ORIGINAL ARTICLE

Anesthetic approach to trauma patients in the city hospital after the 2023 Maraş earthquake

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ABSTRACT

BACKGROUND: The February 6, 2023, Kahramanmaraş earthquake caused significant destruction across our country. More than 50,000 people lost their lives, thousands were injured, and health facilities were damaged. Victims were transferred to hospitals in other provinces for treatment. This study evaluates the anesthesia approach applied to the injured who were transferred to our tertiary hospital.

METHODS: We retrospectively reviewed the data of patients who underwent surgery between February 6 and February 20, 2023. The study included earthquake victims who underwent emergency trauma surgery, aged 10 years and above. We recorded the date of admission to the hospital, demographic information, type of surgery, surgical site, anesthesia technique, preference for peripheral block, laboratory values, dialysis and intensive care needs, and survival rates. Data analysis was performed using the IBM® Statistical Package for the Social Sciences (SPSS®) Version 26.0.

RESULTS: A total of 375 cases were included in the study. Of these, 323 patients underwent surgery for extremity injuries, and 35 for vertebral injuries. Among the extremity injuries, 61.6% were to the lower extremities, and 17.1% to the upper extremities. Debridement was performed on 147 patients, fasciotomy on 49 patients, and amputation on 33 patients. General anesthesia was applied to 352 patients, spinal anesthesia to 19 patients, and sedoanalgesia to four patients. Peripheral nerve block was performed on 33 patients. Dialysis treatment was administered to 105 patients. Twenty-six patients were lost during the treatment process. There were no intraoperative patient deaths.

CONCLUSION: The predominance of extremity injuries among earthquake victims increases the inclination towards regional anesthesia. Incorporating Plan A blocks into basic anesthesia skills could enhance the preference for regional anesthesia in disaster situations. Furthermore, transferring the injured to advanced centers may reduce morbidity.

Keywords: Anesthesia; crush syndrome; earthquake; regional anesthesia; trauma.

INTRODUCTION

On February 6, 2023, Turkey experienced two major earthquakes with moment magnitudes (Mw) of 7.7 and 7.6. These were centered in Pazarcık-Kahramanmaraş (37.288 N, 37.043 E) and Elbistan-Kahramanmaraş (38.089 N, 37.239 E), respectively.[1] The area affected by the earthquake is illustrated in Figure 1.

Earthquakes are large-scale, sudden-onset natural disasters that can be more destructive than other types of disasters.[2] High numbers of deaths and injuries are often reported when densely populated areas are impacted.[3] The most common injuries associated with earthquakes include extremity injuries and Crush Syndrome.[4] Patients with crush injuries, such as those experiencing Crush Syndrome, are generally first treated at the disaster site. Initial interventions can include basic life

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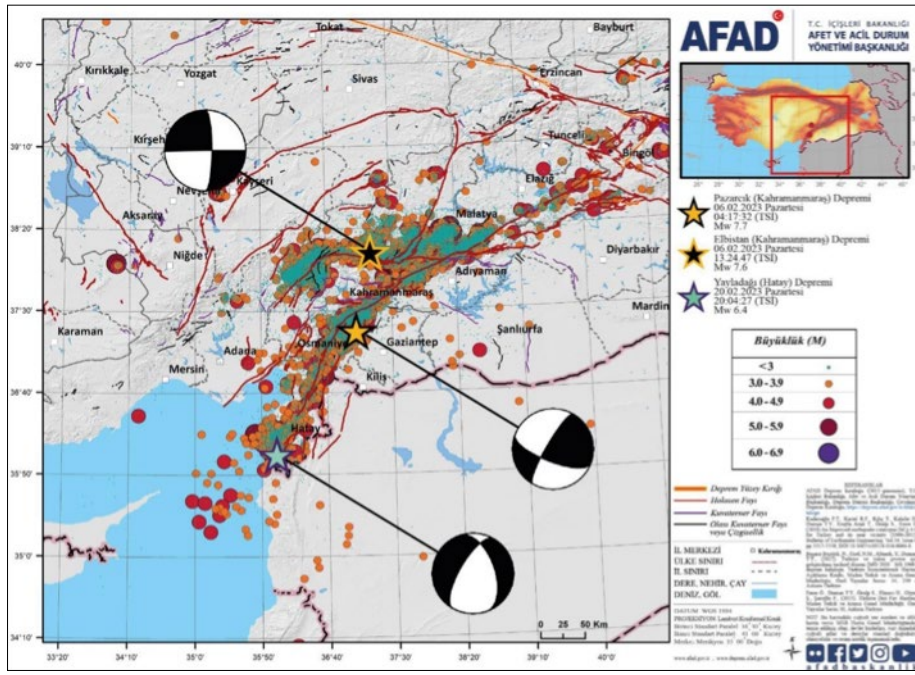

