflammatory markers such as mentioned above have important role in preventing cardiovascular mortality and morbidity.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: In this study,national and international ethical rules are observed.

Tokat Gaziosmanpaşa unıversity/21-KAEK-007/28.01.2021

ORCID and Author contribution: Ç.Z. ***(0000-0003-4085-8151):*** Conception, Materials, Analysis and/or Interpretation, Writing. ***S.E.Ö. (0000-0002-6209-1732):*** Design, Data Collection and/or Processing, Literature Review, Writing. ***S.Y. (0000-0003-4738-3478):*** Supervision, Resource, Writer, Critical Review

Peer-review: Externally peer reviewed.

Acknowledgement: Authors, thanks to parents for their contribution.

References

1. Lee MS, Park SJ, Kandzari DE et al. Saphenous vein graft intervention. JACC Cardiovasc Interv. 2011;4:831-43. DOI: 10.1016/j.jcin.2011.05.014.
2. Allaire E, Clowes AW. Endothelial cell injury in cardiovascular surgery: the intimal hyperplastic response. Ann Thorac Surg. 1997;63:582-91 DOI: 10.1016/s0003-4975(96)01045-4.
3. Wiedemann D, Kocher A, Bonaros N et al. Perivascular administration of drugs and genes as a means of reducing vein graft failure. Curr Opin Pharmacol. 2012;12:203-16. DOI: 10.1016/j.coph.2012.02.012.
4. Motwani JG, Topol EJ. Aortocoronary saphenous vein graft disease: pathogenesis, predisposition, and prevention. Circulation. 1998;97:916-31. DOI: 10.1161/01.cir.97.9.916.
5. Kaya MG. Enflamasyon ve koroner arter hastalığı: Yeni biyobelirteç olarak nötrofil/lenfosit oranı [Inflammation and coronary artery disease: as a new biomarker neutrophil/lymphocyte ratio]. Turk Kardiyol Dern Ars. 2013;41:191-2. DOI: 10.5543/tkda.2013.84484.
6. Kurtul A, Murat SN, Yarlioglues M et al. Association of platelet-to-lymphocyte ratio with severity and complexity of coronary artery disease in patients with acute coronary syndromes. Am J Cardiol. 2014;114:972-8. DOI: 10.1016/j.amjcard.2014.07.005.
7. Besli F, Ilter A, Gungoren F. The Link Between Mean Platelet Volume to Lymphocyte Ratio and Complexity of Coronary Artery Disease. Angiology. 2018;69:358-9. DOI: 10.1177/0003319717743315.
8. Ornek E, Kurtul A. Relationship of mean platelet volume to lymphocyte ratio and coronary collateral circulation in patients with stable angina pectoris. Coron Artery Dis. 2017;28:492-7. DOI: 10.1097/MCA.0000000000000530.
9. Tanriverdi Z, Gungoren F, Tascanov MB, Besli F, Altiparmak IH. Comparing the Diagnostic Value of the C-Reactive Protein to Albumin Ratio With Other Inflammatory Markers in Patients With Stable Angina Pectoris. Angiology. 2020;71:360-5. DOI: 10.1177/0003319719897490.
10. Yayla C, Gayretli Yayla K. C-Reactive Protein to Albumin Ratio in Patients With Saphenous Vein Graft Disease. Angiology. 2021 Mar 8:3319721998863. DOI: 10.1177/0003319721998863.
11. Sahn D.J, Maris A, Kisslo J. For the committee on M-mode standardization of the American Society of Echocardiography Recommendation regarding quantitation in M-mode echocardiographic measurements. Circulation 1978;58:1072-83. DOI: 10.1161/01.cir.58.6.1072.
12. Cankurt T, Celik İE, Ozturk S, Maden O. Inflammatory Conditions in Acute Coronary Syndrome Patients Treated with Percutaneous Coronary Intervention of Saphenous Vein Graft. Int J Angiol. 2020;29:237-44. DOI: 10.1055/s-0040-1714751.
13. Yavuz F, Kilic S, Kaplan M, Yıldırım A, Kucukosmanoglu M, Dogdus M. Impact of Atherogenic Indexes in Saphenous Vein Graft Stenosis. Arq Bras Cardiol. 2020;115:538-44. DOI: 10.36660/abc.20190683.
14. Qiao S, Gao W, Guo S. Neutrophil-Lymphocyte Ratio (NLR) for Predicting Clinical Outcomes in Patients with Coronary Artery Disease and Type 2 Diabetes Mellitus: A Propensity Score Matching Analysis. Ther Clin Risk Manag. 2020;16:437-43. DOI: 10.2147/TCRM.S244623.
15. Wada H, Dohi T, Miyauchi K et al. Neutrophil to Lymphocyte Ratio and Long-Term Cardiovascular Outcomes in Coronary Artery Disease Patients with Low High-Sensitivity C-Reactive Protein Level. Int Heart J. 2020;61:447-53. DOI: 10.1536/ihj.19-543.
16. Umei TC, Kishimoto Y, Aoyama M et al. High Plasma Levels of Legumain in Patients with Complex Coronary Lesions. J Atheroscler Thromb. 2020;27:711-7. DOI: 10.5551/jat.52027.
17. Kalyoncuoglu M, Durmus G. Relationship between C-reactive protein-to-albumin ratio and the extent of coronary artery disease in patients with non-ST-elevated myocardial infarction. Coron Artery Dis. 2020;31:130-6. DOI: 10.1097/MCA.0000000000000768.
18. Collet JP, Kerneis M, Hulot JS et al. Point-of-care genetic profiling and/or platelet function testing in acute coronary syndrome. Thromb Haemost. 2016;115:382-91. DOI: 10.1160/TH15-05-0394.
19. Leader A, Pereg D, Lishner M. Are platelet volume indices of clinicaluse? A multidisciplinary review. Ann Med 2012;44:805–16. DOI: 10.3109/07853890.2011.653391.
20. Gary T, Pichler M, Belaj K et al. Lymphocyte-to-monocyte ratio: a novel marker for critical limb ischemia in PAOD patients. Int J Clin Pract. 2014;68:1483-7. DOI: 10.1111/ijcp.12495.
21. Qiu Z, Jiang Y, Jiang X et al. Relationship Between Platelet to Lymphocyte Ratio and Stable Coronary Artery Disease: Meta-Analysis of Observational Studies. Angiology. 2020;71:909-15. DOI: 10.1177/0003319720943810.
22. Azab B, Zaher M, Weiserbs KF et al. Usefulness of neutrophil to lymphocyte ratio in predicting short- and long-term mortality after non-ST-elevation myocardial infarction. Am J Cardiol. 2010;106:470-6. DOI: 10.1016/j.amjcard.2010.03.062.
23. Soeki T, Sata M. Inflammatory biomarkers and atherosclerosis. Int Heart J. 2016;57:134-9. DOI: 10.1536/ihj.15-346.
24. Keramat S, Karahan O, Patel M, Fazeli B. Acute phase reactant proteins in Buerger's disease: Is it a systemic disease? Vascular. 2023 Jun;31(3):473-476. doi: 10.1177/17085381211069715.
25. Gabay C, Kushner I. Acute-phase proteins and other systemic responses to inflammation. N Engl J Med. 1999;340:448-54. DOI: 10.1056/NEJM199902113400607.
26. Karahan O, Acet H, Ertaş F, et al. The relationship between fibrinogen to albumin ratio and severity of coronary artery disease in patients with STEMI. Am J Emerg Med. 2016 Jun;34(6):1037-42. DOI: 10.1016/j.ajem.2016.03.003.
27. Karabağ Y, Çağdaş M, Rencuzogullari I et al. Relationship between C-reactive protein/albumin ratio and coronary artery disease severity in patients with stable angina pectoris. J Clin Lab Anal. 2018;32:e22457. DOI: 10.1002/jcla.22457.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 219-225
Doi: 10.30565/medalanya.1293559

Retrospective Evaluation of Patients Who Were Treated in the Intensive Care Unit Due to Road Traffic Accidents

Karayolu Trafik Kazaları Nedeniyle Yoğun Bakım Ünitesinde Takip ve Tedavi Edilen Hastaların Retrospektif Olarak Değerlendirilmesi

Yıldız Yiğit[1], Nuriye Esen Bulut[2], Arzu Yıldırım Ar[1]

[1] Department of Anesthesiology and Reanimation,University of Health Sciences, Fatih Sultan Mehmet Training and Research Hospital, Istanbul, Türkiye

[2] Department of General Surgery,University of Health Sciences, Fatih Sultan Mehmet Training and Research Hospital, Istanbul, Türkiye

ABSTRACT

Aim: We aimed to investigate intensive care unit (ICU) treatments and factors associated with mortality in patients admitted to the ICU after road traffic accidents(RTAs).

Methods: This study retrospectively analyzed patient comorbidities,-features of traumas,alcohol use,Revised Trauma Score(RTS), interventions performed,ICU and hospital stays,the presence and extent of invasive mechanical ventilation(IMV),Acute Physiology and Chronic Health Evaluation (APACHE II), Simplified Acute Physiology Scores (SAPS II), as well as Glasgow Coma Scale (GCS) and NRS 2002 (Nutritional Risk Screening 2002) scores upon admission to the ICU. Brain death rates, transfusion rates, and ICU death rates were analyzed.

Results: 90 of the 109 patients treated in the ICU for RTAs survived, and 19 patients (17.4%) died.GCS scores were lower and APACHE II scores were greater in the non-surviving patients than in the surviving patients ($p < 0.0001$). The number of patients who received cardiopulmonary resuscitation (CPR) was significantly higher in the non-surviving patient group($p < 0.0001$).The most frequent etiology of trauma was non-vehicle traffic accidents(45%).The head was the most common site of traumas(71.5%).The GCS and RTS scores of non-survivor patients were significantly lower($p = 0.013$,$p = 0.001$,respectively), and the APACHE II and SAPS II scores were higher($p < 0.001$).It was found that the rates of intubation(100%),CPR(47.4%), and IMV(100%) in non-surviving patients outweighed in surviving patients($p= 0.005$,$p < 0.001$, and $p = 0.012$,respectively).

Conclusion: Multiple parameters are influential for determining the prognoses of patients treated in the ICU for traumas caused by RTAs.In particular,a high APACHE II score and CPR requirement are associated with mortality.

Key Words: Road traffic accidents, intensive care unit, mortality

ÖZET

Amaç: Karayolu trafik yaralanması sonrası yoğun bakım ünitesine(YBÜ) kabul edilen hastalarda ybü süreçleri ve mortalite ile ilişkili faktörleri incelemeyi amaçladık.

Yöntem: Bu çalışmada retrospektif olarak hastaların komorbiditeleri, travmaların özellikleri, alkol kullanımı, Revize Travma Skoru (RTS), yapılan girişimler, yoğun bakım ve hastanede kalış süreleri, invaziv mekanik ventilasyonun (IMV) varlığı ve süresi, yoğun bakım ünitesine kabul sırasında;Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi (APACHE II), Basitleştirilmiş Akut Fizyoloji Skorları (SAPS II) ve ayrıca Glasgow Koma Ölçeği (GCS) ve NRS 2002 (Beslenme Risk Taraması 2002) puanları incelendi. Beyin ölümü oranları, transfüzyon oranları ve yoğun bakım ünitesindeki ölüm oranları analiz edildi.

Bulgular: YBÜ'de RTA nedeniyle tedavi edilen 109 hastanın 90'ı hayatta kaldı ve 19 hasta (%17,4) öldü. Ölen hasta grubunda, sağ kalan hasta grubuna göre GKS skoru daha düşük ve APACHE II skorları yüksekdi ($p<0.0001$). Resusitasyon(KPR) uygulanan hasta sayısı, ölen hasta grubunda anlamlı şekilde yüksekdi ($p<0.0001$).En sık travma etyolojisi araç dışı trafik kazası idi (%45). En sık %71,5 ile kafa travması görüldü.Ölen hastaların GKS ve RTS skorları, anlamlı düzeyde düşük olup ($p:0.013$) ($p:0.001$), APACHE II ve SAPS II skorları yüksek idi ($p<0.001$). Ölen hastaların entübe edilme (%100),KPR uygulanma (%47,4) ve IMV yapılma oranını (%100), sağ kalan hastalardan anlamlı düzeyde yüksek bulduk ($p:0.005$)($p<0,001$) ($p:0.012$).

Sonuç: Karayolu trafik kazasına bağlı travma nedeniyle yoğun bakımda takip ve tedavi edilen hastaların prognoz tayininde farklı parametrelerin etkili olduğunu ve özellikle yüksek APACHE II ve KPR uygulanmasının mortalite ile ilişkili olduğu kanaatindeyiz.

Anahtar Kelimeler: Karayolu trafik kazaları, yoğun bakım ünitesi, mortalite

Recieved Date: 07.05.2023 / **Accepted Date:** 16.10.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Yıldız Yiğit, Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi E 5 karayolu üzeri 34752.İçerenköy,Ataşehir,İstanbul/Türkiye.

Phone: +9053324464 06 / **mail:** yildizyigityigit@gmail.com

ORCID: 0000-0002-8665-6646

To cited: Yiğit Y,Esen Bulut N, Yıldırım Ar A. Retrospective Evaluation Of Patients Who Were Treated In The Intensive Care Unit Due To Road Traffic Accidents. Acta Med. Alanya 2023;7(3): 219-225 doi: 10.30565/medalanya.1293559

CC BY NC ND

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Road traffic wounds adress a crucial worldwide public health issue that can be effectively prevented, but is often neglected.[1] In our country, trauma-related deaths rank sixth among the leading causes of mortality.[2] In addition, road traffic accidents (RTAs) have the potential to result in major traumas worldwide, presenting the main cause of disease and mortality.[3] Indeed, approximately 1.2 million die and over 50 million people get injured around the world.[4,5]

A substantial number of patients with major trauma due to RTAs require monitoring and treatment in intensive care units (ICUs). Assessments of trauma severity and prognosis determination involve the use of different scores, one of which is the Revised Trauma Score (RTS).[6] The RTS is a physiologically based system that has high inter-rater accountability, indicated accuracy in estimating in-hospital mortality, and can objectively determine injury severity in trauma patients.[7,8,9] The RTS is based on bedside clinical and physiological data premised on the Glasgow Coma Score (GCS), systolic blood pressure (SBP), and respiratory rate (RR). It is calculated using the formula RTS = (0.9368 × GCS) + (0.7326 × SBP) + (0.2908 × SS) and takes a value in the range of 0 and 7.8408.

We aimed to investigate the intensive care course and elements related with fatality in patients admitted to the ICU following road traffic injuries.

Methods

After obtaining ethical approval from our hospital's ethics committee (Approval No: E-17073117-050.06), we retrospectively evaluated the medicinal records of patients stayed in the ICU of Health Sciences University Fatih Sultan Mehmet Training and Research Hospital between January 1, 2013, and May 31, 2021, following RTAs. We included 109 patients aged 18 and older who admitted to the ICU for over 24 hours, excluding patients under 18 and those who died in the emergency department.

We collected data on age, gender, comorbidities, trauma etiology (motor vehicle accidents, non-vehicle traffic accidents, motorcycle accidents), trauma region (head, neck, chest, abdominal, extremity, pelvis), alcohol use, single or multiple traumas, Revised Trauma Score (RTS), the need for surgery due to traffic accidents, initial intubation, APACHE II (Acute Physiology and Chronic Health Evaluation) score upon initial admission to the ICU, SAPS II (Simplified Acute Physiology Score), and GCS and NRS 2002 (Nutritional Risk Screening 2002) scores. Additionally, we recorded initial albumin, hemoglobin, and platelet levels and administered albumin, ES, platelet transfusions, and FFP replacements. We also noted the presence of CPR, tube thoracostomy, and hemodialysis (HD), the duration of stay in the ICU, the presence and duration of IMV, the presence of brain death, the method of discharge from the ICU, and mortality rates.

Results

In our study; 5,557 patients were treated in our ICU over eight years, and 109 (1.96%) of these patients were treated for trauma resulting from RTAs. The mean age of the patients was 35.4 ± 16.85, with 91 (83.5%) male and 18 (18.5%) female. We found that 31 (28.4%) patients had motor vehicle accidents, 49 (45%) had pedestrian accidents, and 29 (26.6%) had motorcycle accidents. Hypertension was the most common comorbid illness observed in 16 (14.7%) of the patients. Head trauma was the most frequent injury, occurring in 78 (71.5%) of cases. Multiple traumas were present in 79 (72.5%) of the patients. The demographics, comorbidities, trauma regions, and interventions performed are summarized in Table 1.

The mean scores of GCS, RTS, APACHE II, SAPS II, and NRS 2002 upon admission to our ICU are presented in Table 1. The mean albumin level on the first day of ICU admission was 3.4 ± 0.73, with an average of 3.24 ± 7.85 albumin replacements.

The mean hemoglobin and platelet levels on the first day of ICU admission were 11.92 ± 2.49 and 214.14 ± 76.46, respectively, with an average of 2.13 ± 3.08 erythrocyte suspension (ES) replacements and 0.18 ± 1.58 platelet replacements. The mean number of FFP replacements was 1.72 ± 2.68. Hemodialysis was performed in 1.8% of the patients, and IMV was administered to 78% of the patients.

Our patients' average hospitalization length was 10.97 ± 13.89 days, with an average stay in ICU of 10.28 ± 13.45 days and an average IMV duration of 6.47 ± 9.85 days.

While 81.7% of our patients were successfully treated and discharged to the ward, 17.4% unfortunately passed away, and one patient became a care case (0.9%). Brain death was detected in 3.7% of the patients.

When we analyzed the patients treated and followed in the ICU after RTAs as two groups, survivors and non-survivors, no significant differences were observed in demographic data, comorbidity presence, alcohol usage, trauma location, and number of traumas. However, non-survivors had notably lower GCS and RTS scores compared to survivors (p: 0.013, p: 0.001, respectively), and we observed higher APACHE II and SAPS II scores in non-survivors (p: 0.000, p: 0.000, respectively). See Table 2.

Table 3 presents the average values of interventions performed, initial admission albumin levels, the amount of

Acta Medica Alanya 2023;7(3): 219-225
Doi: 10.30565/medalanya.1293559

Table 1. Patient, trauma characteristics and evaluation of scores at first presentation

		n	%
Comorbidities	Hypertension	16	14,7
	Diabetes Mellitus	9	8,3
	Cardiac Disease	7	6,4
	Lung Disease	8	7,3
	Rheumatological	8	7,4
	Neurological	5	4,6
Trauma Sites	Head Trauma	78	71,5
	Chest Trauma	45	41,3
	Abdominal Trauma	20	18,3
	Neck Trauma	5	4,5
	Extremity Trauma	43	39,4
	Pelvic Trauma	19	17,4
Number of trauma sites	Single trauma	30	27,5
	Multiple traumas	79	72,5
Arrival Intubated	Yes	32	29,4
	No	77	70,6
Tube Thoracostomy	Yes	90	82,6
	No	19	17,4
Surgery	Yes	61	56,0
	No	48	44,0
Alcohol Use	Yes	91	83,5
	No	18	16,5
Cardiopulmonary Resuscitation	Yes	96	88,1
	No	13	11,9
Scores	Min-Max	Mean ± SD	Median
GCS	3-15	10.29±4.11	11
RTS	1-8	6.58±1.46	7
APACHE II	2-41	16.61±9.14	15
SAPS II	3-86	31.59±18.18	29
NRS 2002	0-6	0.93±1.25	0

GCS: Glasgow Coma Scale RTS: Revised Trauma Score APACHE II: Acute Physiology and Chronic Health Evaluation SAPS II: Simplified acute physiology score NRS 2002: Nutrition Risk Screening 2002

administered albumin, initial admission hemoglobin (Hb) levels, the number of administered ES, platelet levels, the number of administered platelet suspensions, FFP given, the presence of IMV, the number of days of IMV, ICU stay days, and hospital stay days in survivors and non-survivors in the ICU.

We observed higher rates of endotracheal intubation, CPR, and IMV application in non-surviving patients in comparison to survivor ones(p: 0.005, p: 0.000, and p: 0.012, respectively). Additionally, initial admission albumin levels in the ICU were lower in surviving patients (p: 0.015), and the number of administered FFP units was greater in surviving patients (p: 0.046). See Table 3.

Having evaluated the effects of GKS, RTS, APACHE II, SAPS II, CPR, IMV presence, IMV days, albumin, number of administered FFP, initial intubation, and brain death parameters on mortality through logistic regression analysis, it was found that the model was significant ($p < 0.05$) and Nagelkerke R square value was 0.592 that indicated a good level of explanatory power (90%). The impact of the APACHE II score was significant ($p < 0.05$), with a higher APACHE II score associated with a 1.158 times increase in

Table 2. Comparison of surviving and non-survivoring patients

		Survivors (n=90)	Non-survivors (n=19)	
		n (%)	n (%)	p
Gender	Male	75 (83.3%)	16 (84.2%)	[1]1.000
	Female	15 (16.7%)	3 (15.8%)	
Age Mean ± SD (median %)		34.41±16.4 (30.5%)	40.11±18.56(36%)	[2]0.196
Alcohol Use	Yes	75 (83.3%)	16 (84.2%)	[1]1.000
	No	15 (16.7%)	3 (15.8%)	
Trauma Etiology	Vehicle collision	25 (27.8%)	6 (31.6%)	[3]0.829
	Pedestrian accident	40 (44.4%)	9 (47.4%)	
	Motorcycle accident	25 (27.8%)	4 (21.1%)	
Comorbidities	Hypertension	11 (12.2%)	5 (26.3%)	[1]0.150
	Diabetes Mellitus	8 (8.9%)	1 (5.3%)	[1]1.000
	Cardiac Disease	4 (4.4%)	3 (15.8%)	[1]0.100
	Lung Disease	8 (8.9%)	0 (0%)	[1]0.346
	Thyroid Disease	4 (4.4%)	0 (0%)	[1]1.000
	Neurological	4 (4.4%)	1 (5.3%)	[1]1.000
	Rheumatological	4 (4.4%)	0 (0%)	[1]1.000
Trauma Sites	Head Trauma	64 (71.1%)	14 (73.7%)	[4]1.000
	Chest Trauma	34 (37.8%)	11 (57.9%)	[4]0.173
	Abdominal Trauma	17 (18.9%)	3 (15.8%)	[1]1.000
	Neck Trauma	5 (5.6%)	0 (0%)	[1]0.584
	Extremity Trauma	39 (43.3%)	4 (21.1%)	[4]0.122
	Pelvic Trauma	15 (16.7%)	4 (21.1%)	[1]0.740
Number of trauma sites	Single trauma	24 (26.7%)	6 (31.6%)	[4]0.878
	Multiple traumas	66 (73.3%)	13 (68.4%)	
Scores	GCS Mean ± SD (median %)	10.81±3.67 (11%)	7.84±5.21 (6%)	[2]0.013*
	RTS Mean ± SD (median %)	6.86±1.15 (7%)	5.26±2.02 (5%)	[2]0.001*
	APACHE II Mean ± SD (median %)	14.24±7.58 (14%)	27.84±7.47 (28%)	[2]0.000*
	SAPS II Mean ± SD (median %)	26.78±14.06 (25.5%)	54.37±18.51 (51%)	[2]0.000*
	NRS 2002 Mean ± SD (median %)	0.79±1.06 (0%)	1.58±1.77 (2%)	[2]0.110

[1]Fisher's Exact Test
[2]Mann Whitney U Test
[3]Chi-squared test
[4]Yates continuity correction *p<0.05
GCS: Glasgow Coma Scale RTS: Revised Trauma Score APACHE 2: Acute Physiology and Chronic Health Evaluation
SAPS 2: Simplified acute physiology score NRS 2002: Nutritional Risk Screening 2002

mortality. On the other hand, the application of CPR had a remarkable impact on mortality increasing by 5.526 times. It was observed that the effect of the SAPS 2 score was 1.047 times increse in mortality whereas it was not statistically significant (borderline significant).

Statistical Analysis

IBM SPSS Statistics 22 software was used for the statistical analyses. The normal distribution of data was evaluated using the Shapiro–Wilk test.The Mann–Whitney U test

Acta Medica Alanya 2023;7(3): 219-225
Doi: 10.30565/medalanya.1293559

Table 3. Interventions, laboratory values, transfusion amounts, and ICU data of surviving and non-survivoring patients

n (%)		Survivors (n=90) n (%)	Non-survivors(n=19)	p
Interventions	Arrival Intubated	58 (64.4%)	19 (100%)	[1]0.005*
	Tube Thoracostomy	16 (17.8%)	3 (15.8%)	[2]1.000
	Surgery	39 (43.3%)	9 (47.4%)	[1]0.946
	Cardiopulmonary Resuscitation	4 (4.4%)	9 (47.4%)	[2]0.000*
	Hemodialysis	1 (1.1%)	1 (5.3%)	[2]0.320
	Invasive Mechanical Ventilation	66 (73.3%)	19 (100%)	[2]0.012*
Albumin Mean ± SD (median%)		3.48±0.69 (3.5%)	3±0.79 (3.1%)	[3]0.015*
Number of Administered Albumin Doses Mean ± SD (median%)		2.93±7.56 (0%)	4.68±9.2 (0%)	[3]0.165
Hemoglobin Mean ± SD (median%)		11.96±2.43 (12.5%)	11.72±2.81 (12.2%)	[3]0.789
Erythrocyte Suspensions Transfused Mean ± SD (median%)		1.94±2.94 (1%)	3±3.67 (2%)	[3]0.240
Thrombocyte Count Mean ± SD (median%)		212.19±66.08 (209%)	223.37±115.65 (224%)	[3]0.949
Thrombocytes Transfused Mean ± SD (median%)		0.04±0.42 (0%)	0.84±3.67 (0%)	[3]0.216
Fresh Frozen Plasma Transfused Mean ± SD (median%)		1.44±2.42 (0%)	3±3.48 (2%)	[3]0.046*
Days on Invasive Mechanical Ventilation Mean ± SD (median%)		5.92±9.65(2%)	9.05±10.65 (5%)	[3]0.018*
ICU stay (days) Mean ± SD (median%)		10.54±14.01 (5%)	9.05±10.65 (5%)	[3]0.694
Hospital stay (days) Mean ± SD (median%)		11.61±14.57 (6%)	7.95±9.87 (4%)	[3]0.164

[1]Yates continuity correction
[2]Fisher's Exact Test
[3]Mann Whitney U Test
ICU:Intensive care unit

was used for comparisons between the two groups for parameters that did not show a normal distribution. The chi-square test, Yates continuity correction, and Fisher's exact test were used to compare qualitative data. Logistic regression analysis was used for the multivariate analysis, with the significance set at $p < 0.005$.

Discussion

RTAs are among the leading causes of death in patients admitted to the ICU. In our study, we found that injuries resulting from RTAs were more common in young male patients, with head injuries occurring most frequently. Compared to the group of patients who survived, the non-survivors had lower GCS and RTS scores but higher APACHE II and SAPS II scores, and used IMV for a longer period of time. We also noted that all patients who did not survive required IMV.

In a retrospective stdudy conducted by Bener et al. who investigated the frequency and severity of head and neck injuries in 6,709 patients involved in RTAs, they found that the proportion of male patients was 85.9%.[10]

In Chelly et al.'s analysis of 694 patients treated in the ICU for head trauma following traffic accidents, they found 592 male patients (85.3%) and 102 female patients. This results in a mal/female ratio of 5.8.[11]

In Pogorzelski et al.'s retrospective study, where they analyzed the epidemiology, prognostic factors, and conse-

quences of trauma ICU patients, they determined that the proportion of male patients was 83%. Additionally, they found that patients had head trauma with 71%, chest trauma with 37 %, and abdominal trauma with 21%.[12]

Likewise, 83.5% of the participants were male, and 18.5% were female in our study. The ratio of male to female was 5.05. The age range was 35.4 ± 16.85. We observed that 71.5% of the patients had head trauma, 41.3% had chest trauma, and 18.3% had abdominal trauma. Additionally, we found that 45% of the patients were involved in non-vehicle traffic accidents (NVTA), 28.4% in vehicle traffic accidents (IVTA), and 26.6% in motorcycle accidents.

Accoridng to the study carried out by Adıyaman et al., it was found out that APACHE II score was considerbly greater in non-surviving paients.[13]

In a retrospective study, Yazar et al. examined the elements influencing mortality in 150 trauma patients who received treatment in the ICU. They found that the GCS value in surviving patients was higher than in non-survivors.[14]

Papadimitrio et al.'s retrospective study investigated mortality markers in 326 trauma patients and they found out that the GCS value was greater in survivors.[15]

In the retrospective study conducted by Chelly et al., they examined the clinical characteristics and prognoses of ICU patients who had head trauma in RTA. It was stated that GCS score was <8 and it was related with poor prognosis. They also found a good correlation between SAPS II and mortality. Surviving patients had lower SAPS II scores compared to those who died.[11]

Ünlü et al. performed retrospective research in which they used RTS scores in order to determine prognoses in 349 trauma patients and they found that the RTS score was lower in non-surviving patients.[6]

In a retrospective study by Yousefzadeh-Chabok et al. with 352 patients, they compared the various scores and it was found that the average TRISS and RTS scores were higher in surviving patients than in non-surviving patients.[9]

Zhao Xj et al.'s retrospective work examined the factors influencing mortality in 3,361 ICU patients with multitrauma and coma and they concluded that RTS values, similar to GCS values, are linked to mortality and it is significant to use these scoring systems in order to manage trauma rapidly and effectively.[16]

Reviewing the literature, we found that APACHE II and SAPS II values were higher and GCS and RTS values lower in non-survivors compared with the survivor group.We discovered that low RTS values were associated with mortality.

In Kara et al.'s retrospective study with 108 patients to analyze the variables influencing mortality in trauma patients, they found that the ratios and amounts of ES, FFP, and albumin replacement were higher in the non-surviving patients. They found that the rate of patients undergoing CPR with cardiac arrest for any reason in the pre-ICU or in the ICU was higher in the non-surviving patients. Moreover, they found that 90 % or p: 0.006 was the rate of IMV application in the non-survivors.[17]

In the retrospective study of Atrash et al., they examined the relationship between albumin levels and mortality in critically ill patients and found out that there was a close link between hypoalbuminemia and increased ICU mortality.[18]

In our study, the albumin levels of the non-survivors were considerably lower than those of the surviving patients (p: 0.015).

The retrospective study conducted by Taşdemir et al. with 117 trauma patients found an approximate IMV application rate as 53%. They observed a higher need for IMV and a longer duration of IMV in the non-surviving patients.[19]

Accoding to our study, IMV was administered in 78% of the patients, and 100 % of the non-survivors were admitted to the ICU on the first day. Those were intubated and receieved IMV support (p: 0.005, p: 0.012). We also observed a longer staying period in IMV in non-surviving patients when it was compared to those surviving patients (p: 0.018).

The literature has noted that invasive procedures and blood transfusions are frequently administered in patients whose overall health and trauma scores were poor.[20,21] Subsequently, it has been observed that mortality, coagulopathy, and sepsis rates are significantly increased in these patients.[20]

In our study, the number of FFP units administered to the patients who passed away was markedly higher than the surviving patients (p: 0.046). The number of erythrocyte suspension, platelet transfusions, and albumin administrations were very similar to both groups. We believe that the different patient numbers in the study groups may have contributed to these varying results.

In addition, we found that the ratio of CPR performed in passed away patients was 47.4% and 4.4% in surviving patients (p: 0.000) that the difference was noticeably high. Thus, our study indicated that the application of CPR was associated with a higher mortality rate.

The limitations of our research include the fact that our study is retrospective and the relatively small sample size of patients.

In conclusion, we found that in patients treated in the ICU for RTA-related traumas, especially high APACHE II scores and the application of CPR were associated with mortality.

Acta Medica Alanya 2023;7(3): 219-225
Doi: 10.30565/medalanya.1293559

Consistent with the literature, in our study, nonsurviving patients had higher APACHE II scores and lower GCS and RTS values compared to the surviving patient group. Correspondingly, we believe that the APACHE II score, which is routinely used for determining mortality in the trauma patients we follow and treat in the ICU, can guide us effectively.

Conflict of Interest: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this study has received no financial support

Ethics Committee Approval: The study was approved by the Ethics Committee of Fatih Sultan Mehmet Training and Research Hospital with the number E-17073117-050.06

ORCID and Author contribution: ***Y.Y. (0000-0002-8665-6646):*** Concept and Design, Analysis, Literature Search,Writing. ***N.E.B. (0000-0002-4845-8964):***Concept and Design, Interpretation, Writing, Critical Review, Final Approval. ***A.Y.A. (0000-0002-5867-0897):*** Analysis and/or Interpretation, Writing, Final Approval. Critical Review, Data collecting.

All the authors had contribution to all stages of the article, read the final version, and approved it.

Peer-review: Externally peer reviewed.

References

1. Razzaghi A, Soori H, Abadi A, Khosravi A. World Health Organization's estimates of death related to road traffic crashes and their discrepancy with other countries' national report. J Inj Violence Res. 2020;6;12(3):39–44. doi: 10.5249/jivr.v12i3.1425.
2. T.C. İstatistik Kurumu Başkanlığı (TÜİK) Haber Bülteni. Ölüm Nedeni İstatistikleri, 2019 Verileri. Sayı: 33710, 24.06. 2020 Erişim: 24.06.2020 https://data.tuik.gov.tr/Bulten/Index?p=Olum-ve-Olum-Nedeni-Istatistikleri-2019-33710
3. Shamim M. Pattern of Injuries from Road Traffic Accidents Presented at a Rural Teaching Institution of Karachi. Indian J Surg. 2017;79(4):332-7. doi: 10.1007/s12262-017-1605-3.
4. Bacchieri G, Barros AJ. Traffic accidents in Brazil from 1998 to 2010: many changes and few effects. Rev Saude Publica. 2011;45(5):949-63. doi: 10.1590/s0034-89102011005000069.
5. Moafian G, Aghabeigi MR, Heydari ST, Hoseinzadeh A, Lankarani KB, Sarikhani Y. An epidemiologic survey of road traffic accidents in Iran: analysis of driver-related factors. Chin J Traumatol. 2013;16(3):140-4. PMID: 23735547.
6. Ünlü AR, Ülger F, Dilek A, Barış S, Murat N, Sarıhasan B. Evaluation of the Relationship Between Revised Trauma Score, and Trauma and Injury Severity Scores with Prognosis of Trauma Patients in Intensive Care Unit. Türk Anest Rean Der Dergisi. 2012;40(3):128-35. doi: 10.5222/JTAICS.2012.128.
7. Galvagno SM Jr, Massey M, Bouzat P, Vesselinov R, Levy MJ, Millin MG, et al. Correlation Between the Revised Trauma Score and Injury Severity Score: Implications for Prehospital Trauma Triage.Prehosp Emerg Care. 2019;23(2):263-70. doi: 10.1080/10903127.2018.1489019.
8. Norouzi V, Feizi I, Vatankhah S, Pourshaikhian M. Calculation of the probability of survival for trauma patients based on trauma score and the injury severity score model in fatemi hospital in ardabil. Arch Trauma Res. 2013;2(1):30-5. doi: 10.5812/atr.9411.
9. Yousefzadeh-Chabok S, Hosseinpour M, Kouchakinejad-Eramsadati L, Ranjbar F, Malekpouri R, Razzaghi A, et al.Comparison of Revised Trauma Score, Injury Severity Score and Trauma and Injury Severity Score for mortality prediction in elderly trauma patients. Ulus Travma Acil Cerrahi Derg. 2016;22(6):536-40. doi: 10.5505/tjtes.2016.93288.
10. Bener A, Rahman YS, Mitra B. Incidence and severity of head and neck injuries in victims of road traffic crashes: In an economically developed country. Int Emerg Nurs. 2009;17(1):52-9. doi: 10.1016/j.ienj.2008.07.007.
11. Chelly H, Bahloul M, Ammar R, Dhouib A, Mahfoudh KB, Boudawara MZ, et al. Clinical characteristics and prognosis of traumatic head injury following road traffic accidents admitted in ICU "analysis of 694 cases". Eur J Trauma Emerg Surg. 2019;45(2):245-53. doi: 10.1007/s00068-017-0885-4.
12. Pogorzelski GF, Silva TA, Piazza T, Lacerda TM, Spencer Netto FA, Jorge AC,et al. Epidemiology, prognostic factors, and outcome of trauma patients admitted in a Brazilian intensive care unit. Open Access Emerg Med. 2018;10:81-8. doi: 10.2147/OAEM.S162695.
13. Adıyaman E, Tokur ME, Bal ZM, Gökmen AN,Koca U. Retrospective Analysis of Trauma Patients Who were Treated and Followed in Anesthesia Intensive Care Unit. Turkish J Intensive Care. 2019;17(3):146-53. doi: 10.4274/tybd.galenos.2018.82905.
14. Yazar MA, Sarıkuş Z, Horasanlı E. Thirty-day Mortality Outcomes of Trauma Patients in the Intensive Care Unit: A Three-year Retrospective Study. Turk J Intensive Care. 2019;17(1):18-24. doi: 10.4274/tybd.galenos.2018.75437.
15. Papadimitriou-Olivgeris M, Panteli E, Koutsileou K, Boulovana M, Zotou A, Marangos M, et al. Predictors of mortality of trauma patients admitted to the ICU: a retrospective observational study.Braz J Anesthesiol. 2021;71(1):23-30. doi: 10.1016/j.bjane.2020.12.006.
16. Zhao XJ, Kong LW, DU DY, Su HJ. Analysis on care outcome of patients with polytrauma and coma. Chin J Traumatol. 2007;10(1):53-8. PMID: 17229352.
17. Kara İ, Altınsoy S, Gök U, Onur A, Sarıbapıccı R. Mortality Analysis of Trauma Patients in General Intensive Care Unit of a State Hospital. Türk Yogun Bakim Dernegi Dergisi. 2015;13(2):68-74. doi: 10.4274/tybdd.54154.
18. Atrash AK, de Vasconcellos K. Low albumin levels are associated with mortality in the critically ill: A retrospective observational study in a multidisciplinary intensive care unit. South Afr J Crit Care. 2020;36(2):74-9. doi: 10.7196/SAJCC.2020.v36i2.422.
19. Taşdemir BB, Tüfek D, Sıvacı R, Doğan İ. Retrospective Analysis of the Prognosis in Trauma Patients Followed up in Intensive Care Unit. Turkiye Klinikleri J Anest Reanim. 2017;15(3):89-94. doi: 10.5336/anesthe.2017-56978.
20. Wafaisade A, Wutzler S, Lefering R, Tjardes T, Banerjee M, Paffrath T, et al. Trauma Registry of DGU. Drivers of acute coagulopathy after severe trauma: a multivariate analysis of 1987 patients. Emerg Med J. 2010;27(12):934-9. doi: 10.1136/emj.2009.088484.
21. Pape HC, Moore EE, McKinley T, Sauaia A. Pathophysiology in patients with polytrauma. Injury. 2022;53(7):2400-12. doi: 10.1016/j.injury.2022.04.009.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 226-231
Doi: 10.30565/medalanya.1376796

Lymphocyte-to-Monocyte Ratio is a Good Marker of Adhesive Capsulitis in Rotator Cuff Tears

Lenfosit-Monosit Oranı Rotator Manşet Yırtıklarında Adeziv Kapsülitin İyi Bir Belirtecidir

İlhan Çelik[1], Hümeyra Çelik[2], Tacettin Ayanoğlu[3], Emre Arıkan[4], Seyit Ali Kayış[5]

[1] Alanya Education and Training Hospital, Department of Orthopaedics and Traumatology, Antalya, Türkiye
[2] Alanya Alaaddin Keykubat University Medical School, Department of Physiology, Alanya, Antalya, Türkiye
[3] Bolu Abant Izzet Baysal University Medical School, Department of Orthopaedics and Traumatology, Bolu, Türkiye
[4] Bursa Yuksek Ihtisas Training and Research Hospital, Department of Orthopaedics and Traumatology, Bursa, Türkiye
[5] Bolu Abant Izzet Baysal University Medical School, Department of Biostatistics and Medical Informatics, Bolu, Türkiye

ABSTRACT

Purpose: The aim of the study is to evaluate the prediction of adhesive capsulitis in the preoperative period of rotator cuff tear (RCT) by neutrophil-lymphocyte (NLR), platelet-lymphocyte (PLR), neutrophil-monocyte (NMR), lymphocyte-monocyte (LMR) ratios.

Methods: This study was designed as a retrospective case-control study. After ethical approval, preoperative hemogram and biochemistry data of 128 patients who were operated on for RCT were collected from the archive of hospitale. Among the patients who underwent arthroscopy due to RCT, those with signs of adhesive capsulitis in the intraoperative period were included in the RCT+Adhesive capsulitis group. Age, blood glucose, CRP, sedimentation, white blood cell, neutrophil, monocytes, lymphocytes, platelets, fasting blood glucose, hemoglobin and hematocrit values, and NLR, PLR, NMR, and LMR ratios were compared between healthy control and RCT+Adhesive capsulitis. Logistic regression analysis of the ratios was also performed.

Results: A total of 64 healthy RCT (group 1) and 64 patients with RCT+Adhesive capsulitis (group 2) were included in the study. Fasting blood glucose, lymphocyte, CRP values, and NMR and LMR were found to be higher in patients with adhesive capsulitis ($p<0.05$); and monocyte, NLR and PLR were found to be lower in group 2 compared to group 1 ($p<0.05$). According to ROC analysis, it was revealed that LMR was the best predictor of adhesive capsulitis in RCT.

Conclusion: It has been demonstrated that the inflammation rate LMR obtained from the hemogram, which is an easy, low-cost, and reproducible method, is a variable that predicts adhesive capsulitis in RCT.

Key Words: Adhesive capsulitis; rotator cuff tear; lymphocyte-monocyte rate

ÖZET

Amaç: Çalışmanın amacı, rotator manşet yırtığındaki (RMY) adeziv kapsüliti preoperatif olarak ölçülen nötrofil-lenfosit (NLO), trombosit-lenfosit (PLO), nötrofil-monosit (NMO), lenfosit-monosit (LMO) oranlarından öngörmektir.

Yöntem: Bu çalışma retrospektif vaka kontrol çalışması olarak tasarlandı. Etik onay alındıktan sonra, RMY amacıyla ameliyat edilen 128 hastanın ameliyat öncesi hemogram ve biyokimya verileri hastane arşivinden toplandı. RMY nedeniyle artroskopi yapılan hastalardan intraoperatif dönemde adeziv kapsülit bulguları olanlar RMY+Adeziv kapsülit grubuna dahil edildi. Sağlıklı kontrol ve RMY+Adeziv kapsülit grupları arasında yaş, kan şekeri, CRP, sedimantasyon, beyaz kan hücresi, nötrofil, monositler, lenfositler, trombositler, açlık kan şekeri, hemoglobin ve hematokrit değerleri ile NLO, PLO, NMO ve LMO oranları karşılaştırıldı. Oranların lojistik regresyon analizi yapıldı.

Bulgular: Çalışmaya toplam 64 sağlıklı RMY (grup 1) ve 64 RMY+Adeziv kapsülit hastası (grup 2) dahil edildi. Açlık kan şekeri, lenfosit, CRP değerleri, NMO ve LMO adeziv kapsülitli hastalarda yüksek bulundu ($p<0,05$); monosit, NLO ve PLO ise grup 2'de grup 1'e göre daha düşük bulundu ($p<0,05$). ROC analizine göre RMY'de adeziv kapsülitin en iyi belirleyicisinin LMO olduğu ortaya çıktı.

Sonuç: Kolay, düşük maliyetli ve tekrarlanabilir bir yöntem olan hemogramdan elde edilen LMO'nun inflamatuar bir oran olarak RMY'de adeziv kapsüliti öngören bir değişken olduğu gösterilmiştir.

