Turk J Intensive Care 2023;21:41-7
DOI: 10.4274/tybd.galenos.2022.20591

ORIGINAL RESEARCH / *ÖZGÜN ARAŞTIRMA*

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Evaluation of Trauma Patients Followed Up and Treated in Intensive Care Unit: The Sample of İstanbul Province Training and Research Hospital

Yoğun Bakım Ünitesinde Takip ve Tedavisi Yapılan Travma Hastalarının Değerlendirilmesi: İstanbul İli Eğitim ve Araştırma Hastanesi Örneği

Received/Geliş Tarihi : 10.05.2022
Accepted/Kabul Tarihi : 03.08.2022

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ABSTRACT *Objective:* Trauma is an important cause of functional limitation, disability, and mortality. This study investigated the clinical characteristics of trauma patients and the factors affecting mortality in intensive care unit (ICU).
Materials and Methods: The data of patients who were followed up due to trauma in the ICU of University of Health Sciences Turkey, İstanbul Kanuni Sultan Süleyman Training and Research Hospital between January 2019-2020 were evaluated retrospectively. Demographic data, comorbidities, trauma etiologies, Glasgow coma score (GCS), Acute Physiology Assessment and Chronic Health Evaluation-II (APACHE-II) score, revised trauma score (RTS), lactate levels, and mortality were investigated.
Results: Two hundred fifty (25.2%) patients were followed up in the ICU with a trauma diagnosis. 60.4% of the patients were male, and the median age was 58.5 (1-97). 71.6% of the patients had no systemic disease. While blunt trauma was observed in 94% of the patients, the most common type of trauma was falling, with 64.4%. ICU and mechanical ventilation (MV) stay median lengths were 4 (1-86) and 1 (0-53) days. The median ICU admission GCS was 11 (3-15), APACHE-II score was 22 (5-56), RTS of 7 (2-10) and lactate value was 1.66 (0.7-19.8) mmoL. While 85.6% of the patients were discharged, 14.4% died. Age, duration of stay in ICU and MV, lactate levels, and APACHE-II scores were significantly higher in patients with mortality. GCS and RTS scores were significantly lower ($p<0.05$). In multiple logistic regression analyses, RTS and lactate values were independent risk factors for mortality.
Conclusion: We think that high lactate levels and low RTS help predict mortality in trauma patients in the ICU.
Keywords: Trauma, intensive care unit, mortality, scoring systems, lactate

ÖZ *Amaç:* Travma fonksiyonel kısıtlılık, sakatlık ve mortalitenin önemli bir sebebidir. Bu çalışmada, yoğun bakım ünitesinde (YBÜ) takip edilen travma hastalarının klinik özellikleri ile mortaliteyi etkileyen faktörler araştırılmıştır.
Gereç ve Yöntem: Ocak 2019-2020 tarihleri arasında Sağlık Bilimleri Üniversitesi, İstanbul Kanuni Sultan Süleyman Eğitim ve Araştırma Hastanesi YBÜ'sünde travma nedeniyle takip edilen hastaların verileri retrospektif olarak değerlendirildi. Hastaların demografik verileri, komorbiditeleri, travma etiyolojileri, yatış sırasındaki Glasgow koma skoru (GKS), Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi-II (APACHE-II) skoru, revize travma skoru (RTS), laktat düzeyleri ve mortaliteler araştırıldı.
Bulgular: YBÜ'de travma nedenli 250 (%25,2) hasta takip edilmiştir. Hastaların %60,4'ü erkek ve medyan yaş 58,5 (1-97) idi. Hastaların %71,6'sının sistemik hastalığı yoktu. Hastaların %94'ünde künt travma gözlenirken, en sık travma şekli %64,4 ile düşme idi. YBÜ ve mekanik ventilatörde (MV) ortanca kalış süresi 4 (1-86) ve 1 (0-53) gün idi. Giriş GKS medyan 11 (3-15), APACHE-II skoru 22 (5-56), RTS 7 (2-10) ve laktat değeri 1,66 (0,7-19,8) mmoL idi. Hastaların %85,6'sı taburcu edilirken, %14,4'ü vefat etti. Mortalite gelişenlerde yaş, YBÜ ve MV'de kalma süreleri, laktat düzeyleri, APACHE-II skorları, anlamlı olarak yüksek saptanırken, GKS ve RTS skorları anlamlı düşük bulundu ($p<0,05$). Çoklu lojistik regresyon analizinde RTS ve laktat değerlerinin mortalite üzerine bağımsız risk faktörleri olduğu saptandı.
Sonuç: YBÜ'deki travma hastalarında yüksek laktat düzeyi ve düşük RTS'nin mortalitenin öngörülmesinde yol gösterici olduğunu düşünüyoruz.
Anahtar Kelimeler: Travma, yoğun bakım ünitesi, mortalite, skorlama sistemleri, laktat

Introduction

Trauma; is a broad term that can include traffic accidents, falls, injuries, acts of violence and war, burns, drowning, and poisoning. It is generally classified as blunt and penetrating.