Figure 1. February 6, 2023, earthquakes in Pazarcık (Kahramanmaraş) Mw 7.7, Elbistan (Kahramanmaraş) Mw 7.6, and Yayladağı (Hatay) Mw 6.4, and aftershock activity from February 6 to May 6, according to the AFAD Earthquake Report.

support and emergency surgical procedures (e.g, fasciotomy, amputation) for conditions like compartment syndrome. For surgical procedures performed in the field, techniques such as deep sedation (using intravenous ketamine, midazolam, etc.) while maintaining spontaneous breathing, local anesthesia, or peripheral nerve blocks can be utilized.[5] Following initial intervention, patients require transfer to centers equipped with intensive care units for continued treatment.

After the earthquakes, there is an increased demand for healthcare services due to the number of injuries. It is well-documented that the highest demand for hospital services occurs within the first 72 hours following a disaster.[6,7] However, in the affected areas, health services often face challenges due to damaged infrastructure, a lack of trained personnel in local response teams, shortages of necessary equipment, and issues with coordination and transportation.[3]

In many natural disasters, the strategy of sending rescue teams and health supplies to the affected zone is complemented by transferring patients to surrounding hospitals to ensure the continuation of health services.[6] Following the February 6 Kahramanmaraş earthquake, victims received treatment after being transferred to hospitals within the disaster area and to advanced center hospitals.

The aim of this study is to evaluate the anesthesia and analgesia methods employed for earthquake victims who underwent surgery at the tertiary Ministry of Health Training and Research Hospital. It seeks to share data on hospital morbidity, mortality in the first 15 days after the earthquake, and insights gained from managing this disaster.

MATERIALS AND METHODS

This descriptive cross-sectional study compiled data from a total of 438 patients who underwent surgery in the Neurology-Orthopedics operating room of our hospital between February 6, 2023, and February 20, 2023. Information was gathered from anesthesia reports and the hospital's information processing software (EBYS). The study population comprised earthquake victims aged 10 years and older who received emergency trauma surgery in the Neurology-Orthopedics operating room of our hospital.

Patients' hospital admission dates, demographic information (gender, age, weight, height), type and region of surgery, anesthesia technique, preference for peripheral block, laboratory values (hemoglobin (Hb), hematocrit (Hct), white blood cell count (WBC), platelet (Plt), activated partial thromboplastin time (aPTT), international normalized ratio (INR), creatinine (Cr), urea, glomerular filtration rate (GFR) and electrolyte levels including sodium (Na), potassium (K), chloride (Cl), calcium (Ca), and phosphorus (P), as well as creatine kinase (CK), creatine kinase myocardial band (CK-MB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH) and blood gas levels) were recorded. The need for renal replacement therapy, intensive care, and patient survival status were also documented. The collected data were analyzed using descriptive statistics and are presented in descriptive form through line charts, funnel charts, box plots, and tables.

Statistical Analysis

The IBM® Statistical Package for the Social Sciences (SPSS®)

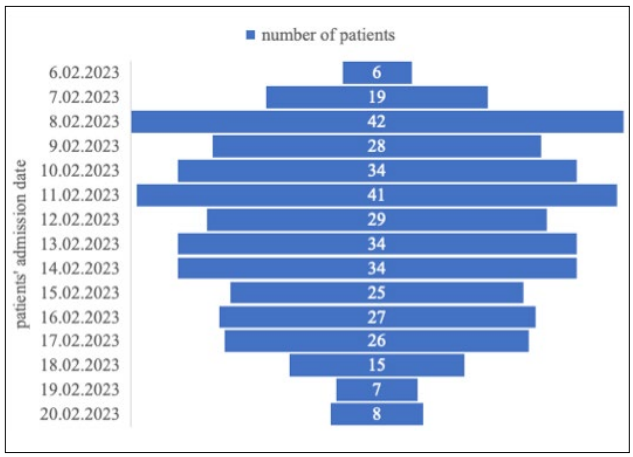

Figure 2. Number of patients by day.