Anahtar Kelimeler: Adeziv kapsülit; rotator manşet yırtığı; lenfosit-monosit oranı

Recieved Date: 16.10.2023 / **Accepted Date:** 09.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Hümeyra Çelik, MD, Assisstant Professor, Alanya Alaaddin Keykubat University Medical School, Department of Physiology, Alanya, Antalya, Turkey
Phone: +905530522807 / **mail:** humeyra.colaker@gmail.com
ORCID: 0000-0002-3394-2438

To cited: Çelik İ, Çelik H, Ayanoğlu T, Arıkan E, Kayış SA. Lymphocyte-to-Monocyte Ratio is a Good Marker of Adhesive Capsulitis in Rotator Cuff Tears. Acta Med. Alanya 2023;7(3): 226-231 doi: 10.30565/medalanya.1376796

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 226-231
Doi: 10.30565/medalanya.1376796

Introduction

Adhesive capsulitis, also known as 'frozen shoulder', is known as the presence of significant limitation and pain in active and passive shoulder range of motion due to inflammatory fibrotic contracture of the glenohumeral joint capsule.[1] Although it has an increasing incidence with age[2], it has been reported to be more common, especially in adults between the ages of 52 and 72[3], and to be associated with some diseases such as diabetes mellitus, hypo-hyperthyroidism, myocardial infarction.[4] Non-infectious and limited chronic low-grade inflammation and fibrosis formation without necrosis are suggested for the formation of adhesive capsulitis.[5] Inflammation-based histopathology of adhesive capsulitis has been supported by magnetic resonance imaging (MRI).[6]

For the diagnosis of adhesive capsulitis, when abduction-external rotation restriction is detected in the physical examination, it is supported by MRI, but the definitive diagnosis is made during the repair of RCT (rotator cuff tear) in arthroscopy.[7] To support the diagnosis, it is known that blood glucose and HbA1c elevation among laboratory findings[8] are associated with adhesive capsulitis, and C-reactive protein[9] shows high sensitivity in adhesive capsulitis, but there are no preoperative and specific laboratory findings for it. The formation of adhesive capsulitis based on inflammation is a guide for the investigation of inflammatory markers supporting the diagnosis.

It has been demonstrated that neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), neutrophil-monocyte ratio (NMR), and lymphocyte-monocyte ratios (LMR) reflect the level of systemic inflammation, and have recently been suggested as inflammatory markers.[10] These parameters, which can be easily calculated from blood samples collected under simple laboratory conditions, represent low-cost and reproducible tests, and are included in the hemogram for preoperative routine examination.[11, 12] These parameters can be associated with adhesive capsulitis, which has a hypothesis of inflammation in its etiopathogenesis. If the adhesive capsulitis accompanying rotator cuff tendinitis was diagnosed during the preoperative preparation, additional measures such as frozen shoulder manipulation could be added before arthroscopy, and the preoperative preparation process could be strengthened.

In light of this information, we aim to contribute to the diagnostic approach of adhesive capsulitis by evaluating NLR, PLR, NMR, and LMR in preoperative hemograms of patients with RCT.

Material-Method

Ethical approval of the study was obtained from Bolu Abant İzzet Baysal University Clinical Research Ethics Committee (decision number: 78/2021). This study was designed as a retrospective case-control study. Demographic and clinical data of the patients were obtained from Bolu Abant İzzet Baysal University Medical Faculty Hospital Orthopaedics-Traumatology Department in the hospital database. Patients who have undergone surgery and fracture, have rheumatic disease, septic arthritis and diagnosed with degenerative arthritis excluded the study. Two groups were formed in the study as RCT (Group 1) and RCT+Adhesive capsulitis (Group 2). Those included in the RCT+adhesive capsulitis group applied to Bolu Abant İzzet Baysal University Training and Research Hospital Polyclinics between 2021-2022 and were randomly selected from the patient population who diagnosed with adhesive capsulitis according to physical examination, MRI, and arthroscopic findings. RCT patients were randomly selected from those who did not show signs of intraoperative adhesive capsulitis. Preoperative hemograms taken routinely from the patients were used in the study. The age, gender, blood glucose value, CRP, sedimentation, white blood cell, neutrophil, monocytes, lymphocyte, platelet values and neutrophil-to-lymphocyte, platelet-to-lymphocyte, lymphocyte-to-monocyte and neutrophil-to-monocyte ratios were evaluated in the study. Physical examination findings suggestive of adhesive capsulitis: Impaired range of motion with forward flexion, abduction, and external and internal rotation the MRI findings of the RCT+adhesive capsulitis group may include : thickening of the coracohumeral ligament, inflammation and edema, accumulation of fibrous tissue, thickening of the joint capsule, narrowing of the joint space, increased synovial fluid, involvement of the rotator cuff capsule. All patients were operated on in the lateral decubitus position with traction. A diagnosis of RCT was made by standard glenohumeral examination. The diagnosis of adhesive capsulitis was made arthroscopically with intraoperative visualization: synovial inflammation concentrated in the rotator interval and hypertrophy, reactive capsular fibrosis, increased capsule and coracohumeral ligament thickness.[13] Rotator interval excision was additionally applied based on RCT.

Statistical Analysis

As descriptive statistics, numbers and percentages were used for categorical data, and mean±standard deviation or median (min.-max.) was used for continuous data. The

distributional properties of the continuous data were evaluated using the Shapiro-Wilk Test. Control and adhesive capsulitis groups were compared t-test for normally distributed variables and via Mann Whitney U test for non-normally distributed variables. Bivariate comparisons of categorical data were conducted using Chi-square tests. Initially, a single explanatory variable logistic regression analysis model was fit for all variables. Than multiple explanatory variable logistic regression analysis model, was fitted by including all significant independent variables. A backward-elimination approach in the multiple explanatory variable logistic regression model was conducted to evaluate the model for potential confounding effects. In this model, the factors/covariates were removed one at a time, starting with the factor/covariate that had the largest P value, until all remaining factors had a two-sided P value <0.05. The goodness of fit was tested using the Hosmer–Lemeshow Test.

Results

CRP:C-reactive protein, WBC:White blood cell, HMG: Hemoglobin, HCT: Hematocrit, Group 1: RCT, Group 2: RCT+Adhesive capsulitis

Descriptive statistics of Groups 1 and 2 are given in Table 1. No statistically significant difference were found between groups 1 and 2 for hemoglobin (p=0.100) and hematocrit (p=0.080), but for fasting blood glucose was found higher statistically in Group 2 (p=0.009). There was no difference between the white blood cell (p=0.520), neutrophil (p=0.860) and platelet (p=0.334) values of the groups evaluated in the hemogram. In Group 2, lymphocytes (p=0.033) were found higher statistically and monocytes (p=0.000) were found lower statistically. The sedimentation used to assess systemic inflammation was similar between groups (p=0.090) and CRP (p=0.040) was found higher in Group 2 (Figure 1).

NLR (p=0.024), NMR (p=0.000), LMR (p=0.000) and PLR (p=0.011), which are thought to be helpful in diagnosis, were statistically different between groups 1 and 2. While LMR and NMR were higher in group 2, NLR and PLR were higher in group 1 (Figure 1).

In the logistic regression analysis, the cut-off value for LMR was determined as 3.02, this value was found to be 0.83 sensitive and 0.61 specific (Tables 2 and 3, Figure 2).

Discussion

To summarize the findings of the study, preoperative blood glucose, CRP, lymphocyte, NMR and LMR were found to be significantly higher in the preoperative RCT+Adhesive capsulitis group; monocytes, NLR, and PLR values were found to be high in the RCT group. In addition, LMR was found to have the highest sensitivity and specificity among the NMR, LMR, NLR and PLR to predict adhesive capsulitis in the preoperative period in RCT patients.

Diabetes mellitus is known as a condition predisposing to the formation of adhesive capsulitis[14], and chronic low-grade inflammation caused by diabetes is estimated to constitute the pathophysiology of adhesive capsulitis.[15] For this purpose, adhesive capsulitis has been included among the skeletal system complications caused by diabetes[16], HbA1c has been shown to be correlated with the increasing incidence of diabetes mellitus[8], and it has been reported that there is a relationship between adhesive capsulitis and the hyperglycemia component of the metabolic syndrome.[4] In our study, consistent with the literature, plasma glucose levels were found to be high in

Table 1. The descriptive statistics of Group 1 (RCT) and Group 2 (RCT+Adhesive capsulitis)

Variable	Group 1(n=63)	Group 2 (n=63)	*P* value
Age, year[b]	57 (50-65)	59 (44-67)	0.742
Plasma glucose, gr/dL[b]	115 (96-153)	102 (93-117)	0.009
CRP, mg/dL[b]	3.2 (0.5-6.6)	1.4 (0.2-3.5)	0.040
Sedimentation, mm/h[b]	14 (10-20)	18 (12-26)	0.090
Neutrophil, K/µL[b]	4.20 (3.6-4.8)	3.9 (3.3-5.1)	0.860
Lymphocyte, K/µL[b]	2.3 (1.8-3.0)	2.0 (1.6-2.6)	0.033
Monocyte, K/µL[b]	0.5 (0.4-0.6)	0.6 (0.5-0.9)	0.000
Platelet, K/µL[b]	255 (214-303)	264 (229-306)	0.334
WBC, K/µL[b]	7.3 (6.0-8.7)	7.0 (5.9-8.4)	0.520
HGB, g/dL[a]	14.3±1.73	13.8±1.46	0.100
HCT, %[a]	43.5±4.67	42.2±4.19	0.080

[a] Means SD; P values were determined via t-test.

[b] Values are median (Q1-Q3); P values were determined via Mann Whitney U test.

Acta Medica Alanya 2023;7(3): 226-231
Doi: 10.30565/medalanya.1376796

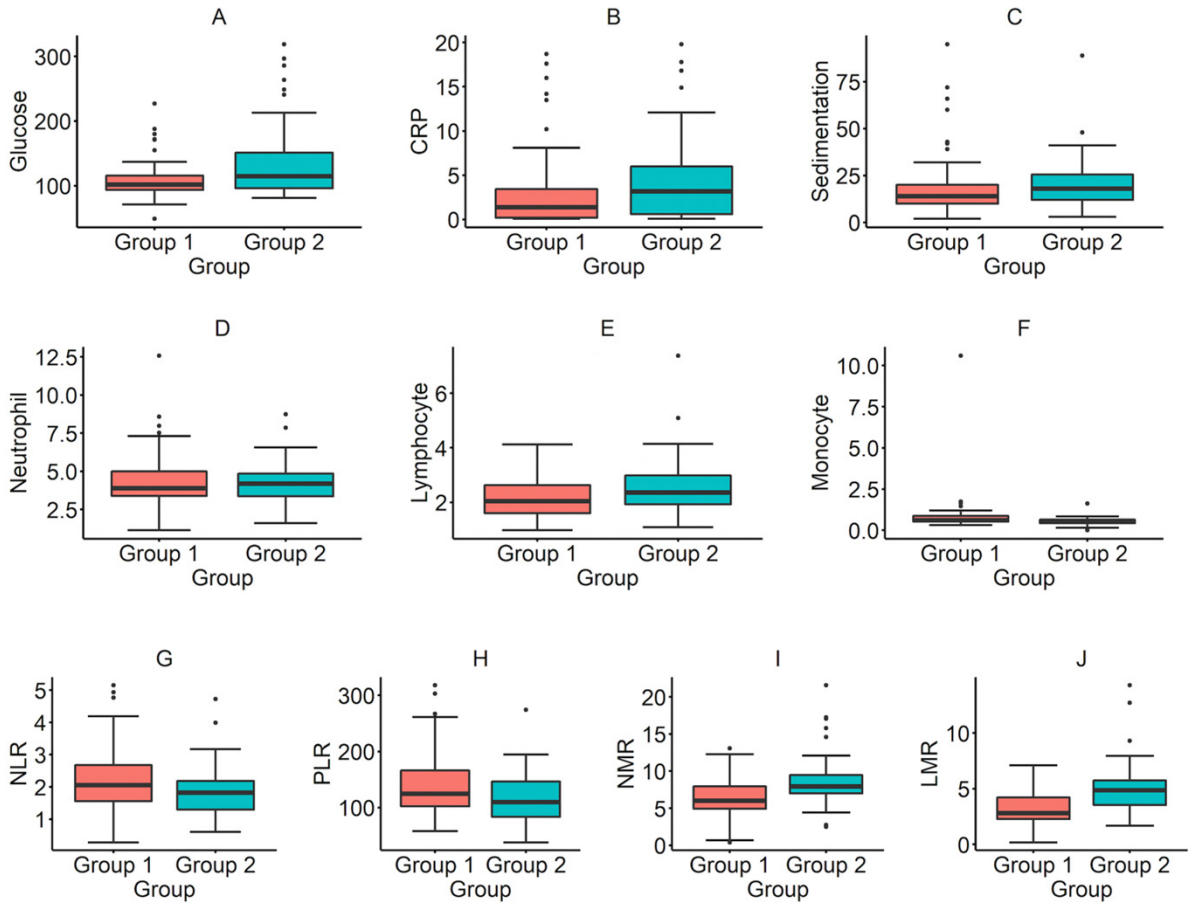


Figure 1. Comparison of glucose (A), CRP (B), sedimentation (C), neutrophil (D), lymphocyte (E), monocytes (F), NLR (G), PLR (H), NMR (I) and LMR (J) between groups. (Group 1:RCP; Group 2:RCP+Adhesive capsulitis; CRP: C-reactive protein; NLR:Neutrophil-Lymphocyte Ratio; PLR:Platelet-Lymphocyte Ratio; NMR: Neutrophil-Monocyte Ratio; LMR: Lymphocyte-Monocyte Ratio.)

Table 2. Results of the single explanatory variable logistic regression analysis for inflammation rates
[a] Values are median (Q1-Q3).

Variable	Group 1 (n=63)	Group 2 (n=63)	Odds ratio	(95 % CI)	P value
NLR[a]	2.05 (1.5-2.7)	1.82 (1.2-2.2)	1.64	1.09-2.57	*0.02*
NMR[a]	6.0 (4.9-7.9)	7.95 (6.9-9.5)	0.76	0.64-0.88	*0.00*
PLR[a]	124.8 (101.7-169.0)	109.9 (82.9-146.3)	1.01	1.00-1.02	*0.00*
LMR	2.0 (2.2-4.2)	4.8 (3.4-5.7)	0.49	0.36-0.65	*0.00*

Table 3. Results of the multiple explanatory variable analysis for inflammation rates

Variable	Odds ratio (95 % CI)	P value
NLR	1.25 (0.34-5.42)	0.745
NMR	0.87 (0.72-1.04)	0.14
PLR	1.00 (0.99-1.01)	0.31
LMR	0.68 (0.31-1.42)	*0.00*

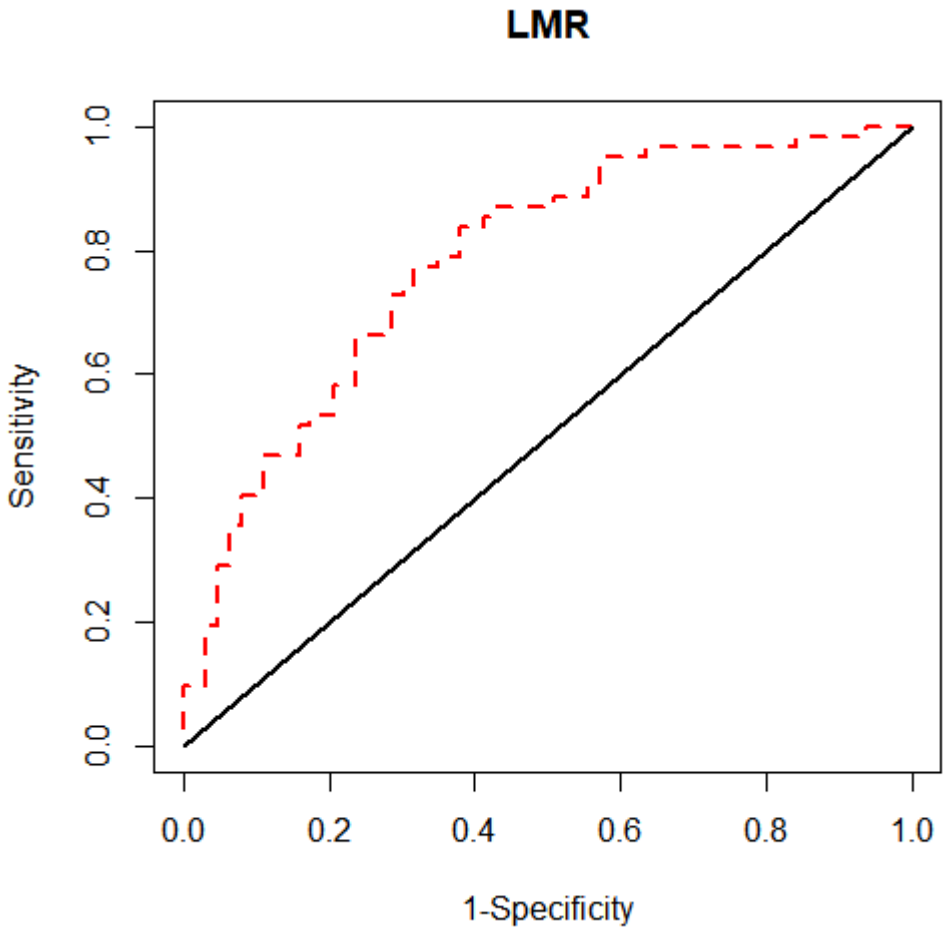


Figure 2. ROC curve for separating RCT and RCT+Adhesive capsulitis for LMR (Area Under the Curve 0.783, p value 0.00).

patients with adhesive capsulitis, and the formation of adhesive capsulitis based on hyperglycemia was confirmed.

Capsular fibrosis of adhesive capsulitis develops against the background of chronic low-grade inflammation.[17] C-reactive protein and erythrocyte sedimentation rate are frequently used as markers of systemic inflammation in clinical practice. Although there are studies showing that C-reactive protein is normal[18] and high[19] in adhesive capsulitis, a more sensitive form of CRP, called high sensitivity-CRP, shows high sensitivity.[9] There are studies reporting that ESR is normal[18] and high[19] in adhesive capsulitis. In our study, CRP was high and ESR was normal in the RCT+Adhesive capsulitis group. Here, sedimentation normality associated with CRP elevation may be used in differential diagnosis to predict preoperative adhesive capsulitis in patients with RCT.

Lymphocytes provide cell-mediated immunity as part of adaptive immunity and play a role in chronic inflammation.[20] Neutrophils[21] and monocytes[22] represent acute inflammation as part of innate immunity. Inflammatory rates, which are easily and inexpensively obtained under basic laboratory conditions by routine hemogram evaluation from automated systems such as NLR, PLR, NMR and LMR, are studied for biomarker purposes in diseases whose symptoms are not within sharp limits and many methods are used for diagnosis.[23] These markers have been studied in many diseases such as inflammatory bowel diseases, malignancies, cardiovascular diseases, and acute pancreatitis, and significant results have been obtained in this regard.[24] In relation to the pathophysiology of chronic low-grade inflammation of adhesive capsulitis, our results showed high lymphocyte value and low monocyte value. In connection with these values, LMR and NMR were high, and NLR and PLR were low in patients with RCT+Adhesive capsulitis. When we measured which rate could better predict adhesive capsulitis in the preoperative period in patients with RCT with the highest sensitivity and specificity, we revealed that LMR may be the best biomarker candidate. The definitive diagnosis of adhesive capsulitis is made by arthroscopic intervention, but our study revealed that the correct interpretation of inflammatory rates in the hemogram, as well as physical examination during the preoperative planning period, will contribute to supporting the diagnosis.

Acta Medica Alanya 2023;7(3): 226-231
Doi: 10.30565/medalanya.1376796

Limitations: The lack of clinical data in cases of adhesive capsulitis in our study constituted the limitation; of the study. The advantage of the present study was that inflammatory rates in adhesive capsulitis were studied for the first time with sensitivity and specificity values.

Conclusion: Easy and inexpensive diagnostic approaches to predict whether adhesive capsulitis accompanies a rotator cuff tear in the preoperative period can strengthen the perioperative strategy and contribute to the surgical organization. We believe that future multicenter studies with more patients and groups will contribute to the early diagnosis and treatment of adhesive capsulitis with RCT.

Conflict of Interest: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this study has received no financial support.

Ethics Committee Approval: In this study, national and international ethical rules are observed.

Ethic Board: Bolu Abant İzzet Baysal University Clinical Research Ethics Committee 2021/78

ORCID and Author contribution: H. Ç. (0000-0002-3394-2438), İ. Ç. (0000-0003-3709-2511),T. A. (0000-0002-3089-9913),E. A. (0000-0001-5033-893X),S.A.K. (0000-0003-4791-8946). All the authors had contribution to all stages of the article, read the final version, and approved it.

Peer-review: Externally peer reviewed.

References

1. Neviaser AS, Neviaser RJ. Adhesive capsulitis of the shoulder. J Am Acad Orthop Surg. 2011;19:536-42. doi: 10.5435/00124635-201109000-00004.
2. Balci N, Balci MK, Tüzüner S. Shoulder adhesive capsulitis and shoulder range of motion in type II diabetes mellitus: association with diabetic complications. J Diabetes Complications. 1999;13:135-40. doi: 10.1016/s1056-8727(99)00037-9.
3. Bridgman JF. Periarthritis of the shoulder and diabetes mellitus. Ann Rheum Dis. 1972;31:69-71. doi: 10.1136/ard.31.1.69.
4. Austin DC, Gans I, Park MJ, Carey JL, Kelly JD 4th. The association of metabolic syndrome markers with adhesive capsulitis. J Shoulder Elbow Surg. 2014;23:1043-51. doi: 10.1016/j.jse.2013.11.004
5. Nathan C, Ding A. Nonresolving inflammation. Cell. 2010;140:871-82. doi: 10.1016/j.cell.2010.02.029.
6. Sofka CM, Ciavarra GA, Hannafin JA, Cordasco FA, Potter HG. Magnetic resonance imaging of adhesive capsulitis: correlation with clinical staging. HSS J. 2008;4:164-9. doi: 10.1007/s11420-008-9088-1.
7. Ramirez J. Adhesive Capsulitis: Diagnosis and Management. Am Fam Physician. 2019;99:297-300. PMID: 30811157
8. Chan JH, Ho BS, Alvi HM, Saltzman MD, Marra G. The relationship between the incidence of adhesive capsulitis and hemoglobin A_{1c}. J Shoulder Elbow Surg. 2017;26:1834-7. doi: 10.1016/j.jse.2017.03.015
9. Park HB, Gwark JY, Jung J, Jeong ST. Association Between High-Sensitivity C-Reactive Protein and Idiopathic Adhesive Capsulitis. J Bone Joint Surg Am. 2020;102:761-8. doi: 10.2106/JBJS.19.00759.
10. Fusar-Poli L, Natale A, Amerio A, et al. Neutrophil-to-Lymphocyte, Platelet-to-Lymphocyte and Monocyte-to-Lymphocyte Ratio in Bipolar Disorder. Brain Sci. 2021;11:58. doi: 10.3390/brainsci11010058.
11. Sun Y, Lin J, Luo Z, Chen J. Preoperative Lymphocyte to Monocyte Ratio Can Be a Prognostic Factor in Arthroscopic Repair of Small to Large Rotator Cuff Tears. Am J Sports Med. 2020;48:3042-50. doi: 10.1177/0363546520953427.
12. Sarıçam G. Neutrophil/Lymphocyte, Platelet/Lymphocyte and Neutrophil/Monocyte Rates in Carpal Tunnel Syndrome. Turkiye Klinikleri J Cardiovasc Sci. 2018;30:107-12. doi: 10.5336/cardiosci.2018-62886
13. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. Shoulder Elbow. 2017;9:75-84. doi: 10.1177/1758573216676786.
14. Dias R, Cutts S, Massoud S. Frozen shoulder. BMJ. 2005;331:1453-6. doi: 10.1136/bmj.331.7530.1453.
15. Milgrom C, Novack V, Weil Y, Jaber S, Radeva-Petrova DR, Finestone A. Risk factors for idiopathic frozen shoulder. Isr Med Assoc J. 2008;10:361-4. PMID: 18605360
16. Gordon JA, Farooqi AS, Rabut E, et al. Evaluating whole-genome expression differences in idiopathic and diabetic adhesive capsulitis. J Shoulder Elbow Surg. 2022;31:e1-13. doi: 10.1016/j.jse.2021.06.016.
17. Pietrzak M. Adhesive capsulitis: An age related symptom of metabolic syndrome and chronic low-grade inflammation? Med Hypotheses. 2016;88:12-7. doi: 10.1016/j.mehy.2016.01.002.
18. Hamdan TA, Al-Essa KA. Manipulation under anaesthesia for the treatment of frozen shoulder. Int Orthop. 2003;27:107-9. doi: 10.1007/s00264-002-0397-6.
19. Bulgen DY, Binder A, Hazleman BL, Park JR. Immunological studies in frozen shoulder. J Rheumatol. 1982;9:893-8. PMID: 7161781
20. Miller BJ, Gassama B, Sebastian D, Buckley P, Mellor A. Meta-analysis of lymphocytes in schizophrenia: clinical status and antipsychotic effects. Biol Psychiatry. 2013;73:993-9. doi: 10.1016/j.biopsych.2012.09.007.
21. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002. Innate Immunity.Available from: https://www.ncbi.nlm.nih.gov/books/NBK26846/
22. Fogg DK, Sibon C, Miled C, et al. A clonogenic bone marrow progenitor specific for macrophages and dendritic cells. Science. 2006;311:83-7. doi: 10.1126/science.1117729.
23. Balta S, Demirkol S, Unlu M, Arslan Z, Celik T. Neutrophil to lymphocyte ratio may be predict of mortality in all conditions. Br J Cancer. 2013;109:3125-6. doi: 10.1038/bjc.2013.598.
24. Posul E, Yilmaz B, Aktas G, Kurt M. Does neutrophil-to-lymphocyte ratio predict active ulcerative colitis? Wien Klin Wochenschr. 2015;127:262-5. doi: 10.1007/s00508-014-0683-5.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 232-237
Doi: 10.30565/medalanya.1384162

Lessons Learned From Covid-19 Pandemia: Pregnancy Anxiety Level Increases During A Life Threatening Period

Kovid-19 Pandemisinden Öğrenilen Dersler: Hayatı Tehdit Eden Bir Dönemde Gebelik Kaygı Düzeyi Artıyor

Emre Köle[1], Lale Aksoy[2], Gökşen Görgülü[3], Hakan Demir[4], Merve Çakır Köle[1], Erdoğan Aslan[1]

[1] Department of Obstetrics and Gynecology, Antalya Education and Research Hospital, Antalya, Turkey

[2] Department of Obstetrics and Gynecology, Geyve State Hospital, Sakarya, Turkey

[3] Department of Obstetrics and Gynecology, Tepecik Education and Research Hospital, İzmir, Turkey

[4] Department of Obstetrics and Gynecology, Zonguldak Obstetrics and Gynecology State Hospital, Zonguldak, Türkiye

ABSTRACT

Introduction: We aimed to highlight the psychological effects of the disease in the pandemic process along with the epidemiological data in pregnant women with COVID 19 infection, and the effects of increased anxiety in pandemic on pregnancy outcomes.

Material and Methods: This study was performed in 100 women of 15 to 49 years of reproductive age who applied to the Gynecology and Obstetrics Outpatient Clinic, Pandemic Outpatient Clinic and the Pregnant Outpatient Clinic. Fourty-six pregnant women with positive COVID 19 PCR test were compared with negative COVID 19 PCR test as control group. Patients were administered a questionnaire and Beck Anxiety Inventory.

Results: An evaluation using the Beck Anxiety Scale revealed that anxiety levels were significantly higher in the COVID-19 positive pregnant group compared to the COVID-19 negative pregnant group (p=0.001). When comparing the groups in terms of becoming pregnant and giving birth during the pandemic, it was found that "severe anxiety" significantly increased in the COVID-19 negative pregnant group (p=0.032)

Discussion: We found that being COVID-19 positive, based on the Beck Anxiety Inventory, significantly increased the anxiety levels during pregnancy when compared to negative groups.

Key Words: anxiety, pandemia, pregnancy,COVID19, mental health

ÖZET

Giriş: Bu çalışmada, COVID-19 enfeksiyonlu hamile kadınlardaki epidemiyolojik verilerle birlikte, pandemi sürecinde hastalığın oluşturduğu psikolojik etkileri ve pandemide artan anksiyetenin gebelik sonuçlarına etkilerini vurgulamayı amaçladık.

Materyal ve Yöntemler: Bu çalışma,15 ila 49 yaşlarındaki 100 kadında gerçekleştirildi ve katılımcılar, Kadın Hastalıkları ve Doğum Polikliniği, Pandemi Polikliniği ve Gebelik Polikliniği'ne başvuranlardan seçildi. Kırk altı COVID-19 pozitif gebe kadın, kontrol grubu olarak negatif COVID-19 PCR testi olanlarla karşılaştırıldı. Katılımcılara bir anket ve Beck Anksiyete Envanteri uygulandı.

Bulgular: Beck Anksiyete Envanteri kullanılarak yapılan bu çalışmada COVID-19 pozitif gebe grubunda anksiyete düzeylerinin COVID-19 negatif gebe grubuyla karşılaştırıldığında anlamlı derecede yüksek olduğunu gösterildi (p=0.001). Gruplar, pandemi sırasında gebe kalma ve doğum yapma açısından karşılaştırıldığında, "şiddetli anksiyete" nin COVID-19 negatif hamile grubunda anlamlı derecede arttığı bulundu (p=0.032).

Tartışma: Beck Anksiyete Envanterine dayalı olarak, COVID-19 pozitif olanların negatif gruplarla karşılaştırıldığında gebelik sırasında anksiyete düzeylerini anlamlı derecede artırdığını tespit ettik.

Anahtar Kelimeler: Adeziv kapsülit; rotator manşet yırtığı; lenfosit-monosit oranı

Recieved Date: 31.10.2023 / **Accepted Date:** 16.11.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Emre Köle, MD. Alanya Alaaddin Keykubat University School of Medicine, Antalya, Turkey Address: Kestel, Karapınar Caddesi 07450 Alanya/Antalya
Phone: +90 (530) 9221337 / **mail:** emre.kole.41@gmail.com
ORCID: 0000-0002-4940-8862

To cited: Köle E, Aksoy L, Görgülü G, Demir H, Çakır Köle M, Aslan E. Lessons Learned From Covid-19 Pandemia: Pregnancy Anxiety Level Increases During A Life Threatening Period. Acta Med. Alanya 2023;7(3): 232-237 doi: 10.30565/medalanya.1384162

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 232-237
Doi: 10.30565/medalanya.1384162

Introduction

In December 2019 a new coronavirus infection, which was first described in Wuhan, China, also showed its effect in our country. Our first case was detected on 11.03.2020, and according to current data, approximately 140 thousand cases have been followed since then. In the light of up-to-date official data worldwide, nearly 4.5 million infected people and nearly 300,000 deaths have occurred in the COVID 19 pandemic for now. The number of infected pregnant women and the number of maternal deaths remained unknown because of heterogenity of data and global scale of disease spread.[1, 2, 3, 4, 5, 6]

In recent years, it is known that some mental diseases can be seen frequently in pregnancy. Depression and anxiety in pregnant women are the leading pshycological pathologies which are observed more frequently when compared with general population.[7, 8] Antenatal anxiety is more prevalent than depression with, serious maternal and fetal consequences.[9] Maternal anxiety is related to maternal sociodemographic properties such as age of mother, marital status, children number, education level, history of smoking, alcohol and substance use, and if the pregnancy was planned or not.[10] Anxiety symptoms during pregnancy leads to increased the rate of fear of vaginal delivery and a preference for cesarean section.[11] Also, prenatal anxiety has been recognized as a potential etiology that may lead to preterm birth and low birth weight.[12] Consequently, anxiety during pregnancy was found to be associated with poor neonatal outcomes, and pregnant women should therefore be screened for anxiety and, be informed about the risks.[13, 14]

Due to the rapid and easy transmission of infection during the global pandemic period, most countries implemented socially restrictive measures such as isolation and quarantine. Those measures inevidently caused to exacerbate preexisting mental illnesses and, caused emergence of new symptoms. Many countries therefore planned psychosocial support programs especially for pregnant women in their health policies following such a large scale catastrophy.[15, 16]

We aimed to highlight the psychological effects of the disease in the pandemic process along with the epidemiological data in pregnant women with corona virus infection, and the effects of increased anxiety in pandemic on pregnancy outcomes.

As the emergence of new subtypes of Corona virus is being noticed now and then, the public memories of recent pandemics is kept alive. There are crucial lessons to be learned from such a heavy experience world-wide including prevention of transmission, reflex responses for such threats and preventive measures such as vaccines. However, a special subgroup of susceptible patients such as pregnant women should not be forgotten, and their mental wellbeing be considered

Material and Methods

This prospective case-control study was conducted, Department of Obstetrics and Gynecology with approval from the local ethics committee. The study was designed in accordance with the guideline devised by the World Medical Association (Helsinki), and written informed consent was obtained from the participating women.

This study was performed in 100 women of 15 to 49 years of reproductive age who applied to the Gynecology and Obstetrics Outpatient Clinic, Pandemic Outpatient Clinic and the Pregnant Outpatient Clinic. The study patients were selected sequentially, understood Turkish and consented to participate. Lack of understanding Turkish, previous history or presence of medical and psychiatric problems that may interfere with capability of interviewing were accepted as exclusion criteria.

Fourty-six pregnant women with positive COVID 19 PCR test were compared with negative COVID 19 PCR test as control group. Patients were administered a questionnaire and Beck Anxiety Inventory. Data on socio-demographic parameters such as age, education, employment status, literacy status and marital status were gathered. At the same time, also information about the patient's height, weight, BMI, chronic disease history, smoking and alcohol use history, drug and substance abuse history, and previous surgery history, and, information about the current pregnancy, still births or fetal congenital abnormalities, gravidity, parity, miscarriages, number of surviving children, gestational week and trimester, reason for admission to the hospital and type of delivery were recorded. We also reported hemogram, white blood cells, neutrophil and platelet levels, vital signs which were fever, pulse, blood pressure and oxygen saturation level. Data about the infant concerning the gestational age, gender, birth weight, APGAR scores, hospital admission or neonatal death were collected.

At the same time, a questionnaire consisting of two questions was applied to the patients and they were asked to score their anxiety levels between 0-10. These questions were

"Do you worry that you have to give birth or become pregnant during the COVID 19 pandemic?" and " Do you worry about having an examination or giving birth at Pandemic hospital?" Beck Anxiety Inventory to investigate anxiety in patients (BAI) has been implemented. This survey contains 21 items consists of somatic and cognitive anxiety, complaints a

likert type questioner, such as "shakiness in legs," "scared," and "worry of losing control, and scored between 0 and 3 scale, maximum score 63, cut-off score 17 is considered as. Based on the total score, 8-15 points, 16-25 points and, 26-63 points represent mild, medium and, severe levels of anxiety respectively. Beck's Anxiety Inventory Turkish validity and reliability was made by Ulusoy and friends.[17, 18]

The statistical analyses were performed with SPSS (Version 22, SPSS Inc, Chicago, IL, USA). Chi-square tests were used to show differences in categorical variables and Student's t-test were used to evaluate differences in the continuous variables for paired groups. BAI scores of patients were analysed with Spearman correlation analysis. The p value was taken as <0,05 for statistical significance. In the analysis, anxiety scores and COVID 19 infection were considered as dependent variables and age, occupation status, education level, gravidity, and BMI were considered as independent variables.

Results

In the study, 54 pregnant women who tested positive for COVID-19 by PCR and 46 pregnant women who tested negative for COVID-19 were included. Demographic characteristics of the two groups were similar (Table 1). In the COVID-negative group, the most common reason for hospital admission was contractions, while in the COVID-positive group, the most common reason was cough/dyspnea (Table 2).

An evaluation using the Beck Anxiety Scale revealed that anxiety levels were higher in the COVID-19 positive pregnant group compared to the COVID-19 negative pregnant group (p=0.001) (Table 3). When comparing the groups in terms of becoming pregnant and giving birth during the pandemic, it was found that "severe anxiety" significantly increased in the COVID-19 negative pregnant group (p=0.032) (Table 4).

However, when evaluated in terms of receiving medical examinations or giving birth at the pandemic hospital, the anxiety levels of both groups were not different (p=0.259) (Table 5).

Discussion

The anxiety levels were reported to be increased in a systematic review by Yuan et al. In their study they analyzed the data obtained from a heterogenous group of population consisting of general public, health workers, university students, older adults, infected patients, survivors of infection, and pregnant women were analyzed for anxiety levels during infectious disease epidemics. The anxiety levels were highest in pregnant women during epidemics.[19]

In another study done by Zilver et al. the fear of childbirth in pregnant women during the pandemic was compared with a reference group from before the pandemic in Netherlands.[20] Surprisingly, they concluded that the fear of childbirth was not increased during he pandemic. Such a finding can be secondary to the trust of population on the healthcare infrastructure of a developed country such as Netherlands. However, a study conducted in Turkey by Ayaz et.al indicated that the anxiety levels and depression symptoms of pregnant women during the pandemic was found to be significantly increased which is parallel to our findings.[21] In our study COVID-19 positive pregnant women had significantly higher anxiety levels when compared to COVID negative pregnant women. Limitations of the study; Depending on religion, ethnicity, family structure, belief factors, anxiety levels may change. At the same time, determining anxiety types and the number of cases is an important limitation in their effects on pregnancy outcomes. While analyzing the relationship between COVID positive cases and anxiety levels, we anticipated that determining anxiety types and evaluating pregnancy results according to these types would be more valuable.

Although the emergence of new subtypes of Corona virus is still being notified, currently, the pandemic process seems to ceased. There left a burden of mixed data concerning psychologic morbidities observed after such an extreme life-event. We believe that analysing this data will eventually add to our preparedness for next pandemics.

Most of the health authorities of developped countries implemented specialised clinical surveyance to monitor mental consequences of pandemics. Pregnancy as a susceptible group should not be forgotten to be included since the data we have shown is clearly depicting the adverse neonatal outcomes of pregnant women with anxiety.

Anxiety levels vary according to religion, ethnicity, family structure, cultural belief factors. Since we could not gather data about the above mentioned variables, this might be regarded as a limitation to our study. At the same time anxiety types may have unpredictable effects on pregnancy outcomes. While analyzing the relationship between COVID positive cases and anxiety levels, we anticipated that determining anxiety types and evaluating pregnancy results according to these types would be more valuable.

Conclusion

Depression and anxiety during pregnancy are associated with adverse pregnancy and perinatal outcomes. In our study, no significant impact on anxiety levels was observed regarding pregnant women's choice of receiving medical examinations and giving birth at a pandemic

Acta Medica Alanya 2023;7(3): 232-237
Doi: 10.30565/medalanya.1384162

Table 1. Sociodemographic Characteristics of the Patients

	COVID-19 Positive Group (n= 46)	COVID- 19 Negative Group (n= 54)	*p*
Age (Years) [a]	27 (20-45)	26.5 (17-40)	0.936
Height (cm) [a]	160 (150- 169)	159.5 (145- 174)	0.501
Weight (kg) [b]	68,95 ±12.91	70 ± 10.9	0.672
BMI (Body Mass Index)	26.80 ±4.64	27.59 ±4.45	0.408
Gravida			
Parity			
Education Level	n (%)	n (%)	0.081
Illiterate	3 (6.5)	4 (7.4)	
Primary School	4 (8.7)	13 (24.1)	
Secondary Education	16 (34.8)	19 (35.2)	
High School	13 (28.3)	14 (25.9)	
University	10 (21.7)	4 (7.5)	
Employment Status [c]	n (%)	n (%)	0.361
Employed	7 (15.2)	5 (9.3)	
Unemployed	39 (84.8)	49 (90.7)	

[a] Median (min-max)
[b] Mean ± std
[c] The percentage of patients, % within the group

Table 2. Reason for Admission

Reason for Admission	COVID-19 Positive Group (n= 46)	COVID- 19 Negative Group (n= 54)
Routine Checkup	15 (37.5)	15 (27.8)
Contractions	4 (10)	28 (51.9)
Vaginal Bleeding	0 (0)	1 (1.9)
Nausea/Vomiting	3 (7.5)	0 (0)
Cough/Shortness of Breath	17 (42.5)	0 (0)
Sore Throat	4 (10)	0 (0)
Childbirth	3 (7.5)	10 (18.5)

Table 3. Distribution of COVID-19 Positive and Negative Groups According to the Beck Anxiety Scale

	COVID-19 Positive Group (n= 46)	COVID- 19 Negative Group (n= 54)	*p*[*]
Beck Anxiety Scale			
0-7 Points (Minimal Anxiety)	**28**	**9**	
8-15 Points (Mild Anxiety)	**19**	**18**	***0.001***
16-25 Points (Moderate Anxiety)	**4**	**15**	
26-63 Points (Severe Anxiety)	**3**	**4**	

For statistical significance, p<0.05 *Fisher Exact Test

Table 4. Comparison of Anxiety Levels in Terms of Pregnancy or Childbirth During the COVID-19 Pandemic

Pregnancy or Childbirth During the COVID-19 Pandemic	COVID-19 Positive Group (n= 46)	COVID- 19 Negative Group (n= 54)	p^*
No Anxiety	**16**	**7**	*0.032*
Mild Anxiety	**1**	**1**	
Moderate Anxiety	**14**	**24**	
Severe Anxiety	**23**	**14**	

For statistical significance, p<0.05 *Fisher Exact Test

Table 5. Comparison of Anxiety Levels in Terms of Receiving Medical Examinations or Giving Birth at a Pandemic Hospital

Receiving Medical Examinations or Giving Birth at a Pandemic Hospital	COVID-19 Positive Group (n= 46)	COVID- 19 Negative Group (n= 54)	p^*
No Anxiety	**17**	**17**	*0.259*
Mild Anxiety	**5**	**1**	
Moderate Anxiety	**15**	**20**	
Severe Anxiety	**17**	**12**	

For statistical significance, p<0.05 *Fisher Exact Test

hospital or not. It was found that being COVID-19 positive, based on the Beck Anxiety Inventory, significantly increased the anxiety levels during pregnancy when compared to negative groups.

These results help us understand the psychological effects of the pandemic on pregnant women. Given the trend of increased anxiety levels in pregnant women during the pandemic and its more pronounced effect on those who are COVID-19 positive, it emphasizes the need to develop additional measures and support systems to promote the emotional well-being of pregnant women.

Conflict of Interest: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this article received no financial support.

Ethics Committee Approval: Kocaeli Derince Education and Research Hospital Clinical Research Ethics Committee on 16.06.2020 no.2020/60.

ORCID and Author contribution: ***E.K. (0000-0002-4940-8862):*** Literature search, writing, critical review. ***L.A. (0000-0001-9344-808x):*** Literature search, writing, editing. ***G.G. (0000-0003-2837-8497):*** Literature search, writing, editing. ***H.K. (0000-0001-8503-0230):*** Literature search, writing, editing. ***M.Ç.K. (0000-0002-9330-3363):*** Literature search, writing, editing. ***E.A. (0000-0002-4940-8862):*** Literature search, writing, editing.

Peer-review: Externally peer reviewed.

