

Factors affecting mortality in trauma patients hospitalized in the intensive care unit

Travma nedeniyle yoğunbakım ünitesinde izlenen hastalarda mortaliteyi etkileyen faktörler

Ahmet Atlas ¹, Evren Büyükfırat ¹, Kadri Burak Ethemoğlu ², Mahmut Alp Karahan ¹, Nuray Altay ¹

¹ Department of Anesthesiology and Reanimation, Harran University Faculty of Medicine, Sanliurfa, Turkey

² Department of Neurosurgery, Harran University Faculty of Medicine, Sanliurfa, Turkey

ORCID ID of the author(s)

AA: 0000-0001-5999-0510

EB: 0000-0002-6396-0426

KBE: 0000-0002-2392-9934

MAK: 0000-0002-7210-9481

NA: 0000-0002-7111-7893

Corresponding author / Sorumlu yazar:
Ahmet Atlas

Address / Adres: Harran Üniversitesi Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Bölümü, Osmanbey Kampüsü, Haliliye, Şanlıurfa, Türkiye
E-mail: ahmetatlas@harran.edu.tr

Ethics Committee Approval: The study was approved by the Harran University Ethics Committee (Approval No: E.7334, Date: February 11, 2020). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Etik Kurul Onayı: Çalışma Harran Üniversitesi etik komitesi tarafından onaylandı (Onay No: E.7334, Tarih: 11 Şubat 2020). İnsan katılımcıların katıldığı çalışmalarındaki tüm prosedürler, 1964 Helsinki Deklarasyonu ve daha sonra yapılan değişiklikler uyarınca gerçekleştirilmiştir.

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

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Financial Disclosure: The authors declared that this study has received no financial support.
Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

Published: 11/17/2020

Yayın Tarihi: 17.11.2020

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Published by JOSAM

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Abstract

Aim: An accurate estimation of the prognosis of patients admitted to the intensive care unit (ICU) is of prime importance for their clinical management. The aim of this retrospective study was to investigate factors affecting mortality in trauma patients hospitalized in the ICU.

Methods: This retrospective study reviewed medical records of trauma patients who received ICU care at Harran University Medical School Anesthesiology and Reanimation Department between January 2015 and December 2019. Age, gender, comorbidities, Glasgow Coma Scale (GCS), and Acute Physiology and Chronic Health Evaluation 2 (APACHE-II) scores, Revised Trauma Score (RTS), duration of hospital and ICU stay, mortality rate, and brain death rate were reviewed for each patient. Additionally, other factors that could affect the mortality and morbidity of patients, including admission lactate level and the clinical department of referral were evaluated.

Results: A total of 155 patients comprised 76.8% men and 23.2% women. Comorbidities were present in 10.3% of the patients. Of all patients, 90.3% had been referred from the emergency service, 8.4% of them from operating theatres, and 1.3% of them from inpatient clinics. Mean duration of mechanical ventilation was 12.3 (28.6) days, mean duration of ICU stay was 8.5 (20.7) days, and the mean duration of hospital stay was 12.9 (21.7) days. Among 155 patients, 123 (79.4%) were discharged (surviving group) and mortality occurred in the remaining 32 (20.6%) patients (non-surviving group). The non-surviving group comprised 68.8% men and 31.2% women. In all patients, mean admission lactate level was 2.9(3.6) mmol/L and mean APACHE-II score was 14.1(7.1). Multivariate analysis indicated that a single unit increase in APACHE-II score increased the mortality risk by 2.45-fold. A significant relationship was found between admission lactate level, APACHE-II score, and mortality ($P=0.001$ for both). Mean RTS score was 10.1 (2.5) and mean GCS score was 11.7 (4.4). The analysis also indicated that a single unit increase in RTS score decreased the mortality risk by 94%, and a single unit increase in GCS score decreased the mortality risk by 69%. A significant relationship was found between decreased RTS and GCS scores and mortality ($P=0.001$ for both).

Conclusion: Admission GCS, APACHE-II, and RTS scores and admission lactate levels could be useful predictors of mortality and could also be guiding in the determination of prognosis in patients transferred to the ICU due to trauma.

Keywords: Mortality, Intensive care units, Trauma, Revised trauma score

Öz

Amaç: Yoğun bakım ünitelerine (YBÜ) travma nedeniyle kabul edilen hastaların prognozunun doğru tahmin edilmesi, hastaların klinik yönetimi açısından çok önemlidir. Bu çalışmada YBÜ'lerde travma nedeniyle izlenen hastalarda mortaliteyi öngören faktörlerin belirlenmesi amaçlandı.