Version 26.0 software package (IBM Corp.; Armonk, New York, USA) was employed for the statistical analysis of the research data. In the section on descriptive findings, categorical variables are presented as number (n) and percentage (%), while continuous variables are expressed as mean±standard deviation (SD) [minimum (min) - maximum (max)].

RESULTS

The study examined the data of 438 patients. A total of 62 patients who underwent emergency trauma surgery but were not earthquake victims were excluded from the study. Additionally, one patient, an earthquake victim whose operation was canceled due to ventricular fibrillation, was not included in the assessment. Some patients (n=84) underwent multiple operations, and statistical evaluations were conducted with 375 cases.

On the first day following the earthquake, six cases were operated on in our hospital. The highest number of operations, 42 cases, was performed on the third day, as illustrated in Figure 2.

During this period, 192 females (51.2%) and 183 males (48.8%) were operated on. The overall mean age of the patients was 38.81±16.67 years [minimum 12, maximum 93], with the mean age for male patients at 37.86±16.82 years [minimum 12, maximum 93] and for female patients at 39.72±16.51 years [minimum 12, maximum 84].

As shown in Table 1, 48.3% of the patients were admitted to the operating room from the emergency department, 30.4%

Table 1. Demographic and perioperative details of the patients

Age (years)	**Mean±SD**	**Median (Min-Max)**
Male	37.86±16.82	35 (12-93)
Female	39.72±16.51	38.5 (12-84)
Total	38.81±16.67	37 (12-93)
	n	**n (%)**
Gender		
Male/Female	183/192	48.8/51.2
Unit Where the Patient Comes to the Operating Room		
Emergency Department	181	48.3
Inpatient Service	114	30.4
ICU	80	21.3
Unit Where the Patient Was Transferred Postoperatively		
Inpatient Service	185	49.3
ICU	190	50.6
The Patient's Need for Renal Replacement Therapy		
Yes	105	28
No	270	72
Number of Operations		
Operated Once	157	41.86
Operated 2 or More Times	84	22.4
Survival Rate		
Alive/Exitus	349/26	93.1/6.9

*Data are shown as mean ± standard deviation. SD: Standard Deviation; n: Number; n%: Percentage; ICU: Intensive Care Unit.

Table 2. Operation area of the patients

Surgery Site	n	n (%)
Lower limb	231	61.6
Upper limb	64	17.1
Vertebra	35	9.3
Upper + Lower limb	28	7.5
Pelvis	8	2.1
Upper limb + Vertebra	3	0.8
Lower extremity + Pelvis	2	0.5
Lower limb + Vertebra	1	0.3
Scapula	1	0.3
Pelvis + Vertebra	1	0.3
Cranium	1	0.3

*Data are shown as number (n) and percentage (n%).

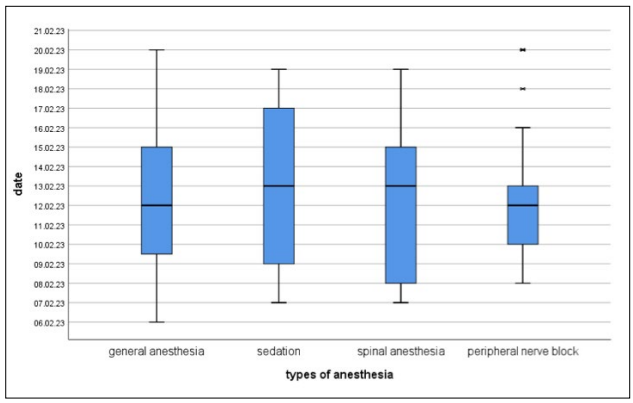

Figure 3. Types of anesthesia applied to patients.

Table 3. Peripheral nerve blocks applied to patients

Peripheral Nerve Block	n	n (%)
Sciatic nerve block	9	2.4
Popliteal sciatic nerve block	4	1.1
Interscalene brachial plexus block	4	1.1
Axillary brachial nerve block	3	0.8
Stellate ganglion block	3	0.8
Erector spinae plane block	3	0.8
Infraclavicular brachial nerve block	2	0.5
Fascia iliaca nerve block	2	0.5
Femoral nerve block	2	0.5
Popliteal sciatic nerve + Saphenous nerve block	1	0.3

*Data are shown as number (n) and percentage (n%).

from inpatient services, and 21.3% from intensive care units. Post-operation, 49.3% of the patients were transferred to inpatient services, and 50.6% to intensive care units.