References

1. WHO Coronavirus disease 2019 (COVID-19) situation report 116. May 16,2020, https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200515-covid-19-sitrep-116.pdf?sfvrsn=8dd60956_2 (accessed May 16, 2020)
2. Keskek SO, Erdogan H. COVID-19: A Current Brief Review. Acta Med. Alanya 2020;4(2):197-202. doi:10.30565/medalanya.747238
3. Yu N, Li W, Kang Q, Xiong Z, Wang S, Lin X et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study. Lancet Infect Dis. 2020;20(5):559-564. doi: 10.1016/S1473-3099(20)30176-6.
4. Lu H, Stratton CW, Tang Y-W. Outbreak of pneumonia of unknown etiology in Wuhan, China: the mystery and the miracle. J Med Virol. 2020; published online Jan 16. doi: 10.1002/jmv.25678.
5. WHO. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected: interim guidance. Jan 28, 2020. https://www.who.int/docs/default-source/ coronaviruse/clinical-management-of-novel-cov.pdf (accessed Jan 28, 2020).
6. Öncel CR, Aslan A. Trend topics in prestigious and popular medical journals: The effect of Covid-19. Acta Med. Alanya 2020;4(3):207-208. doi:10.30565/medalanya.809103
7. Ayele TA, Azale T, Alemu K, Abdissa Z, Mulat H, Fekadu A. Prevalence and Associated Factors of Antenatal Depression among Women Attending Antenatal Care Service at Gondar University Hospital, Northwest Ethiopia. PLoS One. 2016;11(5):e0155125. doi: 10.1371/journal.pone.0155125.
8. Tunç S, Yenicesu O, Çakar E, Özcan H, Pekçetin S, Danışman N. Anxiety and depression frequency and related factors during pregnancy. The Journal of Gynecology-Obstetrics and Neonatology 2012;9(35):1431-5
9. Fairbrother N, Janssen P, Antony MM, Tucker E, Young AH. Perinatal anxiety disorder prevalence and incidence. J Affect Disord. 2016;200:148-55. doi: 10.1016/j.jad.2015.12.082.

Acta Medica Alanya 2023;7(3): 232-237
Doi: 10.30565/medalanya.1384162

10. Daglar G, Bilgic D, Koc S, Yörük B, Coskun Pl. Anxiety and depression levels of women's pre and post-labor stage and influencing factors. Innovative Journal of Medical and Health Science 2016;6(4):114-20 doi: 10.15520/ijmhs.2016.vol6.iss4.127.
11. Rubertsson C, Hellström J, Cross M, Sydsjö G, Anxiety in early pregnancy: prevalence and contributing factors. Arch Womens Ment Health. 2014;17(3):221-8. doi: 10.1007/s00737-013-0409-0.
12. Xiu-Xiu Ding, Yi-Le Wu, Shao-Jun Xu, Ruo-Ping Zhu, Xiao-Min Jia, Shi-Fen Zhang, et al. Maternal anxiety during pregnancy and adverse birth outcomes: a systematic review and meta-analysis of prospective cohort studies. J Affect Disord. 2014;159:103-10. doi: 10.1016/j.jad.2014.02.027.
13. Rose MS, Pana G, Premji S. Prenatal maternal anxiety as a risk factor for preterm birth and the effects of heterogeneity on this relationship: a systematic review and meta-analysis. Biomed Res Int. 2016;2016:8312158. doi: 10.1155/2016/8312158.
14. Grigoriadis S, Graves L, Peer M, Mamisashvili L, Tomlinson G, Vigod SN, et al. Maternal Anxiety During Pregnancy and the Association With Adverse Perinatal Outcomes: Systematic Review and Meta-Analysis. J Clin Psychiatry. 2018;79(5):17r12011. doi: 10.4088/JCP.17r12011
15. Taylor S. The psychology of pandemics: Preparing for the next global outbreak of infectious disease., Cambridge Scholars Publishing; Newcastle upon Tyne: 2019.
16. Asmundson GJG, Taylor S. Coronaphobia: Fear and the 2019-nCoV outbreak. J Anxiety Disord. 2020;70:102196. doi: 10.1016/j.janxdis.2020.102196.
17. Beck AT, Epstein Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. J Consult Clin Psychol 1988;56:893- 7. doi: 10.1037//0022-006x.56.6.893.
18. Ulusoy M, Şahin NH, Erkmen H. Turkish version of the Beck Anxiety Inventory: Psychometric properties. J Cogn Psychother 1998;12:163-72.
19. Yuan K, Zheng YB, Wang YJ, Sun YK, Gong YM, Huang YT, et al. A systematic review and meta-analysis on prevalence of and risk factors associated with depression, anxiety and insomnia in infectious diseases, including COVID-19: a call to action. Mol Psychiatry. 2022 Aug;27(8):3214-3222. doi: 10.1038/s41380-022-01638-z.
20. Zilver SJM, Hendrix YMGA, Broekman BFP, de Leeuw RA, de Groot CJM, van Pampus MG. Fear of childbirth in pregnancy was not increased during the COVID-19 pandemic in the Netherlands: a cross-sectional study. Acta Obstet Gynecol Scand. 2022 Oct;101(10):1129-1134. doi: 10.1111/aogs.14409. Epub 2022 Jun 27.
21. Ayaz R, Hocaoğlu M, Günay T, Yardımcı OD, Turgut A, Karateke A. Anxiety and depression symptoms in the same pregnant women before and during the COVID-19 pandemic. J Perinat Med. 2020 Nov 26;48(9):965-970. doi: 10.1515/jpm-2020-0380.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

Assessing Patient Demographics and Emergency Response Adaptation in a Primary-Level State Hospital Following the 6 February Türkiye Earthquakes

6 Şubat Türkiye Depreminde Bir İkinci Basamak Devlet Hastanesindeki Hasta Demografisinin ve Acil Müdahale Uyumunun Değerlendirilmesi

Suat Batar[1], Mehmet Talha Aydın[1], Mehmet Berke Yuşan[2], Savaş Çamur[1], Mehmet Salih Söylemez[1]

[1] Department of Orthopaedics and Traumatology, Umraniye Training and Research Hospital, Istanbul, Türkiye

[2] Department of Orthopaedics and Traumatology, Fatih Sultan Mehmet Training and Research Hospital, Istanbul, Türkiye

ABSTRACT

Aim: On 6 February 2023, a series of earthquakes with magnitudes of 7.8, 6.6, and 7.6 struck the south-eastern region of Türkiye within a span of 10 hours, starting from 04:00 am. These earthquakes resulted in a devastating loss of life, with casualties exceeding 50,000 across 10 provinces. The destruction caused by these earthquakes was widespread with the collapse of many buildings, including hospitals. This study aimed to assess the patient demographics and emergency response adaptation in a primary-level state hospital following the 6 February Türkiye earthquakes.

Material and Methods: The study was conducted at the Reyhanlı State Hospital, which remained largely unaffected by the earthquakes. The hospital faced challenges in providing medical care due to the loss of staff, damaged infrastructure, and limited resources. A volunteer orthopaedic surgery team, along with other medical professionals, provided treatment to the earthquake victims. The patient data was collected from the conventional record book of the operating room.

Results: From 6 to 12 February 2023, a total of 111 surgeries were performed at the hospital, with 92 (%83) being earthquake-related. Orthopaedic surgeons operated on most of the patients. The most common surgeries included fasciotomies, amputations, and fracture fixations. The surgeries were performed in a time-sensitive manner, with immediate life- and extremity-saving procedures prioritized. The hospital's infrastructure challenges and the lack of digital recording systems hampered the data collection process.

Conclusion: The study highlights challenges faced by a primary-level Hospital during the earthquakes. Our indings stress the importance of preparedness, infrastructure, and efficient patient records for effective emergency healthcare during natural disasters. Lessons learned can aid future plans for better emergency medical care in earthquake-prone regions.

Key Words: Earthquake, patient demographics, infrastructure challenges, medical records, emergency adaptation

ÖZET

Amaç: 6 Şubat 2023 tarihinde, 04:00'ten itibaren 7.8, 6.6 ve 7.6 büyüklüğünde bir dizi deprem, Türkiye'nin güneydoğu bölgesini 10 saat içerisinde etkiledi. Bu depremler, 10 ilde 50.000'i aşkın can kaybına neden olan yıkıcı bir tabloya yol açtı. Hastaneler de dahil olmak üzere birçok binanın çökmesiyle beraber bu depremlerin yol açtığı yıkım oldukça geniş kapsamlıydı. Bu çalışmada, 6 Şubat Türkiye depremi sonrasında ikinci basamak bir devlet hastanesinde hasta demografik özellikleri ve acil müdahale uyumunun değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Çalışma depremden ağır düzeyde etkilenmeyen Reyhanlı Devlet Hastanesi'nde gerçekleştirildi. Hastane, personel kaybı, hasarlı altyapı ve sınırlı kaynaklar nedeniyle sağlık hizmeti sunumunda zorluklarla karşı karşıya kaldı. Gönüllü bir ortopedi ekibi, diğer branş hekimleriyle birlikte depremzedelerin tedavisinde görev aldı. Hasta verileri ameliyathanenin kayıt defterinden elde edildi.

Bulgular: 6-12 Şubat 2023 tarihleri arasında ilgili hastanede 92'si (%83) depremle ilgili olmak üzere toplam 111 ameliyat gerçekleştirildi. Hastaların çoğu ortopedistler tarafından ameliyat edildi. En sık uygulanan cerrahi işlemler fasyotomiler, amputasyonlar ve kırık tespitlerinden oluşmaktaydı. Ameliyatlar hızlı bir şekilde, acil hayat ve ekstremite kurtarma prosedürlerine öncelik verilerek gerçekleştirildi. Hastanenin altyapı zorlukları ve dijital kayıt sistemlerinin olmayışı veri toplama işlemlerini zorlaştırdı.

Sonuç: Çalışmamız, depremler sırasında birinci düzey bir hastanede karşılaşılan zorlukları ortaya koymuştur. Bulgularımız, doğal afetler sırasında etkili ve verimli acil sağlık hizmeti için hazırlıklı olmanın, altyapının ve tıbbi kayıtların önemini vurgulamaktadır. Elde edilen veriler, deprem riski taşıyan bölgelerdeki acil tıbbi hizmetlerin iyileştirilmesi için gelecekteki planlara yardımcı olabilir.

Anahtar Kelimeler: Deprem, hasta demografisi, altyapı sorunları, tıbbi kayıtlar, acil duruma uyum

Recieved Date: 16.11.2023 / **Accepted Date:** 07.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Suat Batar, MD. Elmalıkent, Adem Yavuz Street, No: 1, 34764 Umraniye/Istanbul, Türkiye

Phone: +9005055740897 / **mail:** drsuatbatar@gmail.com

ORCID: 0000-0002-6952-9493

To cited: Batar S, Aydın MT, Yuşan MB, Çamur S, Söylemez MS. Assessing Patient Demographics and Emergency Response Adaptation in a Primary-Level State Hospital Following the 6 February Türkiye Earthquakes. Acta Med. Alanya 2023;7(3): 238-248 doi: 10.30565/medalanya.1391661

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

Introduction

Türkiye is located in a region prone to seismic activity, with a significant portion of its land lying over seismic zones. The devastating earthquake of 7.4 magnitude that struck the Marmara region on 17 August 1999 resulted in high losses of life, with over 17,000 fatalities and countless injuries. This earthquake, along with historical events such as the 1939 Great Erzincan Earthquake, played a pivotal role in shaping earthquake risk mitigation policies in Türkiye. Legislation such as Law No. 4623 was introduced to implement measures before and after quakes. In response to the 1999 earthquake, the National Earthquake Strategy and Action Plan was developed to prevent future casualties, particularly in Istanbul. Within this framework, the Disaster and Emergency Management Authority (AFAD) initiated a project in 2013 to revise seismic hazard maps and update the national seismic design code for buildings.[1] Furthermore, earthquake drills and simulations have been conducted to enhance community involvement and preparedness, inspired by previous successful drills in seismically active regions such as Mexico City.[2,3] Despite extensive efforts to prevent casualties caused by earthquakes, it remains impossible to guarantee zero losses. Therefore, it is crucial to create new action plans by evaluating data obtained from past earthquake experiences. In this regard, it is essential to record and analyse real-time data during and after earthquakes without allowing chaos. The significance of robust hospital medical recording systems and infrastructure becomes evident in the aftermath of an earthquake.[4] Accurate and reliable patient recording systems play critical roles in effective disaster response and management. These systems enable healthcare providers to maintain comprehensive medical records, including patient histories, diagnoses, treatments, and follow-up care. Access to complete and up-to-date patient records is vital for the continuity of care, coordination among healthcare teams, and timely decision-making in the chaotic aftermath of earthquakes. Efficient patient recording systems streamline the process of identifying and addressing patient needs, thereby improving overall healthcare delivery in challenging circumstances.[5]

On 6 February 2023, a series of earthquakes with magnitudes of 7.8, 6.6, and 7.6 struck the south-eastern region of Türkiye within a span of 10 hours, starting from 04:00 am. These earthquakes resulted in a devastating loss of life, with casualties exceeding 50,000 across 10 provinces. The destruction caused by these earthquakes was widespread with the collapse of many buildings, including hospitals. As a result, the remaining hospitals at all levels had to be utilized for immediate patient care until the transfer of patients to tertiary-care units became possible. Despite its close proximity (30 km) to the earthquake epicentre, the physical conditions of the Reyhanlı State Hospital remained generally unaffected. However, severe losses were observed among medical service providers as most of the staff, including doctors, nurses, other medical staff, and managers, resided in the vicinity of the epicentre, in Antakya/Hatay. In the aftermath of the earthquakes, the hospital received thousands of victims due to the lack of other operating hospitals nearby. These patients were transported from the wreckage by ambulances or volunteers using various means. Volunteer doctors, nurses, paramedics, and other medical personnel provided treatment to these patients in the hospital.

Volunteers who responded to the earthquakes found hospitals with damaged infrastructure and a lack of medical resources. Understanding the pivotal role of a hospital's infrastructure and its medical recording systems during and post-natural disasters is critical. Despite this significance, there is a scarcity of research focusing on the specific adversities hospitals face and the importance of robust medical recording systems in the aftermath of seismic events. This study aims to bridge this research gap by shedding light on the experiences encountered by an orthopedic surgery team upon their arrival at Reyhanlı State Hospital in the wake of the earthquakes. By delving into the demographic profiles of patients who underwent surgery, the spectrum of surgical procedures conducted, and an evaluation of the hospital's infrastructure concerning its medical records system, this research endeavors to offer valuable insights into the hospital's adaptability during emergencies. The insights gleaned from this study aspire to not only augment the current body of literature but also provide actionable recommendations for enhancing emergency healthcare and fortifying infrastructure resilience in regions susceptible to earthquakes

Materials And Method

Ethics committee approval was obtained from Umraniye Training and Research Hospital ethics Committee (ID: B.10.1.TKH.4.34.H.GP.0.01/119).

In the aftermath of the devastating earthquakes that struck the south-eastern region of Türkiye, the Reyhanlı State Hospital faced significant challenges in providing medical care. The first teams of doctors and nurses arrived at the hospital in the 16th hour following the quakes. The hospital's emergency department was understaffed, with only two intern doctors and no surgeon available. Additionally, the hospital's digital system, which relied on the internet, failed completely, resulting in the loss of X-rays and CT scans. As a result, patient images were recorded with mobile phones if available, or patients had to be sent for repeated X-rays or CT scans. Blood and laboratory testing was also hampered, with certain tests unavailable for

the first 19 hours and results only obtainable in hard-copy format.

The entire hospital was in disarray as all staff members, including doctors, nurses, and other medical personnel, were themselves victims of the earthquakes. With the exception of a few intubated patients in the intensive care unit, all patients were discharged, leaving the wards empty. The orthopaedic surgery team that intervened consisted of 7 volunteering individuals, including 3 associate professors, 2 assistant professors, and 2 senior residents. The lack of surgeons at the institution meant that general surgeons and other specialists stepped in to support orthopaedic interventions, while plastic surgery residents dedicated themselves to suturing various injuries using local anaesthesia. Despite the hospital having 3 operating rooms, there were limited resources for urgent interventions, with a lack of both external fixators and service staff who could provide them.

Despite the chaos and lack of digital registry systems, the medical professionals worked tirelessly in shifts to ensure continuous care and support for the earthquake victims. An orthopaedic surgeon and his assistant reorganized the emergency ward processes to use all staff effectively and ensure that patients in the emergency ward could be followed and appropriate interventions could be performed. During the earthquake response, general surgeons played a crucial role in interventions for critical cases in the red area and postoperative care for patients in the wards, particularly focusing on crush syndrome management. The only internist supervised the follow-up of metabolic disorders including crush syndrome. Meanwhile, an orthopaedic surgery resident was responsible for monitoring incisions, peripheral vascular status, and dressing changes. Additionally, the general surgeons willingly supported the emergency room by following preoperative patients for crush syndrome, working alongside senior orthopaedic surgeons. They also provided assistance in the resuscitation area for patients requiring urgent resuscitation. In a room adjacent to the orthopaedic team's intervention room, four plastic surgery residents worked tirelessly, offering their voluntary services to suture various types of injuries that could be managed with local anaesthesia.

Collaborating closely with the orthopaedic surgeons, two vascular surgeons and one general paediatric surgeon joined the emergency intervention room. They actively participated in fracture reduction, splinting, casting, stitching, and dressing changes. Additionally, they provided ongoing care for critical patients and assisted with the changing of fasciotomy dressings in the intensive care unit. The brain surgery team followed an 8-hour shift schedule, remaining available in the field whenever consultations were required for patients in need of their expertise.

Triage was performed in line with the recommendations of the Advanced Trauma Life Support Manual. Only patients who could be treated with the available resources were operated on, and only life- and extremity-saving surgeries were performed. Relatively shorter procedures were performed and patients needing time-consuming interventions or fracture fixation were transferred to other hospitals.[6]

Regarding emergency reception records, in the first 5 days after the quakes no types of records were obtained for any patients admitted to the emergency room, including conventional book-based records. Moreover, records related to the medical histories of patients operated on and followed in the wards were not available. The only available recording system was the conventional record book of the operating room, written in by operating surgeons and anaesthesiologists. All available records were obtained from this hard-copy conventional recording system. All data on the patients' ages, genders, injured sides, trauma mechanisms, surgery types, and surgery durations were obtained from this book. Only patients operated on by the orthopaedic surgery team were analysed further due to the limited availability of the records of earthquake-related cases.

Surgical interventions commenced at 11:00 am on February 6 following the arrival of the first orthopedic surgical team. Medical records for patients admitted to the Emergency Room were largely unavailable, and only the records for patients operated on by the initial team, which handed over duties to another team on February 12, 2013, were relatively appropriate for analysis. Surgeries conducted by the first surgical team between February 6, 2023, at 11:00 am and February 12, 2023, at 5:00 pm were included in the analysis. A total of 111 surgeries were performed in the operating rooms during this period.

Data were analyzed using SPSS software (ver. 22.0; IBM Corp., Armonk, NY, USA). The normality of the data distribution was evaluated by the Shapiro-Wilk test. Quantitative variables are expressed as mean ± standard deviation and minimum and maximum values. Qualitative variables are expressed as frequencies or ratios. P-values < 0.05 were considered to indicate statistical significance.

Results

From 11:00 am on 6 February 2023 to 17:00 pm on 12 February 2023, 111 surgeries were performed in the operating rooms. Of the 111 surgeries, 92 (%83) were earthquake-related and orthopaedic surgeons operated on most of the patients ($p<0.05$).

Brain surgery: Eight (%7) earthquake victims required brain surgery, including 2 operated on for lumbar frac-

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

tures and stabilization with posterior instrumentation, 3 with subdural haematoma requiring decompression, 1 with a skull fracture, and 2 requiring a stitching procedure performed for the degloving of the scalp.

Thoracic surgery: For 1 (%0.9) patient, open coagulation of the left lung for unstable earthquake-related haemothorax was performed.

General surgery: Two laparotomy procedures for 2 patients with earthquake-related suspicious intra-abdominal bleeding were performed. Further surgical interventions were not necessary for these 2 patients. Two acute appendicitis patients, 1 acute abdomen patient, and 1 patient with a stab wound to the abdomen were also treated from among cases not related to the earthquakes (%5.4).

Gynaecology: Among surgeries not related to the earthquakes, 15 caesarean births were performed (%13.5).

Orthopaedic surgery: A total of 85 (%77) surgeries were performed by orthopaedic surgeons for a total of 81 patients. Of those 81 patients, 3 needed revision surgeries, with 1 patient requiring 2 revision surgeries. All revision surgeries were amputations. While 46 (%56.8) of patients undergoing orthopaedic surgery were male, 35 (%43.2) were female. The median age of these patients was 25 years (range: 1-81, IQR: 25.5). The vast majority were in the second or third decade of life (Table 1).

Table 1. Distribution of trauma patients among different decades of life

Decade	N (%)
0-5 years old	4 (4.9%)
6-10 years old	3 (3.7%)
11-20 years old	23 (28.4%)
21-30 years old	19 (23.5%)
31-40 years old	11 (13.6%)
41-50 years old	10 (12.3%)
51-60 years old	7 (8.6%)
61-70 years old	3 (3.7%)
71-80 years old	1 (1.2%)

The youngest patient was a 14-month-old child with compartment syndrome of the left forearm requiring fasciotomy admitted on the 4th day after the earthquakes. This patient had been taken to a bonesetter for left elbow pain due to the lack of health services in an urban area after extraction of the child from the rubble on the 3rd day. Relatives referred the family to the Hospital for increased pain. An examination revealed a forearm compartment with good peripheral vascular refill and total neurological dysfunction of the hand. X-rays revealed no bone pathology. A forearm volar fasciotomy was performed for this child (Figure 1). Near-to-full recovery had been achieved for this patient at the postoperative 3th month.

The most common reason for surgery was cruris compartment syndrome followed by foot compartment syndrome needing urgent fasciotomy. Details of the types of injuries are provided in Table 2.

Forty-four surgeries (%44.8) were performed on the 2nd day following the earthquakes and 21 (%24.7) were performed on the 3rd day (Figure 2).

Cruris fasciotomy (23, %27.1) was the most common surgery, followed by foot fasciotomy procedures (16, %18.8). Lower extremity amputations (12, %14.1) were more common than upper extremity amputations (4, %4.7). Only 13 (%15.3) patients underwent fracture fixations, reduction of the elbow or shoulder, or wound debridement. Details of the performed surgeries are provided in Table 3 and Supplementary Table 1.

Fasciotomies and amputations were performed on the 2nd and 3rd days following the earthquakes. Fracture, dislocation, and wound management procedures were generally performed on the 3rd and 4th days (p=0.006) (Supplementary Table 2).

The median surgery duration was 40 min (range: 10-160, IQR: 35). The durations of surgeries performed for amputations were significantly longer than those for fasciotomies (p=0.001; 87.1±30.8 (45-160) min vs. 40.5±23.5 (10-120) min, respectively) (Supplementary Table 3).

Moreover, the durations of lower extremity surgeries were significantly shorter than those of upper extremity fasciotomies (36.2±19.8 (10-120) min vs. 62.7±29.5 (30-120) min, respectively). In contrast, lower extremity amputation surgery durations were significantly longer than those of upper extremity amputation surgeries (94.1±30.5 (60-160) min vs. 66.2±23.9 (45-100) min, respectively) (p=0.001). More details are provided in Supplementary Table 4 and Figure 3.

Eighty-two (%96.3) surgeries were performed using endotracheal intubation and the remaining 3 surgeries were performed with spinal anaesthesia. All surgeries with spinal anaesthesia were performed on the 4th and 5th days for fracture fixation of lower extremities, including 2 femur fractures and 1 ankle fracture dislocation. Of these patients, only 6 (%7.4) were followed in the intensive care unit. One of those patients, with 3 extremity amputations, had disseminated intravascular coagulation and was transferred to another hospital by helicopter ambulance. One had haemo-pneumothorax due to lung injury and was operated on by the thoracic surgery team. Three had 3 or 4 compartment injuries necessitating intervention and 2 were elderly patients who underwent shoulder-level amputations.

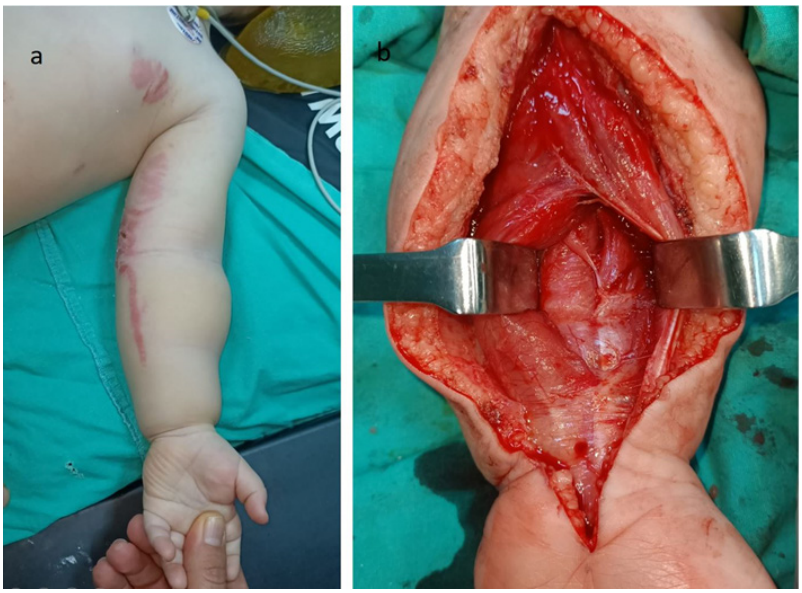


Figure 1. A 14-month-old girl with left forearm compartment syndrome and total neurological dysfunction of the hand. a) Ecchymosis of the skin due to inappropriate and tight stabilization by traditional methods. b) Forearm fasciotomy showing pallor of muscles with initiation of necrosis in the deep volar forearm compartment.

Table 2. Features of diagnosed injuries among the patients

Injury type	N (%)
Arm compartment syndrome, shoulder girdle compartment syndrome	1 (1.2%)
Arm crush injury	1 (1.2%)
Arm crush injury, shoulder girdle crush injury	1 (1.2%)
Closed fracture	8 (9.9%)
Cruris compartment syndrome	23 (28.4%)
Cruris compartment syndrome, closed fracture	1 (1.2%)
Cruris compartment syndrome, thigh compartment syndrome	2 (2.5%)
Cruris crush injury, foot compartment syndrome	2 (2.5%)
Cruris crush injury, thigh crush injury, hand crush injury	1 (1.2%)
Foot compartment syndrome	17 (21.0%)
Foot compartment syndrome, arm compartment syndrome	1 (1.2%)
Foot compartment syndrome, cruris compartment syndrome	3 (3.7%)
Foot crush injury	6 (7.4%)
Foot crush injury, cruris crush injury	1 (1.2%)
Foot crush injury, open fracture	1 (1.2%)
Forearm compartment syndrome	3 (3.7%)
Forearm compartment syndrome, arm compartment syndrome	1 (1.2%)
Hand compartment syndrome, forearm compartment syndrome	1 (1.2%)
Hand compartment syndrome, forearm compartment syndrome, arm compartment syndrome	1 (1.2%)
Hand crush injury	2 (2.5%)
Open fracture	2 (2.5%)
Shoulder girdle compartment syndrome	1 (1.2%)
Thigh crush injury, cruris crush injury	1 (1.2%)

"Compartment syndrome" refers to injuries needing fasciotomy and "crush injury" refers to injuries with severe loss of soft tissue and open fractures necessitating debridement, wound closure, or amputation.

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

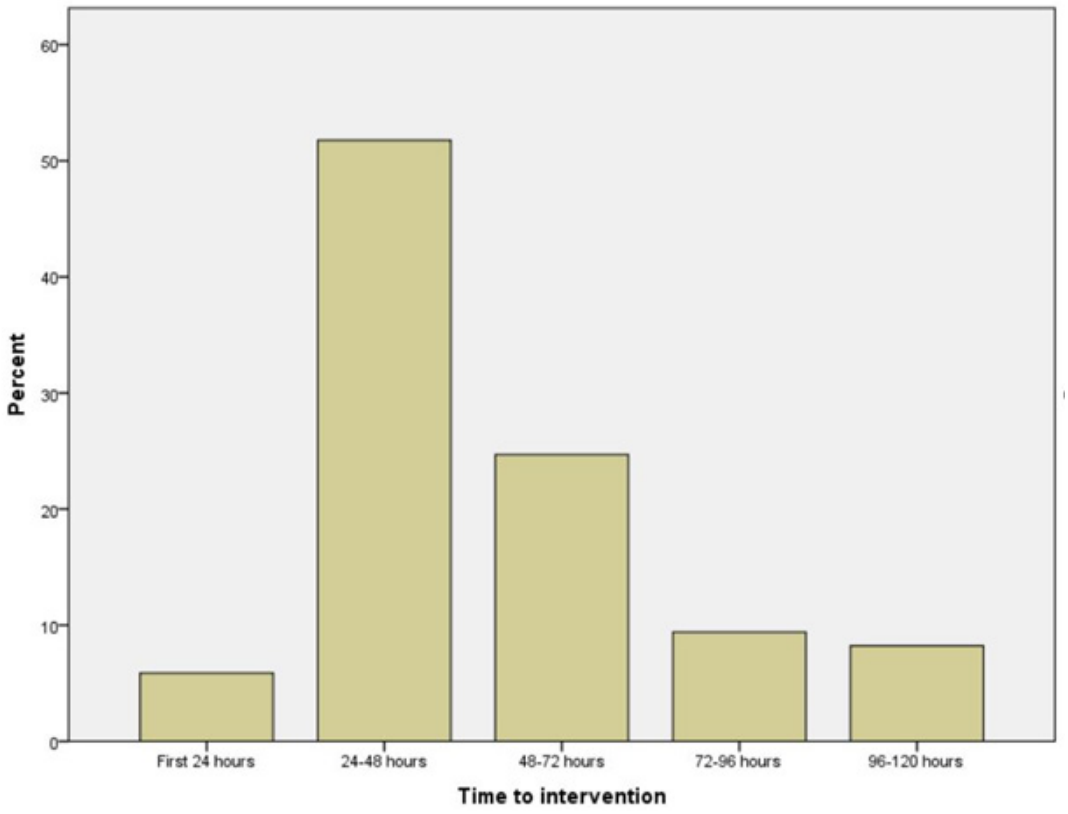


Figure 2. Graph depicting the density of surgeries on the first 5 days.

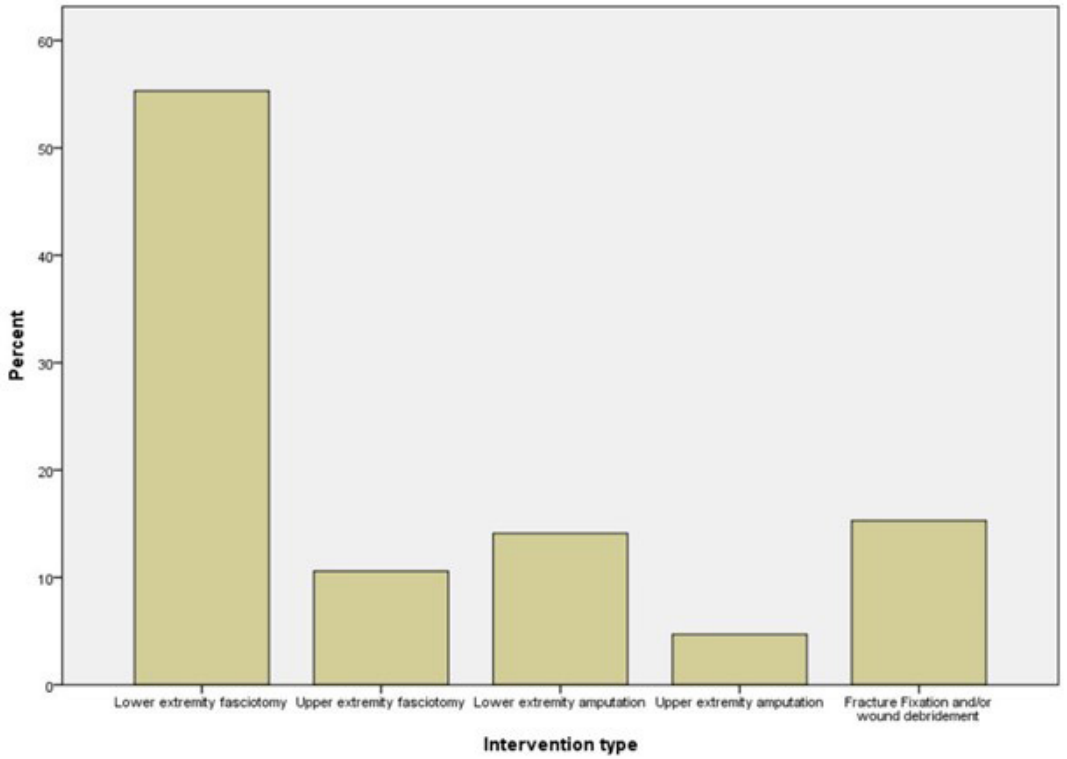


Figure 3. Graph depicting the types of interventions.

Table 3. Distribution of performed surgeries

Surgery	N (%)
Lower extremity fasciotomy	47 (55.3%)
Upper extremity fasciotomy	9 (10.6%)
Lower extremity amputation	12 (14.1%)
Upper extremity amputation	4 (4.7%)
Fracture fixation, dislocation stabilization, and/or wound debridement	13 (15.3%)

Supplementary Table 1. Details of the performed surgeries

Surgery	N %	
Above-the-knee amputation	3	3.5%
Wrist-level amputation	1	1.2%
Ankle-level amputation	2	2.4%
Arm fasciotomy, shoulder girdle fasciotomy	2	2.4%
Below-the-knee amputation	3	3.5%
Below-the-knee amputation, above-the-knee amputation	2	2.4%
Cruris fasciotomy	23	27.%
Cruris fasciotomy, fracture fixation	1	1.2%
Cruris fasciotomy, thigh fasciotomy	2	2.4%
Debridement	5	5.9%
Foot fasciotomy	16	18.8%
Foot fasciotomy, arm fasciotomy	1	1.2%
Foot fasciotomy, cruris fasciotomy	3	3.5%
Foot fasciotomy, debridement	1	1.2%
Forearm fasciotomy	3	3.5%
Forearm fasciotomy, arm fasciotomy	1	1.2%
Fracture fixation	8	9.4%
Hand fasciotomy, forearm fasciotomy	1	1.2%
Hand fasciotomy, forearm fasciotomy, arm fasciotomy	1	1.2%
Hand fasciotomy, forearm fasciotomy, arm fasciotomy, above-the-knee amputation	1	1.2%
Hand-level amputation	2	2.4%
Hip disarticulation amputation	1	1.2%
Shoulder disarticulation amputation	2	2.4%
Total	85	100.0

Supplementary Table 2. Timing of surgeries

Day of intervention	Fasciotomy (N=56)	Amputation (N=16)	Fracture and wound surgery (N=13)	Total
First 24 hours	3 (5.4%)	2 (12.5%)	0 (0%)	5 (5.9%)
24-48 hours	36 (64.3%)	7 (43.8%)	1 (7.7%)	44 (51.8%)
48-72 hours	10 (17.9%)	6 (37.5%)	5 (38.5%)	21 (24.7%)
72-96 hours	2 (3.6%)	1 (6.3%)	5 (38.5%)	8 (9.4%)
96-120 hours	5 (8.9%)	0 (0%)	2 (15.4%)	7 (8.2%)

Percentages are within columns.

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

Supplementary Table 3. Durations of surgeries (minutes)

Surgery type	Mean±SD (minimum-maximum)	p
Fasciotomy	40.5±23.5 (10-120)	0.001
Amputation	87.1±30.8 (45-160)	
Fracture fixation, dislocation stabilization, and/or wound debridement	44.2±27.3 (10-110)	

Supplementary Table 4. Duration of surgeries for different extremities (minutes).

Injured extremity surgery	Mean±SD (minimum-maximum)	p
Lower extremity fasciotomy	36.2±19.8 (10-120)	0.001
Upper extremity fasciotomy	62.7±29.5 (30-120)	
Lower extremity amputation	94.1±30.5 (60-160)	
Upper extremity amputation	66.2±23.9 (45-100)	
Fracture fixation, dislocation stabilization, and/or wound debridement	44.2±27.3 (10-110)	

Bilateral involvement needing surgical intervention was seen in 9 (%10.6) cases. Lower extremities were the most common site (65, %76.5) and both lower and upper extremities were involved in 3 (%3.5) cases. While 63 (%74.1) surgeries were performed for injuries in a single compartment, 1 (%1.2) patient underwent surgery for 4 compartments in the same session (Supplementary Table 5).

Thirty-nine (%45.9) of the patients were refugees under temporary protection.

No patients died during these treatments in the Reyhanlı State Hospital. All patients were followed for only 16-24 hours and then evacuated to advanced facilities.

Discussion

Recent extensive geophysical studies on stress transfer related to the 1999 Kocaeli earthquake have indicated the heightened likelihood of a major earthquake in the vicinity of Istanbul, with the probability of an earthquake of 7 Mw in the next 30 years being approximately %70.[7] While preparing for a major earthquake in Istanbul, Türkiye experienced huge quakes in the south-east of the country. This tragedy has shown us the importance of being prepared for mass casualties in any part of the country as we are living in a seismically active zone. In light of these scientific predictions, we must be better prepared for significant

Supplementary Table 5. Demographics of the patients.

Origin	N (%)
Local	46 (54.1%)
Refugee	39 (45.9%)
Injured site	
Right	32 (37.6%)
Left	44 (51.8%)
Bilateral	9 (10.%)
Injured extremity	
Lower limb	65 (76.5%)
Upper limb	17 (20.0%)
Upper and lower limbs	3 (3.5%)
Injured compartments	
One compartment	63 (74.1%)
Two compartments	17 (20.0%)
Three compartments	4 (4.7%)
Four compartments	1 (1.2%)

earthquake disasters on a nationwide scale. The present study aimed to analyse the demographic characteristics of and surgical interventions performed for individuals who required surgery following the earthquakes in Kahramanmaraş, Türkiye, on 6 February 2023. We believe that sharing the inevitable challenges that we encountered in the wake of those earthquakes with the medical community will be helpful in planning responses to future disasters. Our observations may shed light on several key points, as discussed in detail below.[8]

Chaotic disorganization may be a natural result after disasters like earthquakes, but for modern facilities, it is not acceptable. During the influx of large numbers of patients, standard hospital documentation often proves to be insufficient.[9] To enhance efficiency, it has been recommended that casualty cards and prearranged requests for laboratory tests, X-rays, and other diagnostic procedures be utilized.[10] Additionally, hospitals should proactively equip themselves with the necessary resources to operate independently for a minimum of 72 hours following a disaster.[11] Our initial observations revealed a shortage of medical personnel and a disorganized hospital environment. The absence of surgeons and limited emergency staff hindered the ability to provide timely surgical interventions and comprehensive patient care as no operations had been performed in the first 16 hours. The damaged infrastructure further exacerbated the challenges faced by healthcare providers, affecting the availability of essential equipment, supplies, and support services. Of course, earthquakes may also damage the hospitals themselves. After an earthquake, a disaster plan must quickly be activated due to the forthcoming influx of patients. Medical service staffing and resources must be redistributed to available hospitals and the departments anticipated to have the largest demand, including emergency departments.[4]

In many cases, initial interventions for earthquake victims are carried out at tertiary-level hospitals located on the outskirts of earthquake-affected regions.[12] This is primarily due to the ease of transporting volunteers and medical equipment to these facilities, which helps ensure that healthcare service providers are not overwhelmed. Moreover, it is common for hospitals in the earthquake-affected areas to suffer severe damage. However, providing care to victims at a first-level hospital located at the epicenter of the disaster presents unique challenges. The dependence on internet-based digital systems for medical record-keeping proved to be a significant disadvantage in our experience. The failure of the hospital's digital system resulted in the loss of valuable patient data, including X-rays and CT scans. This loss of information hindered accurate diagnosis, treatment planning, and follow-up care. The reliance on printed hard copies for test results and the use of mobile phones for image storage indicate that ad hoc measures may be taken to address system failures, but they are not sustainable or reliable in the long run.[13] Nie et al. reported 2283 earthquake-related admissions to their advanced university hospital during the first 2 weeks following an earthquake in Sichuan, China, in 2008.[4] They reported that all medical records were initially based on handwritten records and only 0.1% to 0.2% of the medical records were lost. This suggests that despite such approaches being old-fashioned, all emergency departments should be trained and ready to convert to conventional record-keeping methods during mass casualty situations.

The absence of a functioning medical recording system compromises patient safety and the continuity of care. Without access to complete and up-to-date medical records, healthcare providers face challenges in understanding a patient's medical history, allergies, medications, and previous treatments. This lack of information increases the risk of medical errors, adverse events, and delayed or inappropriate treatments.[13] During our initial 2 days in the Reyhanlı Sate Hospital, all accessible personnel were dedicated to patient transport and prompt conveyance of survey results from laboratories to doctors. The circumstances potentially impeded the accurate registration of patients at the emergency department's registry desk. This highlights the need for a significantly larger workforce compared to normal operations when manual processes are in place.[14] The major advantage in our experience was the hospital's quick and prompt evacuation of patients to other advanced hospitals postoperatively. This prevented inappropriate postoperative care and also alleviated the workload of the limited staff.[15]

In the face of limited resources and personnel, effective collaboration and resource management become crucial. The formation of voluntary teams and coordination between different specialties such as orthopaedics, general surgery, plastic surgery, and anaesthesia demonstrate the importance of interdisciplinary collaboration and the sharing of responsibilities. Such collaborations help optimize patient care, ensuring that medical professionals can provide timely interventions, manage postoperative complications, and address critical patient needs. Under exceptional circumstances, routine care can be upheld with only a select few key participants stepping forward and taking on coordinating roles.[16] According to Nie et al., senior emergency physicians demonstrate greater accuracy in diagnosing patients during triage evaluations, while junior emergency physicians and residents tend to over-triage.[4] On the other hand, specialty surgeons were found to be more prone to under-triage. As a result, Nie et al. proposed a triage model where junior emergency doctors and residents handle initial triage, senior emer-

Acta Medica Alanya 2023;7(3): 238-248
Doi: 10.30565/medalanya.1391661

gency surgeons take charge of final triage decisions and advanced triage, and specialty surgeons focus on providing specialized treatment for specific pathologies. However, in our case, an emergency physician was not available. Therefore, a senior orthopaedist took responsibility together with a senior general surgeon and performed the triage. In our experience, this collaboration worked very effectively.

The study findings regarding patient demographics and surgical procedures align closely with observations made during the 1999 earthquake in Türkiye's Marmara region.[17] Most patients were young adults, primarily men, requiring orthopedic surgeries (%77), a trend consistent with previous earthquake-related trauma reports.[17] Notably, an infant's case with left forearm compartment syndrome underscored the vulnerability of infants post-earthquakes due to delayed proper medical attention. Timely access to medical services remains crucial to prevent misguided interventions. Surgical interventions included various trauma types, with lower extremity injuries being the most prevalent (%36.2), followed by upper extremity, head, spinal, chest, and abdominal injuries.[17] Brain and thoracic surgeries were performed for specific cases, while general surgeries addressed a range of conditions, including obstetric care.[18,19]

The surgeries' temporal distribution revealed a surge in procedures on the 2nd and 3rd days post-earthquake, indicating healthcare professionals' immediate response to meet urgent surgical needs. Notably, fasciotomies and amputations were performed primarily in the initial days to mitigate complications from compartment syndrome.[20] Differences in surgical durations were noted: amputation surgeries generally took longer than fasciotomies, and lower extremity surgeries were briefer than upper extremity fasciotomies. Most surgeries employed endotracheal intubation (%96.3) for fast anesthesia, optimizing operating room turnover.[21] Nearly half of the patients undergoing surgery were displaced refugees, emphasizing the unique healthcare needs of displaced populations during natural disasters.[22]

Limitations: There are several limitations of this study. First, the study focused on surgeries performed by orthopaedic surgeons due to the lack of available data for other surgical specialties. Consequently, the analysis might not provide a comprehensive overview of all surgical interventions performed following the earthquakes. Second, the study did not extensively explore the long-term outcomes and complications associated with these surgeries. Future research could delve into these aspects to better understand the impact of initial surgical interventions on the overall recovery and rehabilitation of earthquake survivors.