It has been reported that deaths from trauma exceed 5 million annually worldwide, constituting 9% of all deaths. Trauma is the most common cause of death among young people aged 1-44 worldwide. It ranks sixth among all deaths in our country (1). It has been reported that approximately 400,000 patients in Turkey have been exposed to traumatic injuries due to falls, traffic accidents, stab wounds, and beatings (2). Mortality in trauma patients; is affected by many parameters such as age, current medical history, interventional procedures, scoring systems in the first 24 hours, length of stay in the intensive care unit (ICU), and need for mechanical ventilation.

Treating trauma patients with a multidisciplinary approach, starting from the emergency services, is important in reducing mortality and morbidity (3,4). This study aims to investigate the clinical features, mortality rates, and factors affecting mortality in trauma patients followed in the ICU of a tertiary center in İstanbul.

Materials and Methods

This retrospective cross-sectional study was approved by the University of Health Sciences Turkey, İstanbul Kanuni Sultan Süleyman Training and Research Hospital Ethics Committee (decision no: 200, date: 30.06.2021). The study was started following the principles of the Declaration of Helsinki. All patients followed up and treated in the Istanbul Kanuni Sultan Süleyman Training and Research Hospital ICU between 01.01.2019 and 01.01.2020 for one year were retrospectively analyzed through the hospital information system.

The Anesthesiology and Reanimation Clinic provided ICU service with 36 beds on the relevant dates. Clinical and laboratory results were included in the study for patients from all age groups who stayed in the ICU for more than 24 hours and did not have deficiencies in scoring systems. In this descriptive study, no sample was selected, and all patients diagnosed with trauma between the relevant dates were tried to be reached.

Demographic data of patients such as age and gender, indications for admission to ICUs, comorbidities, operation, and re-operation requirements, length of stay in intensive care, mechanical ventilator and hospital, renal replacement therapy (RRT) requirements, percutaneous tracheostomy opening status and duration, thorax tube availability, microorganism growth status in blood, urine, tracheal aspirate and other cultures in the ICU, Glasgow coma score (GCS), Acute Physiology Assessment and Chronic Health Evaluation-II (APACHE-II) score, revised trauma score (RTS) and blood gas lactate levels and 28 and 90-day mortality were investigated. Data were analyzed by categorizing the mortality group and the discharge group patients.

Statistical Analysis

Percentage, median, and range of distribution values were used to generate descriptive statistics using SPSS Inc., Chicago, IL, USA (SPSS v22.0) program. The conformity of the variables to the normal distribution was evaluated analytically (Shapiro-Wilks test) and visually (histogram). Pearson chi-square test and Fisher's Exact test evaluated categorical data between groups. The Mann-Whitney U test was used to determine the difference between groups in quantitative data. Multiple logistic regression analysis was applied to the significant variables in univariate analysis. The statistical significance limit was accepted as $p<0.05$.

Results

Nine hundred ninety-two patients were followed up and treated between the relevant dates in our ICU. A total of 250 (25.2%) patients who were followed up for trauma and whose data were not missing were included in the study. 60.4% (n=151) of the patients were male. While 85.6% (n=224) of the patients were discharged after their treatment, 14.4% (n=36) died. 50% (n=18) of 36 patients in the mortality group were male. The median age in the overall discharge group and mortality group was 58.5 (1-97), 55.5 (1-97), and 77 (4-95) years, respectively. 47.2% (n=118) of the patients were transferred from the clinical services, 34.8% (n=87) from the operating room, and 18% (n=45) from the emergency service. Of the patients, 85.5% (n=101) were transferred to the ICU from orthopedics and traumatology, 9.3% (n=11) from neurosurgery, and 5.2% (n=6) from general surgery.

There was no systemic disease in 71.6% of the patients. 12% had cardiac, 8.4% had metabolic and renal diseases, 5.6% had the respiratory system, and 2.4% had neurological and psychiatric disorders.

All of the patients who died were exposed to blunt trauma. While 88.4% (n=221) of the patients underwent

surgery, 11.6% (n=29) were followed up without surgery. More than one operation was performed on the patients' 4.4% (n=11).