Out of the earthquake victims, 323 (86%) underwent surgery due to extremity injuries. Among these, 231 (61.6%) had lower extremity injuries, 64 (17.1%) had upper extremity injuries, and 28 (7.5%) had injuries to both upper and lower extremities. There were 35 cases of vertebral injuries, eight of pelvic fractures, three of upper extremity injuries with vertebral fractures, two of lower extremity injuries with pelvic fractures, one of lower extremity injury with vertebral fracture, one combined pelvic and vertebral fracture, one scapular fracture, and one case of subarachnoid hemorrhage. The operation areas of the patients are detailed in Table 2.

For extremity injuries, debridement was performed on 147 patients, fasciotomy on 49, and amputation on 33. Surgeries for fractures included 20 femurs, 19 tibias, 10 humeruses, and eight pelvises. A combination of fasciotomy and amputation was conducted on seven patients. Neurosurgery was performed on 35 patients for vertebral fractures.

Of the earthquake victims, 352 patients (93.9%) received general anesthesia, 19 patients (5.1%) underwent spinal anesthesia, and four patients (1.1%) were given sedation. Additionally, peripheral nerve blocks were administered to 33 patients (8.8%). The anesthesia methods applied are depicted in Figure 3. Table 3 lists the specific types of peripheral nerve blocks performed, including sciatic nerve block (n=9), popliteal sciatic nerve block (n=4), interscalene brachial plexus block (n=4), axillary brachial plexus block (n=3), stellate ganglion block (n=3), erector spinae plane block (n=3), infraclavicular brachial plexus block (n=2), fascia iliaca block (n=2), femoral nerve block (n=2), and a combined popliteal sciatic and saphenous nerve block (n=1).

Renal replacement therapy was administered to 28% of patients during their treatment, while 72% did not require this therapy throughout their hospital stay.

The perioperative laboratory values of 375 patients were

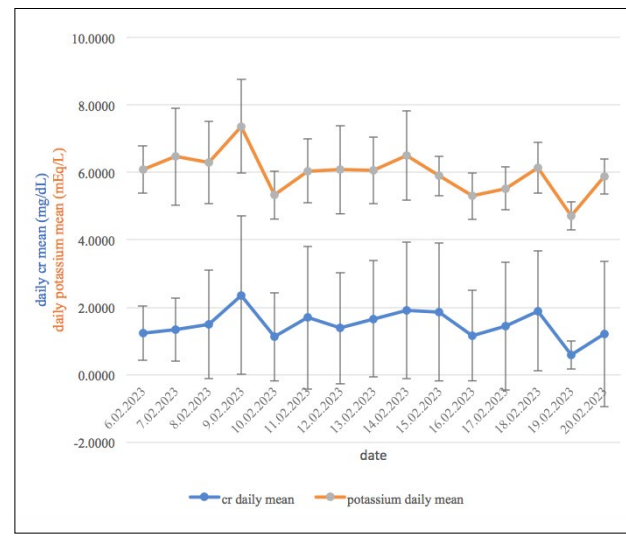

Figure 4. Daily mean creatinine (Cr) and potassium changes. Data are expressed as mean±SD.

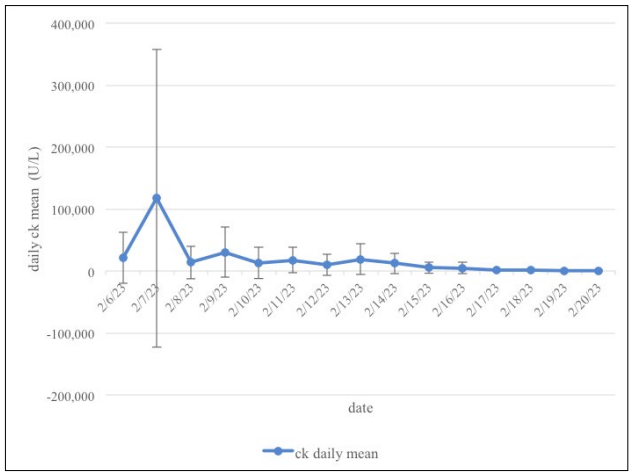

Figure 5. Daily mean creatine kinase (CK) changes. Data are expressed as mean±SD.