Conclusion: The experiences described here demonstrate the essential role of hospital infrastructure and functional medical recording systems in facilitating efficient and effective healthcare delivery during and after earthquakes. Robust infrastructure, including operating rooms, equipment, and staffing, is vital for prompt surgical interventions and patient management. Additionally, reliable and accessible medical recording systems play a critical role in maintaining accurate patient information, ensuring patient safety, and supporting the continuity of care. These observations highlight the need for disaster-prepared healthcare facilities with resilient infrastructure and comprehensive medical recording systems to enhance post-earthquake response and ensure optimal patient outcomes. Fast postoperative transfers to advanced facilities may have prevented catastrophic problems during follow-ups, but we had no chance of evaluating the demographics of patients admitted to the emergency room who did not need surgical interventions. The results of this study provide valuable insights into the demographics of patients undergoing surgical interventions following the earthquakes and the types of surgical interventions. This study underscores the significance of orthopaedic surgeries for earthquake-related injuries and the importance of prompt medical attention and early interventions, particularly in cases of compartment syndrome. Understanding the demographic profiles and surgical needs of affected individuals can aid healthcare providers and policymakers in developing targeted disaster response plans and resource allocation strategies to effectively manage such crises in the future.

Conflicting of Interests: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this study has received no financial support.

Ethics Committee Approval: In this study, national and international ethical rules are observed. Umraniye Training and Research Hospital ethics Committee. Date: 24/04/2023 decision number: 100 (ID:B.10.1.TKH.4.34.H.GP.0.01/119)

ORCID and Author contribution: All authors reviewed and approved the final manuscript. *S.B. (0000-0002-6952-9493):* Design of the study, statistical analysis, interpretation of data, writing, drafting and revision. *M.T.A. (0009-0005-6235-1900):* Analysis of the data, co-writing of the article. *M.B.Y. (0000-0003-1645-2020):* analysis of the data, co-writing of the article. *S.Ç. (0000-0001-5899-6910):* Contributed to the interpretation of the data and design of the research. *M.S.S. (0000-0002-0828-0145):* Design of the study, statistical analysis, interpretation of data, writing of the article, and revision of the article.

Acknowledgement: We extend our gratitude to all volunteer surgeons, doctors, and other medical care staff, with special recognition to the general surgeons and anesthesia team from Ankara, who, although not included as authors in this study, contributed significantly through their collaboration and tireless efforts in rescuing victims during the initial week following the earthquake.

References

1. Akkar S, Azak T, Çan T, Çeken U, Demircioğlu Tümsa MB, Duman TY, et al. Evolution of seismic hazard maps in Turkey. Bulletin of Earthquake Engeenering. 2018;16:3197-228. doi: 10.1007/s10518-018-0349-1.
2. Jalali R. Civil society and the state: Turkey after the earthquake. Disasters. 2002;26:120-39. PMID: 12096846
3. Arroyo-Berezowsky C, Abonce-Zenteno J. The epidemiology of patients treated at a private hospital as a consequence of the September 19th 2017 earthquake in Mexico City. Acta Ortop Mex. 2020;34:215-21. PMID: 33535278
4. Nie H, Tang SY, Lau WB, Zang CJ, jiang YW, Lopez BL, et al. Triage during the week of the Sichuan earthquake: a review of utilized patient triage, care, and disposition procedures. Injury. 2011;42:515-20. PMID: 20153857
5. Lerner EB, Schwartz RB, Coule PL, Weinstein ES, Cone DC, Hunt RC, et al. Mass casualty triage: an evaluation of the data and development of a proposed national guideline. Disaster Med Public Health Prep. 2008;2(Suppl. 1):S25-34. PMID: 18769263
6. ATLS Subcommittee; American College of Surgeons' Committee on Trauma; International ATLS Working Group. Advanced Trauma Life Support (ATLS®): The Ninth Edition. J Trauma Acute Care Surg. 2013;74:1363-6. PMID: 23609291
7. Erdik M, Demircioglu M, Sesetyan K, Durukal E, Siyahi B. Earthquake hazard in Marmara region, Turkey. Soil Dynamics and Earthquake Engineering. 2004; 24: 605-631. doi: 10.1016/j.soildyn.2004.04.003
8. Aslan A, Balta O, Coşkun HS. Evaluation of the Orthopedic Traumas in the Earliest Days of the 2023 Kahramanmaraş Earthquakes In Türkiye. Acta Med. Alanya 2023;7(1): 1-4 doi: 10.30565/medalanya.1303749
9. Cartwright C, Hall M, Lee ACK. The changing health priorities of earthquake response and implications for preparedness: a scoping review. Public Health. 2017;150:60-70. PMID: 28645042
10. Savage PEA. Disaster planning: a review. Injury. 1972;3:49-55. PMID: 5115153
11. Arboleya-Casanova H, Zavala-Sánchez HM, Gómez-Peña EG, López-Jacinto EA, Flores-Soto JA, Méndez-Hernández EM, et al. Earthquakes and healthcare: the organization of the services of medical attention. Salud Pública de México. 2018;60(Suppl. 1):59-64. doi: 10.21149/9328.
12. Kilic E, Bingol O, Durgal A, Karlidag T, Keskin OH, Ozdemir G. Hyperbaric oxygen therapy does not change the amputation level in patients with fasciotomy after an earthquake: Our single-center experience after 2023 Kahramanmaras earthquake. Jt Dis Relat Surg. 2023;34(2):480-7. PMID: 37462661
13. Moore L, Clark DE. The value of trauma registries. Injury. 2008;39: 686-95. PMID: 18511052
14. Basu M, Ghosh S, Jana A, Bandyopadhyay S, Singh R. Medical requirements during a natural disaster: a case study on WhatsApp chats among medical personnel during the 2015 Nepal earthquake. Disaster Med Public Health Prep. 2017;11:652-55. PMID: 28606208
15. Bar-On E, Lebel E, Kreiss Y, Merin O, Benedict S, Gill A, et al. Orthopaedic management in a mega mass casualty situation. The Israel Defence Forces Field Hospital in Haiti following the January 2010 earthquake. Injury. 2011;42:1053-9. PMID: 21507401
16. Haverkort JJ, de Jong MB, Foco M, Gui D, Barhoum M, Bahouth H, et al. Dedicated mass-casualty incident hospitals: an overview. Injury. 2017;48:322-6. PMID: 28024651
17. Kurt N, Küçük HF, Celik G, Demirhan R, Gül O, Altaca G. Evaluation of patients wounded in the 17 August 1999 Marmara earthquake. Ulus Travma Derg. 2001;7:49-51. PMID: 11705174
18. Igarashi Y, Matsumoto N, Kubo T, Yamaguchi M, Nakae R, Onda H, et al. Prevalence and characteristics of earthquake-related head injuries: a systematic review. Disaster Med Public Health Prep. 2022;16:1253-8. PMID: 33947499
19. Sugawara J, Hoshiai T, Sato K, Tokunaga H, Nishigori H, Arai T, et al. Impact of the Great East Japan Earthquake on regional obstetrical care in Miyagi Prefecture. Prehosp Disaster Med. 2016;31:255-8. PMID: 27005003
20. Görmeli G, Görmeli CA, Güner S, Ceylan MF, Dursun R. The clinical profile of musculoskeletal injuries associated with the 2011 Van earthquake in Turkey. Eklem Hastalik Cerrahisi. 2012;23(2):68-71. PMID: 22765483
21. Rice MJ, Gwertzman A, Finley T, Morey TE. Anesthetic practice in Haiti after the 2010 earthquake. Anesth Analg. 2010;111:1445-9. PMID: 20889938
22. Wasay M, Mushtaq K. Health issues of internally displaced persons in Pakistan: preparation for disasters in future. Am J Disaster Med. 2010;5:126-8. PMID: 20496645

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 249-253
Doi: 10.30565/medalanya.1393223

An Examination of the 2D:4D Ratio, Handedness and Footedness in Attention Deficit Hyperactivity Disorder

Dikkat Eksikliği Hiperaktivite Bozukluğunda 2D:4D Oranı, El ve Ayak Dominansının İncelenmesi

Orhan Kocaman[1], Tayfun Kara[1], Pınar Aydoğan Avşar[2], Tacettin Kuru[3]

[1] Alanya Alaaddin Keykubat University, Faculty of Medicine, Department of Child and Adolescent Psychiatry, Antalya, Turkey

[2] Department of Child and Adolescent Psychiatry, Alanya Training and Research Hospital, Antalya, Turkey

[3] Department of Psychiatry, Alanya Training and Research Hospital, Antalya, Turkey

ABSTRACT

Aim: The purpose of this study was to examine hand 2D:4D ratios and their association with ADHD. The study was intended to compare hand 2D:4D ratios according to hand and foot dominance in individuals with ADHD.

Methods: 168 children were included in the study, 91 diagnosed with ADHD and 77 healthy volunteers. All participants were evaluated via DSM-5 based psychiatric examinations, and their sociodemographic data were collected using forms prepared by the authors. The participants' ADHD symptoms were assessed using the Conners' Parent Rating Scale-Revised Short Form (CPRS-RS). 2D:4D ratios were determined by measuring the lengths of the bilateral second and fourth fingers using a digital compass. Hand and foot dominances were determined by evaluation in a clinical setting. The scores obtained were then compared.

Results: Lower right and left hand 2D:4D ratios were determined in the individuals with ADHD than in the healthy controls (p=0.001 for both). No correlation was found between ADHD subscales and right or left hand 2D:4D ratios in the case group (p>0.05). No differences in 2D:4D ratios were also observed according to hand and foot dominances in the case group (p>0.05).

Conclusion: This study produced important findings concerning whether hand 2D:4D ratios can be used as a marker of ADHD. We think that the data obtained may be of assistance to other studies assessing the phenotype characteristics of individuals with ADHD.

Key Words: Attention deficit hyperactivity disorder, 2D:4D ratio, handedness, footedness

ÖZ

Amaç: Bu çalışmada fetal testosteron maruziyetinin göstergesi olan el 2D:4D oranları ile DEHB arasındaki ilişkinin incelenmesi amaçlanmıştır. Ayrıca DEHB olanlarda el ve ayak tercihlerine göre el 2D:4D oranlarının karşılaştırılması amaçlanmıştır.

Yöntem: Çalışmaya 91 DEHB tanılı ve 77 sağlıklı gönüllü olmak üzere 168 katılımcı ergen alındı. Tüm katılımcılar DSM-5 temelli psikiyatrik muayene ile değerlendirildi ve sosyodemografik verileri araştırmacılar tarafında hazırlanan formlar ile elde edildi. Katılımcıların DEHB belirtileri Conners Anababa Dereceleme Ölçeği-Yenilenmiş Kısa Form (CADÖ-YK) ile değerlendirildi. 2D:4D oranları, her iki elin 2. ve 4. parmak uzunlukları dijital kumpas ile ölçülerek belirlendi. El ve ayak tercihleri klinik ortamda değerlendirilerek belirlendi. Elde edilen skorlar istatistiksel olarak karşılaştırıldı.

Bulgular: DEHB olan bireylerde sağlıklı kontrollere göre sağ ve sol elde daha düşük 2D:4D oranları saptandı (sırasıyla p=0,001, p=0,001). Olgu grubunda DEHB alt ölçekleri ile sağ ve sol el 2D:4D oranları arasında ilişki bulunmadı (p>0.05). Olgu grubunda 2D:4D oranları ile el ve ayak tercihleri arasında fark saptanmadı (p>0.05.

Sonuç: Çalışmamızda 2D:4D oranlarının DEHB de bir belirteç olarak kullanılabileceğine dair önemli sonuçlar elde edilmiştir. Elde ettiğimiz veriler gelecekte DEHB li bireylerin fenotipik özelliklerini değerlendiren diğer çalışmalara katkıda bulunabileceği kanaatindeyiz.

Anahtar Kelimeler: Dikkat eksikliği hiperaktivite bozukluğu, 2D:4D Oranı, el tercihi, ayak tercihi

Recieved Date: 20.11.2023 / **Accepted Date:** 30.11.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Orhan Kocaman, Department of Child and Adolescent Psychiatry, Alanya Alaaddin Keykubat University, Faculty of Medicine, Antalya, Türkiye

Phone: +905324882207 / **mail:** dr_orhankocaman@hotmail.com

ORCID: 0000-0002-7504-5604

To cited: Kocaman O, Kara T, Aydoğan Avşar P, Kuru T. An Examination of the 2D:4D Ratio, Handedness and Footedness in Attention Deficit Hyperactivity Disorder. Acta Med. Alanya 2023;7(3): 249-253 doi: 10.30565/medalanya.1393223

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by hyperactivity, inattention, and impulsivity.[1] The global prevalence of ADHD in children and adolescents is 5-7.1.[2] The condition is 2-4 times more common in male gender.[3] Despite this greater prevalence in boys, this gender variation has not yet been explained, although the focus is on genetics and hormones.[4] Sex hormones in the prenatal period are known to affect fetal brain development.[5]

The evaluation of fetal testosterone levels in the intrauterine period is invasive and costly. Two finger ratios have therefore been employed instead of fetal testosterone levels in research.[6] Fetal testosterone levels in the prenatal period are known to affect the second and fourth finger ratio (2D:4D) and the length of those fingers. The 2D:4D ratio is inversely correlated with fetal testosterone levels in both sexes, the ratio decreasing as fetal testosterone rises.[7] Few studies have investigated the relationship between the 2D:4D ratio and clinically diagnosed ADHD, and their results are inconsistent. One such study reported a significantly lower 2D:4D ratio in boys diagnosed with ADHD compared to healthy controls, together with a significant negative correlation between the severity of ADHD subtypes and 2D:4D.[8] However, another study reported no difference in 2D:4D ratios between ADHD and control groups.[9]

Cerebral lateralization refers to one hemisphere of the brain being responsible for specific functions. While the right hemisphere is responsible for some cerebral functions, the left hemisphere is dominant in others, and both hemispheres are currently regarded as being specialized to perform certain functions and process information in a specific manner. Several behavioral asymmetries emerge as a result of hemispheric asymmetry, the most marked of which being hand dominance. Handedness is directly linked to hemisphere dominance.[10] Studies have reported atypical cerebral lateralization in individuals with ADHD.[11] Only limited numbers of studies have directly examined the association between ADHD and handedness. While some have observed more frequent left hand and mixed use in individuals with ADHD[12,13], others have determined no atypical handedness.[14] Research has suggested that individuals exposed to excessive testosterone during the fetal period exhibit greater left handedness.[15] However, no research has evaluated the relationship between fetal testosterone exposure and hand and foot dominance in individuals with ADHD.

There has been little research into the relationship between the 2D:4D ratio and ADHD in children with the condition, and the reported findings are inconsistent. To the best of our knowledge, no previous research has compared 2D:4D ratios, an indicator of fetal testosterone exposure, in terms of handedness and footedness in individuals diagnosed with ADHD. This research compared the 2D:4D ratios of children diagnosed with ADHD with those of healthy controls, and examined the relationship between ADHD symptoms and the 2D:4D ratio. The unique aspect of this study is that it compared 2D:4D ratio according to handedness and footedness in children diagnosed with ADHD.

Method

Sampling and Application: The study was performed with 168 children and adolescents aged 6-18 years, 91 diagnosed with and under follow-up for ADHD, and 77 healthy volunteers. All participants underwent psychiatric evaluations based on the Turkish version of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5 TR). These evaluations were conducted by experienced child and adolescent mental health and diseases specialists. The study was completed in October and November 2023. Written and verbal consent was obtained from the families of all particıpating adolescents. Children wıth additional psychiatric diagnoses or with known physical diseases were excluded from the study. The participating families' sociodemographic data were collected using forms prepared by the authors and face-to-face interviews. Participants with difficulties in reading and understanding the forms or who were unable to complete the evaluation process were excluded. The parents completed the Conners' Parent Rating Scale-Revised Short form (CPRS-RS) in order to scan the ADHD symptoms of the children in the study group. The bilateral index and ring fingers of the children and adolescents enrolled in the study were measured using a digital caliper sensitive to 0.01 mm from the proximal fold on the volar surface of the metacarpophalangeal joint to the tip of the finger, and the ratio of the length of the index finger to the length of the ring finger was determined from these values. The children's hand and foot dominances were determined by the authors by means of evaluations in a clinical setting. Ethical approval for the study was granted by the Alanya Alaaddin Keykubat University clinical research ethical committee, Türkiye, under decision no. 14-03.

Tools

Sociodemographic Information Form: This was used to elicit sociodemographic characteristics, including name and surname, age, sex, education status, the ages of the mother and father, and the parents' education levels, occupations, and incomes. Psychiatric and physical problems experienced during pregnancy, alcohol and sub-

Acta Medica Alanya 2023;7(3): 249-253
Doi: 10.30565/medalanya.1393223

stance use, treatments received, modes of delivery and gestational complications were also investigated.

Conners' Parent Rating Scale-Revised Short Form (CPRS-RS): This scale was developed by Conners for the purpose of evaluating behaviors in childhood.[16] The CPRS-RS consists of 27 items in three subscales - (Oppositional -O, Cognitive Problems/ Inattention- CP-I, and Hyperactivity-H) and one assistant scale (ADHD Index -ADHD-I). Each item is scored between 0 and 3; never (at no time, very rarely) 0; sometimes true (sometimes) 1; often true (frequently) 2; and very true (very frequently) 3. The higher the score, the greater the possession of problems described in the CPRS-RS. Reliability and validity were investigated by Kaner.[17]

Statistical Analysis: Frequency and percentage values were calculated for categorical data and mean and standard deviation values for continuous data. Normality of distribution of the data collected through the scales was evaluated using skewness-kurtosis values, histograms, and Q-Q plot graphics. For kurtosis and skewness, values in a range of ±1.5 were evaluated in favor of normal distribution. Levene's test was applied to examine whether the measured variable variances in the groups were equal. The applicability of the scales used for the study group was examined using the Cronbach-alpha method. The independent samples t test was applied for differences between the groups. Relationships between parameters were evaluated using Pearson correlation coefficient results. Statistical analyses were conducted on SPSS version 22 software, and p values <0.05 were regarded as significant.

Results

One hundred sixty-eight individuals voluntarily agreeing to take part and providing informed consent were enrolled in the study. Ninety-one (54.2%) individuals diagnosed with ADHD constituted the case group and 77 (45.8%) individuals similar to that group in terms of age and sex were included as the control group. Girls constituted 101 (60.1%) of the participants. The mean age of the participants was 9.45±2.28 years. Right hand dominance was present in 150 (89.3%) participants and right foot dominance in 136 (81%).

No difference was determined between the case and control groups in terms of age (p = 0.094) or sex (p = 0.315). No difference was also determined between the groups in terms of hand dominance (p = 0.104) or foot dominance (p = 0.66). Right hand 2D/4D values were lower in the case group than in the control group (t (166) = -3.403, p = 0.001). Similarly, left hand 2D/4D values were significantly lower in the case group (t (166) = -3.364, p = 0.001) (Table 1).

The skewness and kurtosis values used as evaluation tools were within the ±1.5 range and possessed a good level of internal consistency. No associations were found between finger ratios and O (right hand; p = 0.995, left hand; p = 0.764), BP/D (right hand; p = 0.487, left hand; p = 0.475), H (right hand; p = 0.669, left hand; p = 0.263), or ADHD-1 (right hand; p = 0.823, left hand; p = 0.589) in the case group (Table 2).

No significant difference was determined between individuals with right and left hand dominance in terms of right 2D:4D results ($t_{(89)}$ = -0.957, p = 0.341). No significant difference in hand dominance was also found in left hand 2D:4D ratios (t (89) = -1.957, p = 0.127). In terms of footedness, no significant differences were found between the right and left foot dominance groups for either right foot 2D:4D results ($t_{(89)}$ = -0.884, p = 0.379) or left foot 2D:4D results ($t_{(89)}$ = -0.877, p = 0.384) (Table 3).

Discussion

The 2D:4D ratio was significantly lower in the children diagnosed with ADHD in this study compared to the healthy controls, but no association was determined between the severity of ADHD symptoms and 2D:4D ratios. In addition, 2D:4D ratios were investigated in terms of hand and foot dominances in the children with ADHD, but no significant differences were found.

Table 1. A comparison of the case and control group measurements

	Case	Control	χ2. *t*	*P*
Gender (F)	60 (65.9%)	41 (53.2%)	2.800	0.094
Age (years)	9.60 ± 2.60	9.26 ±1.83	1.007	0.315
Tight hand ratio (2D/4D)	0.98 ± 0.046	1.01 ± 0.043	-3.403	**0.001**
Left hand ratio (2D/4D)	0.97 ± 0.043	0.99 ± 0.044	-3.364	**0.001**
Hand dominance (right)	78 (87.7%)	72 (93.5%)	2.647	0.104
Foot dominance (left)	69 (75.8%)	67 (87%)	3.386	0.066

Chi-square test, Independent Samples t Test, p<0.05 results shown in bold

Table 2. Relationships between ADHD subdimension characteristics and finger ratios

	Mean±SD (Min-Max)	RIGHT 2D/4D *P* (Pearson's r)	LEFT 2D/4D *P* (Pearson's r)	Skew	Kurt	α
O	9.45±5.11(0-18)	0.995 (0.001)	0.764 (-0.032)	-0.02	-1.17	0.876
CP/I	11.41±4.42(0-18)	0.487 (-0.074)	0.475 (-0.076)	-0.43	-0.60	0.838
H	8.58±5.05(0-18)	0.669 (-0.045)	0.263 (-0.119)	0.16	-0.92	0.873
ADHD-I	21.90±7.23(2-35)	0.823 (-0.024)	0.589 (-0.057)	-0.45	-0.13	0.859

O: Opposition, CP/I: Cognitive Problems/Inattention, H: Hyperactivity. ADHD-I: ADHD-Index, α: Cronbach Alpha. Skew: Skewness. Kurt: Kurtosis. Min: minimum, Mac: Maximum, SD: Standard Deviation, p<0.05 results shown in bold

Table 3. A comparison of hand 2D:4D ratios in terms of handedness and footedness

	Hand Dominance	Mean± SD	*t*	*p*	Foot Dominance	Mean± SD	*t*	*p*
Right hand ratio (2D/4D)	Right	0.98±0.05	-0.957	0.341	Right	0.98±0.04	-0.884	0.379
	Left	0.99±0.03			Left	0.99±0.05		
Left hand ratio (2D/4D)	Right	0.97±0.04	-1.539	0.127	Right	0.97±0.04	-0.877	0.384
	Left	0.99±0.03			Left	0.98±0.04		

Independent Samples t Test, p<0.05 results shown in bold

Martel et al. observed a significant lower 2D:4D ratio in children diagnosed with ADHD than in healthy controls.[8] Another study reported significantly lower 2D:4D ratios in both boys and girls with ADHD.[18] However, Lemiere et al. compared children with ADHD and healthy controls and determined no significant difference.[9] Similarly in the present study, 2D:4D ratios for both hands were significantly lower in the children with ADHD than in the healthy controls. In the light of the association between a low 2D:4D ratio and fetal testosterone exposure, it may be suggested that children diagnosed with ADHD were exposed to high levels of testosterone in the intrauterine period.

Various studies have examined the relationship between the severity of ADHD symptoms and the 2D:4D ratio, although the results are inconsistent.[8,9,19,20] Lemier et al. found no association between ADHD symptoms and the 2D:4D ratio.[9] Similarly, Wang et al. determined no relationship between ADHD symptoms and 2D:4D ratios.[21] However, other studies have reported a negative correlation between ADHD and the 2D:4D ratio.[8,22] The present research investigated correlations between ADHD symptoms in children with the condition and the 2D:4D ratios for both hands, and observed no significant association. Hand 2D:4D ratios vary depending on age, sex, and hand.[23] The inconsistencies among research findings may be attributable to different gender distributions and age groups in previous studies and the sample group in some consisting only of males.

Although several studies have investigated atypical cerebral lateralization in ADHD, the means by which this lateralization occurs is still unclear.[24] One meta-analysis concerning ADHD and hand preference reported that the condition does not affect the individual's preference but does result in limitations in extremity function.[11] No significant differences were determined between 2D:4D ratios for both hands in the present study and the hand and foot dominances of the children with ADHD. Societal norms encouraging or obliging the use of the right hand may be present in some societies. This results in hand preference not representing an unbiased indicator in showing cerebral lateralization.[25] The fact that the present research was conducted in a society with norms encouraging right hand and foot use may account for this findings.

Limitations: This study will make an important contribution to the existing literature by examining 2D:4D ratios and hand and foot dominances in children diagnosed with ADHD. However, there are also a number of limitations to this study. One is the use of a self-report scale completed only by mothers for the determination of the severity of ADHD. Another limitation is that no structured scale was employed for hand and foot dominance.

Conclusions: 2D:4D ratios were lower in the children with ADHD than in the healthy controls. No relationship was determined between the severity of ADHD symptoms and 2D:4D ratios. No significant variation was determined between the bilateral hand 2D:4D ratios according to hand

Acta Medica Alanya 2023;7(3): 249-253
Doi: 10.30565/medalanya.1393223

and foot dominance in the children with ADHD. This study elicited important results concerning whether or not 2D:4D ratios can be used as an indicator of ADHD in the future. We think that the data emerging from this study may also be useful to future studies evaluating the phenotypic characteristics of individuals with ADHD.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declared that this study has received no financial support.

Ethics Committee Approval: Alanya Alaaddin Keykubat University, Clinical Research Ethics Committee, 18/10/2023, Number:14-03

ORCID and Author contribution: *O.K. (0000-0002-7504-5604), T.K. (0000-0002-2156-3457), P.A.A. (0000-0001-5938-3243) and T.K. (0000-0002-0313-558X).* All authors contributed to the manuscript conception, design, literature search, writing, critical review and final approval.

Acknowledgement: We wish to express our gratitude to the participants; without their contribution, this study would not have been possible.

References

1. Sanwo O, Huzair H. What's new in attention-deficit/hyperactivity disorder: updates on assessment and management. Paediatr Child Health. 2022;32(8):282-9. doi: 10.1016/j.paed.2022.05.002.
2. Gül H, Öncü Çetinkaya B. Environmental Factors in the Etiology of Attention Deficit Hyperactivity Disorder. Current Approaches in Psychiatry. 2018;10(2):138-75. doi: 10.18863/pgy.358094.
3. Davies W. Sex differences in Attention Deficit Hyperactivity Disorder: Candidate genetic and endocrine mechanisms. Front Neuroendocrinol. 2014;35(3):331-46. doi:10.1016/j.yfrne.2014.03.003.
4. Else-Quest NM, Hyde JS, Goldsmith HH, Van Hulle CA. Gender differences in temperament: A meta-analysis. Psychol Bull. 2006;132(1):33-72. doi: 10.1037/0033-2909.132.1.33.
5. Li M, Usui N, Shimada S. Prenatal Sex Hormone Exposure Is Associated with the Development of Autism Spectrum Disorder. Int J Mol Sci. 2023;24(3):2203. doi: 10.3390/ijms24032203.
6. Işık Ü, Kılıç F, Aktepe E, Tanrıtanır B. The relationship between second-to-fourth digit ratios, attention-deficit/hyperactivity disorder symptoms, aggression, and intelligence levels in boys with attention-deficit/hyperactivity disorder. Psychiatry Investig. 2020;17(6):596-602. doi: 10.30773/pi.2020.0003.
7. Manning J, Kilduff L, Cook C, Crewther B, Fink B. Digit Ratio (2D:4D): A Biomarker for Prenatal Sex Steroids and Adult Sex Steroids in Challenge Situations. Front Endocrinol (Lausanne). 2014;5:9. doi: 10.3389/fendo.2014.00009.
8. Martel MM, Gobrogge KL, Breedlove SM, Nigg JT. Masculinized Finger-Length Ratios of Boys, but Not Girls, Are Associated With Attention-Deficit/Hyperactivity Disorder. Behav Neurosci. 2008;122(2):273-81. doi: 10.1037/0735-7044.122.2.273
9. Lemiere J, Boets B, Danckaerts M. No association between the 2D:4D fetal testosterone marker and multidimensional attentional abilities in children with ADHD. Dev Med Child Neurol. 2010;52(9):e202-8. doi: 10.1111/J.1469-8749.2010.03684.X.
10. Soysal AŞ, Arhan E, Aktürk A, Can H. Hand Dominance and Factors Determining Hand Dominance. Türkiye Çocuk Hastalıkları Dergisi. 2007;1(2):60-68.
11. Nastou E, Ocklenburg S, Hoogman M, Papadatou-Pastou M. Handedness in ADHD: Meta-Analyses. Neuropsychol Rev. 2022;32(4):877-92. doi: 10.1007/s11065-021-09530-3.
12. Lin HL, Tsuang HC. Handedness and Attention Deficit/Hyperactivity Disorder Symptoms in College Students. Psychiatr Q. 2018;89(1):103-10. doi: 10.1007/s11126-017-9517-8.
13. Rodriguez A, Kaakinen M, Moilanen I, et al. Mixed-handedness is linked to mental health problems in children and adolescents. Pediatrics. 2010;125(2):e340-8. doi: 10.1542/peds.2009-1165.
14. Ghanizadeh A. Lack of association of handedness with inattention and hyperactivity symptoms in ADHD. J Atten Disord. 2013;17(4):302-7. doi: 10.1177/1087054711429789.
15. Richards G, Medland SE, Beaton AA. Digit ratio (2D:4D) and handedness: A meta-analysis of the available literature. Laterality. 2021;26(4):421-84. doi: 10.1080/1357650X.2020.1862141.
16. Conners CK, Sitarenios G, Parker JDA, Epstein JN. The revised Conners' Parent Rating Scale (CPRS-R): factor structure, reliability, and criterion validity. J Abnorm Child Psychol. 1998;26(4):257-68. doi: 10.1023/a:1022602400621.
17. Kaner S, Büyüköztürk Ş, İşeri E. Conners Parent Rating Scale-Revised Short: Turkish Standardization Study. Archives of Neuropsychiatry. 2013;50(2):100-109. doi: 10.4274/npa.y 6219.
18. Stevenson JC, Everson PM, Williams DC, Hipskind G, Grimes M, Mahoney ER. Attention deficit/hyperactivity disorder (ADHD) symptoms and digit ratios in a college sample. Am J Hum Biol. 2007;19(1):41-50. doi: 10.1002/ajhb.20571.
19. Wang LJ, Lee SY, Chou MC, Lee MJ, Chou WJ. Dehydroepiandrosterone sulfate, free testosterone, and sex hormone-binding globulin on susceptibility to attention-deficit/hyperactivity disorder. Psychoneuroendocrinology. 2019;103:212-8. doi: 10.1016/j.psyneuen.2019.01.025.
20. Fink B, Manning JT, Williams JHG, Podmore-Nappin C. The 2nd to 4th digit ratio and developmental psychopathology in school-aged children. Pers Individ Dif. 2007;42(2):369-379. doi: 10.1016/j.paid.2006.07.018.
21. Wang LJ, Chou MC, Chou WJ, et al. Potential role of pre- and postnatal testosterone levels in attention-deficit/hyperactivity disorder: Is there a sex difference? Neuropsychiatr Dis Treat. 2017;13:1331-9. doi: 10.2147/NDT.S136717
22. Williams JHG, Greenhalgh KD, Manning JT. Second to fourth finger ratio and possible precursors of developmental psychopathology in preschool children. Early Hum Dev. 2003;72(1):57-65. doi: 10.1016/S0378-3782(03)00012-4.
23. Xu Y, Zheng Y. The digit ratio (2D:4D) in China: A meta-analysis. Am J Hum Biol. 2015;27(3):304-9. doi: 10.1002/ajhb.22639.
24. Hale TS, Smalley SL, Walshaw PD, et al. Atypical EEG beta asymmetry in adults with ADHD. Neuropsychologia. 2010;48(12):3532-9. doi: 10.1016/j.neuropsychologia.2010.08.002.
25. Tran US, Voracek M. Footedness Is Associated With ADHD Symptoms in the Adult General Population. J Atten Disord. 2018;22(3):261-8. doi: 10.1177/1087054715586570.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 254-258
Doi: 10.30565/medalanya.1396535

Retrospective Analysis of the Determining Factors for Open Reduction in Pediatric Humerus Supracondylar Fractures: Are Factors Such as Time Until Operation and Surgeon's Experience Effective?

Pediatrik Humerus Suprakondiler Kırıklarında Açık Redüksiyonu Belirleyen Faktörlerin Retrospektif Analizi: Operasyona Kadar Geçen Süre ve Cerrahın Deneyimi Gibi Faktörler Etkili midir?

Murat Taşcı[1], Muhammed Enes Karataş[2], Bahattin Kemah[1]

[1] Umraniye Training and Research Hospital, Department of Orthopaedics and Traumatology, Istanbul, Türkiye,

[2] Kartal Training and Research Hospital, Department of Orthopaedics and Traumatology, Istanbul, Türkiye

ABSTRACT

Aim: Indications for open surgery are very limited in supracondylar humerus fractures (SCHFs).

In our study, we aimed to examine whether the patient's fracture type, waiting time of the patient before the operation, and the experience of the surgeon are effective on the treatment decision for open surgical method in our SCHF patients treated with open reduction.

Methods: A group of pediatric patients treated with open reduction for SCHF between the years of 2010 and 2022 were examined for our study. Trauma mechanism, type of fracture, time until operation, neurovascular injuries and years of experience of the surgeons were retrospectively reviewed.

Results: A total of 110 patients were included in the study. The mean age was 5.7 years. Nine patients were flexion-type SCHF. According to the Gartland classification, 19 patients were Type II and 82 patients were Type III. Ninety-four patients were operated in the first 24 hours, 16 patients were operated after 24 hours. There was no statistical correlation between the surgeons' experience or time until operation and the type of the fractures. Patients with flexion type fractures were significantly older than the other patients.

Conclusion: Supracondylar humerus fractures in children are difficult fractures regardless of the surgeon's experience and the waiting time for surgery. Regardless of the surgeon's years of experience and the type of the fracture, some fractures cannot be treated with closed reduction and require open reduction.

Key Words: Pediatric supracondylar humerus fractures, open reduction, surgeon's experience, time until surgery

ÖZ

Amaç: Suprakondiler humerus kırıklarında (SKHK) açık cerrahi için kesin endikasyonlar çok sınırlıdır.

Çalışmamızda açık redüksiyon ile tedavi edilen SKHK hastalarımızda, hastanın kırık tipi, operasyon öncesi hastanın bekleme süresi ve cerrahın deneyiminin açık cerrahi yöntem için tedavi kararında etkili olup olmadığını incelemeyi amaçladık.

Yöntem: Çalışmamız için 2010-2022 yılları arasında SKHK nedeniyle açık redüksiyon ile tedavi edilen çocuk hasta grubu incelendi. Travma mekanizması, kırık tipi, operasyona kadar geçen süre, nörovasküler yaralanmalar ve cerrahların yıllara dayanan deneyim süreleri retrospektif olarak incelendi.

Bulgular: Çalışmaya toplam 110 hasta dahil edildi. Ortalama yaş 5.7 idi. 9 hasta fleksiyon tipi SKHK idi. Gartland sınıflamasına göre 19 hasta Tip II, 82 hasta Tip III idi. 94 hasta ilk 24 saatte, 16 hasta 24 saat sonra ameliyat edildi. Cerrahların deneyimi veya ameliyata kadar geçen süre ile kırık tipi arasında istatistiksel bir ilişki yoktu. Fleksiyon tipi kırığı olan hastalar diğer hastalardan anlamlı olarak daha ileri yaştaydı.

Sonuç: Çocuklarda görülen suprakondiler humerus kırıkları, cerrahın tecrübesi ve ameliyat için bekleme süresinden bağımsız zor kırıklardır. Cerrahın tecrübe yılı ve kırığın tipi ne olursa olsun bazı kırıklar kapalı redüksiyonla tedavi edilemez ve açık redüksiyon gerektirir.

Anahtar Kelimeler: Çocuk humerus suprakondil kırıkları, açık redüksiyon, cerrahın deneyimi, cerrahiye kadar geçen süre

Recieved Date: 29.11.2023 / **Accepted Date:** 16.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Murat Taşcı, MD. Elmalıkent, Adem Yavuz Street, 34764 Umraniye/Istanbul, Türkiye

Phone: +90 0554 801 44 61 / **mail:** drtascimurat@gmail.com

ORCID: 0000-0001-5391-7662

To cited: Taşcı M, Karataş ME, Kemah B. Retrospective analysis of the determining factors for open reduction in pediatric humerus supracondylar fractures: Are factors such as time until operation and surgeon's experience effective? Acta Med. Alanya 2023;7(3): 254-258 doi: 10.30565/medalanya.1396535

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 254-258
Doi: 10.30565/medalanya.1396535

Introduction

Supracondylar humeral fractures (SCHFs) are common and account for 3% of all fractures in the pediatric age group.[1-3] The treatment of these fractures usually depends on the extent of the displacement of the fracture, and the Gartland classification is used for the determination of this extent (degree) and the severity of SCHFs. In Type I fractures, the posterior periosteum is intact without a displacement, so these fractures can be treated with orthopedic immobilization (with a plaster cast); however, severe displaced fractures are treated with surgical (open or closed) reduction and internal fixation with surgical pins.[4-6] Regarding the management of Type II and III fractures, some authors insisted on an operation without a reduction attempt while some others argued that a closed reduction and plaster cast should primarily be given a chance for all degrees of fractures except for those with circulation problems, and surgery should then be performed if appropriate reduction could not be achieved with the help of the aforementioned methods.[7,8] There is no evidence in the current literature showing which method is superior to the others, also, there might be different approaches among the surgeons with different surgical experiences even within the same clinic.

Due to the highly unstable nature of these fractures, a reduction and pin fixation can easily be performed by using proper techniques; however, a minimal varus-valgus angulation may also require open surgery when appropriate techniques are not used. Current literature recommends avoiding open surgery, if possible, in order not to come across with complications such as avascular necrosis, infection, and range of motion limitation. Open surgery may be inevitable in cases in which anatomical reduction cannot be achieved with the closed technique or when the extremity is cyanotic and arterial circulation is impaired.[9]

Definite indications for open surgery are very limited in SCHFs. In literature, there are studies evaluating the effective factors on the decision of the surgery in open surgery patients; however, the factors mostly focused on the type and location of the fracture.[10]

In our study, we aimed to examine whether the patient's fracture type, time until operation, and the amount of experience of the surgeon (regarding expertise in orthopedics and traumatology) are effective on the treatment decision for open surgical method in our SCHF patients treated with open reduction.

Material and Method

Ethics committee approval was obtained prior to the study (ID:215591851). A total of 130 pediatric patients (between 2 and 16 years old) treated with open reduction and pin fixation for SCHF between the years of 2010 and 2022 were examined for our study. We excluded the patients who underwent open surgery due to circulatory problems, with Type III open fractures, who did not have adequate medical records, were followed up after having been treated with closed reduction in another center, and whose closed reduction failed during follow-ups and were reoperated for this reason from the study. Patients who did not get any treatment after the occurrence of the fracture were included in the study.

Demographic characteristics such as age, gender, trauma mechanism, type of fracture according to Gartland classification, time until operation, neurovascular injuries and ipsilateral traumas of the patients and years of experience of the surgeons who operated the patients were retrospectively reviewed and scanned via our institution's patient follow-up system; health Information Systems v:5 (HIS). We divided the patients into two groups according to the time spent until their operation: the ones operated in the first 24 hours and those operated after 24 hours. We also examined the experience of the surgeons in two groups: the ones with an experience of less than 5 years and those with an experience of more than 5 years. In total, thirteen surgeons, who have worked at our clinic in different time, participated in the study. The surgical procedures were conducted by the respective surgeons in accordance with their monthly work schedules.The data were analyzed statistically.

A total of 110 patients were included in the study. Standard procedure was applied to all patients. Closed reduction and cast are performed in Type II fractures in SCHF patients during emergency admission if there are no symptoms of a circulatory or neurological problem. If appropriate anatomic reduction cannot be achieved, the patient's plaster is removed, and surgery is planned. If the fracture was a Type III fracture, only minimal alignment is provided with traction to reduce the pressure on the skin and/or neuro-vascular structures in severely displaced fractures, and then the patient is told to fast prior to the surgery and prepared for operation. It depends on the preference of the responsible surgeon when open surgery should be performed in patients, and after how many unsuccessful closed reduction attempts should the surgeon give up pinning and switch to open treatment. In open surgery, medial or lateral approach was preferred according to the experience of the surgeon and the fracture type. The noted time until surgery was calculated from the admittance of the patients to the hospital until the onset time of the surgery. (Figure 1)

Statistical methods: The data were analyzed using SPSS Version 26 (IBM, New York, USA). Categorical data were an-

Figure 1. A case 7 years old girl, Type 3 supracondylar humerus fracture preop and pospot x ray pictures.

alyzed with the Chi-Squared test and Fischer's exact test, and parametric data of the two groups were compared with the Student's t-test. Categorical data were percentage (%), number (n), and frequency while parametric data were mean, standard deviation, minimum, and maximum values. The data were analyzed at a confidence interval (CI) of 95% and a p-value less than 0.005 was considered statistically significant. ($p<0.05$)

Results

We examined a total of 130 supracondylar humerus fractures treated with open reduction pin fixation. Twenty patients were excluded from the study because they did not meet the inclusion criteria, and the remaining 110 patients were included in the study. The mean age was 5.7 years (between 1 and 11 years). Nine patients were flexion-type SCHF. According to the Gartland classification, 19 patients were Type II and 82 patients were Type III. Ninety-four patients (85.5%) were operated in the first 24 hours, and 16 patients (14.5%) were operated after 24 hours (Table 1). While surgeons with less than 5 years of experience operated 38 of the cases, surgeons with more than 5 years of experience operated 72 patients.

Table 1. Type of fractures and time until operation

	<24 hours	>24 hours
Flexion Type	8 (88.9%)	1 (11.1%)
Type 2	19 (100%)	0 (0%)
Type 3	67 (81.7%)	15 (18.3%)

Of the cases operated in the first 24 hours, 8.5%, 20.2%, and 71.3% were flexion type, Type II, and Type III fractures, respectively. Of the cases operated after 24 hours, 6.3% were flexion type and 93.7% were Type III fractures.

While 81.6% of the surgeons with less than 5 years of experience operated their patients in the first 24 hours, surgeons with more than 5 years of experience operated 87.5% of their cases in the first 24 hours. All Type II fractures were operated in the first 24 hours regardless of the surgeon's experience. Regarding the fracture types, 33.3% of flexion type fractures, 26.3% of Type II fractures, and 36.6% of Type III fractures were operated by surgeons with less than 5 years of experience. Surgeons with more than 5 years of experience operated 66.7% of flexion fractures, 73.7% of Type II fractures, and 63.4% of Type III fractures.

There was no statistical correlation between the surgeon's experience and the Gartland type of fracture that underwent open surgery ($p=0.609$). In other words, inexperienced surgeons did not need to switch to open reduction in Type II fractures more than the experienced ones or experienced surgeons did not prone to perform open reduction in Type III fractures more than the inexperienced ones.