One or more RRTs were applied to 6% (n=15) of the patients during their follow-up. 3.2% (n=8) of the patients had a thoracic tube during hospitalization. Percutaneous tracheostomy was performed in 6% (n=15) of the patients by the ICU team. The median duration of tracheostomy opening was 12 (1-20) days. Growth was detected in blood, urine, or tracheal aspirate cultures in 24% (n=60) of the patients.

The median length of stay in ICU was 4 (1-86), the median length of stay on a mechanical ventilator was 1 (0-53), and the median length of stay in the hospital was 11 (1-87) days. The median GCS for admission to the ICU was 11 (3-15), APACHE-II score was 22 (5-56), RTS was 7 (2-10), and lactate value was 1.66 (0.7-19.8) mmoL.

After the treatment, 84.4% (n=211) of the patients were discharged to the service, and 2.2% (n=3) were discharged home. While two patients (0.8%) were diagnosed with brain death, no organ transplantation was performed. In our study, 28 and 90-day mortality rates were 12.4% (n=31) and 14.4% (n=36), respectively.

Age, length of stay in ICU and mechanical ventilator, lactate levels, and APACHE-II scores were significantly higher in the mortality group. In contrast, GCS and RTS scores were significantly lower at admission (p=0.011 and p<0.001, respectively). Similarly, RRT requirements and microorganism growth status in cultures were significantly higher in this group (p<0.001). Demographic data and clinical and laboratory characteristics of the patients are shown in Table 1.

Multiple logistic regression analyses of factors associated with patients' 28-day mortality status showed that RTS and lactate values continued to be associated with 28-day mortality (p<0.001 and p=0.003, respectively). An increase in RTS was found to reduce the risk of 28-day mortality by approximately 27% [(p<0.001, odds ratio (OR): 0.277; 95% confidence interval (CI): 0.154-0.496]. Multiple logistic regression analysis of factors associated with 28-day mortality is given in Table 2.

Table 1. Demographic data of patients, distribution of some clinical and laboratory characteristics

	Total (n=250)	Discharge group (n=214)	Mortality group (n=36)	p-value
Age (years)*	58.5 (1-97)	55.5 (1-97)	77 (4-95)	0.011
Gender, n (%)				0.198
Female	99 (39.6)	81 (32.4)	18 (7.2)	
Male	151 (60.4)	133 (53.2)	18 (7.2)	
Trauma type, n (%)				0.138
Blunt	235 (94)	200 (79.6)	15 (20.4)	
Penetrating	15 (6)	15 (100)	0	
GCS*	11 (3-15)	12 (3-15)	6 (3-14)	<0.001
APACHE-II score*	22 (5-56)	21 (5-56)	36 (14-56)	<0.001
Laktat level (mmoL)*	1.66 (0.7-19.8)	1.60 (0.7-7.6)	3.96 (2.3-19.8)	<0.001
RTS*	7 (2-10)	7 (3-10)	3 (2-8)	<0.001
Duration of ICU (days)*	4 (1-86)	4 (1-85)	8 (1-86)	<0.001
Duration of MV (days)*	1 (0-53)	1 (0-50)	7.5 (0-53)	<0.001
Duration of hospital (days)*	11 (1-87)	11 (1-85)	13.5 (1-87)	0.355
Need of RRT, n (%)	15 (6)	5 (2)	10 (4)	<0.001
Reproduction in culture, n (%)	60 (24)	39 (15.6)	21 (8.4)	<0.001
Tracheostomy requirement, n (%)	15 (6)	11 (4.4)	4 (1.6)	0.243
Admission thorax tube, n (%)	8 (3.2)	6 (2.4)	2 (0.8)	<0.001
Operation, n (%)	221 (88.4)	189 (75.6)	32 (12.8)	1.000

*Values are given as median and range of distribution (minimum-maximum). GCS: Glasgow coma score, APACHE-II: Acute Physiology Assessment and Chronic Health Evaluation-II, RTS: revised trauma score, ICU: intensive care unit, MV: mechanical ventilation, RRT: renal replacement therapy

Table 2. Multiple logistic regression analysis of factors associated with patients' mortality status			
Variables	**OR**	**p-value**	**95% CI (min-max)**
Age	1.005	0.769	0.970-1.043
GCS	1.111	0.452	0.844-1.463
RTS	0.277	<0.001	0.154-0.496
Laktat	2.565	0.003	1.376-4.781
APACHE-II	1.059	0.150	0.979-1.146
Constant	0.363	0.698	-

OR: Odds ratio, CI (min-max): confidence interval (minimum-maximum), GCS: Glasgow coma scale, RTS: revised trauma score, APACHE-II: Acute Physiology Assessment and Chronic Health Evaluation-II