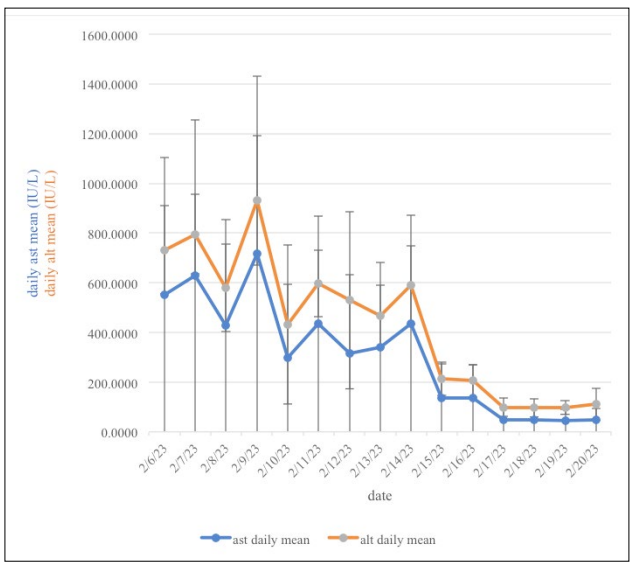

Figure 6. Daily mean aspartate aminotransferase (AST) and alanine aminotransferase (ALT) changes. Data are expressed as mean±SD.

examined. The mean hemoglobin value was 10.89±2.89 g/dL [min 5.5, max 19.9], the mean white blood cell count was 14.63±7.16 x 10^3 (mm^3) [min 3.6, max 47], the mean platelet count was 263.22±125.74 x 10^3 (µL) [min 22, max 697], and the mean pH value was 7.4±0.09 [min 6.93, max 7.62]. Changes in laboratory values are graphically presented in Figures 4, 5, and 6.

Of the 375 patients evaluated, 26 (6.9%) were declared deceased in the unit where they were hospitalized, while 349 (93.1%) were discharged. There were no intraoperative deaths.

DISCUSSION

The severe destruction and losses caused by the earthquake, especially in Hatay, Kahramanmaraş, and Adıyaman, were exacerbated by significant damage to universities and training research hospitals, complicating the continuation of emergency health services in the region. The earthquake's impact on healthcare workers in the region and the high number of injuries caused significant disruptions to healthcare services.

In response to the disaster, national rescue teams, healthcare personnel, and ambulances were swiftly dispatched to the affected area, and field hospitals were established. Furthermore, over 50,000 injured individuals were transferred from the earthquake zone to healthcare facilities in surrounding provinces via air ambulances and sea transport. The relocation of injured patients to our hospital was notably facilitated by the undamaged airports in the region. Along with many advanced hospitals, our facility also provided healthcare services to earthquake victims.[8]

Our institution is a tertiary training and research hospital situated at the center of the province. Immediately following the earthquake, an emergency action plan was activated in the emergency department, intensive care units, and operating rooms of our hospital. A communication network among relevant departments was established to ensure efficient coordination. From the first day following the earthquake, patients were promptly taken to surgery in the Neurology-Orthopedics operating room. Consistent with previous earthquakes, the most intensive surgical interventions on earthquake victims occurred on the third day after the disaster.[9]

As anticipated, the most common injuries among those rescued from the rubble were extremity injuries and Crush Syndrome. In the initial days following the disaster, patients arriving at our emergency department were first treated by having a hemodialysis catheter inserted. After initial treatments, some of the triaged patients were directly admitted to intensive care units, while a significant number were admitted to departments such as orthopedics, neurosurgery, and plastic surgery. Surgical procedures were continuously performed in 20 operating rooms allocated for earthquake victims. Anticipating an increase in patient volume, our hospital made necessary preparations by augmenting equipment and personnel resources accordingly. From the initial days following the earthquake, the surge in patient numbers was managed swiftly and efficiently.

A key indicator of this success was the rapid normalization of laboratory parameters related to Crush Syndrome, particularly after the first day of transporting earthquake victims.