Patients with flexion type fractures were statistically significantly older than the other patients who underwent open surgery ($p=0.008$) (Figure 2). While younger children are likely to suffer more extension-type fractures due to falling on their wrists or elbows in extension from sofas and chairs, older children are more likely to fall on the elbow and suffer flexion-type fractures because they can be injured in activities.

The distribution of Type II and Type III fractures that underwent open surgery was homogeneous ($p=0.134$). There was no statistically significant relationship between the time until operation and fracture type ($p=0.120$).

Discussion

Closed reduction and percutaneous fixation are the most frequently preferred methods of surgical treatment, especially in patients with displaced SCHFs. Open reduction is required in fractures that cannot be adequately reduced by closed methods, fractures with arterial injury, or open fractures.[4,5,9,11-12] The rate of the requirement of open reduction has been reported to be between 3% and 46% in the literature.[13-16]

Acta Medica Alanya 2023;7(3): 254-258
Doi: 10.30565/medalanya.1396535

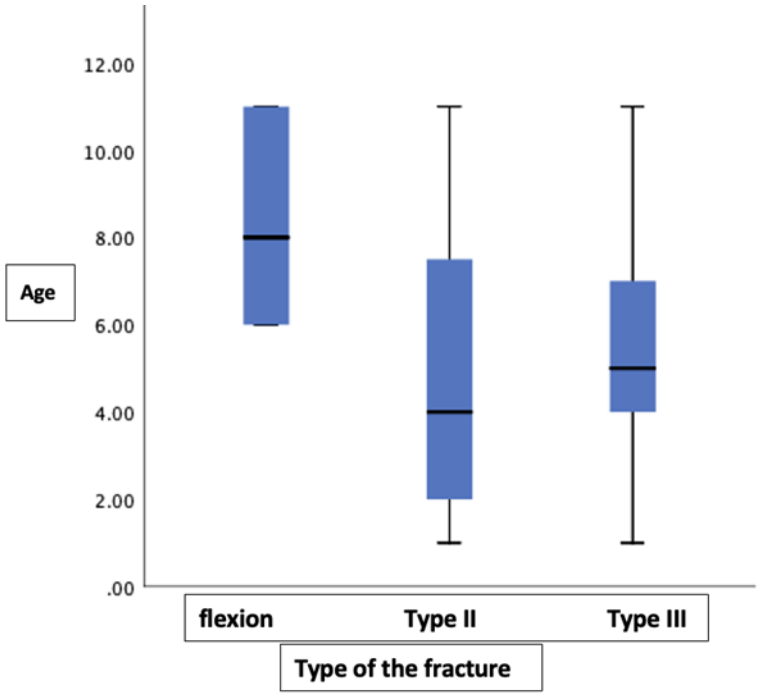


Figure 2. Type of fractures and age.

Many factors, including fracture type and direction, time to surgery, and surgeon experience, influence the decision to open reduction.[9,17,18] A study published in 2017 emphasized the importance of the years of experience of surgeons in having more patience and obtaining the necessary skills to achieve a closed reduction.[19] Open reduction may result in unpleasant skin scars, longer operative time, and sometimes poor functional outcomes.[9,19-21] Mehlman et al. described "a delayed surgery" as an 8-hour-delay in their study and this delay was reported not to increase pin infection, nerve damage, compartment syndrome, or the requirement for open reduction in Gartland Type II and III fractures.[16] Iyengar et al. indicated that a delay of more than 8 hours did not cause an increase in open reduction rates in Type III fractures.[22] Leet et al. found that a mean surgery delay of 21.3 hours in Type III fractures did not increase the need for open reduction or unsatisfactory outcomes.[23] In addition, they did not detect any adverse effects such as prolonged operative time and hospital stay due to the delay of the surgery. In our study, no complication was reported in our patients related to the waiting time that passed until surgery. In the literature, there are many studies on the safety of operating the Gartland Type IIA and Type IIB fracture patients that were admitted at night in the next business day.[22-24] However, in their study, Walmsley et al. found that the requirement for open reduction due to a delay of more than 8 hours in Gartland Type III fractures increased from 11.2% to 33% and the results were significant.[25]

In our cases, the reason why we delayed the surgeries for more than 24 hours was the patients' health conditions such as multitrauma or upper respiratory tract infection. We aim to begin the surgery in the first 24 hours when there is no clinical obstacle to the operation. However, when the surgery time is going to past midnight, we operate the patient next day. In the literature, this decision was not reported as a disadvantage for the patient, and we did not also detect any negative outcomes. Of the patients we treated with open reduction, 74.5% had Type III fractures. We believe that the more displaced the fracture is, the more probable the open reduction is. We also think that as the surgeon's years of experience increase, the probability of performing a successful closed reduction increase, and we also believe that the type of fracture, the age of the patient, and the time until the operation are also effective in a successful closed reduction.

Our study undoubtedly had several limitations. First of all, since the patients included in the study were only open surgery patients, it was impossible to discuss the number of the patients that underwent open surgery, yet this was not the main focus of the study. In addition, the relationship between the duration of the surgeries and the surgeons' experiences as well as the relationship between the surgeons' experience and possible complications could not be examined because the duration of the surgeries was not properly recorded. Furthermore, the patients included and examined in this study were exclusively those who underwent open surgery for all humerus supracondylar fractures. However, considering that the results were obtained based on the resources of a single clinic, we are cognizant of the need for broader-scale studies that en-

compass various clinics to assess different clinical conditions. This understanding underscores the necessity for more comprehensive research initiatives.

Conclusion: Supracondylar humerus fractures in children are difficult fractures regardless of the surgeon's experience and the waiting time for surgery**.** Regardless of the surgeon's years of experience and the type of the fracture, some fractures cannot be treated with closed reduction and require open reduction.

Conflicting of Interests: No conflict of interest was declared by the authors.

Funding sources: The authors declared that this study has received no financial support.

Ethics Committee Approval: In this study,national and international ethical rules are observed. Umraniye Training and Research Hospital Ethics Committee -15.05.2023-ID:215591851.

ORCID and Author contribution: *M.T.(0000-0001-5391-7662):* Concept, Design, Supervision, Writing and Critical Review. *B.K. (0000-0002-4795-4309):* Literature Search, Resources, analysis and/or interpretation. *M.E.K. (0000-0003-0995-0953):* Materials, Data Collection and/or Processing, Writing Manuscript.

Acknowledgement: All authors made appropriate contributions to the conception and design of the study.

References

1. Boyd DW, Aronson DD. Supracondylar fractures of the humerus: a prospective study of percutaneous pinning. J Pediatr Orthop 1992;12:789–74. doi: 10.1097/01241398-199211000-00017.
2. Carmichael KD, Joyner K. Quality of reduction versus timing of surgical intervention for pediatric supracondylar humerus fractures. Orthopedics 2006;29:628–32. doi: 10.3928/01477447-20060701-13.
3. Baratz M, Micucci C, Sangimino M. Pediatric supracondylar humerus fractures. Hand Clin. 2006;22(1):69-75. doi: 10.1016/j.hcl.2005.11.002.
4. Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. J Bone Joint Surg Am 2008;90:1121–32. doi: 10.2106/JBJS.G.01354.
5. Abzug JM, Herman MJ. Management of supracondylar humerus fractures in children: current concepts. J Am Acad Orthop Surg 2012;20:69–77. doi: 10.5435/JAAOS-20-02-069.
6. Edmonds EW, Roocroft JH, Mubarak SJ. Treatment of displaced pediatric supracondylar humerus fracture patterns requiring medial fixation: a reliable and safer cross-pinning technique. J Pediatr Orthop 2012;32:346–51. doi: 10.1097/BPO.0b013e318255e3b1.
7. Skaggs DL, Sankar WN, Albrektson J, Vaishnav S, Choi PD, Kay RM. How safe is the operative treatment of Gartland type 2 supracondylar humerus fractures in children? J Pediatr Orthop. 2008;28(2):139-41. doi: 10.1097/BPO.0b013e3181653ac8.
8. Ariyawatkul T, Eamsobhana P, Kaewpornsawan K. The necessity of fixation in Gartland type 2 supracondylar fracture of the distal humerus in children (modified Gartland type 2A and 2B). J Pediatr Orthop B. 2016;25(2):159-64. doi: 10.1097/BPB.0000000000000251.
9. Reitman RD, Waters P, Millis M. Open reduction and internal fixation for supracondylar humerus fractures in children. J Pediatr Orthop 2001;21:157–61. PMID: 11242241
10. Latario LD, Lubitz MG, Narain AS, Swart EF, Mortimer ES. Which pediatric supracondylar humerus fractures are high risk for conversion to open reduction? J Pediatr Orthop B. 2023;32(6):569-74. doi: 10.1097/BPB.0000000000001042.
11. Uludağ A, Tosun HB, Aslan TT, Uludağ Ö, Gunay A. Comparison of Three Different Approaches in Pediatric Gartland Type 3 Supracondylar Humerus Fractures Treated With Cross-Pinning. Cureus. 2020;23;12(6):e8780. doi: 10.7759/cureus.8780.
12. Carter CT, Bertrand SL, Cearley DM. Management of pediatric type III supracondylar humerus fractures in the United States: results of a national survey of pediatric orthopaedic surgeons. J Pediatr Orthop 2013;33:750–4. doi: 10.1097/BPO.0b013e31829f92f3.
13. Cramer KE, Devito DP, Green NE. Comparison of closed reduction and percutaneous pinning versus open reduction and percutaneous pinning in displaced supracondylar fractures of the humerus in children. J Orthop Trauma. 1992;6:407–12. doi: 10.1097/00005131-199212000-00002.
14. Danielsson L, Pettersson H. Open reduction and pin fixation of severely displaced supracondylar fractures of the humerus in children. Acta Orthop Scand. 1980;51:249–55. PMID: 7435182
15. Hart GM, Wilson DW, Arden GP. The operative management of the difficult supracondylar fracture of the humerus in the child. Injury. 1977;9:30–4. doi: 10.1016/0020-1383(77)90046-8.
16. Mehlman CT, Crawford AH, McMillion TL, et al. Operative treatment of supracondylar fractures of the humerus in children: the Cincinnati experience. Acta Orthop Belg. 1996;62 Suppl 1:41-50. PMID: 9084559
17. Schmid T, Joeris A, Slongo T, Ahmad SS, Ziebarth K. Displaced supracondylar humeral fractures: influence of delay of surgery on the incidence of open reduction, complications and outcome. Arch Orthop Trauma Surg 2015;135:963–9. doi: 10.1007/s00402-015-2248-0.
18. Silva M, Kazantsev M, Aceves Martin B, Delfosse EM. Pediatric supracondylar humerus fractures: is surgeon experience a surrogate for the need of open reduction? J Pediatr Orthop B. 2018;27(2):103-107. doi: 10.1097/BPB.0000000000000487.
19. Ciftci S, Safali S, Ergin M, Özdemir A, Acar MA. Is methyl methacrylate fixator reliable for the treatment of gartland type IV supracondylar fractures? Niger J Clin Pract. 2023;26(10):1463-71. doi: 10.4103/njcp.njcp_15_23.
20. Guven MF, Kaynak G, Inan M, Caliskan G, Unlu HB, Kesmezacar H. Results of displaced supracondylar humerus fractures treated with open reduction and internal fixation after a mean 22.4 years of follow-up. J Shoulder Elbow Surg 2015;24:640–6. doi: 10.1016/j.jse.2014.12.010.
21. Aslan A, Konya MN, Ozdemir A, Yorgancigil H, Maralcan G, Uysal E. Open reduction and pinning for the treatment of Gartland extension type III supracondylar humeral fractures in children. Strategies Trauma Limb Reconstr. 2014;9(2):79-88. doi: 10.1007/s11751-014-0198-7.
22. Iyengar SR, Hoffinger SA, Townsend DR. Early versus delayed reduction and pinning of type III displaced supracondylar fractures of the humerus in children: a comparative study. J Orthop Trauma. 1999;13:51–5. doi: 10.1097/00005131-199901000-00012.
23. Leet AL, Frisancho J, Ebramzadeh E. Delayed treatment of type 3 supracondylar humerus fractures in children. J Pediatr Orthop. 2002;22:203–7. PMID: 11856931
24. Mehlman CT, Strub WM, Roy DR, Wall EJ, Crawford AH. The effect of surgical timing on the perioperative complications of supracondylar humeral fractures in children. J Bone Joint Surg Am. 2001;83(3):323-7. doi: 10.2106/00004623-200103000-00002
25. Walmsley PJ, Kelly MB, Robb JE, Annan IH, Porter DE. Delay increases the need for open reduction of type-III supracondylar fractures of the humerus. J Bone Joint Surg Br. 2006;88(4):528-30. doi: 10.1302/0301-620X.88B4.17491.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 259-262
Doi: 10.30565/medalanya.1397435

Neurovascular Heterodigital Island Flap for Digital Pulp Defect Reconstruction: 58 Case Series

Parmak Pulpa Defektlerinin Nörovasküler Heterodijital Ada Flebi ile Rekonstrüksiyonu: 58 Vakalık Seri

Muhsin Dursun[1]

[1] *Adana Ortadoğu Special Hospital, Department of Orthopedics and Traumatology, Adana, Türkiye*

ABSTRACT

Aim: Our study aims to report the neurovascular heterodigital island flap reconstruction for finger pulp defects.

Patients and Methods: This study included 58 patients presenting to our clinic with pulp defects between 2014 and 2022. The average age of the patients was 26 years (20 - 56 years). Injuries were Allen type 2 for 18 patients, type 3 for 33 patients, and type 4 for 7 patients. Pulp defects were caused by crush injury (n:42) and sharps injury (n:16).

Results: None of the flaps administered to the participating patients developed any total loss. Three patients developed partial loss in the distal flap. Six patients were found to have superficial tissue infection. Two patients were found to have hyperpigmentation and hyperesthesia. While one patient with Allen type 3 pulp defect was detected to have 10 degrees of flexion contracture in the distal interphalangeal (DIP) joint and 5 degrees of flexion contracture in the proximal interphalangeal joint, three patients were found to have 5 degrees of flexion contracture only in the DIP joint. While the mean static two-point discrimination of the pulp-administered flap was 5.2 mm (3-8 mm) it was 3 mm on the contralateral side. The mean Semmes-Weinstein monofilament test was 3.18 g (2.96 – 4.7 g) in the pulp administered flap and 2.92 g in the contralateral side.

Conclusion: Reconstruction of pulp defects with neurovascular heterodigital island flap is a reliable treatment option with satisfactory functional and sensory outcomes.

Key Words: Hand trauma, fingertip reconstruction, heterodigital island flap, local arterialized flap.

ÖZ

Amaç: Çalışmamızın amacı el parmak pulpa defekti olan hastalarda nörovasküler heterodijital ada flebi ile pulpa rekonstrüksiyonu sonuçlarımızı bildirmektir.

Patients ve Metod: Kliniğimize 2014-2022 yılları arasında pulpa defekti ile başvuran 58 hasta (42 erkek, 16 kadın) çalışmaya dahil edilmiştir. Hastaların yaş ortalaması 26'dır (20-56 yaş). Hastaların 18 tanesi Allen tip 2, 33 tanesi Allen tip 3 ve 7 tanesi Allen tip 4 yaralanmalardı. Pulpa defektleri crush yaralanma (n:42) ve kesici alet yaralanması (n:16) ile meydana gelmişti.

Bulgular: Çalışmaya dahil edilen hastalara uygulanan fleplerin hiçbirisinde total kayıp gelişmemiştir. Üç hastada flep distalinde kısmi kayıp gelişti. Hastaların 6 tanesinde yüzeyel doku enfeksiyonu görüldü. Donör saha morbiditesi olarak 2 hastada hiperpigmentasyon ile birlikte günlük hayatını etkilemeyecek şekilde hiperestezi tespit edildi. Allen tip 3 pulpa defektli olan 1 hastada distal IP (interphalangeal) eklemde 10 derece fleksiyon kontraktürü ile birlikte PIP eklemde 5 derece fleksiyon kontraktürü tespit edilirken, 3 hastada sadece distal IP eklemde 5 derece fleksiyon kontraktürü tespit edildi. Flep uygulanmış olan pulpaların ortalama statik 2 nokta diskriminasyonu 5,2 mm (3-8 mm) iken karşı tarafta ortalama 3 mm idi. Ortalama Semmes-Weinstein monofilament testleri flep uygulanmış olan pulpada 3.18 g (2.96 – 4.7 g) iken karşı tarafta 2.92 g idi.

Sonuç: Akut el yaralanmaları sonrası oluşan pulpa defektlerinin nörovasküler heterodijital ada flebi ile rekonstrüksiyonu fonksiyonel, estetik ve duyusal anlamda tatminkar sonuçlara sahiptir.

Anahtar Kelimeler: El travması, parmak ucu replantasyonu, fingertip reconstruction, heterodigital ada flebi, local arterli flep.

Recieved Date: 29.11.2023 / **Accepted Date:** 11.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Muhsin Dursun MD, Phd., Ziyapaşa, 67055 Sk. No:1 01140, Adana Ortadoğu Special Hospital, Adana, Türkiye

Phone: +905053109364 / **mail:** muhsindursun0@yahoo.com

ORCID: 0000-0002-4024-5059

To cited: Dursun M. Neurovascular Heterodigital Island Flap for Digital Pulp Defect Reconstruction: 58 Case Series. Acta Med. Alanya 2023;7(3): 259-262 doi: 10.30565/medalanya.1397435

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Pulp defect of the digit is a common condition in acute hand injuries often resulting in permanent damage to the pulp and potential loss of finger function. The Allen classification stands as the most widely used system for categorizing pulp defects.[1] This classification indicates that type 1 injury includes only the pulp; type 2 injury includes pulp and nail bed; type 3 injury indicates partial loss of the distal phalanx, and type 4 injury indicates injuries proximal to the lunula. Various techniques such as skin graft, pulp flaps such as Atasoy and Kutler flaps, pedicled homodigital/heterodigital island flaps, and free flap repair have been previously described.[2,3] These techniques are frequently used as a single-session reconstruction option in clinical practice.[4] The goal of reconstruction pulp defects is to address functional and sensory losses by creating a cosmetic pulp contour with high quality skin covering. The choice of treatment may vary based on the surgeon's experience, sociocultural factors and available resources.[5]

This retrospective study aims to present the sensory, functional and surgical outcomes of reconstruction using a neurovascular heterodigital island flap for digital pulp defects resulting from acute hand injury.

Patients and Method

All the procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. This study was approved by the Ethics Committee of the University Hospital (decision no: 781).

The study included 58 patients (42 males, 16 females) out of 124 patients who presented to our clinic with digital pulp defects due to acute hand injury between 2014 and 2022. The average age of the patients was 26 years (range:20-56 years). The exclusion criteria were as follows: presence of two or more finger injuries, diagnosis of microangiopathy due to diabetes mellitus, and peripheral vascular disease. Injury classification included Allen type 2 for 18 patients, type 3 for 33 patients, and type 4 for 7 patients (Table 1). Pulp defects were caused by crush injuries in 42 patients and sharp injuries in 16 patients. Thirty-four patients had thumb injuries, 9 patients had second finger injuries and 15 patients had third finger injuries. The average size of the pulp defect was 15 x 28 mm (range:12x22-24x35 mm). Patients with sharps injuries (n=16) underwent an operation on the same day, and patients with crush injuries (n=42) underwent an operation after preparation for reconstruction, involving intermittent debridement and antibiotic treatment, typically on the fifth day on average (range:2-10 days).

***Surgical Technique**:* All the patients underwent surgery under general anesthesia with the application of a tourniquet. The initial stage involved debridement of the recipient site in crush injury patients. The defect and the finger flap donor site were identified. The flap was neurovascularly elevated and freed up to the common digital artery and nerve dissection site. A Bruner-type incision was performed up to the recipient finger with tissue defect site, and the bed of the pedicle was prepared. The flap was transferred to the recipient finger with the pedicle, and flap setting was performed. In all patients, the donor site was repaired with full-thickness skin graft from the inguinal region. All the patients were hospitalized for an average of 48 hours (24-72 hours) for circulatory monitoring and administered antibiotic therapy.

Statistical Analysis

IBM SPSS V25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) was used for the statistical analysis of the study. Before statistical analyses, Shapiro Wilk/ Kolmogorov Smirnov tests were run to determine whether or not continuous variables were normally distributed according to categories. Descriptive characteristics were expressed in number (n) and percentage (%) for categorical variables and mean, standard deviation, and median for continuous variables by using the appropriate measures of central tendency. Independent sample t-test/Mann-Whitney U test was run for the mean/median comparison of two independent groups. The statistical significance was assessed at a significance level of $p<0.05$.

Results

None of the flaps administered to the participating patients developed total loss. Partial loss on the distal side of the flap was observed in three patients. One patient with partial loss achieved secondary recovery while two

Table 1. Table of patients' demographics

Allen classification	Number of people	Males/Females	Age
TIP II	18	12/6	26(20—50) years
TIP III	33	25/8	27(20-56) years
TIP IV	7	5/2	25(20-33) years

Acta Medica Alanya 2023;7(3): 259-262
Doi: 10.30565/medalanya.1397435

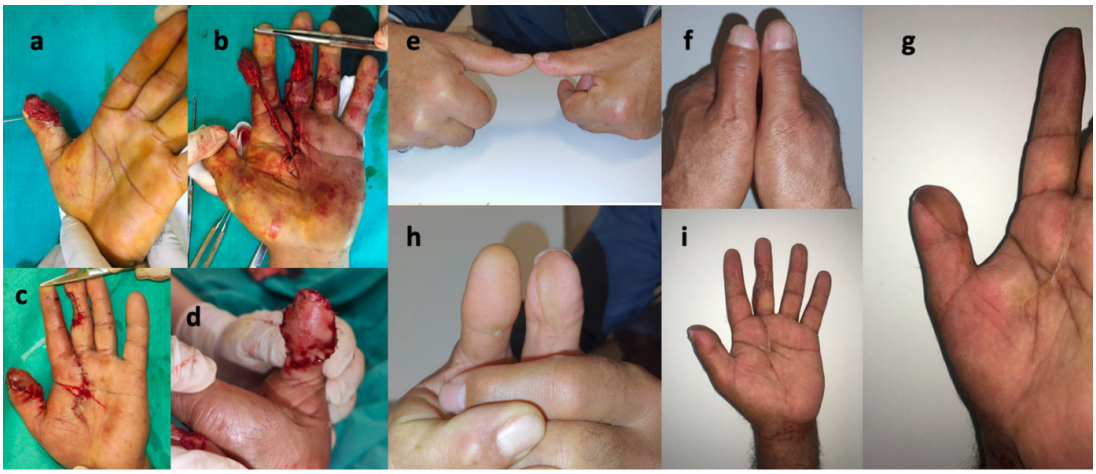


Figure 1. 45 years old male patient a) Left hand thumb Allen type 2 sharp injury b) Raise of neurovascular heterodigital island flap form third finger radial side c,d) Postoperative view e,f,g,h,i) Postoperative 6th month view.

other patients administered additional repair with a partial thickness skin graft. Superficial tissue infection was identified in six patients, and recovery was achieved with parenteral antibiotics. Two patients exhibited hyperpigmentation and hyperesthesia that did not affect their daily lives (Figure 1).

The patients were followed up for an average of 12 months (range:6-23 months). In the last follow-up, finger interphalangeal (IP) joint ranges of motion were compared to those of the contralateral fingers. One patient with Allen type 3 pulp defect was detected to have 10 degrees of flexion contracture in the distal IP joint and 5 degrees flexion of contracture in the proximal IP joint and 3 patients were found to have 5 degrees flexion contracture only in the distal IP joint ($p>0.05$). The rest of the patients achieved a full range of motion. In two patients with wide pulp tissue defect with Allen type 2 injury, pincher nail deformity was detected while hook nail deformity was identified in 2 other patients only. Sensory examinations of the flaps were conducted using the static two-point discrimination test and Semmes-Weinstein monofilament test comparing them with the contralateral finger. The mean static two-point discrimination of the pulps where the flap was applied was 5.2 mm (range:3-8 mm) on the flap side and it was 3 mm on the contralateral side. The mean Semmes-Weinstein monofilament test was 3.18 g (range:2.96-4.7 g) on the flap side and 2.92 g on the contralateral side ($p<0.05$).

Discussion

This study, reporting results of reconstruction of pulp defects using a neurovascular heterodigital island flap in patients with finger pulp defects, achieved favorable outcomes with low complication rates and high patient satisfaction. An evaluation of the patients, particularly in terms of sensory, functional, and aesthetic aspects, showed that two-point discrimination and DIP range of motion values were at a satisfactory level.

Pulps of the thumb, second and third fingers play a crucial role in functions requiring fine skills, such as squeezing and pinching. Consequently, injuries affecting these areas necessitate the preference for neurovascular flaps.[6] The literature has presented various flap alternatives for pulp defects; Atasoy, Kutler, free foot pulpa flap and Moberg are advantageous techniques in terms of the use of a single operation site and short surgery duration.[2,3,7] However, conventional procedures like these come with certain disadvantages. These flaps are limited in size and may not be suitable for large defects. They are the best options in defects with a pulp advancement requiring 10 to 15 mm size, yet complication rates increase in case of more advancement requirements. The most common complications include flap loss, sensation loss, residual pulp dystrophy, hook nail deformity, and flexion contracture in the distal IP joint.[8] In our study, up to 24x35 mm tissue defects were successfully reconstructed and yielded satisfactory results.

Reverse homodigital flap is a favorable reconstructive technique, yet its applicability is limited to small volar and tip defects. Free sensate flaps harvested from various regions such as the thenar, hypothenar, and flexor aspects of the wrist serve as excellent options for larger defects. More recently, innovative techniques, including toe-to-thumb and wrap-around flap, have gained widespread application. However, the utilization of free microvascular flaps is at times constrained due to extended operation time, heightened skill requirements, and potential donor site morbidity.[6,7]

The neurovascular heterodigital island flap was initially described by Littler.[9] After free flaps, it stands out the best alternative, particularly for large pulp defects. Flaps up to 3.5 cm in length can be raised for substantial volar and dorsal finger tissue defects.[10] No specific complica-

tions have been reported for neurovascular heterodigital island flap. Although the literature has indicated a small number of various complications in previous studies, Lai et al. identified total flap necrosis in two cases out of 52 reconstructed fingers.[12] Pham et al. reported no instance of total necrosis in their patients.[10] Similarly, the present study, also reported no total flap necrosis in any patients, but partial flap loss was noted in three patients.

While one of the patients who had partial loss had secondary recovery with dressing follow-up, two patients were additionally administered repair with partial thickness skin graft. Pham et al. reported a two-point discrimination between 6.2 mm on average in patients who underwent neurovascular island flap.[10] Chi et al. also reported that it ranged from 7 to 13 mm in patients who underwent radial artery superficial perforator branch free flap for digital injury reconstruction.[13] The mean two-point discrimination level was 5.2 on average in our study. The mean Semmes-Weinstein monofilament tests were 3.18 g (2.96 - 4.7 g) on the pulp administered flap and 2.92 g on the contralateral side. Flexion contracture is another complication reported in the literature. While one patient with Allen type 3 pulp defect in our study had 10 degrees of flexion contracture in the distal IP (interphalangeal) joint and 5 degrees of flexion contracture in the proksimal IP joint, three patients had 5 degrees of flexion contracture only in the distal IP joint. A full range of motion was achieved in the other patients. This complication is considered to be caused by excessive tension of the neurovascular pedicle especially in large defects. Other complications reported in the literature are hyperpigmentation, hyperesthesia, and contour deformity in the donor site.[10] As donor site morbidity, two patients in our study had hyperpigmentation and hyperesthesia that did not affect daily live.

If a repairable vessel is present, replantation can always be considered as an option.[11] When replantation is not possible, reconstruction should be planned. Advantages of heterodigital neurovascular island flap include simultaneous reconstruction of the soft tissue and providing excellent sensory and aesthetic restoration at the recipient site. Drawbacks of this technique encompass the necessity to sacrifice a digital artery from a donor digit, potentially leading to a temporary reduction in arterial flow and causing mild numbness of the dorsal surface of the phalanx.

The limitation of the study is that the absence of a control group impedes the analysis of comparative results. However, the low complication rate of the surgical technique and surgeon's experience may reduce the likelihood of errors in the conclusion.

Conclusions: Reconstruction of pulp defects following acute hand injuries with neurovascular heterodigital island flap has shown satisfactory outcomes in terms of functional, aesthetic and sensory improvement. Further studies are necessary to assess these results with a larger sample size and to compare them with other techniques.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: In this study, national and internatioanl ethical rules are observed. The Ethics Committee of the Ortadoğu Hospital. 22/11/2022. Desicion No: 781

ORCID and Author contribution: **M.D.**(0000-0002-4024-5059): The Corresponding researcher carried out all stages of the manuscript.

Peer-review: Externally peer reviewed.

References

1. Allen MJ. Conservative management of finger tip injuries in adults. Hand. 1980 Oct;12(3):257-65. doi: 10.1016/s0072-968x(80)80049-0.
2. Kwon HJ, Yoon S, Han HH, Moon SH. Partial second-toe pulp free flap for fingertip reconstruction: Experience and surgical tips to minimize complications. Microsurgery. 2021 Oct;41(7):629-636. doi: 10.1002/micr.30804.
3. Kutler W. A new method for finger tip amputation. J Am Med Assoc. 1947 Jan 4;133(1):29. doi: 10.1001/jama.1947.62880010007007.
4. Atasoy E, Ioakimidis E, Kasdan ML, Kutz JE, Kleinert HE. Reconstruction of the amputated finger tip with a triangular volar flap. A new surgical procedure. J Bone Joint Surg Am. 1970 Jul;52(5):921-6. PMID: 4920906.
5. Spyropoulou GA, Shih HS, Jeng SF. Free Pulp Transfer for Fingertip Reconstruction-The Algorithm for Complicated Allen Fingertip Defect. Plast Reconstr Surg Glob Open. 2016;3(12):e584. doi: 10.1097/GOX.0000000000000569.
6. Liu H, Regmi S, He Y, Hou R. Thumb Tip Defect Reconstruction Using Neurovascular Island Pedicle Flap Obtained From Long Finger. Aesthetic Plast Surg. 2016 Oct;40(5):755-60. doi: 10.1007/s00266-016-0674-1.
7. Zhang X, Wang Z, Ma X, Jin Y, Wang J, Yu H, Li T, Xiu X. Repair of finger pulp defects using a free second toe pulp flap anastomosed with the palmar vein. J Orthop Surg Res. 2022 Jul 16;17(1):352. doi: 10.1186/s13018-022-03232-z.
8. Germann G, Rudolf KD, Levin SL, Hrabowski M. Fingertip and Thumb Tip Wounds: Changing Algorithms for Sensation, Aesthetics, and Function. J Hand Surg Am. 2017 Apr;42(4):274-284. doi: 10.1016/j.jhsa.2017.01.022.
9. Littler JW. Theneurovascular pedicle method of digital transposition for reconstruction of the thumb. Plast Reconstr Surg (1946). 1953;12(5):303e319.
10. Pham DT, Netscher DT. Vascularized Heterodigital Island Flap for Fingertip and Dorsal Finger Reconstruction. J Hand Surg Am. 2015 Dec;40(12):2458-64. doi: 10.1016/j.jhsa.2015.06.112.
11. Öztürk Aİ, Turğut MC, Engin MÇ, Köse A, Baran T, Şencan A. [Pulp Replantation. A case report]. Acta Med. Alanya 2018;2(2):124-126. Turkish DOI:10.30565/medalanya.381817
12. Lai CS, Lin SD, Chou CK, Tsai CW. A versatile method for reconstruction of finger defects: reverse digital artery flap. Br J Plast Surg. 1992 Aug-Sep;45(6):443-53. doi: 10.1016/0007-1226(92)90208-f. PMID: 1393248.
13. Chi Z, Pafitanis G, Pont LEP, Vijayan R, Marcelli S, Gao W, Li Z, Zhou X, Song D, Yang P. The use of innervated radial artery superficial palmar branch perforator free flap for complex digital injuries reconstruction. J Plast Surg Hand Surg. 2018 Apr;52(2):111-116. doi: 10.1080/2000656X.2017.1360317.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 263-266
Doi: 10.30565/medalanya.1399134

The Effect of Topical Anti-Glaucomatous Drops on Intraocular Pressure Changes in Patients Treated with Intravitreal Aflibercept

İntravitreal Aflibersept Uygulanan Hastalarda Topikal Antiglokomatöz Damlanın Göziçi Basıncı Değişimine Etkisi

Mehmet Coşkun[1]

[1] ***Karabük Universty, Medical Faculty, Department of Ophthalmology, Karabük, Turkey***

ABSTRACT

Aim: The aim is to investigate the effect of using topical dorzolamide-timolol (DT) drops before intravitreal aflibercept (IVA) administration on intraocularpressure (IOP) changes.

Materials and Methods: Forty-five eyes of 45 patients with diabetic retinopathy and macular edema who received DT drops 1 hour before IVA were considered as group 1, and 45 eyes of 45 patients without DT drops were considered as group 2. Patients who had previously undergone intravitreal injection, intraocular surgery, and who used any eye drops were excluded from the study. IOP values were measured with Tonopen contact handheld tonometer before blepharostatinsertion (BBIOP), after blepharostat insertion (ABIOP) and at 1 minute after injection (AIIOP).

Results: There were 23 males and 22 females in group 1 and 22 males and 23 females in group 2 (p=0.96). The mean age was 55.23 ±7.53 years in group 1 and 55.70 ±9.78 years in group 2.(p=0. 97) In group 1, BBIOP was 18.12 ±4.18 mmHg, ABIOP 20.98 ±4.42 mmHg, AIIOP 43.20 ±15.80 mmHg, while in group 2, BBIOP 18.65 ±3.52 mmHg, ABIOP 22.80 ±3.90 mmHg, AIIOP 39.08 ±13.18 mmHg. The difference between AIIOP and BBIOP was 25.04 ±16.30 mmHg in group 1 and 20.36 ±13.82 mmHg in group 2, the difference was not statistically significant.(p=0.21) The difference between AIIOP and ABIOP was 22.32 ±16.48 mmHg in group 1 and 16.18 ±13.05 mmHg in group 2, the difference was statistically significant.(p=0.03)

Conclusion: In the group using topical DT drops before IVA administration, BBIOP and ABIOP values were lower, while AIIOP values were higher.

Key Words: Aflibercept, antiglaucomatous drop, intraocular pressure

ÖZ

Amaç: İntravitreal aflibersept(IVA) uygulaması öncesi topikal dorzolamid-timolol(DT) damla kullanımının göziçi basıncı(GİB) değişimine etkisinin incelenmesidir.

Gereç ve Yöntem: Diyabetik retinopati ve makula ödemi nedeniyle IVA uygulamasından 1 saat önce DT damlatılan 45 hastanın 45 gözü grup 1, DT damlatılmayan 45 hastanın 45 gözü grup 2 olarak kabul edildi.Daha önceden intravitreal enjeksiyon yapılan,göziçi cerrahisi geçiren ve herhangi bir göz damlası kullanan hastalar çalışmaya alınmadı. Enjeksiyon öncesi blefarosta takılmadan önce (ÖGİB), blefarosta takıldıktan sonra (BGİB), enjeksiyon sonrası 1. dakikada(EGİB) Tonopen kontakt el tonometresi ile GİB değerleri ölçüldü.

Bulgular: Grup 1 de 23 erkek, 22 kadın, grup 2 de 22 erkek, 23 kadın mevcut olup (p=0.96) yaş ortalaması grup 1 de 55.23 ±7.53 yıl, grup 2 de 55.70 ±9.78 yıldı.(p=0.97) Grup 1 de ÖGİB 18.12 ±4.18 mmHg, BGİB 20.98 ±4.42 mmHg, EGİB 43.20 ±15.80 mmHg iken grup 2 de ÖGİB 18.65 ±3.52 mmHg, BGİB 22.80 ±3.90 mmHg, EGİB 39.08 ±13.18 mmHg bulundu. Grup 1 de EGİB-ÖGİB farkı 25.04 ±16.30 mmHg, grup 2 de EGİB-ÖGİB farkı 20.36 ±13.82 mmHg bulunurken aradaki fark istatistiksel olarak anlamlı değildi.(p=0.21) Grup 1 de EGİB-BGİB farkı 22.32 ±16.48 mmHg, grup 2 de EGİB-BGİB farkı 16.18 ±13.05 mmHg bulundu, aradaki fark istatistiksel anlamlıydı.(p=0.03)

Sonuç: IVA uygulaması öncesi topikal DT damla kullanılan grupta ÖGİB ve BGİB değerleri daha düşükken,EGİB değerleri daha yüksek bulunmuştur.

Anahtar Kelimeler: Aflibersept, antiglokomatöz damla, göz içi basıncı

Recieved Date: 01.12.2023 / **Accepted Date:** 17.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Mehmet Coşkun, MD, Karabük Üniversitesi, Tıp Fakültesi, Göz Hastalıkları Anabilim Dalı, Karabük/Türkiye

Phone: 05056462411 / **mail:** mdmehmetcoskun@gmail.com

ORCID: 0000-0001-7314-2994

To cited: Coşkun M. The Effect Of Topical Anti-Glaucomatous Drops On Intraocular Pressure Changes In Patients Treated With Intravitreal Aflibercept. Acta Med. Alanya 2023;7(3): 263-266 doi: 10.30565/medalanya.1399134

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Intravitreal injection is the most widely used ophthalmic intervention in the world. Although its safety has been demonstrated, it may cause various ocular side effects. One of these side effects is sudden increase in intraocular pressure (IOP).[1,2] In diabetic retinopathy and age-related macular degeneration, the two diseases in which intravitreal antiVEGFs are most commonly used, the commonly used treatment protocol is three injections one month apart and then repeated injections.[1] Repetition of IOP elevations that may occur during injections may have important clinical consequences in patients with poor visual nerve reserve such as glaucoma and some retinal diseases[3]

The aim of our study was to investigate the effect of topical antiglaucomatous drops before intravitreal injection on intraocular pressure changes during injection.

Materials and Methods

Ninety eyes of 90 patients who underwent intravitreal aflibercept (IVA) for diabetic retinopathy and macular edema in the ophthalmology department of Karabük University Medical Faculty Training and Research Hospital were retrospectively evaluated with the approval of the ethics committee. Forty-five eyes of 45 patients who received topical DT drops 1 hour before intravitreal injection were considered as group 1 and 45 eyes of 45 patients who did not receive topical DT drops were considered as group 2. Patients who were on ocular medication or who underwent surgery were excluded from the study.

All injections were performed under operating room conditions following the same protocol. All injections were performed by the same surgeon and the same type of blepharostat was used. Intraocular pressures were measured with a contact handheld tonometer Tonopen (Tono-pen XL tonometer, Mentor O&O Inc. Norwell, MA, USA) before blepharostat insertion (BBIOP), after blepharostat insertion (ABIOP) and 1 minute after injection (AIIOP) with the patient lying supine on the operating table. All patients underwent ocular surface cleaning with 10% povidone iodine following topical anesthesia. Following sterile drape and blepharostat application, IVA 2 mg/0.05 ml was injected using a 30 G syringe tip, marking 3.5 mm from the limbus. Following the injection, the entry site was massaged with ear cotton. BBIOP, ABIOP, AIIOP values and both BBIOP-AIIOP differences and ABIOP-AIIOP differences were compared between the two groups.

We aimed to evaluate the effect of topical DT drops on intraocular pressure changes in patients treated with intravitreal aflibercept.

Statistical analyses were performed using SPSS version 16.0 (SPSS Inc, Chicago, Illinois, USA) and a p value below 0.05 was considered statistically significant. Before the analysis, it was shown that the variables were suitable for normal distribution by Kolmogorov Smirnov test.Mean and standard deviation values of the groups were calculated. Independent t test was used to compare the numerical variables of the two groups. The chi-square test was used to evaluate whether there was a difference between the groups in terms of gender.

Results

There were 23 male and 22 female patients in group 1 and 22 male and 23 female patients in group 2, there was no statistically significant difference between the groups in terms of gender (p=0.96). The mean age was 55.23 ±7.53 years in group 1, 55.70 ±9.78 years in group 2, there was no statistically significant difference between the groups. (p=0.97) In group 1, BBIOP was 18.12 ±4.18 mmHg, ABIOP 20.98 ±4.42 mmHg, AIIOP 43.20 ±15.80 mmHg, while in group 2, BBIOP 18.65 ±3.52 mmHg, ABIOP 22.80 ±3.90 mmHg, AIIOP 39.08 ±13.18 mmHg. The difference between AIIOP and BBIOP was 25.04 ±16.30 mmHg in group 1 and 20.36 ±13.82 mmHg in group 2, the difference was not statistically significant.(p=0.21) The difference between AIIOP and ABIOP was 22.32 ±16.48 mmHg in group 1 and 16.18 ±13.05 mmHg in group 2, the difference was statistically significant.(p=0.03) (Table 1)

Discussion

The sudden increase in IOP observed during intravitreal injection is expected immediately after injection due to the increase in vitreous volume and studies have reported that it may be transient or permanent.[3-6] It is thought that intravitreal antiVEGFs leave the vitreous cavity via choroidal circulation or aqueous drainage after retinal penetration.[7] One or both of these routes are effective in normalization of elevated IOP.

Goldmann applanation tonometry (GAT) is a widely used and accepted gold standard method for the measurement of IOP, which is still the only treatable risk factor in glaucoma. The Tonopen electronic tonometer, which has become widely used in ophthalmology practice in the last decade, is recommended as an alternative to Goldmann applanation tonometry for IOP measurement.[8] It is a handheld applanation tonometer that is easy to calibrate and use and allows IOP measurement in patients with corneal pathology. In comparative studies of Tonopen and Goldmann applanation tonometry, it was reported that Tonopen gave accurate results both in the normal population and in eyes with glaucoma.[9,10] We also used Tonopen in our study.

Five hundred and thirty retina specialists participated in the study in which clinicians were questioned about intra-

Acta Medica Alanya 2023;7(3): 263-266
Doi: 10.30565/medalanya.1399134

Table 1. Comparison of age, gender and IOP values in groups

	Group 1	Group 2	P value
Age	55.23 ±7.53	55.70 ±9.78	0,97
Gender	23 M, 22 F	22 M, 23 F	0,96
BBIOP	18.12±4.18 mmHg	18.65 ±3.52 mmHg	
ABIOP	20.98 ±4.42 mmHg	22.80 ±3.90 mmHg	
AIIOP	43.20±15.80mmHg	39.08±13.18mmHg	
AIIOP-BBIOP	25.04±16.30mmHg	20.36±13.82mmHg	0,21
AIIOP-ABIOP	22.32±16.48mmHg	16.18±13.05mmHg	0,03

vitreal antiVEGF injection protocol, drug preference, needle diameter, injection volume, injection technique and long-term IOP elevation observations. 292 retina specialists said that they believed that intravitreal antiVEGF injection caused long-term IOP elevation, but drug preference was not related to IOP elevation. It was stated that rapid injection technique and the use of high volume may cause persistent IOP elevation in antiVEGF injection. Rapid IOP elevation may cause trabeculum damage and lead to this complication.[11]

In our study, we evaluated the change in IOP before and after injection in patients who received intravitreal aflibercept with the use of topical DT drops 1 hour before the procedure. The AIIOP-ABIOP difference was significantly higher in the group with topical DT drops. The reason for this may be that the IOP decreased more in the group that received drops before injection and the difference between the IOP after injection was found to be higher. All patients were treated by the same surgeon, using the same method, using the same diameter needle tip.