Discussion

Trauma is a public health problem and a cause of functional limitation, disability, and mortality, especially in young people. Falls, traffic accidents, beatings, and stab wounds are important reasons for patient admission to the ICU. In a study from the USA, it was reported that approximately 15% of patients admitted to the ICU were trauma patients (5). In studies reported from Turkey, trauma patients' rates are between 10.4% and 26.2%. In our study, the rate of trauma patients admitted to the ICU was 25.2%. Reporting trauma rates at different rates in ICUs necessitates the establishment of standardization for trauma follow-up. We think that the rate of trauma patients is above the average since our hospital functions as a trauma center.

Trauma has been reported more frequently in males (1-5). Although 60.4% of trauma patients were male in our study, there was no significant difference between the genders (p=0.198). When the literature was searched, it was reported that mortality was higher in the elderly population in trauma patients (6-8). In a study from our country, Ünlü et al. (8) reported no significant difference. In our research, while the median age was 55 in the discharged group, it was 77 in the mortality group. Consistent with the literature, age was significantly higher in the mortality group in our study (p=0.011). However, age was not found to be an independent risk factor for mortality (p=0.769, OR:1.005, CI: 0.970-1.043).

Mortality in trauma patients can vary according to many factors such as age, gender, location and severity of the injury, and response to treatment. In the literature, mortality rates of trauma patients in patients hospitalized in the ICU have been reported to be between 15-and 61.3% (6-9). It is often used to evaluate treatment outcomes of 28 or 30-day mortality trauma patients. It has been reported that deaths occurring in a more extended period may not be directly related to the first injury (9). Kara et al. (10) reported a 28-day mortality of 19.4% in their study. In our study, 28-day mortality rates were below the average and were found to be 12.4%. We think mortality is lower because 71.6% of our patients do not have comorbidities. The literature has reported no significant gender difference between discharged and deceased patients (8,10). In our study, half of the 36 patients who developed mortality were male and half female, and following the literature, no difference was found in gender (p=0.198).

It is known that the risk of infection and mortality increases as the patients' length of stay in the ICU increases (10). Adıyaman et al. (11), in their study from our country, stated that prolonged stay in the ICU of trauma patients did not affect mortality. They explained this situation by prolonging hospitalization in multiple trauma, primarily infection, initiation of early enteral nutrition, implementation of ventilator-associated pneumonia preventive protocols, and early initiation of appropriate antibiotics (11). In the same study, Kara et al. (10) found that the median length of stay in ICU was three days, and Ünlü et al. (8) reported the median as five days in the same study. Render et al. (12), in their study, which included 46,053 patients, reported the average duration of stay in the ICU as 3.1 days. In our study, the median length of stay in the ICU was found to be 4 (1-86) days, similar to the literature, and the duration of stay in the group with mortality was significantly higher (p<0.001).

It has been reported in the literature that there is a significant relationship between the duration of stay on a mechanical ventilator in trauma patients and mortality (10-13). In our study, the duration of mechanical ventilation was significantly higher in the mortality group (p<0.001). The duration of mechanical ventilation is a risk factor for mortality in trauma patients, so the duration of mechanical ventilation should be kept as short as possible.

Trauma is the most common cause of death in the first four decades of life globally and in our country. When the causes of trauma are examined, it is seen that the most common cause in developed countries is traffic accidents. On the other hand, traffic accidents, beatings, falls, and stab wounds come to the fore in developing countries. In our country, Ateşçelik and Gürger (14) stated that traffic accidents are the most common reason for trauma admission to emergency services. Keskinoglu and İnan (15) reported the most common reason for admission as falling. In our study, falls from a height of 64.4% or the same level and traffic accidents by 20.8% were the most common trauma causes. While falls from height are more common in young people, falls from the same level are more common in geriatric patients. The diagnoses of patients admitted to the ICU are shown in Table 3.

Trauma scoring systems have been defined to determine the severity of trauma and predict mortality. In the follow-up of trauma patients in ICUs, physiological scoring systems such as APACHE-II or scoring systems such as GCS and RTS where clinical and physiological evaluation can be performed together are often preferred (16). GCS is frequently selected to evaluate consciousness and estimate mortality, and the relationship between GCS and mortality is known (17). The RTS is a physiologically based triage score. RTS; consists of 3 variables: respiratory rate, systolic blood pressure, and GCS (18). Table 4 shows the RTS.