In cases managed by the Orthopedics clinic, injuries to the lower extremities were more commonly observed than those to the upper extremities, a trend consistent with previous earthquake disasters.[6,10–12] The most frequent orthopedic surgical interventions included debridement and fasciotomy, followed by amputation, surgeries for long bone fractures (femur, tibia, humerus), and procedures for pelvic fractures.[13] During the initial days post-disaster, fasciotomies and debridements were performed frequently, with debridement becoming the most common surgery in subsequent cases. Surgery for vertebral fractures was the most common sur-

gery performed by neurosurgeons.

In natural disasters with a high casualty toll, such as earthquakes, the choice of anesthesia technique is contingent upon the existing conditions and the anesthesiologist's experience. In disaster zones where hospitals and infrastructure suffer damage and there is a scarcity of clinicians, selecting a rapid, effective, and safe anesthesia technique with the available resources becomes essential.[14,15]

Historical data from past earthquakes have shown that both general and regional anesthesia techniques are frequently utilized for patients affected by disasters.[16] General anesthesia can be an effective option for hemodynamically unstable, multitrauma earthquake victims. However, administering general anesthesia in disaster zones can be difficult due to the lack of ventilation devices, oxygen sources, inhalation agents, monitoring equipment, airway management tools, and trained personnel. Additionally, patients may not be in a fasting state, necessitating rapid sequence intubation. General anesthesia may lead to cardiorespiratory depression, necessitating increased postoperative care and monitoring.[5,14] Administering general anesthesia to a large number of patients requires a sufficient supply of anesthesia machines and anesthetic drugs. However, these conditions may not be readily achievable in disaster areas during the initial days following the event.[3] Our hospital, located far from the earthquake zone, did not face any constraints in providing general anesthesia, both in terms of technical equipment and the availability of competent healthcare personnel. On the first day following the disaster, most patients undergoing surgery received general anesthesia. This decision was driven by several factors, including the prevalence of Crush Syndrome among patients, unstable vital signs, and psychological distress. Until a balance was reached between the high volume of patients and the availability of doctors competent in regional anesthesia, peripheral nerve blocks could not be administered to all patients for postoperative analgesia management. Therefore, on the first day, a multimodal analgesia, primarily consisting of systemic Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) and opioids, was implemented.

The frequent occurrence of extremity injuries in earthquake victims in recent years has prompted anesthesiologists to use regional anesthesia for these cases.[15,17,18] It is well-established that neuraxial and peripheral nerve blocks provide effective and safe anesthesia and postoperative analgesia for extremity traumas.[19] Moreover, the use of regional anesthesia reduces the incidence of side effects such as respiratory depression, nausea, and vomiting by decreasing the reliance on narcotics. This reduction in side effects also diminishes the need for postoperative intensive care and monitoring.[14]

However, to administer regional anesthesia, which offers numerous advantages, especially under disaster conditions, specific equipment and expertise are necessary. This includes an ultrasound device, a nerve stimulation device, peripheral block needles, and a clinician experienced in regional anesthesia. Despite our hospital having both the necessary equipment and competent doctors for regional anesthesia, the high volume of patients on the first day disrupted the application of peripheral nerve blocks. Particularly, the psychological shock experienced by patients and the absence of their relatives hindered the collection of sufficient medical history. For instance, without being able to inquire about the use of antiplatelet drugs and other medications, central blocks such as spinal anesthesia were avoided.

During the initial days of the disaster, general anesthesia was predominantly chosen for patients undergoing surgery. As the patient load decreased in the following days, spinal and regional anesthesia techniques began to be utilized. Starting from the second day after the earthquake, spinal anesthesia was adopted as the primary method of anesthesia in our clinic. From the second day onwards, with the organization of doctors competent in regional anesthesia and the support of auxiliary healthcare personnel, anesthesia techniques including peripheral nerve blocks and multimodal analgesia were applied to all patients. Patients undergoing upper extremity surgery under general anesthesia received regional anesthesia for postoperative analgesia, either while still under general anesthesia or after awakening, while those undergoing lower extremity surgery were administered a postoperative peripheral nerve block following either general or spinal anesthesia.

In cases requiring repeated extensive extremity debridement, general anesthesia with supraglottic airway devices was preferred due to the patients' psychological states and the short duration of the surgeries. Peripheral nerve blocks were selected for postoperative pain management and the prevention of phantom pains.