According to the Kim et al. study, intravitreal injection is well tolerated by patients in the short post-injection period. In their series, IOP values in all patients decreased to normal values within 30 minutes without any intervention. Repeated or prolonged IOP follow-up after intravitreal injection was not considered necessary. However, it has been reported that post-injection IOP monitoring may be necessary in patients who received more than 0.05 ml injection with a fine needle such as 27 gauge, which does not allow vitreous reflux, or in patients who did not have vitreous reflux after injection despite injection with a larger needle, or in patients with a history of glaucoma.[12] The tolerance of the patients in our study was also good, patients with a previous diagnosis of glaucoma were not included in our study and IOP values were normal in all patients after 1 day, but we think that careful evaluation is needed in patients with low optic nerve reserve such as glaucoma.

Frenkel et al. recommended discontinuation of topical drops or systemic medication for intravitreal injections and paracentesis only in patients with known optic nerve damage with previous episodes of sudden IOP elevation and loss of light perception within minutes after injection.[13] In our study, no patient had loss of light perception and anterior chamber paracentesis was not required. In a prospective, double-blind, placebo-controlled study by Theoulakis et al., placebo (artificial tears) or Combigan (brimonidine-timololol) was instilled in one eye of 88 patients with normotensive age-related macular degeneration who received intravitreal ranibizumab the day before and twice daily on the day of injection, and IOP was measured before and 5, 10, 15 minutes and 1 hour after injection.[14] As a result, IOP was found to be normal in all patients at 1 hour after injection.

Limitation: Although IOP returned to normal in all patients on post-procedure day 1, the limitation of our study is that we did not evaluate the interval period.

Conclusion: In our study, we aimed to evaluate the effect of topical DT drops on IOP changes induced by the injection procedure in patients receiving intravitreal aflibercept and we observed that IOP changes were greater in patients receiving DT drops.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: In this study,national and international ethical rules are observed.

Ethic Board: KBÜ Etik Kurul 2023/1580

ORCID and Author contribution: M.C. (0000-0001-731-2994): The Corresponding **author** carried out all stages of the manuscript.

Peer-review: Externally peer reviewed.

References

1. Tolentino M. Systemic and ocular safety of intravitreal anti-VEGF therapies for ocular neovascular disease. Surv Ophthalmol. 2011;56(2):95-113. doi: 10.1016/j.survophthal.2010.08.006.

2. Wong LJ, Desai RU, Jain A, Feliciano D, Moshfeghi DM, Sanislo SR, Blumenkranz MS. Surveillance for potential adverse events associated with the use of intravitreal bevacizumab for retinal and choroidal vascular disease. Retina. 2008;28(8):1151-8. doi: 10.1097/IAE.0b013e31817e100f.
3. Bakri SJ, Pulido JS, McCannel CA, Hodge DO, Diehl N, Hillemeier J. Immediate intraocular pressure changes following intravitreal injections of triamcinolone, pegaptanib, and bevacizumab. Eye (Lond). 2009;23(1):181-5. doi: 10.1038/sj.eye.6702938.
4. Sharei V, Höhn F, Köhler T, Hattenbach LO, Mirshahi A. Course of intraocular pressure after intravitreal injection of 0.05 mL ranibizumab (Lucentis). Eur J Ophthalmol. 2010;20(1):174-9. doi: 10.1177/112067211002000124.
5. Kotliar K, Maier M, Bauer S, Feucht N, Lohmann C, Lanzl I. Effect of intravitreal injections and volume changes on intraocular pressure: clinical results and biomechanical model. Acta Ophthalmol Scand. 2007;85(7):777-81. doi: 10.1111/j.1600-0420.2007.00939.x.
6. Gismondi M, Salati C, Salvetat ML, Zeppieri M, Brusini P. Short-term effect of intravitreal injection of Ranibizumab (Lucentis) on intraocular pressure. J Glaucoma. 2009;18(9):658-61. doi: 10.1097/IJG.0b013e31819c4893.
7. Höhn F, Mirshahi A. Impact of injection techniques on intraocular pressure (IOP) increase after intravitreal ranibizumab application. Graefes Arch Clin Exp Ophthalmol. 2010;248(10):1371-5. doi: 10.1007/s00417-010-1382-1.
8. Whitacre MM, Stein R. Sources of error with use of Goldmann-type tonometers. Surv Ophthalmol. 1993;38(1):1-30. doi: 10.1016/0039-6257(93)90053-a.
9. Güngör İ,Turgut Coban D,Beden Ü,Arıtürk N,Öge İ. Tonopen ile Goldmann aplanasyon tonometresine en yakın ölçümlerin elde eldilmesinde yöntemler. MN Oftalmoloji. 2007; 14(4): 241 - 244.
10. Yildiz, I., Altan, C., Cakmak, S., Genc, S., Yildirim, Y., & Agca, A., (2022). Comparison of Intraocular Pressure Measurements With Goldmann Applanation Tonometry, Tonopen XL, and Pascal Dynamic Contour Tonometry in Patients With Descemet Membrane Endothelial Keratoplasty. Journal of Glaucoma,2022;31(11): 909-914.
11. Yannuzzi NA, Patel SN, Bhavsar KV, Sugiguchi F, Freund KB. Predictors of sustained intraocular pressure elevation in eyes receiving intravitreal anti-vascular endothelial growth factor therapy. Am J Ophthalmol. 2014;158(2):319-327.e2. doi: 10.1016/j.ajo.2014.04.029.
12. Kim JE, Mantravadi AV, Hur EY, Covert DJ. Short-term intraocular pressure changes immediately after intravitreal injections of anti-vascular endothelial growth factor agents. Am J Ophthalmol. 2008;146(6):930-4.e1. doi: 10.1016/j.ajo.2008.07.007.
13. Frenkel MP, Haji SA, Frenkel RE. Effect of prophylactic intraocular pressure-lowering medication on intraocular pressure spikes after intravitreal injections. Arch Ophthalmol. 2010;128(12):1523-7. doi: 10.1001/archophthalmol.2010.297.
14. Theoulakis PE, Lepidas J, Petropoulos IK, Livieratou A, Brinkmann CK, Katsimpris JM. Effect of brimonidine/timolol fixed combination on preventing the short-term intraocular pressure increase after intravitreal injection of ranibizumab. Klin Monbl Augenheilkd. 2010;227(4):280-4. doi: 10.1055/s-0029-1245201.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 267-273
Doi: 10.30565/medalanya.1394770

A New Effective and Reliable Technique for Bleeding Control in The Modified Stoppa Approach to Acetabulum Quadrilateral Region Fractures; Ligate the Obturator Artery

Asetabulum Quadrilateral Bölge Kırıklarına Stoppa Yaklaşımda Kanama Kontrolünde Efektif ve Güvenilir Yeni Bir Teknik; Obturatör Arteri Bağlamak

Necati Doğan[1]

[1] *Basaksehir Çam and Sakura City Hospital, Department of Orthopaedics and Traumatology, İstanbul, Turkey*

ABSTRACT

Objectives: This study aims to share the methods of managing foci that cause bleeding in the modified Stoppa approach to acetabulum quadrilateral region fractures. In addition, it is to reveal the amount of perioperative bleeding and the clinical effect of ligated arteries in patients whose surgery was performed with advanced bleeding control technique.

Patients and Methods: Between May 1, 2020, and June 30, 2023, perioperative bleeding data of 13 patients with acetabulum quadrilateral region fractures operated on with a modified Stoppa approach and advanced bleeding control technique were evaluated retrospectively. Age, gender, fracture mechanism, fracture side, fracture type, amount of perioperative bleeding, and follow-up periods were determined. The clinical effect of ligated arteries was observed in the postoperative period. In the CT scans taken in the postoperative period, the diameters of the gluteal muscles and adductor muscles were compared to the healthy side.

Results: Of the 13 patients included in the study, 5 were women, and 8 were men. While the average age was 35.6 years, the average follow-up period was 15.3 months. The average number of sponges used during the modified Stoppa approach and the amount of bleeding measured with an aspirator was 284.2 ml. The middle area of the gluteal muscles compared to the healthy side was 0.89, while the average area of the adductor muscles was 0.89. No problems related to the ligated vessels were observed in any patient during the postoperative period and outpatient follow-up.

Conclusion: Routine ligation of the obturator artery does not have any clinically observable adverse effects, and with advanced bleeding control, it facilitates both the hemodynamic management of the patient in terms of anesthesia and the management of the surgical field for the surgeon.

Key Words: Acetabulum quadrilateral fractures, modified Stoppa approach, bleeding foci, obturator artery

ÖZ

Amaç: Bu çalışmanın amacı asetabulum quadrilateral bölge kırıklarına modifiye stoppa yaklaşımda kanamaya neden olan odakların yönetimi konusunda elde edilen çözüm metodlarını paylaşmaktır. Ayrıca ileri kanama kontrolü tekniği ile cerrahisi sağlanan hastaların perioperatif kanama miktarını ve bağlanan arterlerin klinik etkisini ortaya çıkarmaktır.

Hastalar ve Yöntem: 1 Mayıs 2020-30 Haziran 2023 tarihleri arasında asetabulum quadrilateral bölge kırığına sahip, modifiye stoppa aproach ve ileri kanama kontrolü tekniği ile opere edilen 13 hastanın perioperatif toplanan kanama verileri geriye dönük olarak değerlendirildi. Yaş, cinsiyet, kırık mekanizması, kırık tarafı, kırık tipi, perioperatif kanama miktarı ve takip süreleri belirlendi. Postoperatif dönemde bağlanan arterlerin klinik etkisi gözlemlendi. Ameliyat sonrası dönemde çekilen bilgisayarlı tomografilerde gluteal kasların ve addüktör kasların çapları sağlıklı tarafla karşılaştırıldı.

Bulgular: Çalışmaya alınan 13 hastanın 5'i kadın iken 8'i erkek idi. Ortalama yaş 35,6 iken ortalama takip süresi 15,3 ay idi. Modifiye stoppa aproach esnasında kullanılan spanç sayısı ve aspiratör ile ölçülen kanama miktarı ortalama 284,2 cc olarak hesaplandı. Gluteal kasların sağlıklı tarafa göre ortalama alanı 0,89, adduktor kasların ortalama alanı ise 0,89 olarak belirlendi. Postoperatif dönemde ve poliklinik takiplerinde hiçbir hastada bağlanan damarlar kaynaklı problem gözlenmedi.

Sonuç: Obturatör arterin rutin bağlanmasının klinik olarak gözlenebilen bir olumsuz etkisi olmadığı gibi ileri kanama kontrolü ile hem anestezi açısından hastanın hemodinamik yönetimini, hem de cerrah açısından cerrahi alan yönetimini kolaylaştırmaktadır.

Anahtar Kelimeler: Asetabulum quadrilateral bölge kırıkları, modifiye stoppa yaklaşım, kanama odakları, obturatör arter

Recieved Date: 05.12.2023 / **Accepted Date:** 26.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Necati Doğan, MD. Başakşehir Çam ve Sakura Şehir Hastanesi, Ortopedi ve Travmatoloji Kliniği, Olimpiyat Bulvarı Yolu, 34480 Basaksehir, Istanbul, Türkiye

Phone: +90-553 185 6544 / **mail:** drnecatidogan@gmail.com

ORCID: 0000-0001-9503-5676

To cited: Doğan N. A New Effective And Reliable Technique For Bleeding Control İn The Modified Stoppa Approach To Acetabulum Quadrilateral Region Fractures; Ligate The Obturator Artery. Acta Med. Alanya 2023;7(3): 267-273 doi: 10.30565/medalanya.1394770

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Acetabular fractures often occur with high-energy injuries in young people and can be a part of multiple injuries. The need for surgery often arises in the treatment. The most common forms are the posterior column, anterior wall, anterior column fractures, and quadrilateral region fractures involving both columns. Surgical approaches are preferred according to the location of the fracture, such as posterior, anterior, or combined.[1,2]

The ilioinguinal and modified Stoppa approaches are the most commonly preferred approaches for acetabulum quadrilateral region fractures. The preference for the modified Stoppa approach is increasing due to its better field of view for the quadrilateral region and its more minimally invasive approach. The modified Stoppa is entered through an approach phannelstein incision, and the bladder is excluded. It provides access to the quadrilateral region of the acetabulum from under the rectus muscle.[3,4] In these approaches, many bleeding foci occur due to the proximity to the external and internal branches of the iliac artery.[5] Bleeding with a very high flow rate causes severe blood loss during the operation, and sometimes, support from cardiovascular surgery may be requested. By effectively managing these bleeding foci, less blood loss, precise surgical field evaluation, better anesthesia hemodynamics, and reduced mortality and morbidity can be achieved.

This study, which aims to share the solution methods obtained in the management of these foci that cause bleeding in the modified Stoppa approach to acetabulum quadrilateral region fractures, also seeks to reveal the amount of perioperative bleeding and the clinical effect of the ligated arteries in patients who underwent surgery with advanced bleeding control technique.

Patients and Methods

Between May 1, 2020, and June 30, 2023, the perioperative collected data of 13 patients with acetabulum quadrilateral region fractures operated on with a modified Stoppa approach and advanced bleeding control technique were evaluated retrospectively. Approval was obtained from the local ethics committee (KAEK/2023.01.04).

Patients over 18 years of age who had acetabulum quadrilateral region fractures and were operated on with a modified Stoppa approach were included in the study. Patients who were not operated on with advanced bleeding control techniques and patients who were delayed for more than three weeks were not included in the study.

Antithrombotic prophylaxis (Low molecular weight heparin) was started in all patients from the moment of hospitalization and continued for one month. The same implant material and system (TST Medical Instruments Industry and Trade Ltd. Co. Pendik/Istanbul, Turkey) **(Figure 1)** was used in all patients.

Figure 1. Quadrilateral anatomical plate.

Surgical preparation phase: All surgeries were performed under general anesthesia, and at least six units of erythrocytes were prepared before surgery. After the patient is transferred from anesthesia, fluoroscopy checks of the pelvic region are performed on the radiolucent table. After ensuring that inlet, outlet, and judet radiographs can be taken without any problems, the patient is sterilely painted and draped. In fractures that do not require manual traction, only the pubic region is left open, while in fractures that will require traction and extremity maneuvers, the extremity of the relevant side is also left exposed, and the painting and covering process is applied.

Approaching The Surgical Field And Finding And Managing Bleeding Foci

Advanced bleeding control technique: It is the name that is deemed appropriate for the process of exposing the surgical field with slow and sponge-assisted blunt dissections during surgery and identifying and ligating or cauterizing previously detected arterial foci that cause bleeding without spontaneous rupture during the dissection.

1. bleeding focus (corona mortis): After draping the surgery area, a 10 cm transverse Phannelstein incision is made 1-2 cm above the pubic arm. The linea alba and rectus muscles are then cut longitudinally and opened. The bladder is excluded and protected. It is removed by cutting the rectus muscle from where it connects to the pubic arm towards the side where the fracture is located. The area is exposed by pushing the tissues along the iliopectal line with slow and blunt dissections over the inguinal arm.

Acta Medica Alanya 2023;7(3): 267-273
Doi: 10.30565/medalanya.1394770

The initial bleeding focus is the corona mortis structure here, and it must be located, identified, and ligated or cauterized.

2. bleeding focus (external iliac artery and vein): After the corona mortis is ligated, blunt dissection is continued along the iliopectinal line towards the sacrum. The iliopectinal fascia is cut open with a scalpel along the iliopectinal line. Then, the area that is opened bluntly by staying on the bone from the bottom of the rectus muscle to the middle part of the iliac wing is fixed by inserting a pointed "S" retractor into the bone, and the rectus muscle and iliacus muscle are retracted. Especially the external iliac vessels above and lateral to the iliacus muscle will be protected and removed from the area with this maneuver.

3. bleeding focus (superior gluteal artery): As we approach the sacrum, the second bleeding focus is the superior gluteal artery, which we will encounter here. If necessary, the parts close to the sacrum should be exposed during the implant placement phase. While it may be excluded during dissection, it may also rupture and cause bleeding. Because it is so deep, it isn't easy to ligat or sear it. Bleeding can usually stop on its own. However, in young people, bleeding may not stop spontaneously and may disturb the surgical area with simple leaks. At this stage, the anesthetist may be asked to reduce the blood pressure as much as possible to control this bleeding. Additionally, sponges impregnated with 1/6 diluted adrenaline and transamine can be placed in this area as a tampon (in order not to forget a sponge inside the patient, the circulating nurse should be warned about all sponges left inside and be careful about counting. In addition, fluoroscopy checks should be made using x-ray-marked sponges and pads).

4. bleeding focus (presacral veins): As the sacrum is exposed, the presacral veins bleed, but there is no need to worry. Bleeding can be stopped with a simple sponge or tampons. There is generally no need to expose the sacrum in quadrilateral region fractures. Since the sacrum is deep and challenging to manage, it should be avoided as much as possible.

5. bleeding focus (obturator artery): After the pubic arm, anterior corner of the sacrum, and iliopectinal line are entirely exposed, the quadrilateral area is exposed by going deep from the side of the bladder with blunt deduction over the bone. The fifth and most frightening bleeding may occur at this stage. The obturator vessel and nerve bundle pass close to the wall and are also seen to be tense **(Figure 2-3)**. The tension of this artery and its proximity to the quadrilateral region almost always results in its rupture and bleeding. Bleeding from this artery may occur from the proximal, middle, or distal areas where it enters the obturator ring. While midsection bleeding can be contained and ligated, proximal and distal bleeding can be very difficult to control. Most of the time, bleeding in these parts stops with tamponade of the pads and bleeding of the arteries until they spontaneously thrombose. If you do not remain calm during this bleeding, uncontrollable severe bleeding may occur. Most of the time, the surgeon becomes extremely worried at this stage, and a cardiovascular surgeon is invited to the case. As in the superior gluteal artery, here, too, the patient's blood pressure should be reduced by tamponade at first, and the arteries should be thrombosed with pads impregnated with adrenaline and transamin. The bleeding should be expected to stop spontaneously. At this stage, bleeding from the obturator artery can be prevented by tying it in the middle and cutting it without risking bleeding from the obturator artery.

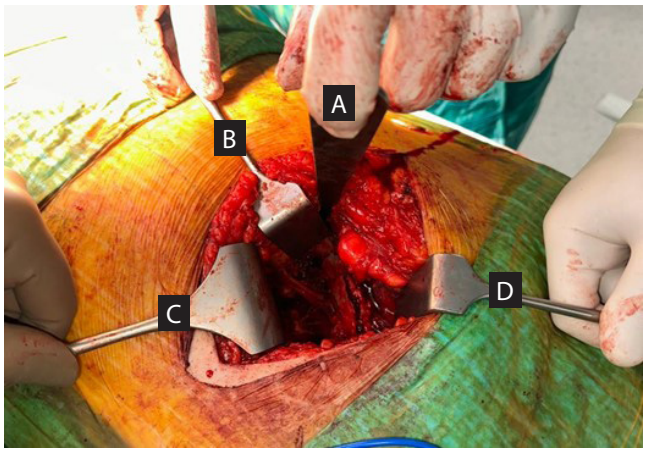


Figure 2. Modified Stoppa approach, ***A;*** Retractor that excludes the iliac vessels, rectus muscle, and iliacus muscle, ***B;*** Retractor revealing the part of the iliopectinal line leading towards the sacrum, ***C;*** retractor protecting the bladder, ***D;*** retractor that exposes the pubic arm and exposes the area where corona mortis is located

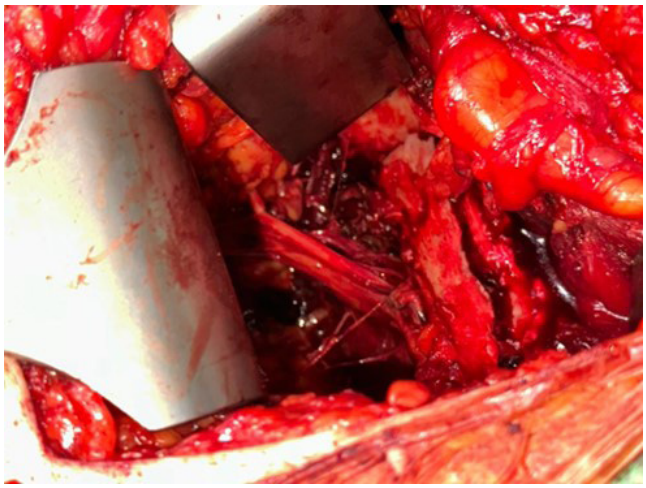


Figure 3. Obturator vessel and nerve bundle

In addition, the color and consistency of the obturator nerve, with which it travels, is quite different from the artery. Still, care should be taken not to connect the nerve accidentally. During the implant placement, the obturator nerve should be prevented from entering between the implant and the bone **(Figure 4)**.

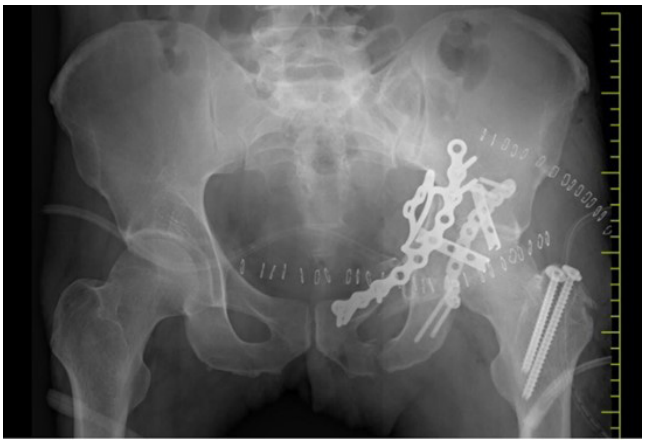


Figure 4. Postoperative image of the implant

Tracked parameters: Age, gender, fracture mechanism, fracture side, fracture type (Letournel Classification), and follow-up periods were determined.

The amount of perioperative bleeding was determined by blood in the aspirator and sponge counting. The amount of blood in the aspirator was calculated by subtracting the liquid used for washing. All sponges are considered half wet and correspond to 5 cc of bleeding. In multi-traumas, bleeding during the modified Stoppa approach was calculated separately. The clinical effect of ligated arteries was observed in the postoperative period. In the computer tomography (CT) scans taken in the postoperative period, the gluteal and adductor muscles' diameters were compared to the healthy side.

Statistical analysis: Microsoft Excel (2007) (USA) program was used for statistical analysis. Only descriptive statistics (mean, standard deviation, median, frequency, rate, range) were made.

Results

Of the 13 patients in the study, 5 were women and 8 were men. While the average age was 35.6 years, the average follow-up period was 15.3 months. Three patients had motor accidents (MA), three patients had fallen from height (FFA), three patients had non-vehicular traffic accidents (NVTA), two patients had in-vehicle traffic accidents (İVTA), and two patients had work accidents (WA). While the injured side of 6 patients were on the right side, seven were injured on the left side. According to the Letournel classification, six patients had anterior column + posterior hemitransverse fractures, 3 had transverse fractures, 3 had both column fractures, and 1 had a t-shaped fracture type (Table I).

While the average number of sponges used during the modified Stoppa approach was 31.9±7.2, the estimated amount of bleeding resulting from these sponges (x5 ml) was 159.6 ml. The average amount of bleeding measured with an aspirator was 123.8 ml. When the sum of the bleeding in the sponge and aspirator was calculated, the moderate bleeding was calculated as 284.2±32.2 ml (Table I).

No patient received blood replacement during the operation. No problems related to the ligated vessels were observed in any patient during the postoperative period and outpatient follow-up. In the last CT image, the average area of the gluteal muscles compared to the healthy side was 0.89, while the middle area of the adductor muscles was 0.89.

In 1 patient, a superficial infection developed at the wound site and resolved without any problems with wound care and debridement in the outpatient clinic. One patient developed avascular necrosis of the femoral head and was treated with total hip arthroplasty. In one patient, heterotopic ossification developed and was excised after maturation due to restriction of hip movements.

Discussion

In this study, it was revealed that surgeries for quadrilateral region fractures could be completed with a minimal amount of bleeding with advanced bleeding control techniques. In addition, the bleeding foci were detailed, and it was observed that no clinical problems occurred due to the routine ligation of these foci. Additionally, there was no significant necrosis or atrophy in the CT scans of the gluteal and adductor muscles.

There are great difficulties in the surgery of pelvis-acetabulum fractures due to the proximity to the pelvic internal organs, large arteries, and their branches. The most common cause of death from pelvic injuries is bleeding.[5] Knowing the anatomic position of the arteries and managing them operatively to control abdominal bleeding during surgery is the main element of pelvic surgery. In addition, many variations have been identified in cadaver studies, and these anatomical variations must also be defined to ensure surgery.[6] The possible variations of corona mortis and obturator artery are numerous, and knowing these variations during approach will be even more helpful in bleeding control.[7,8]

Advanced bleeding control technique creates a bloodless area for the surgeon. Due to its proximity to large arteries,

Acta Medica Alanya 2023;7(3): 267-273
Doi: 10.30565/medalanya.1394770

Table 1. Demographic data of patients and parameters that are followed

Cases	Age	Gender	Fracture mechanism	Fracture side	Fracture type (Letournel)	Follow-up time (months)	Amount of sponge bleeding (ml)	Amount of aspirator bleeding (ml)	Amount of perioperative bleeding (ml)	Gluteal muscles area rate*	Adductor muscles area rate*
1	36	F	NVTA	R	Transvers	6	150	140	290	-	-
2	24	M	MA	L	Transvers	24	200	100	300	-	-
3	52	M	WA	R	T-Shaped	8	125	130	255	0.95	0.89
4	18	M	FFA	R	Ant. colon + post. ht	10	175	160	335	0.83	0.91
5	23	F	İVTA	R	Both colon	12	100	80	180	0.91	0.89
6	41	M	MA	L	Ant. colon + post. ht	14	125	100	225	0.96	0.9
7	63	M	MA	L	Ant. colon + post. ht	15	150	120	270	0.91	0.95
8	36	M	NVTA	L	Both colon	17	225	70	295	0.85	0.89
9	34	F	NVTA	R	Ant. colon + post. ht	19	125	140	265	0.89	0.91
10	27	F	İVTA	R	Transvers	21	150	120	270	0.81	0.84
11	21	F	FFA	L	Ant. colon + post. ht	23	175	110	295	0.93	0.91
12	46	M	FFA	L	Ant. colon + post. ht	13	200	160	360	0.85	0.92
13	42	M	WA	L	Both colon	17	175	180	355	0.9	0.88
A	35,6	-	-	-		15,3	159,6	123,8	284,2	0,89	0,89
Sd	13,2	-	-	-		5,5	36,1	32,2	49,8	0,04	0,02

A: Average
Sd; Standart deviation
* The last postoperative CT scans obtained were evaluated. (average 1-2th month CT scans)

bleeding tends to occur and makes the management of the surgical field difficult, while excessive blood aspiration drives the surgeon into panic. Therefore, controlling these foci before bleeding develops should be the primary method to ensure a safe environment for these surgeries. In addition, it is tough to find and hold the focus of sudden bleeding due to the deep anatomy of the region. For this reason, it will be more comfortable to identify and extinguish the foci before bleeding develops.

Although the diameter and positional variations of corona mortis, which is the first bleeding focus we encounter, may make it difficult to control bleeding, it can be easily found and tied with a blunt and meticulous approach. Since it is anatomically close to the surface, tying and burning can be done safely.[9]

While removing the external iliac vessels from the surgical field with a retractor thanks to the iliacus muscle, waiting for the retractor tension to open spontaneously as the approach expands and not keeping it excessively tense will prevent injury to the external iliac vessels. Although the superior gluteal artery, which can be encountered close to the sacrum as it descends deep into the ilipectinal line, can sometimes be traumaticly injured and bleed, its bleeding can be stopped without causing any clinical problems.[10] Sometimes, there is a need to open the superior areas of the sacrum and iliac crest to reveal the fracture line or the area where the implant needs to be fixed, and this vessel may be encountered at this deepening stage. Surgery can be performed only if it is required.

After the iliopectinal line is revealed, a deep dissection between the bladder and the bone must disclose the quad-

rilateral area. At this stage, utmost care is needed to avoid damage to the obturator vessel and nerve bundle that appear when we go deeper with blunt dissections. In our previous experience, the bleeding we frequently encountered in this region is excessive and dangerous, and to stop it, it is necessary to use pressurized tamponade and wait for spontaneous thrombosis. Due to deep bleeding, it is not possible to catch and tie the bleeding acutely. In addition, as this vessel develops from the proximal or distal, bleeding runs the risk of getting out of control, which may cause mortality. This risk can be overcome with routine ligation of this vessel, and access to the quadrilateral region and implant placement will be easier. Better reduction quality can be achieved in a bloodless field. In addition, completely exposing the area where the implant will be placed can ensure the reduction's safe, stable, and anatomical fixation. Improving the quality of reduction and fixation will improve clinical and radiological parameters. Bleeding and interventions of the obturator artery have been previously reported in several cases in the literature. The first of these is the iatrogenic bleeding from the obturator artery after nailing for hip fracture, which did not stop spontaneously and was tried to be solved by embolization.[11] The second is that the obturator artery was torn and retracted during surgery in the obturator groove. For the solution, the artery was reached with pubic arm osteotomy, and the bleeding was stopped with difficulty.[12] Embolization is preferred by interventional radiology in some internal iliac artery branches and obturator artery injuries and does not cause any clinical loss.[13] In this study, as a result of postoperative observations, no pathology related to the routine ligation of the obturator artery developed.

Some previous studies determined that the amount of bleeding in the modified Stoppa approach was around 450-2000 ml.[3,4] In this study, the average amount of bleeding remained around 284 ml, thanks to the advanced bleeding control technique. While this technique considerably reduces the amount of bleeding, it can also provide a significant advantage to anesthesia in managing the patient's hemodynamic control.

The use of transaminic acid to reduce bleeding seems controversial. Publications are reporting that it is ineffective, as well as publications reporting that it reduces bleeding.[14,15] However, in this study, although not systemically, the coagulative effect of the sponges was impregnated with adrenaline as well as transamine, locally, not systemically, to control bleeding, and thus effective bleeding control could be achieved for leaky vessels. Compared to the ilioinguinal approach, which is an alternative to the modified stoppa approach, the stoppa approach has the advantage of less bleeding.[3,4] Although it was preferred in this study due to better access to the quadrilateral region, this approach contributes extra to bleeding control.

It was observed that the patient's gluteal and adductor muscle groups were atrophic at an average rate of around 10 percent. Although the cause of this atrophy may be long-term disuse of the relevant extremity, muscle infarction may also play a role in the etiology. The low atrophy rate is encouraging. Although clinical problems that may develop regarding the ligation of the obturator artery have not been observed, it would be better to closely follow the subcutaneous evaluations and sensory examinations of the gluteal muscle and adductor muscles, as well as the examination of the bladder and intestinal systems during the postoperative period. In addition, ligation of the obturator artery should only be preferred when deep dissection is required when placing an anatomical plate in the quadrilateral region.

Limitations of this study: The number of cases is quite limited, and a control group must be needed. This study may lead to multicenter and prospective studies in the future.

As a result, the most common source of bleeding during the modified Stoppa approach appears to be the obturator artery as a result of perioperative observations. Routine ligation of the obturator artery has no clinically observable adverse effects. Advanced bleeding control facilitates both the hemodynamic management of the patient in terms of anesthesia and the management of the surgical field for the surgeon.

Conflict of Interest: The author declares no conflict of interest related to this article.

Funding sources: The author declares that this study has received no financial support.

Ethics Committee Approval: This study observes national and international ethical rules. Basaksehir Çam and Sakura City Hospital IRB (KAEK/2023.01.04)

ORCID and Author contribution: N.D. (0000-0001-9503-5676), the corresponding author, carried out all stages of the manuscript.

Peer-review: Externally peer-reviewed.

Acknowledgment: The author thanks the parents for their contribution.

References

1. Otto W. Azetabulumfrakturen. Diagnostik, Klassifikation, Bewertung [Acetabulum fractures. Diagnosis, classification, evaluation]. Zentralbl Chir. 2000;125(9):725-9. German. Doi: 10.1055/s-2000-10663. PMID: 11050752.
2. Haas NP, Stöckle UC, Hoffmann R. Azetabulumchirurgie. Entwicklung, Stand und Ausblick [Acetabulum surgery. Development, current status, and prospects]. Zentralbl Chir. 1999;124(11):999-1003. German. PMID: 10612205.

Acta Medica Alanya 2023;7(3): 267-273
Doi: 10.30565/medalanya.1394770

3. Elmadağ M, Güzel Y, Acar MA, Uzer G, Arazi M. The Stoppa approach versus the ilioinguinal approach for anterior acetabular fractures: a case-control study assessing blood loss complications and function outcomes. Orthop Traumatol Surg Res. 2014 Oct;100(6):675-80. doi: 10.1016/j.otsr.2014.05.020.
4. Sharma A, Das S, Kaganur R, Paul N, Pragadeeshwaran J, Khande CK, Kunwar BB. A Comparative Analysis of Commonly Used Surgical Approaches for Anterior Acetabular Fractures. Cureus. 2023 May 13;15(5):e38979. doi: 10.7759/cureus.38979.
5. Biffl WL. Control of pelvic fracture-related hemorrhage. Surg Open Sci. 2022 Jan 26;8:23-26. doi: 10.1016/j.sopen.2022.01.001.
6. Báča V, Marvanová Z, Štefela J, Hašplová K, Kachlík D, Džupa V. Riziko krvácení z arteria iliaca interna a jejích větví při zlomeninách pánve: kadaverózní studie [Risk of bleeding from the internal iliac artery and its branches in pelvic fractures: cadaver study]. Acta Chir Orthop Traumatol Cech. 2015;82(1):48-50. Czech. doi:10.55095/achot2015/006
7. Sanna B, Henry BM, Vikse J, Skinningsrud B, Pękala JR, Walocha JA, Cirocchi R, Tomaszewski KA. The prevalence and morphology of the corona mortis (Crown of death): A meta-analysis with implications in abdominal wall and pelvic surgery. Injury. 2018;49(2):302-308. doi: 10.1016/j.injury.2017.12.007.
8. Heichinger R, Pretterklieber ML, Hammer N, Pretterklieber B. The Corona mortis is similar in size to the regular obturator artery but is highly variable at the level of origin: an anatomical study. Anat Sci Int. 2023;98(1):43-53. doi: 10.1007/s12565-022-00671-w.
9. Elhence A, Gupta A. Corona Mortise- anatomical variants and implications in pelvic-acetabular surgery: An evidence-based review. J Orthop. 2023 Jan 28;37:9-14. Doi: 10.1016/j.jor.2023.01.011.
10. Kwon H, Jang JH, Moon NH, Rhee SJ, Ryu DY, Ahn TY. Superior gluteal artery injury in pelvic ring injury and acetabular fracture: Single-center observational study. J Orthop Sci. 2023 Oct 20:S0949-2658(23)00279-8. doi: 10.1016/j.jos.2023.10.007.
11. Leunig M, Meyer M, Beck M, Triller J, Stupnicki A, Zimmermann H. Fatal retroperitoneal hemorrhage caused by perforation of a guidewire pin for proximal femur fixation. Arch Orthop Trauma Surg. 2002;122(1):61-3. doi: 10.1007/s004020100350.
12. Seeker LC, Bartlett CS. Management of Obturator Vessel Hemorrhage by Pubic Ramus Osteotomy During Acetabular Fixation-A Technical Trick. J Orthop Trauma. 2023 Oct 1;37(10):e416-e420. doi: 10.1097/BOT.0000000000002545.
13. Vaidya R, Waldron J, Scott A, Nasr K. Angiography and Embolization in the Management of Bleeding Pelvic Fractures. J Am Acad Orthop Surg. 2018;26(4):e68-e76. doi: 10.5435/JAAOS-D-16-00600.
14. Wadhwa H, Rohde M, Oquendo Y, Chen MJ, Tigchelaar SS, Bellino M et al. Interaction of preoperative chemoprophylaxis and tranexamic acid use does not affect transfusion in acetabular fracture surgery. Eur J Orthop Surg Traumatol. 2023 Oct 21. doi: 10.1007/s00590-023-03763-z.
15. Kenmegne GR, Zou C, Lin Y, Yin Y, Huang S, Banneyake EL, Gunasekera IS, Fang Y. A prophylactic TXA administration effectively reduces the risk of intraoperative bleeding during open management of pelvic and acetabular fractures. Sci Rep. 2023;13(1):12570. doi: 10.1038/s41598-023-39873-1.

Acta Medica Alanya

Research Article

Araştırma

Acta Medica Alanya 2023;7(3): 274-284
Doi: 10.30565/medalanya.1401259

Comparative Analysis of the Impact of Continuous Spinal Anesthesia and Single-Dose Spinal Anesthesia Techniques On Hemodynamics, Sensory and Motor Block Levels in Transurethral Surgery Cases

Transüretral Cerrahi Vakalarında, Sürekli Spinal ve Tek Doz Spinal Anestezi Tekniklerinin Hemodinami, Duyusal ve Motor Blok Seviyesi Üzerine Etkilerinin Karşılaştırılması

Mehmet Mert Tuna[1], Özcan Erdemli[2]

[1] Alanya Education and Research Hospital, Department of Anesthesiology and Reanimation. Alanya, Turkey.

[2] Acıbadem Altunizade Hospital, Department of Anesthesiology and Reanimation. İstanbul, Turkey

ABSTRACT

Aim: In this study, it was aimed to compare in patients undergoing transurethral resection surgery: 1- The effectiveness of single-dose and continuous spinal anesthesia techniques, 2- Hemodynamic chang-es, sensory-motor block levels and durations, anesthetic drug doses and side effects.

Method: Forty American Society of Anesthesiology I–III patients in the age group of 40–75 years who were scheduled for transurethral surgery were randomly divided into two groups: single dose spinal anes-thesia (Group 1) (n = 20) and continuous spinal anesthesia (Group 2) (n = 20). The patients' hemo-dynamic data, analgesia status and motor block levels were evaluated.

Results: With regard to the hemodynamic parameters, the mean values of systolic–diastolic blood pressure and heart rate were found to be significantly lower in the single dose spinal anesthesia group (Group 1) than in the continuous spinal anesthesia group ($p < 0.05$). In terms of sensory and motor block levels, the maximum block level was T9 in the continuous spinal anesthesia group, while it was T8 in the single dose spinal anesthesia group ($p < 0.05$). Upon reaching T10, two-segment regression and sensory and motor block termination times were found to be significantly lower in the continuous spinal anesthesia group when compared to the single dose spinal anesthesia group ($p < 0.05$). There was no difference between the two groups in terms of Bromage score values ($p > 0.05$). In the con-tinuous spinal anesthesia group, the mean dose and volume of the local anesthetic required to achieve analgesia in the T10 dermatome were found to be 7.12 ± 1.46 ml and 1.4 ± 0.29, respective-ly. Furthermore, the amount of fluid administered intraoperatively was found to be significantly lower in the continuous spinal anesthesia group than in the single dose group ($p < 0.05$).

Conclusion: With the continuous spinal anesthesia method, it can be titrated and by using lower doses of local anesthetic, a level of sensory-motor blockade close to the single-dose spinal anesthesia method and a more stable hemodynamics can be achieved.

Key Words: Continius spinal anestesia, Single dose spinal anestesia, Transuretral surgery

ÖZET

Amaç: Bu çalışmada transüretral rezeksiyon cerrahi yapılacak hastalarda: 1- Tek doz ve sürekli spinal anestezi tekniklerinin etkinliğinin 2- Hastalardaki hemodinamik değişikliklerin, duyu-motor blok dü-zeylerinin ve sürelerinin, anestezik ilaç dozlarının ve yan etkilerin karşılaştırılması amaçlanmıştır.

Yöntem: Transüretral cerrahi planlanan 40-75 yaş arası ASA I-III grubu 40 hasta tek doz spinal anestezi (Grup 1)(n:20) ve sürekli spinal anestezi (Grup 2) (n=20) olarak rastgele iki gruba ayrıldı. Hastaların he-modinamik verileri, analjezi durumları ve motor blok seviyeleri değerlendirildi.

Bulgular: Hemodinamik parametreler açısından, uygulama öncesine göre tek doz spinal anestezi grubu (grup 1) sistolik-diastolik kan basıncı ve kalp hızı ortalama değerleri sürekli spinal anestezi grubuna göre anlamlı olarak düşük bulundu ($p<0,05$). Duyusal ve motor blok seviyelerine bakıldığında; tek doz spinal anestezi grubunda maksimum blok seviyesi T8 iken sürekli spinal anestezi grubunda T9 ola-rak bulundu ($p<0,05$). T10 'a ulaşma, iki segment gerileme, duyusal ve motor blok sonlanma zaman-ları sürekli spinal anestezi grubunda, tek doz spinal anestezi grubuna göre anlamlı olarak düşük bu-lundu ($p<0,05$). Her iki grup arası bromage skor değerleri açısından fark yoktu ($p>0,05$). Sürekli spinal anestezi grubunda, T10 dermatomunda analjezi sağlamak için gerekli olan lokal anestezik dozu ortalama 7,12±1,46 ml, hacmi ise 1,4±0,29 olarak bulundu. Yine intraoperatif verilen sıvı mikta-rı, sürekli spinal anestezi grubunda anlamlı olarak düşük bulundu ($p<0,05$).

Sonuç: Sürekli spinal anestezi yöntemiyle, titre edilebilir ve daha az dozda lokal anestezik kullanılarak, tek doz spinal anestezi yöntemine yakın bir duyusal-motor blok seviyesi ve daha stabil bir hemodinami sağlanabilir.

Anahtar Kelimeler: Sürekli spinal anestezi, Tek doz spinal anestezi, Transüretral cerrahi

Recieved Date: 06.12.2023 / **Accepted Date:** 29.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: M.Mert Tuna, Alanya Eğitim Ve Araştırma Hastanesi, Anestezi ve Reanimasyon Kliniği, Oba Mah. Fidanlık Cad, 07400, Alanya/Antalya, Türkiye

Phone: +90 5059178676 / **mail:** merttuna@hotmail.com

ORCID: 0000-0003-3896-4027

To cited: Tuna MM, Erdemli Ö. Comparative Analysis of the Impact of Continuous Spinal Anesthesia and Single-Dose Spinal Anesthesia Techniques On Hemodynamics, Sensory And Motor Block Levels In Transurethral Surgery Cases. Acta Med. Alanya 2023;7(3): 274-284 doi: 10.30565/medalanya.1401259

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Acta Medica Alanya 2023;7(3): 274-284
Doi: 10.30565/medalanya.1401259

Introduction

Transurethral resection (TUR) surgery is an endoscopic surgical technique employed for diagnosing and treating symptomatic problems of the lower urinary tract and bladder. It is commonly favored in medical practice, particularly for cases of prostatic hyperplasia.[1] Spinal anesthesia is commonly favored in TUR because it has a quick onset of effect and is easy to administer.[2,3] Nevertheless, the administration of a solitary dosage of spinal anesthetic can result in hemodynamic alterations, including hypotension and bradycardia, as well as potential problems such as post spinal headache, nausea, and vomiting. These adverse effects pose significant hazards to the patient's well-being and can lead to major morbidity and mortality both during and after the surgical procedure.[3-5] Continuous spinal anesthesia offers the same benefits as single-dose spinal anesthesia while ensuring hemodynamic stability and is the recommended choice for individuals at high risk.[4-6] However, the outcomes may not consistently align with expectations due to factors such as the specific characteristics and concentration of the local anesthetic drug, as well as the particular technique employed.[2,6] On the other hand, in recent years, it is advisable to prioritize anesthetic procedures and medicines that have low side effects in order to facilitate quick recovery compared to surgery.[7]

Hence, Our study questions are: 1-Does the continuous spinal anesthetic technique demonstrate efficacy and safety? 2- Are the outcomes of single-dose and continuous spinal anesthesia methods similar in terms of the parameters investigated?