Table 3. Distribution of patients according to trauma etiologies

	n=250
Falls	161 (64.4%)
Traffic accidents	52 (20.8%)
Assault	14 (5.6%)
Gunshot wound	11 (4.4%)
Penetrating stab wounds	6 (2.4%)
Suicidal	5 (2%)
Others	1 (0.4%)

The literature has emphasized that high APACHE-II and low GCS and RTS increase mortality (1,2,7,9,18). Ünlü et al. (8) found a higher APACHE-II score in the patient group with mortality in their same study. They reported a statistically significant relationship between APACHE-II values and the need and duration of mechanical ventilation. Consistent with the literature, the APACHE-II score was significantly higher in our study, with a median of 36 in the mortality group ($p<0.001$). Similarly, the GCS was significantly lower in the group with a median mortality of 6 ($p<0.001$). Öner et al. (2) reported that one of the RTS variables is GCS and the other is the respiratory rate so it may be more beneficial in patients with head trauma. In our study, RTS scores were significantly lower in the mortality group with a median of 3 ($p<0.001$). At the same time, RTS has been identified as an independent risk factor for mortality. RTS increase reduces mortality by 27% ($p<0.001$, OR: 0.277, CI: 0.154-0.496). Following the literature, we think RTS may be more useful in predicting mortality, especially in patients with head trauma.

It is known that high blood lactate levels can predict mortality. Quellet et al. (19) stated in their study that blood lactate level is an indicator of tissue perfusion disorder and is associated with mortality. In our country, Adıyaman et al. (11) reported high blood lactate levels as an independent risk factor for mortality in the same study. Consistent with the literature, in our study, blood lactate level was significantly higher in the mortality group ($p<0.001$). Like RTS, elevated lactate was an independent risk factor for mortality ($p=0.003$, OR: 2.565, CI: 1.376-4.781). We think early hemodynamic resuscitation and adequate oxygen supply to tissues and organs in treating trauma patients are essential in preventing organ failure and death.

The human body is divided into four central regions in trauma: head-face-neck, chest, abdomen, and extremities. The presence of trauma in at least two of these regions is defined as multi-trauma. Multi-traumas, usually life-

Table 4. Revised trauma score

GCS	Respiratory rate	Systolic blood pressure	Score
13-15	10-29	>89	4
9-12	>29	76-89	3
6-8	6-9	50-75	2
4-5	1-5	1-49	1
3	0	0	0

GCS: Glasgow coma scale

threatening, require immediate surgical intervention (20). Kara et al. (10) reported that 42.6% of trauma patients were operated on in their same study. In our study, 88.4% of patients who were followed up for trauma had an operation. 4.4% of the patients had more than one operation. There was no significant difference between the groups regarding operation requirements (p=1.000).

Podoll et al. (5) reported the prevalence of acute kidney injury as 5.7% and the need for RRT as 4.3% in patients followed in the ICU. In our study, RRT was applied to 6% of the patients. RRT requirement was significantly higher in the mortality group (p<0.001).

Dur et al. (16) reported that invasive procedures such as tracheostomy increased mortality in patients with multi-trauma. In our study, the ICU team performed tracheostomy with percutaneous technique in 6% of the patients. No significant difference was found in tracheostomy compared to the groups (p=0.243).

Thoracic wall injuries significantly increase morbidity and mortality due to the proximity of the thorax to the cardiopulmonary system. Although it is mainly related to blunt trauma, it has been reported as the leading cause of death in 25% of trauma-related deaths (21). A thoracic tube was inserted in 3.2% of the patients admitted to the ICU in our study. In the comparison between the groups, the presence of a thorax tube was significantly higher in the mortality group (p<0.001).

The limitation of our study is that it is retrospective and single-center.

Conclusion

Trauma is a significant cause of mortality, although it indicates that many patients are admitted to the ICU. During the follow-up of these patients, high lactate levels and low RTS scores were directly related to mortality. We think that using RTS with proven scores such as APACHE-II and GCS for use in trauma patients will contribute to patient evaluation, selection, follow-up, and treatment.

Ethics

Ethics Committee Approval: This retrospective cross-sectional study was approved by the University of Health Sciences Turkey, İstanbul Kanuni Sultan Süleyman Training and Research Hospital Ethics Committee (decision no: 200, date: 30.06.2021).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: K.A., Concept: K.A., A.S.Ş., N.Y., E.K., Design: K.A., A.S.Ş., N.Y., E.K., Data Collection and Process: K.A., E.K., Analysis or Interpretation: K.A., A.S.Ş., N.Y., Literature Search: K.A., A.S.Ş., E.K., Writing: K.A., N.Y.

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

Financial Disclosure: The authors declared that this study received no financial support.

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