CONCLUSION

This study illustrates that the transportation of earthquake victims suffering from crush syndrome and severe extremity injuries to tertiary care facilities, coupled with a multidisciplinary treatment approach, can enhance clinical recovery outcomes for these patients. While the selection of an anesthesia technique for earthquake victims is contingent upon the situation and the practitioner's discretion, the preference for regional anesthesia could be increased by incorporating Plan A blocks into essential anesthesia skills. We believe that quickly establishing a patient transfer network to advanced centers in disaster situations is a critical life-saving measure, particularly in the initial days following a disaster.

Finally, we wish to underscore the importance of preparing and implementing disaster plans for potential disaster scenarios in earthquake-prone regions, designing hospitals to be resilient in disasters, and forming emergency medical teams with specialized training.

Ethics Committee Approval: This study was approved by the Etlik City Hospital Ethics Committee (Date: 05.04.2023, Decision No: AEŞH-EK1-2023-067).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.K., D.Ö.; Design: A.K.; Supervision: A.K., D.Ö.; Resource: A.K.; Materials: A.K.; Data collection and/or processing: A.K., F.A., S.Ö., N.Y., M.K.; Analysis and/or interpretation: A.K., D.Ö.; Literature search: A.K., F.Ö.S.; Writing: A.K., D.Ö.; Critical review: A.K., C.Ö.Ç., M.Ç., D.Ö.

Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZ*

2023 Maraş depreminde şehir hastanesindeki travma hastalarına anestezik yaklaşım

Aylin Kılınçarslan, Ceyda Özhan Caparlar, Müge Çakırca, Fatma Özkan Sipahioğlu, Funda Atar, Selma Ölmez, Nur Yılmaz, Merve Karaşahin, Derya Özkan

Etlik Şehir Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Ankara, Türkiye

AMAÇ: 6 Şubat 2023 Kahramanmaraş depremi ülkemizde ciddi bir yıkım yaratmıştır. 50 binden fazla kişi hayatını kaybetmiş, binlere kişi yaralanmış ve sağlık kuruluşları hasar almıştır. Depremzedeler tedavi için başka illerdeki hastanelere transfer edilmiştir. Bu çalışma ile 3. basamak hastanemize nakledilen yaralılarda uygulanan anestezi yaklaşımını değerlendirmeyi amaçladık.

GEREÇ VE YÖNTEM: 6-20 Şubat 2023 tarihleri arasında opere edilen hastaların verileri retrospektif olarak incelenmiştir. Çalışmaya acil travma cerrahisi geçiren, 10 yaş ve üzerindeki depremzede hastalar dahil edilmiştir. Hastaların hastaneye kabul tarihi, demografik bilgileri, ameliyat türü, ameliyat bölgesi, anestezi tekniği, periferik blok tercihi, laboratuvar değerleri, diyaliz ve yoğun bakım ihtiyaçları, sağkalımları kaydedilmiştir. Verilerin analizi için IBM® SPSS® 26.0 programı kullanılmıştır.

BULGULAR: Çalışmaya 375 vaka dahil edilmiştir. 323 hasta ekstremite, 35 hasta vertebra yaralanması nedeniyle opere edilmiştir. Ekstremite yaralanmalarının %61.6'sı alt ekstremite, %17.1'i üst ekstremitedir. 147 hastaya debridman, 49 hastaya fasiyotomi ve 33 hastaya ampütasyon uygulanmıştır. Hastaların 352'sine genel anestezi, 19'una spinal anestezi ve 4'üne sedoanaljezi uygulanmıştır. 33 hastaya periferik sinir bloğu yapılmıştır. 105 hastaya diyaliz tedavisi uygulanmıştır. 26 hasta tedavi sürecinde kaybedilmiştir. İntraoperatif hasta kaybı olmamıştır.

SONUÇ: Depremzedelerde en sık ekstremite yaralanmalarının görülmesi rejyonal anesteziye eğilimi arttırmaktadır. Temel anestezi becerilerine Plan A bloklarının eklenmesi ile afet durumlarında rejyonal anestezi tercihi artabilir. Ayrıca yaralıların ileri merkezlere transferi ile morbiditenin azalacağı düşünülebilir.

Anahtar sözcükler: Anestezi; crush sendromu; deprem; rejyonal anestezi; travma.

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