The objective of this study were 1- Effectiveness of single dose and continuous spinal anesthesia techniques 2- Comparison of hemodynamic changes in patients, sensory-motor block levels and durations, anesthetic drug doses and side effects.

Patients and Method

Following the approval of Ankara Türkiye Yüksek İhtisas Training and Research Hospital, Educational Planning and Coordination Board (December 2008), the study was planned prospectively, between 2019-2010. Patients whom ASA 1-3 group according to the American Society of Anesthesiologists (ASA) classification, aged between 40 and 75, who would undergo transurethral surgery and had no contraindications for spinal anesthesia, were included in the study. Patients underwent preoperative evaluation one day before to the surgery, during which standard and hematologic examinations were conducted. The patients were provided with information regarding the procedure and their consent was acquired. A total of forty patients, were randomly assigned to two groups: group 1, receiving a single dose of spinal anesthetic (n=20), and group 2, receiving continuous spinal anesthesia (n=20).

Prior to the patients being transported to the operating table, a 10ml/kg isotonic NaCl solution was administered within a 30-minute timeframe in the premedication room. Following the patient's transfer to the operating table, a premedication dose of 0.03 mg/kg midazolam intravenously was delivered. Following the normal monitoring procedures for general anesthesia, which included electrocardiogram (ECG), non-invasive blood pressure measurement (TA), and pulse oximetry, demographic information along with systolic and diastolic blood pressures, and pulse rate in minutes were recorded. Conditions have been created to switch to general anesthesia at any time. The study utilized Levobupivacaine, a well-established and safe local anesthetic.[8,9]

Patients were positioned in a seated posture on the surgical table, and the targeted area was cleansed with a disinfectant and then covered with a sterile, perforated green cloth. Following the insertion of a 22G spinal (Quicke) needle through the median approach at the L3-L4 distance and confirmation of cerebrospinal fluid (CSF) flow, the first group of patients (Group 1) received 3 ml of 15 mg levobupivacaine (chirocaine®) 0.5%. In Group 2, the dura mater was perforated with a 27G Quinke needle placed into a 22G catheter (Spinocath® Braun) after locating the epidural space by penetrating it with a 20G Touhy needle. Following the monitoring of cerebrospinal fluid (CSF) flow between the needle and catheter, the catheter was inserted into the spinal space by advancing it 2-3 cm beyond the needle. CSF flow was controlled, and the catheter was retracted 1-1.5 cm. Following the connection of the connector and bacterial filter, a volume of 1 ml of levobupivacaine (chirocaine®) with a concentration of 0.5% and a dosage of 5 mg was injected into the subarachnoid space. Subsequently, an additional volume of 0.5 ml of levobupivacaine with a concentration of 0.5% and a dosage of 2.5 mg was provided at 5-minute intervals until the desired surgical level (T10) was achieved. The total dose of medication administered was recorded. The patients were initially seated for a duration of 3 minutes, after which they were positioned in a supine posture with their heads raised at a 30-degree angle.

Sensory block levels were checked every 30 s with a pinprick test. The time from the time of intrathecal injection until the T10 level was reached was considered as "time to T10 level". The "maximum sensory block level" reached after spinal block was recorded. The time from the maximum sensory block level reached until two segments regressed was considered as "two-segment regression time". The duration from the pinprick test in the postoperative recovery unit until the reaction was observed is referred

to as the "sensory block end time". The motor functions of the patients were assessed at 30-second intervals using the bromage score. The time when the bromage score of the patients decreased from three to zero was considered as "motor block termination time".

The operation was started after adequate analgesia was achieved. Throughout the case, patients were given O_2 from mask at 2 L/min. Preoperative, 0, 5, 10, 15, 15, 30, 60, 60, 90, 120, 180 minutes systolic, diastolic blood pressures and pulses, sensory and motor block levels were noted. When the patient had hypotension during the surgery (defined as a fall in systolic arterial pressure of more than 30% from the baseline value), a fast infusion of 200 ml of isotonic solution was supplied within a 10-minute timeframe. If there was no improvement, a 5 mg dose of ephedrine was administered intravenously. When bradycardia (pulse rate below 45/min) developed, 0.5 mg atropine was administered i.v.

No analgesic agent was planned to be administered to any patient in the intraoperative period under normal conditions. Nevertheless, a dose of 0.5-1µg/kg fentanyl intravenously was given to patients who had pain as a result of bladder distension caused by the introduction of irrigation fluid during a transurethral operation and/or at the initiation of resection. In the postoperative period, patients were graded with VAS pain score. NSAIDs (diclofenac sodium; dichloron® 75 mg ampoule i.m) were administered to patients with a score of 4 and above and doses were recorded. The spinal catheters of the patients in the second group were withdrawn when leaving the recovery unit and sent for culture. The present study analyzed the effects of single dose spinal anesthesia (Group 1) and continuous spinal anesthesia (Group 2) on hemodynamic parameters, sensory-motor block levels, dose-volume of local anesthetic utilized, amount of intraoperative fluid administered, and occurrence of side effects.

Statistical analysis: Data were evaluated by a statistical expert using the statistical package program SPSS for windows 14.0. Paried t test was used for comparisons within groups, Mann Whitney U test was used for comparisons of means between groups, and Chi square test was used for comparisons of categorical variables. $p<0.05$ was considered significant. Bonferroni correction for ordinal variables was used to control Type I error in all possible multiple comparisons. Fisher's exact test was used for categorical variables. In comparisons of intra-group hemodynamic measurements, results were considered statistically significant for $p<0.025$ according to Bonferroni Correction.

Results

No statistically significant difference was observed between Group 1 and Group 2 patients in terms of age, sex, and mean body mass index (BMI) values ($p>0.05$, Table 1).

A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min systolic arterial pressure values ($p<0.025$, Table 2). A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min systolic arterial pressure values ($p<0.025$, Table 2).

A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic arterial pressure values ($p<0.025$, Table 3). In group 2, no statistical difference was observed between preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic arterial pressure values ($p>0.05$, Table 3).

In Group 1, a statistically significant difference was observed between preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic heart rate values ($p<0.025$, Table 4). In contrast, there was no statistically significant difference between preoperative and 0 min and 5,10,15,30,60,90,120,180 min heart rate values in Group 2 ($p>0.05$, Table 4).

Table 1. Demographic Characteristics of Patients

Variables	Group I (n=20)	Group II (n=20)	p value*
Age	62,9±8,8	59,3±13,2	0,318*
Gender			0,507**
Man	12 (%60,0)	14 (%70,0)	
Woman	8 (%40,0)	6 (%30,0)	
ASA			0,864**
I	2 (%10,0)	3 (%15,0)	
II	12 (%60,0)	12 (%60,0)	
III	6 (%30,0)	5 (%25,0)	
Body Mass Index	24,0±3,4	23,2±3,6	0,316*

*Mann-Whitney U test
**Chi Square Test

Acta Medica Alanya 2023;7(3): 274-284
Doi: 10.30565/medalanya.1401259

Table 2. Systolic arterial pressure values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p***
Pre-op	162,4±25,3	-	154,7±25,6	-
0.min	152,5±21,7	-	151,6±21,7	-
5. min	129,2±17,7 a;b	p<0,001;p<0,025	150,2±22,4	p>0,05
10. min	114,5±20,3 a;b	p<0,001;p<0,025	150,2±20,3	p>0,05
15. min	114,4±22,8 a;b	p<0,001;p<0,025	152,8±24,5	p>0,05
30. min	120,7±16,5 a;b	p<0,001;p<0,025	151,3±20,0	p>0,05
60. min	121,7±17,0 a;b	p<0,001;p<0,025	152,3±20,0	p>0,05
90. min	127,1±16,7 a;b	p<0,001;p<0,025	153,6±22,1	p>0,05
120. min	131,9±19,5 a;b;d;e	p<0,001;p<0,025;p<0,025;p<0,025	154,3±21,5	p>0,05
180. min	136,8±21,2 a;b;c;d,e;f	p<0,001;p<0,025;p<0,025;p<0,025;p<0,025;p<0,025	154,0±20,3	p>0,05

a-Pre Op ; b-0.min ; c-10.min ; d-30.min ;e-60.min and f-90.min with in them the statistical difference between. ***Paried T test

Table 3. Diastolic arterial pressure values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p value***
Pre-op	89,1±12,7	-	90,7±8,0	-
0.min	83,7±12,0	-	87,8±6,9	-
5.min	68,1±09,9 a;b	p<0,01;p<0,01	86,9±7,1	p>0,05
10.min	69,2±10,6 a;b	p<0,01;p<0,01	86,4±7,1	p>0,05
15.min	63,9±11,3 a;b	p<0,01;p<0,01	87,4±7,8	p>0,05
30.min	72,1±10,4 a;b	p<0,01;p<0,01	88,3±7,3	p>0,05
60.min	70,5±13,1 a;b	p<0,01;p<0,01	87,0±7,5	p>0,05
90.min	73,3±10,2 a;b	p<0,01;p<0,01	89,1±6,7	p>0,05
120.min	75,5±10,6 a;b	p<0,01;p<0,01	88,8±7,2	p>0,05
180.min	77,8±13,3 a;c	p<0,01;p<0,025	87,5±8,5	p>0,05

a-Pre Op ; b-0.min and c-15.min with in them the statistical difference between.***Paried T test

Table 4. Heart rate values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p value***
Pre-op	76,9±15,0	-	72,6±6,2	-
0.min	74,0±13,1	-	73,0±9,1	-
5.min	63,4±12,4 a;b	p<0,025; p<0,01	73,7±8,4	p>0,05
10.min	61,2±9,3 a;b	p<0,025; p<0,01	71,3±9,0	p>0,05
15.min	62,1±9,7 a;b	p<0,025; p<0,01	70,7±7,3	p>0,05
30.min	64,9±8,2 a	p<0,025	70,7±8,3	p>0,05
60.min	65,2±11,3 a	p<0,025	69,8±8,1	p>0,05
90.min	66,0±10,5 a;b	p<0,025; p<0,01	71,2±9,4	p>0,05
120.min	67,2±9,4	p>0,05	71,1±8,2	p>0,05
180.min	68,2±9,4	p>0,05	71,5±8,3	p>0,05

a-Pre Op ; b-0.min with in them the statistical difference between ***Paried T test

There was a significant difference between the groups in terms of systolic and diastolic arterial blood pressure values ($p<0.05$, Graph-1A). Similarly, a significant difference was observed between the groups in terms of heart rate values ($p<0.05$, Graph-1B)

A statistically significant difference was observed between Group 1 and Group 2 in terms of mean sensory block levels at 5,10,15,30,60,90,120 minutes ($p<0.0012$, Table 5). Additionally, a significant difference was observed between the groups in terms of sensory block levels at 5, 10, 15, 15, 30, 60, 90 and 120 minutes ($p<0.05$, Graph-2)

No significant difference was found between the groups in terms of Bromage score values ($p>0.05$, Table 6).

In Group 1, the time to reach the T10 level, two-segment regression time, sensory and motor block times, and maximum sensory block level were longer than in Group 2 ($p<0.05$, Table 7, Graph-3A,B,C,D).

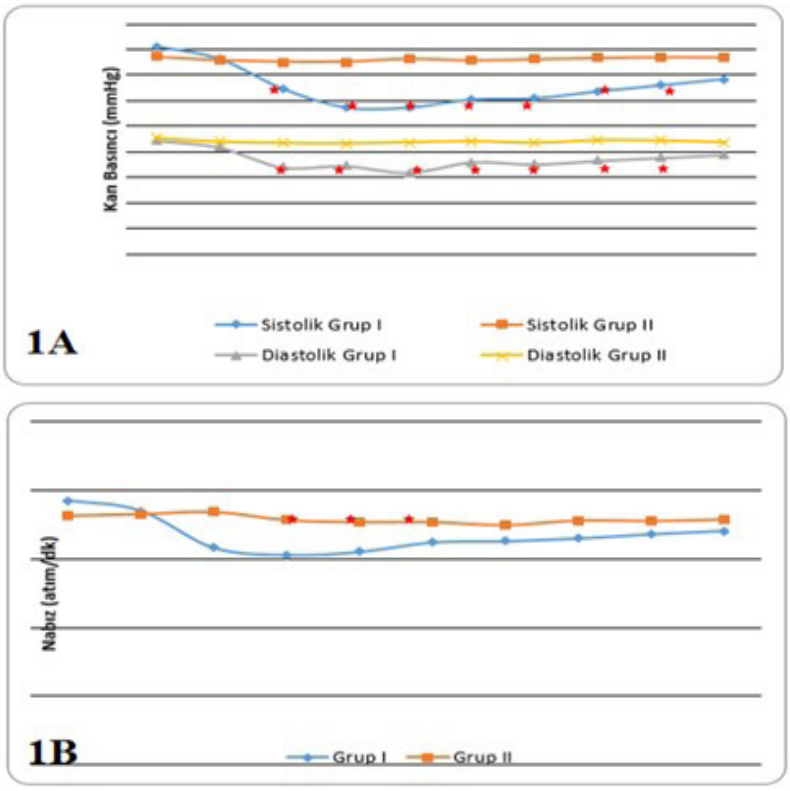
The dosage and quantity of levobupivacaine administered to Group 1 were considerably greater than the dosage and quantity of levobupivacaine administered to Group 2 ($p<0.05$, Graph-4A). In contrast, Group 1 received a considerably greater volume of fluid throughout the intraoperative time compared to Group 2 ($p<0.05$, Table 8, Graph-4B).

No statistically significant difference in side effects was found between the groups ($p>0.05$, Table 8). Both groups did not require any additional medication during and after the surgery (Table 8).

Discussion

The main outcomes of this study indicate that continuous spinal anesthesia can achieve a sensory-motor block level similar to that of single-dose spinal anesthesia. Furthermore, it maintains more stable hemodynamics at adjustable doses, while requiring a smaller amount of local anesthetic.

Currently, there is a growing population of middle-aged and older patients who are undergoing surgery. These patients often experience hemodynamic abnormalities when receiving spinal anesthetic, which is typically regarded an optimal approach for them. As a result, there is a need to explore other methods. This search has highlighted the utilization of continuous spinal anesthetic techniques as a means to promote prompt recovery, successful outcomes, and the maintenance of stable hemodynamics. The hemodynamic effects of spinal anesthesia are determined by the suppression of preganglionic sympathetic



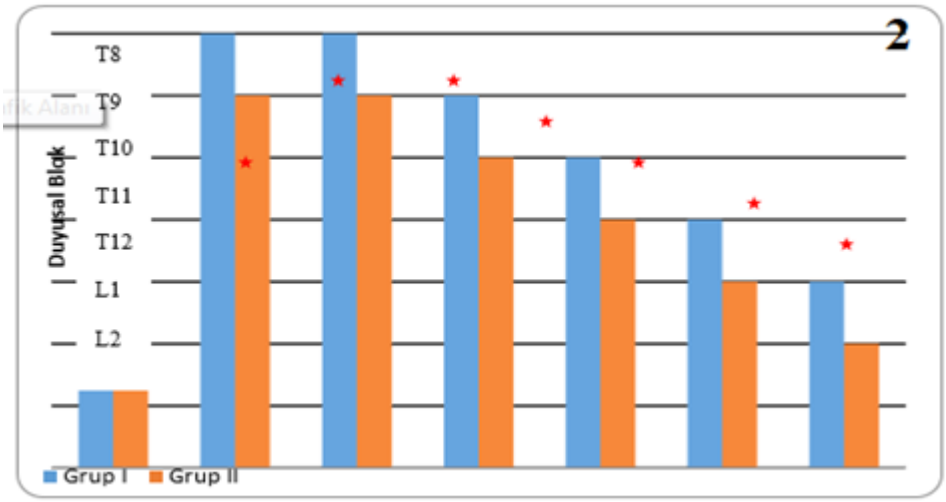
Graph 1. A: Systolic – Diastolic Arterial Pressure Values and Evaluation Between Groups, B: Changes in He-art Rate of Groups

Acta Medica Alanya 2023;7(3): 274-284
Doi: 10.30565/medalanya.1401259

Table 5. Sensory block (Dermatome) levels and intra-group evaluation according to monitoring times

Time	Group I	p value***	Group II	p value***
5.min	T11 (T9-L2)		T12(T8-L1)	
10.min	T8 (T7-T12)		T9 (T8-T11)a	
15.min	T8 (T7-T10)		T9 (T8-T11)a	
30.min	T9 (T8-T11)		T10 (T8-T11)	
60.min	T10 (T9-L1) b;c;d	p<0,0012; p<0,0012; p<0,0012	T11 (T9-L1) b;c;d	p<0,0012; p<0,0012; p<0,0012
90.min	T11 (T9-L1) b;c;d; e	p<0,0012; p<0,0012; p<0,0012; p<0,0012	T12 (T10-L3)b;c;d;e	p<0,0012; p<0,0012; p<0,0012; p<0,0012
120.min	T12 (T10-L3)a;b;c; d;e;f	p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012	L1 (T11-L3) a;b;c;d;e;f	p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012

a-5.min ; b-10.min ; c-15.min ; d-30.min ;e-60.min and f-90.min with in them the statistical difference between. **Paried T test



Graph 2. Sensory Block Levels by Groups

Table 6. Bromage Score mean values according to monitoring times

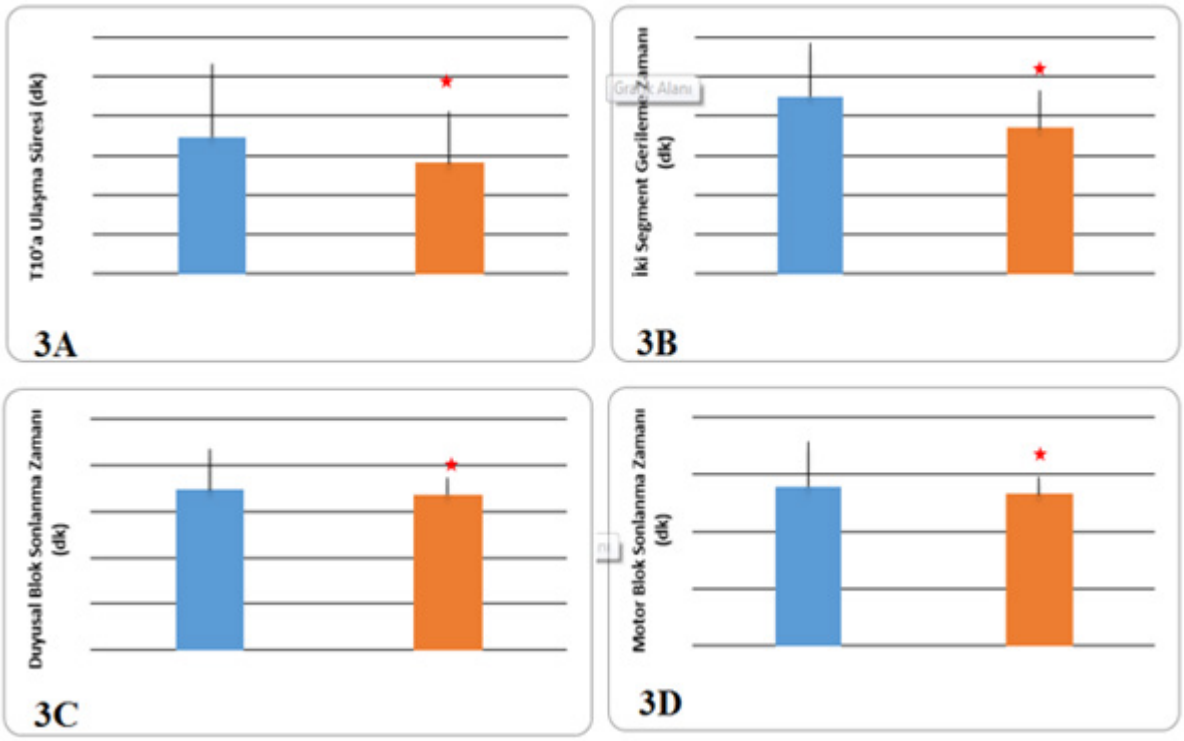
Time	Group I	Group II	p value*
Pre-op	0 (0-0)	0 (0-0)	1,000
0.min	0 (0-0)	0 (0-0)	1,000
5.min	2 (1-2)	2 (1-2)	0,108
10.min	3 (2-3)	3 (2-3)	0,602
15.min	3 (3-3)	3 (3-3)	1,000
30.min	3 (2-3)	3 (2-3)	0,799
60.min	3 (2-3)	3 (2-3)	0,108
90.min	2 (1-3)	2 (1-3)	0,165
120.min	1 (0-2)	1 (0-2)	0,698
180.min	0 (0-2)	0 (0-0)	0,602

*Mann-Whitney U test

Table 7. Reaching T10 Level, Two-Segment Regression, Sensory-Motor Block End Times and Maximum Sensory Block Level

Variables	Group I (n=20)	Group II (n=20)	p value*
Time to Reach T10	6 (3-16)	9 (3-11)	0,021
Segment Regression	68,5±20,2	53,5±13,9	0,039
Sensory Block End Times	172 (120-300)	167,5 (130-210)	0,037
Engine Block End Time	135 (100-270)	130,5 (110-180)	0,038
Maximum Sensory Block Level	T8 (T7-T10)	T9 (T8-T11)	0,041

*Mann-Whitney U test



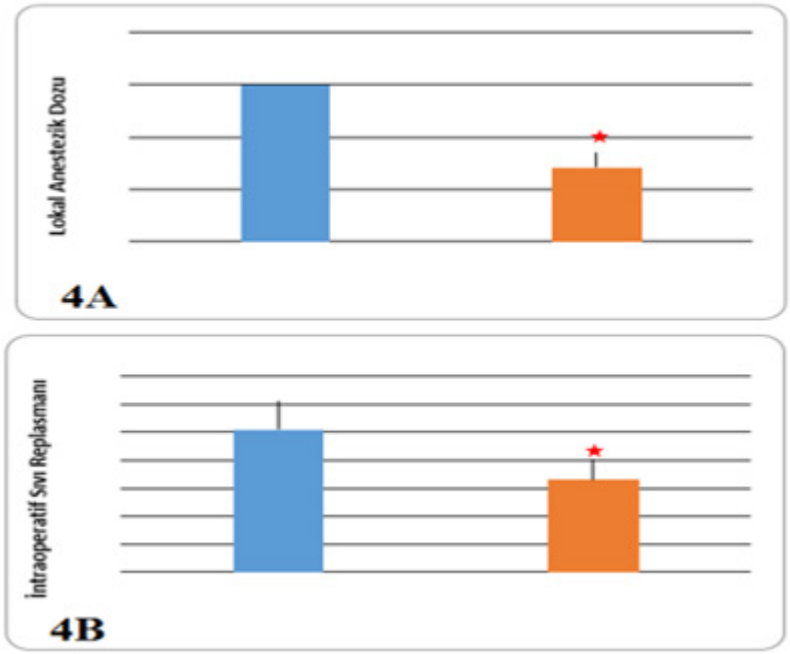
Graph 3. Blue: Group 1 and Orange: Group 2. A: Time to Reach T10 Level, B: Two-Segment Regression Times, C: Sensory Block End Time, D: Motor Block End Time

Table 8. Comparison of complications and additional drug use distribution by groups

Variables	Group I (n=20)	Group II (n=20)	p value**
Nausea	2 (%10,0)	1 (%5,0)	1,000
Nerve Root Pain	0(%0,0)	1(%5,0)	1,000
Headache	1 (%5,0)	1 (%5,0)	-
Allergic Reaction	0(%0,0)	0(%0,0)	-
Additional Fentanyl Use	0(%0,0)	0 (%0,0)	-
Additional NSAID Use	0(%0,0)	0(%0,0)	-
Intraoperative Fluid Replacement	509±101	329±75	0,000

** Chi Square Test

Acta Medica Alanya 2023;7(3): 274-284
Doi: 10.30565/medalanya.1401259



Graph 4. Blue: Group 1 and Orange: Group 2. A: Average Local Anesthetic Doses Applied in the Groups, B: Intraoperative Fluid Replacement in the Groups

activity. As the level of sympathetic block increases, the severity of the resulting hypotension increases. Excessive distribution of the local anesthetic drug in the head region might lead to multisegmented sympathetic blocking, resulting in adverse hemodynamic alterations.[3,10] Our results indicate that in the continuous spinal anesthesia group, administering the local anesthetic drug in small doses resulted in a slower spread of the drug within the spinal cord, leading to a more controlled and stable effect on the sympathetic nerves. On the other hand, in the single dose spinal anesthesia group, the local anesthetic agent was distributed too widely in the upper body, causing a more extensive and unpredictable effect on the sympathetic nerves, which in turn impaired hemodynamic stability.

Previous studies have shown that 80% of patients who received a single dose of spinal anesthesia experienced a reduction in both systolic and diastolic blood pressure values compared to their pre-anesthesia levels. Additionally, the single dose group exhibited significantly more impaired hemodynamics compared to the continuous spinal anesthesia group.[11-13] Similarly, we observed a significant decrease in the single dose spinal anesthesia group compared to the pre-administration values in our study, whereas no significant hemodynamic difference was observed in the continuous spinal anesthesia group compared to the pre-administration values. In our study, which was similar to previous studies[14-18], we also observed that intraoperative heart rate measurements were significantly lower in the group receiving a single dose of continuous spinal anesthesia compared to their preoperative values. However, in the group receiving continuous spinal anesthesia, there was no significant difference between intraoperative heart rates and preoperative values.

A study comparing the effects of isobaric, hypobaric, and hyperbaric bupivacaine in continuous spinal anesthesia revealed that the hyperbaric bupivacaine group experienced a 30% decrease in mean arterial pressure, while the isobaric bupivacaine group had an 18% decrease, and the hypobaric bupivacaine group had a 14% decrease. The study concluded that the use of isobaric bupivacaine in spinal anesthesia allows for better control of hemodynamics.[19] Our study concluded that the patient group who received a single dosage of spinal anesthetic experienced a reduction in systolic and diastolic blood pressure as well as heart rate. This decrease typically occurred between the 10th and 15th minutes, when the sensory block level was at its peak. This phenomenon was believed to be caused by the insufficient adaptation of cardiovascular compensatory mechanisms to the sudden inhibition of sympathetic activity resulting from the administration of a single dose. This finding is consistent with Schnider's segmental block level theory. Schnider et al. conducted a trial including 50 patients, where they delivered 2.5 - 5 mg (0.5 - 1 ml) of 0.05% isobaric bupivacaine and 20 mg (4 ml) of 0.05% isobaric bupivacaine through a 28 G catheter for single dose spinal anesthesia. In the study, it was observed that six patients who had continuous spinal anesthesia and seventeen patients who received a single dose spinal anesthesia had a spinal anesthesia level above T6. Additionally, it was noted that the level of preganglionic

sympathetic block was adjustable in the group of patients who had a catheter inserted. No excessive deterioration in hemodynamic values was found in the group under continuous spinal anesthesia.[20]

Continuous spinal anesthesia, as opposed to single dose spinal anesthesia, offers hemodynamic stability due to its capacity to reduce segmental block and vary the onset of block. It was reported that the main purpose of the spinal catheter is to shape the block step by step and safely to closely monitor hemodynamic changes.[21] However, there are also studies reporting different results in the literature.[22,23] Lundorff et al. conducted a study on 60 patients who were undergoing lower extremity vascular grafting. They administered 17.5 mg of 0.5% isobaric bupivacaine to the group receiving a single dose of spinal anesthesia, and 5 mg of 0.5% bupivacaine to the group receiving continuous spinal anesthesia. In the continuous spinal anesthesia group, they administered 2.5 mg of 0.5% isobaric bupivacaine every 10 minutes until the T 11 sensory block was achieved. There was no difference between the two groups in terms of hemodynamic changes and the dose of ephedrine used. It was stated that inadequate physiological compensatory mechanisms of the patients included in the study due to their advanced age group and comorbidities may cause hemodynamic effects seen at high doses even at low doses. In a trial conducted with 40 patients undergoing orthopedic surgery, Pitkaren M. et al[24] delivered 3 ml of 0.5% bupivacaine to the group receiving single dose spinal anesthesia, and 1 ml of 0.5% bupivacaine followed by a continuous infusion of 2 ml/hour to the group receiving continuous spinal anesthesia. No statistically significant difference was seen in the invasive hemodynamic follow-up between the two groups. However, bradycardia was noted in 6 patients in the single dose spinal anesthesia group and in 4 patients in the continuous spinal anesthesia group. The authors posited that the outcomes could be attributed to intervention at the early stage of hemodynamic deterioration, fluctuations in sympathetic blocking caused by spinal anesthetic, and the impact of catheter location. Furthermore, they indicated that the advanced age of the patients, inadequate premedication fluid administration, and excessive bleeding may lead to hemodynamic instability in the cohort utilizing low dose local anesthetics.

Our study revealed a notable disparity among the groups in relation to all three metrics, namely sensory block achievement, motor block cessation, and segment regression time. Lower doses of local anesthetic agent in continuous spinal anesthesia were believed to be more successful than the single dose spinal anesthesia approach in reducing the time it takes for patients to recover. There was no discernible disparity in the intraoperative and postoperative bromage score values between the two groups. While the duration of motor block termination was longer in the single dose spinal anesthesia group compared to the continuous spinal anesthesia group, there was no variation in the quality of motor block between the two groups. The findings of our study shown congruity with previous study conducted by different scholars.[10, 17] Another study found no disparity in the length of time it took for motor block termination between the groups that received a single dose of spinal anesthesia and those that received continuous spinal anesthesia. The authors attributed this phenomenon to the utilization of elderly patients in their study, who exhibited heightened sensitivity to local anesthetic drugs.[25]

In our study, the continuous spinal anesthesia group received a lower amount of fluid replacement during the surgery compared to the single dose spinal anesthetic group. In the group receiving continuous spinal anesthesia, the stability of hemodynamics was significantly higher compared to the group receiving a single dose spinal anesthesia. This suggests that there was a reduced requirement for fluid in the continuous spinal anesthesia group. Based on our data, it has been reported that the continuous spinal anesthesia method can achieve sufficient anesthesia levels for the operation by using a smaller amount of local anesthetic agent. This is particularly effective in elderly patients. Furthermore, the amount of local anesthetic agent used in continuous spinal anesthesia is lower compared to single dose spinal anesthesia.[11,17,21,26] On the other hand, pain due to nerve root damage may occur after spinal anesthesia.[27] In our study, nerve root pain was observed in only one patient.

Post spinal headache (PSBA) due to CSF leakage in the dura mater during spinal anesthesia is more common especially in young patients. The occurrence of post-spinal backache (PSBA) in continuous spinal anesthesia has been documented in many studies, with reported rates ranging from 0.0% to 9.2%.[28,29] In contrast, certain studies reported the absence of PSBA in a series of continuous spinal anesthesia.[19] Our study found no statistically significant disparity between the two groups in relation to PSBA. PSBA was seen in one patient in each group. Furthermore, cauda equina syndrome and neurologic sequelae were not observed in our study. Our study found that two patients in the single dose spinal anesthesia group and one patient in the continuous spinal anesthesia group experienced nausea. The occurrence of nausea in two patients from the single dose spinal group was linked to a decline in hemodynamics, while the nausea observed in one patient from the continuous spinal group was attributed to the patient's anxiousness. The results were compatible with previous literature.[4-6, 30-32] Lastly, no allergic reaction was observed in our study.

Limitions: This study has some limitations. Firstly, some references may not be up to date. However, this is understandable considering the date when the study was conducted. On the other hand, since the graphs were taken from the original version of the thesis study, some expressions in the graphs had to be presented in Turkish. Finally, it may be considered a disadvantage that in some tables we present them as statistically significant or insignificant, smaller or larger than the threshold value ($p<0.05$ or $p>0.05$). Despite some limitations, we think it is important to publish this study in English literature too, which it is in the gray literature.[33]

Conclusion: In this study, in the continuous spinal anesthesia method, the time to reach the T10 sensory block level and the termination of sensory-motor block were found to be longer than in the single-dose spinal anesthesia method. However, it was evaluated to be a safer method because it provides hemodynamic stability and the need for intraoperative fluid replacement is significantly lower. Continuous spinal anesthesia; It may be an anesthesia technique that can be safely used to prevent hemodynamic disorders that may develop due to high sympathetic block due to spinal anesthesia, especially in high-risk patient groups that are hemodynamically unstable. In addition, this method may allow the appropriate drug dose to be titrated according to the surgical duration and procedure, resulting in less drug use and a shorter and complication-free recovery period for patients.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: (EPK meeting date: 26.12.2008; decision no: 217/ clause 7)

ORCID and Author contribution: M. M. T.(0000-0003-3896-4027) and Ö.E. (0000-0002-8265-9903): All authors contributed to the manuscript conception, design, literature search, writing,critical review and final approval.

Peer-review: Externally peer reviewed.

Acknowledgement: This article was produced from the thesis study of the Corresponding Author

References

1. Cornu JN, Ahyai S, Bachmann A, de la Rosette J, Gilling P, Gratzke C, McVary K, Novara G, Woo H, Madersbacher S. A Systematic Review and Meta-analysis of Functional Outcomes and Complications Following Transurethral Procedures for Lower Urinary Tract Symptoms Resulting from Benign Prostatic Obstruction: An Update. Eur Urol. 2015 Jun;67(6):1066-1096. doi: 10.1016/j.eururo.2014.06.017.
2. Sergin DY, Erhan E, Özyar B, Dizdar GU, Yeğül İ. Açık Prostatektomi Ameliyatı Geçirecek Hastalarda Tek Doz Spinal Anestezi ve Sürekli Spinal Anestezi Tekniklerinin Karşılaştırılması. Klinik Tıp Bilimleri Dergisi, 201;6(2):17-24. https://dergipark.org.tr/tr/download/article-file/776077
3. Marşan A, Kırdemir P, Urfalıoğlu A, Göğüş N. Alt ekstremite girişimlerinde, iki rejyonel anestezi tekniğinin analjezi ve hemodinamik etkilerinin karşılaştırılması. Anestezi Dergisi 2005;13(4):253-257. https://www.acarindex.com/pdfs/405205
4. Aydın ŞP, Bozkırlı F. Transüretral Rezeksiyonda Tek Doz Ve Sürekli Subaraknoid Levobupivakain Uygulamasının Karşılaştırılması. Turkish Journal of Geriatrics 2014; 17 (4) 366-372. https://geriatri.dergisi.org/uploads/pdf/pdf_TJG_848.pdf
5. Üstüner A, Özyuvacı E, Toprak N, Eren N. Total Kalça Protezi Uygulanan Hastalarda Sürekli ve Tek Doz Spinal Anestezi Yöntemlerinin Karşılaştırılması. Istanbul Tıp Dergisi 2007:1;7-10. https://cms.istanbulmedicaljournal.org/Uploads/Article_20946/IMJ-8-7-En.pdf
6. Thomas, J.M., Schug, S.A. Recent Advances in the Pharmacokinetics of Local Anaesthetics. *Clin Pharmacokinet* 36, 67–83 (1999). https://doi.org/10.2165/00003088-199936010-00005
7. Kırdemir P, Solmaz FA. Enhanced Recovery After Surgery (ERAS) and Anesthesia. Acta Med. Alanya 2020;4(1):95-101. doi:10.30565/medalanya.587027
8. Foster RH, Markham A. Levobupivacaine: a review of its pharmacology and use as a local anaesthetic. Drugs. 2000 Mar;59(3):551-79. doi: 10.2165/00003495-200059030-00013.
9. McLeod GA, Burke D. Levobupivacaine. Anaesthesia. 2001 Apr;56(4):331-41. doi: 10.1046/j.1365-2044.2001.01964.x.
10. Maurer K, Bonvini JM, Ekatodramis G, Serena S, Borgeat A. Continuous spinal anesthesia/analgesia vs. single-shot spinal anesthesia with patient-controlled analgesia for elective hip arthroplasty. Acta Anaesthesiol Scand. 2003 Aug;47(7):878-83. doi: 10.1034/j.1399-6576.2003.00173.x.
11. Favarel-Garrigues JF, Sztark F, Petitjean ME, Thicoïpé M, Lassié P, Dabadie P. Hemodynamic effects of spinal anesthesia in the elderly: single dose versus titration through a catheter. Anesth Analg. 1996 Feb;82(2):312-6. doi: 10.1097/00000539-199602000-00017.
12. Minville V, Fourcade O, Grousset D, Chassery C, Nguyen L, Asehnoune K, Colombani A, Goulmamine L, Samii K. Spinal anesthesia using single injection small-dose bupivacaine versus continuous catheter injection techniques for surgical repair of hip fracture in elderly patients. Anesth Analg. 2006 May;102(5):1559-63. doi: 10.1213/01.ane.0000218421.18723.cf.
13. Baydilek Y, Yurtlu BS, Hanci V, Ayoğlu H, Okyay RD, Kayhan GE, Tokgöz H, Mungan G, Ozkoçak I. The comparison of levobupivacaine in continuous or single dose spinal anesthesia for transurethral resection of prostate surgery. Braz J Anesthesiol. 2014;64(2):89-97. doi: 10.1016/j.bjane.2013.03.007
14. Mohamed SA, Hussam AM, Abdallah SA, Sarhan KA, Shaban AM. Ondansetron Is an Effective Alternative to Decrease the Incidence of Postspinal Hypotension in Healthy Subjects Undergoing Infra-Umbilical Surgeries Compared To Combined Volume Loading and Vasoconstrictors: Randomized Controlled Trial. Open Access Maced J Med Sci. 2018;6(12):2363-2368. doi: 10.3889/oamjms.2018.491.
15. Gratadour P, Viale JP, Parlow J, Sagnard P, Counioux H, Bagou G, Annat G, Hughson R, Quintin L. Sympathovagal effects of spinal anesthesia assessed by the spontaneous cardiac baroreflex. Anesthesiology. 1997 Dec;87(6):1359-67. doi: 10.1097/00000542-199712000-00015.
16. Kaur M, Katyal S, Kathuria S, Singh P. A comparative evaluation of intrathecal bupivacaine alone, sufentanil or butorphanol in combination with bupivacaine for endoscopic urological surgery. Saudi J Anaesth. 2011 Apr;5(2):202-7. doi: 10.4103/1658-354X.82804.
17. de Andrés J, Bellver J, Bolinches R. Comparison of continuous spinal anaesthesia using a 32-gauge catheter with anaesthesia using a single-dose 24-gauge atraumatic needle in young patients. Br J Anaesth. 1994 Dec;73(6):747-50. doi: 10.1093/bja/73.6.747.

18. Velickovic IA, Leicht CH. Continuous spinal anesthesia for cesarean section in a parturient with severe recurrent peripartum cardiomyopathy. Int J Obstet Anesth. 2004 Jan;13(1):40-3. doi: 10.1016/S0959-289X(03)00052-9.
19. Van Gessel EF, Praplan J, Fuchs T, Forster A, Gamulin Z. Influence of injection speed on the subarachnoid distribution of isobaric bupivacaine 0.5%. Anesth Analg. 1993 Sep;77(3):483-7. doi: 10.1213/00000539-199309000-00011.
20. Schnider TW, Mueller-Duysing S, Jöhr M, Gerber H. Incremental dosing versus single-dose spinal anesthesia and hemodynamic stability. Anesth Analg. 1993 Dec;77(6):1174-8. doi: 10.1213/00000539-199312000-00016.
21. Mark JB, Steele SM. Cardiovascular effects of spinal anesthesia. Int Anesthesiol Clin. 1989 Spring;27(1):31-9. doi: 10.1097/00004311-198902710-00007.
22. Lundorff L, Dich-Nielsen JO, Laugesen H, Jensen MM. Single-dose spinal anaesthesia versus incremental dosing for lower limb vascular surgery. Acta Anaesthesiol Scand. 1999 Apr;43(4):405-10. doi: 10.1034/j.1399-6576.1999.430407.x.
23. Mark JB, Steele SM. Cardiovascular effects of spinal anesthesia. Int Anesthesiol Clin. 1989 Spring;27(1):31-9. doi: 10.1097/00004311-198902710-00007.
24. Pitkänen M, Rosenberg P, Silvanto M, Tuominen M. Haemodynamic changes during spinal anaesthesia with slow continuous infusion or single dose of plain bupivacaine. Acta Anaesthesiol Scand. 1992 Aug;36(6):526-9. doi: 10.1111/j.1399-6576.1992.tb03512.x.
25. Reisli R, Horasanlı E, Demirbilek S, Dikmen B, Yiğitbaşı B, Göğüş N. Tek doz ve sürekli spinal anestezinin hemodinamik ve anestezik etkilerinin karşılaştırılması. Türk Anest Rean Cem Mecmuası 1999; 27:21-26.
26. Minville V, Asehnoune K, Delussy A, Fourcade O, Colombani A, Rabinowitz A, Samii K. Hypotension during surgery for femoral neck fracture in elderly patients: effect of anaesthetic techniques. A retrospective study. Minerva Anestesiol. 2008 Dec;74(12):691-6. PMID: 19034248.
27. Hewson DW, Bedforth NM, Hardman JG. Spinal cord injury arising in anaesthesia practice. Anaesthesia. 2018 Jan;73 Suppl 1:43-50. doi: 10.1111/anae.14139.
28. Mahisekar UL, Winnie AP, Vasireddy AR, Masters RW. Continuous spinal anesthesia and post dural puncture headache: a retrospective study. Reg Anesth. 1991 Mar-Apr;16(2):107-11. PMID: 2043523.
29. Liu N, Montefiore A, Kermarec N, Rauss A, Bonnet F. Prolonged placement of spinal catheters does not prevent postdural puncture headache. Reg Anesth. 1993 Mar-Apr;18(2):110-3. PMID: 8489976.
30. Faccenda KA, Finucane BT. Complications of regional anaesthesia Incidence and prevention. Drug Saf. 2001;24(6):413-42. doi: 10.2165/00002018-200124060-00002.
31. Carpenter RL, Caplan RA, Brown DL, Stephenson C, Wu R. Incidence and risk factors for side effects of spinal anesthesia. Anesthesiology. 1992 Jun;76(6):906-16. doi: 10.1097/00000542-199206000-00006.
32. Kim NY, Kim SY, Ju HM, Kil HK. Selective spinal anesthesia using 1 mg of bupivacaine with opioid in elderly patients for transurethral resection of prostate. Yonsei Med J. 2015 Mar;56(2):535-42. doi: 10.3349/ymj.2015.56.2.535.
33. Calis H, Aslan A. What is gray literature and how to search for it. Acta Med. Alanya 2020;4(2):111-112. doi:10.30565/medalanya.707584

Acta Medica Alanya

Technical Note

Teknik Not

Acta Medica Alanya 2023;7(3): 285-290
Doi: 10.30565/medalanya.1390145

Using navigation in cases requiring upper cervical instrumentation in clinics without intraoperative imaging technology

İntraoperatif görüntüleme teknolojisi olmayan kliniklerde üst servikal enstrümantasyon gereken olgularda navigasyon kullanımı

Ahmet Karaoğlu[1], Turgut Kuytu[2]

[1] Yüksek Ihtisas Education and Research Hospital, Department of Neurosurgery, Bursa, Turkey

[2] VM Medical Park Bursa Hospital, Istinye University, Department of Neurosurgery, Bursa, Turkey

ABSTRACT

Upper cervical spine surgery which requires instrumentation is a highly complicated procedure, both due to the presence of critical structures in the region and variable pedicle anatomy. Despite the widespread use of technological advances as intraoperative imaging and navigation technologies aimed at preventing screw malposition and injuries to the critical neural and vascular structures, there are only a few clinics capable of employing those technologies. In clinics lacking intraoperative imaging facilities that assist in the instrumentation of the upper cervical spine, navigation technology can be employed in both posterior and anterior approaches with the assistance of the technique described in this manuscript. This approach will not only decrease complication rates compared with the free-hand method, but also considerably lower radiation exposure for both the patient and surgical team.

Key Words: Upper Cervical; Navigation; Radiation Exposure; Screw Malposition

ÖZ

Enstrümantasyon gerektiren üst servikal omurga cerrahisi, hem bölgedeki kritik yapıların varlığı hem de değişken pedikül anatomisi nedeniyle oldukça karmaşık bir işlemdir. Vida malpozisyonunu ve kritik sinir ve damar yapılarının yaralanmasını önlemeyi amaçlayan intraoperatif görüntüleme ve navigasyon teknolojileri gibi teknolojik gelişmeler yaygın olarak kullanılmasına rağmen, bu teknolojileri kullanabilen sadece birkaç klinik bulunmaktadır. Üst servikal omurganın enstrümantasyonuna yardımcı olan intraoperatif görüntüleme olanaklarının bulunmadığı kliniklerde, bu yazıda açıklanan tekniğin yardımıyla navigasyon teknolojisi hem posterior hem de anterior yaklaşımlarda kullanılabilir. Bu yaklaşım, serbest el yöntemine kıyasla komplikasyon oranlarını azaltmakla kalmayacak, aynı zamanda hem hasta hem de cerrahi ekip için radyasyon maruziyetini önemli ölçüde azaltacaktır.

Anahtar Kelimeler: Üst Servikal; Navigasyon; Radyasyona Maruz Kalma; Yanlış Vida Konumu

Recieved Date: 14.11.2023 **/ Accepted Date:** 07.12.2023 **/ Published (Online) Date:** 31.12.2023

Corresponding author: Ahmet Karaoğlu, MD, Yüksek Ihtisas Education and Research Hospital, Department of Neurosurgery, Bursa, Türkiye

Phone: 05324453803 **/ mail:** ahmetkaraoglu16@gmail.com

ORCID: 0000-0002-0505-3027

To cited: Karaoglu A, Kuytu T. Using Navigation In Upper Cervical Instrumentation In Clinics That Do Not Have Intraoperative Imaging Technology. Acta Med. Alanya 2023;7(3): 285-290 doi: 10.30565/medalanya.1390145

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Upper cervical spine surgery requiring instrumentation presents challenges arising from variable pedicle anatomy, the close proximity of the vertebral artery to the surgical field along with vertebral artery anomalies, and the potential risk of spinal cord and nerve root injury. Incorrect positioning of the screw could lead to loss of stability or catastrophic neurologic and vascular complications that may be challenging or impossible to reverse.[1] The rate of freehand screw malposition in upper cervical spine instrumentation has been reported to be 14%–23%, whereas vertebral artery injury has been documented in 2.7%–3.3% of these cases.[2-4] Despite the complicated nature of the region and high rates of screw malposition, intraoperative imaging cannot be performed in all clinics, although computer-based navigation procedures are becoming increasingly common these days in accordance with the developing technology. In Turkey, there are only a few clinics which have intraoperative imaging technology. This article describes our technique of utilizing neuronavigation in upper cervical spine surgery requiring instrumentation in clinics that lack intraoperative imaging facilities.

Technical

Upper Cervical Posterior Intervention

Due to the absence of intraoperative imaging at our clinic, the patient initially underwent a cervical computed tomography (CT) scan to input his/her data into the computerized navigation system and align them in the same position. For patients in whom a posterior intervention was intended, a pillow was positioned under the patient's head during CT imaging to facilitate flexion of the head into the surgical prone position, ensuring surgical comfort. Furthermore, the distance between the manubrium sterni and gnathion was measured metrically. Following intratracheal general anesthesia, the patient was transported to the operating room and positioned in the prone posture using a spiked headgear. The metric measurement obtained from the cervical CT scan, which determined the distance between the manubrium sterni and gnathion, was then applied in the operating room to ensure precise positioning. Following surgical site skin preparation and draping, the vertebrae were exposed via a posterior cervical midline vertical skin incision and bilateral dissection, and a total of seven reference points were randomly marked using a sterile navigation probe (Figure-1).

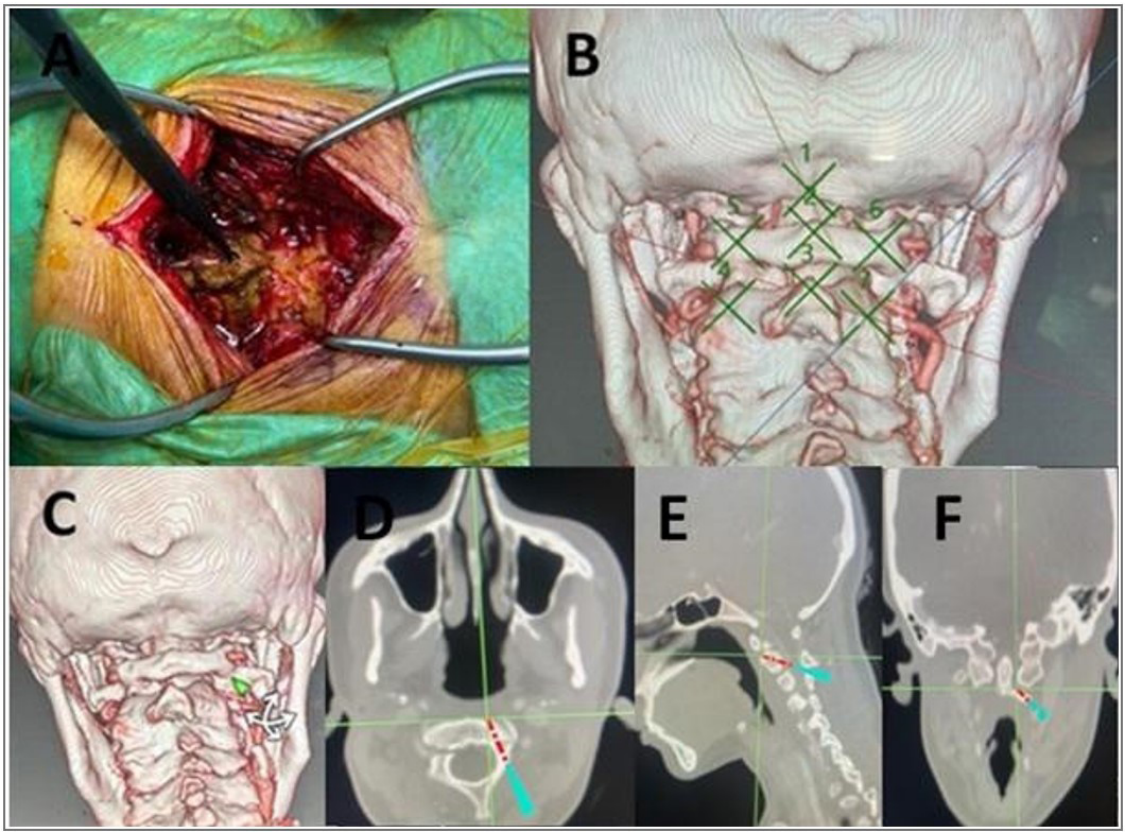


Figure 1. A. After exposing the vertebrae to cervical posterior intervention, the references points were marked using a sterile navigation probe; B.Navigation screenshots after marking the seven reference points; C, D, E, F. Navigation screenshots during positioning before intraoperative vertebral access.

Acta Medica Alanya 2023;7(3): 285-290
Doi: 10.30565/medalanya.1390145

After establishing the reference points, the patient's data were aligned with the CT images loaded onto the computerized navigation device and the surgical procedure was conducted under the guidance of navigation.

In addition, the projections of vascular structures were obtained with the help of navigation in all posterior cervical procedures. This was valuable for us in identifying possible anomalies before intervention (Figure-2).

Upper Cervical Anterior Intervention

For anterior interventions, the patient's head was placed in the supine position with the head extended by placing a towel in the neck cavity to ensure surgical comfort, and the distance between the manubrium sterni and gnathion was measured metrically before the preoperative cervical CT scan. The patient was then transported to the operating room. Following intratracheal general anesthesia, the patient was placed in the supine position with the patient's head aligned in midline neutral position and extended. The metric measurement obtained from the cervical CT scan, which determined the distance between the manubrium sterni and gnathion, was employed to guide the patient's positioning in the operating room. Following surgical site skin preparation and draping, the anterior aspects of the vertebrae were exposed via a right anterior cervical vertical skin incision near the midline and classic dissection, and a total of seven reference points were randomly marked using a sterile navigation probe (Figure-3).

After establishing the reference points, the patient's data were aligned with the CT images loaded onto the computerized navigation device and the surgical procedure was conducted under the guidance of navigation.

Discussion

Surgery for upper cervical pathologies requiring instrumentation is still regarded as a complex procedure.[2-5]

The atlantoaxial joint acts as a highly mobile hinge present at the craniocervical junction. Deformity in this region creates cervical instability and causes severe bulbomedullary compression, which is usually defined as cord dysfunction.[6] Internal fixation is the main treatment for atlantoaxial instability. Currently, the most commonly used methods are atlantoaxial transarticular facet screws (Magerl technique) and axial pedicle screws with atlantal lateral mass screws (Harms technique).[7-9] Both methods

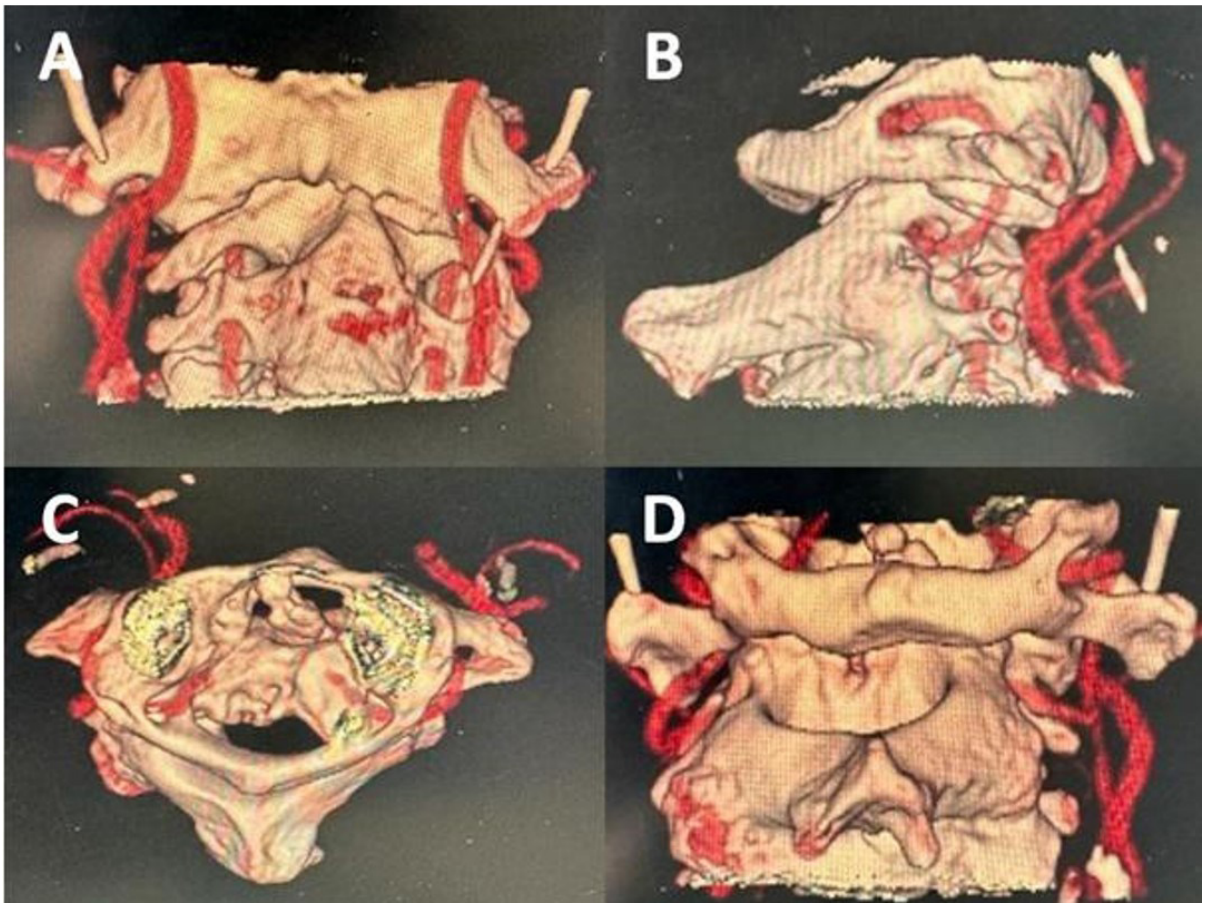


Figure 2. Three-dimensional projections of vertebral arteries with preinterventional navigation

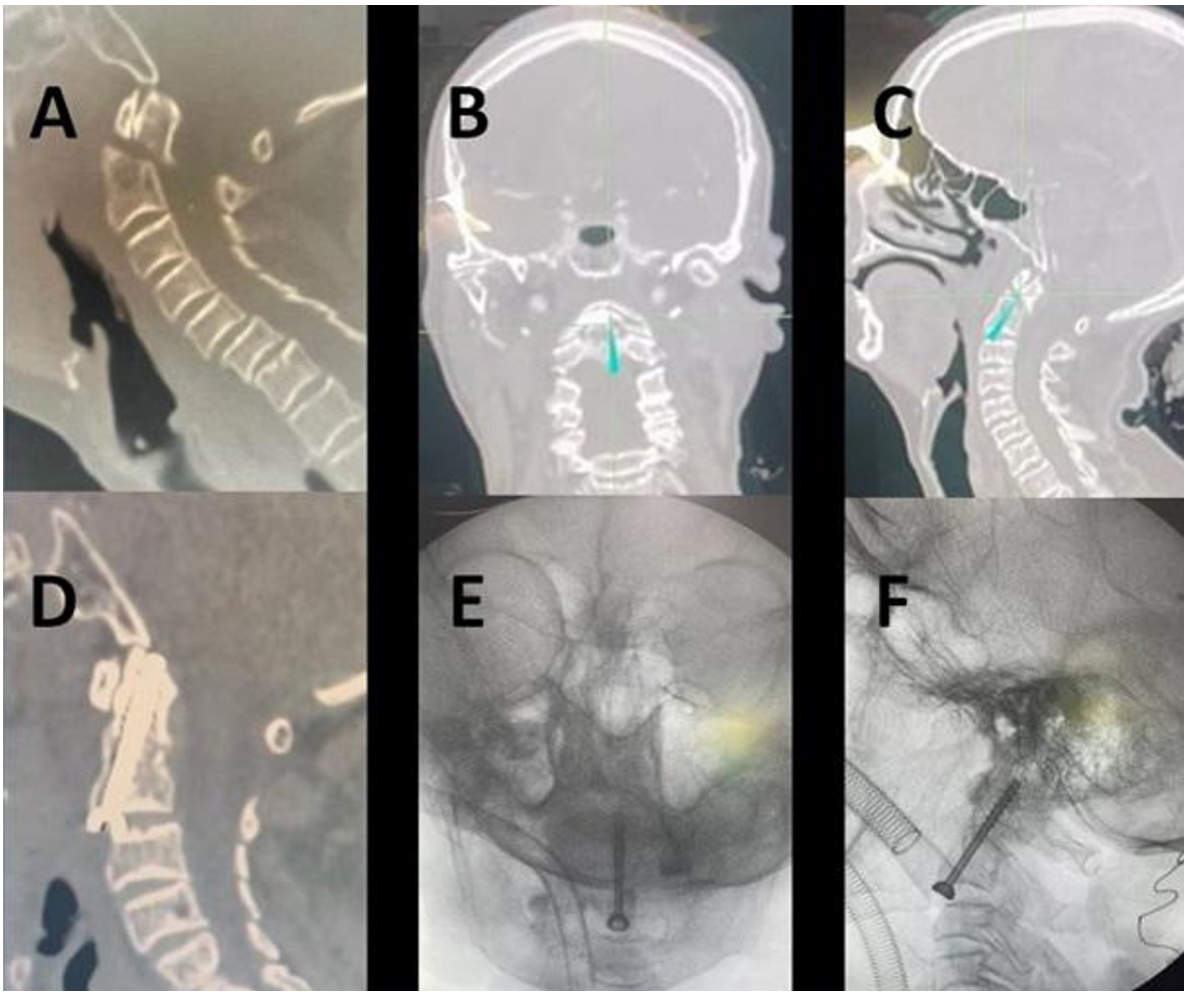


Figure 3. A. Preoperative sagittal view of cervical CT; B.Intraoperative simulation of odontoid screw insertion in coronal plane by navigation; C. Intraoperative simulation of odontoid screw insertion in sagittal plane by navigation; D. Postoperative sagittal view of cervical CT; E. Preoperative scope view after the insertion of the odontoid screw in coronal plane. F. Preoperative scope view after the insertion of the odontoid screw in sagittal plane.

can provide rigid fixation with high fusion rate.[9] However, surgery in this region is exceptionally challenging due to complicated anatomical structures such as the atlantoaxial joint, adjacent ligaments, vertebral arteries, and the spinal cord.[10] Furthermore, the complexity of surgery increases when upper cervical region deformities are combined with these critical structures.[11] Consequently, unusual complications, including bony structure perforation, severe vertebral artery injuries, and spinal cord damage, can arise during the placement of screws within these structures. In addition, conventional methods require repeated exposure of the surgical team to the radiation emitted by the C-arm X-ray device to confirm the positioning of screws during the procedure.[12]

Odontoid fractures may cause serious morbidity and mortality, especially in old-aged patients.[13] Symptoms in these patients range from severe neurological deficits secondary to spinal cord compression to chronic neck pain. According to the Anderson–D'Alonzo classification, high nonunion rates have been reported in type II odontoid fractures, ranging from 15% to 85%, which have poor prognosis.[13-15] The treatment options for unstable type II odontoid fractures vary, but surgical intervention is often required to reduce the rate of nonunion.

Different techniques such as posterior cervical instrumentation and anterior odontoid screw fixation have been described to stabilize these fractures. In these cases, anterior intervention offers several advantages, including high union rates, rapid stabilization, retention of cervical spine mobility, reduced soft tissue damage, and diminished bleeding, as reported in the literature.[16,17] However, serious complications such as injury to the pharynx, esophagus, trachea, vascular, and neural structures have also been reported in anterior interventions, whether performed through open or percutaneous approaches.[16-18]

In addition, upper cervical anterior interventions, just like posterior interventions, require repeated exposure of the

Acta Medica Alanya 2023;7(3): 285-290
Doi: 10.30565/medalanya.1390145

surgical team to the radiation emitted by the C-arm X-ray device to confirm the positioning of screws during the procedure.[18]

The use of computer-based intraoperative navigation provides substantial advantages in terms of understanding the complex spinal anatomy, minimizing screw malposition, reducing radiation exposure, and shortening the operation time in interventions requiring fixation of the upper cervical region, and its use is becoming increasingly common.[19,20] In clinics equipped with intraoperative navigation capabilities, three-dimensional images can be obtained by performing real-time CT scans; this technology considerably reduces the risk of complications compared with conventional fluoroscopic methods.[21] Even though it reduces the radiation dose to the surgeon compared with conventional fluoroscopy, it increases the radiation exposure of the patient.[22]

In addition, intraoperative imaging is not available in all units. In our country, there are only a very few clinics having intraoperative imaging technology. This article describes our technique of utilizing neuronavigation in upper cervical spine surgery requiring instrumentation in clinics that lack intraoperative imaging facilities. In our clinic (Yüksek Ihtisas Education and Research Hospital, Department of Neurosurgery), four atlantoaxial posterior fixations and two anterior odontoid screw fixations were performed using this technique in the last 1 year. In these cases, no perioperative complications occurred, operation times were shorter than in freehand cases, and blood loss was cnsiderably reduced, especially in posterior interventions.

Conclusions: We believe that the use of navigation in clinics that do not have intraoperative imaging facilities will establish a notable advantage over the freehand approach and will also minimize the radiation exposure of the patient and surgical team. Given the rapid pace of technological advancement, we anticipate that navigation will be employed in spinal cases in a remarkably more practical manner, potentially leading to reduced or negligible radiation exposure. This article is expected to provide insight into the progression of these technologies.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: Ethical approval was not required due to technical note article. In this study, national and international ethical rules are observed.

ORCID and Author contribution: A.K. (0000-0002-0505-3027): Study conception and design, Data collection, Draft manuscript preparation, Critical revision, Approved the final version of the manuscript. T.K. (0000-0002-2992-7980): Analysis and interpretation of results, Draft manuscript preparation,

Peer-review: Externally peer reviewed.

Acknowledgement: Authors, thanks to Parents for their contribution. Also, The authors thank Enago – https://www.enago.com.tr/ceviri/ for their assistance in manuscript translation and editing.

References

1. Zhao J, Yang L, Zheng S, Qu Y, Zhang X, Kang M, Dong R, Zhao X, Yu T. A novel screw view model of 3D navigation for upper cervical pedicle screw placement: A case report. Medicine (Baltimore). 2019;98(19):e15291. doi: 10.1097/MD.0000000000015291.
2. Bydon M, Mathios D, Macki M, et al. Accuracy of C2 pedicle screw placement using the anatomic freehand technique. Clin Neurol Neurosurg 2014;125:24–7. doi: 10.1016/j.clineuro.2014.07.017.
3. Pham MH, Bakhsheshian J, Reid PC, et al. Evaluation of C2 pedicle screw placement via the freehand technique by neurosurgical trainees. J Neurosurg Spine 2018;29:235–240. doi: 10.3171/2018.1.SPINE17875.
4. Punyarat P, Buchowski JM, Klawson BT, et al. Freehand technique for C2 pedicle and pars screw placement: is it safe? Spine J 2018;18:1197–1203. doi: 10.1016/j.spinee.2017.11.010.
5. Ondra SL, Marzouk S, Ganju A, et al. Safety and efficacy of C2 pedicle screws placed with anatomic and lateral C-arm guidance. Spine (Phila Pa 1976) 2006;31:E263–7. doi: 10.1097/01.brs.0000214882.34674.be.
6. Li L, Yu X, Wang P, Chen L. Analysis of the treatment of 576 patients with congenital craniovertebral junction malformations. J Clin Neurosci 2012;19: 49–56. doi: 10.1016/j.jocn.2011.03.036.
7. Grob D, Magerl F. Surgical stabilization of C1 and C2 fractures. Orthopade 1987;16: 46–54. PMID: 3574943.
8. Harms J, Melcher RP. Posterior C1-C2 fusion with polyaxial screw and rod fixation. Spine (Phila Pa 1976) 2001;26: 2467–2471. doi: 10.1097/00007632-200111150-00014.
9. Sim HB, Lee JW, Park JT, Mindea SA, Lim J, Park J. Biomechanical evaluations of various c1-c2 posterior fixation techniques. Spine (Phila Pa 1976) 2011;36: E401–E407. doi: 10.1097/BRS.0b013e31820611ba.
10. Tian W, Liu YJ, Liu B, He D, Wu JY, Han XG, et al. Technical Committee on Medical Robot Engineering of Chinese Society of Biomedical Engineering; Technical Consulting Committee of National Robotic Orthopaedic Surgery Application Center. Guideline for Posterior Atlantoaxial Internal Fixation Assisted by Orthopaedic Surgical Robot. Orthop Surg 2019;11(2):160-166. doi: 10.1111/os.12454.
11. Uchino A, Saito N, Watadani T, et al. Vertebral artery variations at the C1-2 level diagnosed by magnetic resonance angiography. Neuroradiology 2012;54(1):19-23. doi: 10.1007/s00234-011-0849-z.
12. Lall R, Patel NJ, Resnick DK. A review of complications associated with craniocervical fusion surgery. Neurosurgery 2010;67:1396–1402. doi: 10.1227/NEU.0b013e3181f1ec73.
13. Anderson LD, D'Alonzo RT. Fractures of the odontoid process of the axis. J Bone Joint Surg Am 1974;56:1663–74. PMID: 4434035
14. Greene KA, Dickman CA, Marciano FF, Drabier JB, Hadley MN, Sonntag VK. Acute axis fractures. Analysis of management and outcome in 340 consecutive cases. Spine 1997;22:1843–52. doi: 10.1097/00007632-199708150-00009.
15. Hsu WK, Anderson PA. Odontoid fractures: update on management. J Am Acad Orthop Surg 2010;18:383–94. doi: 10.5435/00124635-201007000-00001.

16. Shousha M, Alhashash M, Allouch H, Boehm H. Surgical treatment of type II odontoid fractures in elderly patients: a comparison of anterior odontoid screw fixation and posterior atlantoaxial fusion using the Magerl-Gallie technique. Eur Spine J 2019 Mar 16. doi: 10.1007/s00586-019-05946-x.
17. Kuytu T, Karaoglu A, Celik M, Aydemir F, Ozpar R, Tuzun Y. Can The Fracture Line of Type II Odontoid Fractures Come to A Neutral Position After Anterior Odontoid Screw Fixation without a Manipulation? Turk Neurosurg 2022;32(5):793-801. doi: 10.5137/1019-5149.JTN.36245-21.2.
18. Kotheeranurak V, Pholprajug P, Jitpakdee K, Pruttikul P, Chitragran R, Singhatanadgige W, Limthongkul W, Yingsakmongkol W, Kim JS. Full-Endoscopic Anterior Odontoid Screw Fixation: A Novel Surgical Technique. Orthop Surg. 2022 14(5):990-996. doi: 10.1111/os.13271.
19. Navarro-Ramirez R, Lang G, Lian X, et al. Total Navigation in Spine Surgery; A Concise Guide to Eliminate Fluoroscopy Using a Portable Intraoperative Computed Tomography 3-Dimensional Navigation System. World Neurosurg 2017;100:325-35. doi: 10.1016/j.wneu.2017.01.025.
20. Kirnaz S, Gebhard H, Wong T, Nangunoori R, Schmidt FA, Sato K, Härtl R. Intraoperative image guidance for cervical spine surgery. Ann Transl Med. 2021;9(1):93. doi: 10.21037/atm-20-1101.
21. Takamatsu N, Manabe H, Yokoo Y, Wada K, Hirano T, Hibino N, Henmi T, Chikawa T, Sairyo K. Comparison between O-arm Navigation and Conventional Fluoroscopic Guidance in Corrective Posterior Fixation for Cervical Spinal Injury. J Med Invest 2022;69(3.4):273-277. doi: 10.2152/jmi.69.273.
22. Bratschitsch G, Leitner L, Stücklschweiger G, Guss H, Sadoghi P, Puchwein P, Leithner A, Radl R. Radiation Exposure of Patient and Operating Room Personnel by Fluoroscopy and Navigation during Spinal Surgery. Sci Rep 2019;9(1):17652. doi: 10.1038/s41598-019-53472-z.

Acta Medica Alanya

Case Report

Olgu Sunumu

Acta Medica Alanya 2023;7(3): 291-293
Doi: 10.30565/medalanya.1402736

The Occurrence and Curing of Stuttering During The Use of Methylphenidate for ADHD in Childhood: An Inconsistent Relationship

Çocukluk Çağında DEHB Tanısı ile Metilfenidat Kullanımı Sırasında Ortaya Çıkan ve Sonlanan Kekemelik: Tutarsız Bir İlişki

Tayfun Kara[1], Fahri Çelebi[2]

[1] Alanya Alaaddin Keykubat University, Faculty of Medicine, Department of Child and Adolescent Psychiatry, Antalya, Turkey

[2] Doğuş University, Faculty of Arts and Sciences, Department of Psychology, Istanbul, Turkey

ABSTRACT

Stuttering is a childhood onset fluency disorder in speech. It has been suggested to be associated with brain anatomy, functionality or the dysregulation of the dopaminergic activity. Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in childhood and adolescence. Psychostimulant medications are widely used for the psychopharmacologic treatment of ADHD. In this article, two boys who have ADHD with opposite reactions after methylphenidate (MPH) treatment in terms of fluency in the speech are presented. In the first case stuttering was induced with MPH while in the second case stuttering was resolved after MPH treatment. Although MPH seems to have opposite effects on stuttering in our cases, our case report points that dopaminergic system may play a role for the onset of childhood onset fluency disorder. More comprehensive studies are needed to show the neurodevelopmental process and the mechanisms related with ADHD, stuttering and MPH treatment.

Key Words: Methylphenidate; Attention Deficit/ Hyperactivity Disorder, Stuttering, Neural Dynamics, Dopamine, Child

ÖZ

Kekemelik çocukluk döneminde başlayan konuşmada akıcılık bozukluğudur. Beyin anatomisi, işlevselliği veya dopaminerjik aktivitenin düzensizliği ile ilişkili olduğu öne sürülmüştür. Dikkat eksikliği hiperaktivite bozukluğu (DEHB), çocukluk ve ergenlik döneminde en sık görülen psikiyatrik bozukluklardan biridir. DEHB'nin psikofarmakolojik tedavisinde psikostimülan ilaçlar yaygın olarak kullanılmaktadır. Bu makalede, metilfenidat (MPH) tedavisi sonrası konuşma akıcılığı açısından birbirine zıt tepkiler veren DEHB'li iki erkek çocuk sunulmaktadır. İlk vakada kekemelik MPH ile indüklenirken, ikinci vakada kekemelik MPH tedavisinden sonra çözüldü. Olgularımızda MPH'nin kekemelik üzerinde birbirine zıt etkileri varmış gibi görünmektedir, olgu sunumumuz çocukluk çağı başlangıçlı akıcılık bozukluğunun ortaya çıkmasında dopaminerjik sistemin rol oynayabileceğine işaret etmektedir. DEHB, kekemelik ve MPH tedavisi ile ilgili nörogelişimsel süreci ve mekanizmaları göstermek için daha kapsamlı çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Metilfenidat; Dikkat Eksikliği/Hiperaktivite Bozukluğu, Kekemelik, Nöral Dinamikler, Dopamin, Çocuk

Recieved Date: 10.12.2023 / **Accepted Date:** 16.12.2023 / **Published (Online) Date:** 31.12.2023

Corresponding author: Assoc. Prof. Tayfun Kara (Head of Department), Alanya Alaaddin Keykubat University, Faculty of Medicine, Department of Child and Adolescent Psychiatry Kestel Mah. Üniversite Cad. No:80 Alanya 07425, Antalya, Türkiye

Phone: 05059255536 / **mail:** tayfunkara@hotmail.com

ORCID: 0000-0002-2156-3457

To cited: Kara T, Çelebi F. The occurrence and curing of stuttering during the use of methylphenidate for ADHD in childhood: An inconsistent relationship. Acta Med. Alanya 2023;7(3): 291-293 doi: 10.30565/medalanya.1402736

Acta Medica Alanya SEP-DEC 2023 Open Access http://dergipark.gov.tr/medalanya
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License

Introduction

Stuttering is a speech disorder which may cause deficits in the fluency and timing of the speech. Current data suggest that stuttering may be related with central nervous system dysfunction which effects speaking fluently.[1] Lifetime prevalence of stuttering was reported as 5%.[2] Stuttering has been labelled as "childhood onset fluency disorder" and classified in ''neurodevelopmental disorders" according to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5).[3] Neurodevelopmental disorders emerge in early childhood because of the atypical development of central nervous system.[4] The emergence of stuttering is usually between 25th and 48th months in childhood period. Up to 90% of the cases may recover until adulthood naturally.[1] However, stuttering has been reported to be associated with lower quality of life, higher levels of anxiety, emotional and behavioral problems.[1,2]

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized with inattention, hyperactivity and impulsivity. Estimated prevalence of ADHD varies between 6.7% and 12%.[5] Pharmacological agents, psychosocial/behavioral interventions and combined treatments have been widely used for the treatment of ADHD. Imbalance in the dopaminergic and noradrenergic systems in the prefrontal cortex has been suspected for the etiology of ADHD.[5] Psychopharmacologic agents (such as methylphenidate and atomoxetine) that modulate dopaminergic and noradrenergic systems are the first line pharmacologic treatments in ADHD.[6]

Here, we report two cases, one whose stuttering began with MPH therapy and the other whose stuttering resolved with MPH therapy.

Case Presentation

Case 1: A nine year old boy was referred to our clinic by his parents due to hyperactivity, impulsivity, problems engaging with his peers, inattentiveness and failure at school. He had problems to focus on tasks and sustain attention. His psychomotor activity was elevated, impulse control and frustration tolerance was decreased. There was no history of any systemic physical illness, epilepsy or hospitalization in the past. He has achieved psychomotor developmental milestones on time. He was diagnosed with ADHD in our clinic according to DSM-5 criteria.

After diagnosing ADHD, behavioral therapy, psychoeducation and extended release formulation (osmotic controlled-release oral delivery system-OROS) of MPH 18mg/day were initiated. OROS-MPH dose was titrated to 27mg/day and 36mg/day in the second and third interview, respectively and significant recovery was observed. However, after increasing the dose of OROS-MPH to 36mg/day the child's family began to complain about stuttering. There have been no symptoms of stuttering earlier. Moreover, there was no family history of stuttering. They reported that first signs of stuttering have been appeared after increasing the dose to 27mg/day and after taking 36mg daily dose of OROS-MPH stuttering became more severe and frequent. The symptoms were described as not using the breath appropriately. A full medical and neurological work out was done and reported to be normal. These signs have raised the question if there was a relationship between OROS-MPH and symptoms of stuttering. To check this relationship OROS-MPH was stopped. 4 days after cessation the OROS-MPH treatment stuttering resolved while ADHD symptoms were remitted. The patient tolerated the medication well without any side effects that were commonly seen with OROS-MPH.

Case 2: A 7 year old boy who was admitted to our clinic due to behavioral problems at school. His teacher referred him for a psychiatric evaluation for hyperactivity, inattentiveness, difficulty in listening lessons and completing homework. He had had problems with his peers because of his impulsive behaviors and hyperactivity. There was no history of any systemic physical illness, epilepsy or hospitalization in the past. There have been problems in the fluency of the speech for two years before admission. He was diagnosed with ADHD and childhood onset fluency disorder according to the DSM-5. 10mg/day MPH was initiated and the dose was titrated to 20 mg/day in the follow up. Symptoms of ADHD have been improved according to his parents with the dose of 20mg/day in addition to the recovery of stuttering. During the period of COVID-19 pandemics his parents stopped MPH treatment by themselves. After cessation of the oral MPH, symptoms of stuttering appeared again. After the initiation of MPH again, stuttering was disappeared along with the improvement in the symptoms of ADHD.

Discussion

The literature about the association of MPH and stuttering is controversial. A significant relationship was reported between the symptoms of stuttering and MPH treatment.[7,8] In a placebo-controlled trial Rabaeys et al. (2015) found significant decrease in the frequency of stuttering with MPH treatment.[9] Moreover, in a case report it was reported that ongoing stuttering of an 18 year old man from early childhood was resolved after MPH treatment.[10] On the other hand, occurrence of stuttering has been reported under treatment with other dopaminergic agents such as Levodopa and Bupropion.[11,12]

Acta Medica Alanya 2023;7(3): 291-293
Doi: 10.30565/medalanya.1402736

Wu et al (1997) found increased dopaminergic activity at medial prefrontal cortex, deep orbital cortex, insular cortex and auditory cortex in patients who have stuttering. And they suggested that stuttering has been associated with the brain regions that modulate speech.[13] It has been suggested that stuttering and related motor movements may be due to the dysfunction in the basal ganglia or a general dysfunction of the dopaminergic system.[14] Neuroimaging studies have found differences in the brain anatomy and functionality-especially in motor and auditory regions- in children with stuttering.[15] However, the exact effect of the dopaminergic dysfunction in stuttering is not clear. In some cases neuroleptic agents that have anti-dopaminergic effects have been used for the treatment of stuttering[16,17,12]], while in some cases stuttering was induced by antipsychotic agents.[18,19,20] The pathophysiological mechanisms of ADHD, stuttering and MPH activity have not been fully elucidated, but they are all associated with the dopaminergic system.[7]

In addition, children with stuttering have been reported to have more ADHD symptoms than children without stuttering.[21] However, in our cases, the main complaints for their admission to the clinic were ADHD symptoms. In the first case OROS MPH induced stuttering. However, interestingly, stuttering was recovered after MPH treatment in the second case. In this case, improvement in stuttering was observed under long-acting methylphenidate therapy. However, no explanation can be given as to why/how MPH is responsible for the emergence of stuttering in one case and for the decrease in stuttering in the second case. Furthermore, the exact mechanisms of these individual differences in the effect of MPH treatment are unclear.

In this case report we reported two cases with opposite effects of MPH on stuttering. MPH seems to have opposite effects on stuttering in our cases. Although, the mechanisms underlying the symptoms of stuttering are unclear, these cases may point that dopaminergic system may be related with the childhood onset fluency disorder. More comprehensive studies are needed to show the neurodevelopmental and neurochemical pathways and the mechanisms associated with ADHD, stuttering and MPH treatment.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support.

Ethics Committee Approval: Informed consent was obtained from the patient's parents.

ORCID and Author contribution: *T.K.(0000-0002-2156-3457), F.Ç. (0000-0001-9835-9270).* All authors contributed to the manuscript conception, design, literature search, writing and critical review

Peer-review: Externally peer reviewed

References

1. Perez HR, Stoeckle JH. Stuttering: Clinical and research update. Can Fam Physician. 2016; 62:479-84. PMID: 27303004
2. Yairi E, Ambrose N. Epidemiology of stuttering: 21st century advances. J Fluency Disord. 2013; 38:66-87. doi: 10.1016/j.jfludis.2012.11.002
3. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5). 5th ed. Arlington (VA): American Psychiatric Publishing; 2013. doi: 10.1176/appi.books.9780890425596
4. Smith A, Weber C. How Stuttering Develops: The Multifactorial Dynamic Pathways Theory. J Speech Lang Hear Res. 2017; 60:2483-2505. doi: 10.1044/2017_JSLHR-S-16-0343
5. Shier AC, Reichenbacher T, Ghuman HS, Ghuman JK. Pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: clinical strategies. J Cent Nerv Syst Dis. 2012; 5:1-17. doi: 10.4137/JCNSD.S6691
6. Sharma A, Couture J. A review of the pathophysiology, etiology, and treatment of attention-deficit hyperactivity disorder (ADHD). Ann Pharmacother. 2014; 48:209-25. doi: 10.1177/1060028013510699
7. Trenque T, Claustre G, Herlem E, et al. Methylphenidate and stuttering. Br J Clin Pharmacol. 2019;85(11):2634-2637. doi: 10.1111/bcp.14097
8. Alpaslan AH, Coşkun KŞ, Kocak U, Gorücü Y. Stuttering Associated With the Use of Short-Acting Oral Methylphenidate. J Clin Psychopharmacol. 2015; 35:739-41. doi: 10.1097/JCP.0000000000000403
9. Rabaeys H, Bijleveld HA, Devroey D. Influence of Methylphenidate on the Frequency of Stuttering: A Randomized Controlled Trial. Ann Pharmacother. 2015; 49:1096-104. doi: 10.1177/1060028015596415
10. Devroey D, Beerens G, Van De Vijver E. Methylphenidate as a treatment for stuttering: a case report. Eur Rev Med Pharmacol Sci. 2012; 16:66-9. PMID: 23090813
11. Louis ED, Winfield L, Fahn S, Ford B. Speech dysfluency exacerbated by levodopa in Parkinson's disease. Mov Disord. 2001; 16:562-5. doi: 10.1002/mds.1081
12. McAllister MW, Woodhall DM. Bupropion-induced stuttering treated with haloperidol. Clin Toxicol (Phila). 2016; 54:603. doi: 10.1080/15563650.2016.1179749
13. Wu JC, Maguire G, Riley G, Lee A, Keator D, Tang C, Fallon J, Najafi A. Increased dopamine activity associated with stuttering. Neuroreport. 1997; 8:767-70. doi: 10.1097/00001756-199702100-00037
14. Mulligan HF, Anderson TJ, Jones RD, Williams MJ, Donaldson IM. Tics and developmental stuttering. Parkinsonism Relat Disord. 2003; 9:281-9. doi: 10.1016/s1353-8020(03)00002-6
15. Chang SE. Research updates in neuroimaging studies of children who stutter. Semin Speech Lang. 2014; 35:67–79. doi: 10.1055/s-0034-1382151
16. Hoang JL, Patel S, Maguire GA. Case report of aripiprazole in the treatment of adolescent stuttering. Ann Clin Psychiatry. 2016; 28:64-5. PMID: 27500298
17. Lavid N, Franklin DL, Maguire GA. Management of child and adolescent stuttering with olanzapine: three case reports. Ann Clin Psychiatry. 1999; 11:233-6. doi: 10.1023/a:1022365513865
18. Murphy R, Gallagher A, Sharma K, Ali T, Lewis E, Murray I, Hallahan B. Clozapine-induced stuttering: an estimate of prevalence in the west of Ireland.Ther Adv Psychopharmacol. 2015; 5:232-6. doi: 10.1177/2045125315590060
19. Bär KJ, Häger F, Sauer H. Olanzapine- and clozapine-induced stuttering. A case series. Pharmacopsychiatry. 2004; 37:131-4. doi: 10.1055/s-2004-818992
20. Yadav DS. Risperidone induced stuttering. Gen Hosp Psychiatry. 2010; 32:559.e9-10. doi: 10.1016/j.genhosppsych.2010.01.004
21. Druker K, Hennessey N, Mazzucchelli T, Beilby J. Elevated attention deficit hyperactivity disorder symptoms in children who stutter. J Fluency Disord. 2019;59:80-90. doi: 10.1016/j.jfludis.2018.11.002

Acta Medica Alanya 2022;7(3):294

Reviewer List 2022 (Alphabetical) / Hakem Listesi 2022 (Alfabetik)

We would like to thank our peer reviewers who take the time to submit thoughtful contributions to Acta Medica Alanya. We know how much time and effort goes into writing a good peer review, and we deeply value the input of reviewers who volunteer their time and expertise to provide essential feedback that ensures the high quality of research published in the fourth issue of the journal. Editorial Publishing Board

Abdulgani KAYMAZ
Abdullah Alper ŞAHİN
Ahmet AKSOY
Ahmet ASLAN
Ali BİLGE
Anıl ŞAHİN
Banu KARAKUŞ YILMAZ
Bayram CAN
Berrin IŞIK
Bülent KILIÇ
Cemal KÖSEOĞLU
Cemil ERTÜRK
Duran TOPAK
Ebru ALADAĞ
Eyüp AYDOĞAN
Eyüp AYDOĞAN
Eşref SELÇUK
Filiz ALKAYA
Fuat YAVRUM
Furkan YAPİCİ
Gökhan GÜMÜŞTAŞ
Güldem TURAN
Güray ALTUN
Hasan MAY
Hüseyin Çiyiltepe
Kenan Serdar DOLAPÇIOĞLU
Mehmet SEÇER
Metin ÇELİK
Osman CİLOGLU
Oğuz KARAHAN
Pakize KIRDEMİR
Saadettin ÇİFTÇİ
Selime ÇELİK
Semra YILMAZ
Serhat CÖMERT
Tacettin KURU
Tunay ERDEN
Uğur TEKİN
Vahdet UÇAN
Yilmaz GÜLER
Çağla AMUTKAN ÇİÇEK
Ömer Faruk RECEP
Özgür Şakir KEŞKEK
Özlem DELİGÖZ
İshak Suat Övey
İsmail AKALTUN
İsmail BÜYÜKCERAN
Şule YILDIRIM KÖPÜK