Yöntemler: Ocak 2015-Aralık 2019 tarihleri arasında Harran Üniversitesi Araştırma ve Uygulama Hastanesi Anesteziyoloji ve Reanimasyon YBÜ'sinde travma nedeniyle takip ve tedavi edilen hastaların; yaş, cinsiyet, komorbid hastalık, Glaskow Koma Skalaları (GKS), Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi-2 (APACHE-2) skorları, Revize Edilmiş Travma Skoru (RTS), YBÜ'si ve hastane yatış süreleri, mortalite oranları, girişteki laktat düzeyleri, YBÜ'sine geliş yerleri arşivden taranarak incelendi.

Bulgular: Bu çalışmada travma nedeniyle takip edilen 155 hasta incelendi. Hastaların %76,8'i erkek, %23,2'si kadındı. Hastaların %10,3'ünde komorbid hastalık bulunmaktaydı. YBÜ'sine alınan hastaların %90,3'ü acil servisten, %8,4'ü ameliyathaneden alındı. Hastaların ortalama mekanik ventilasyon süresi 12,3(28,6)/gün, yoğunbakım yatış süresi 8,5(20,7)/gün, hastane yatış süresi 12,9(21,7)/gün olarak bulundu. YBÜ'sine travma nedeniyle yatırılan 155 hastanın %79,4'ü taburcu edilmiş, %20,6 hayatını kaybetmiştir. Hayatını kaybeden hastaların %68,8'i erkek, %31,2'si kadındı. Travma nedeniyle YBÜ'sinde takip edilen hastaların giriş laktat düzeyi ortalaması 2,9(3,6), APACHE-2 skoru ortalaması 14,1(7,1) olarak bulundu. APACHE-2 skorundaki her 1 birimlik artışın ölüm riskini 2,45 kat arttırdığı saptandı. Giriş laktat düzeyi ve APACHE-2 skoru artışı ile mortalite arasında anlamlı ilişki saptandı ($P=0.001$, $P=0.001$). RTS ortalaması 10,1(2,5), GKS ortalaması 11,7(4,4) olarak bulundu. RTS'deki 1 birimlik artış ölüm riskini % 94, GKS'deki 1 birimlik artış ölüm riskini %69 oranında azalttığı saptandı. RTS ve GKS değerlerindeki azalma ile mortalite arasında anlamlı ilişki saptandı ($P=0.001$, $P=0.001$).

Sonuç: YBÜ'sine travma nedeniyle kabul edilen hastaların giriş GKS, APACHE-2 ve RTS gibi skorlamalarının ve giriş laktat düzeylerinin prognozunu öngörülmesinde yol gösterici olabileceğini düşünmekteyiz.

Anahtar kelimeler: Mortalite, Yoğun bakım üniteleri, Travma, Revize travma skoru

Introduction

Intensive care unit (ICU) is a dedicated specialty in healthcare, involving multidisciplinary management of patients with acute and often life-threatening organ dysfunction or disease. ICU also provides a privileged environment with airway support, mechanical ventilation, up-to-date treatment practices, and effective administration of drugs and monitoring techniques [1]. An accurate estimation of the prognosis of patients admitted to ICU is of prime importance for their clinical management [2]. Additionally, early detection of high-risk patients leads to more appropriate use of resources, and reduces morbidity and mortality rates [3,4]. Trauma is a common cause of significant functional impairment, disability, and mortality, thus leading to health deterioration and a delay in reaching functional independence [5,6]. Trauma-induced death is the fifth leading cause of death among all age groups and the leading cause of death among individuals aged 1-44 years in the US, while it has been shown by the Turkish Statistical Institute to be the sixth leading cause of death (4.4%) along with poisoning [7,8].

Falls, falls from heights, assaults, gunshot wounds, and penetrating stab wounds as well as road traffic fatalities are considered traumas [9]. Some of these traumas are classified as severe and multiple traumas. Patients with these traumas are admitted to ICU and constitute a significant portion of critical patients [10]. In the ICU, the monitoring process is the key to reducing patients' mortality and morbidity [11,12]. In this process, an accurate estimation of the prognosis is a significant factor for successful management of trauma patients. The aim of this study was to investigate the clinical characteristics, mortality rates, and the factors affecting mortality in trauma patients hospitalized in the ICU.

Materials and methods

Study design

The retrospective cohort study reviewed medical records of 155 patients aged above 18 years who were hospitalized in our ICU due to trauma between January 2015 and December 2019. Demographic and clinical characteristics including age, gender, laboratory parameters, GCS, RTS, and APACHE-II scores, clinical department of referral, duration of hospital and ICU stay, and one-year mortality were reviewed for each patient. The study was approved by the Ethics Committee of Harran University (Approval No: E.7334, Date: February 11, 2020).

The ICU in our department is a tertiary referral unit (Level III ICU) with a total of 20 beds. Between January 2015 and December 2019, a total of 1,418 patients were admitted to our ICU (Figure 1).

Age, gender, comorbidities, Glasgow Coma Scale (GSC), Acute Physiology and Chronic Health Evaluation 2 (APACHE-II) score, Revised Trauma Score (RTS), duration of hospital and ICU stay, mortality rate, and brain death rate were reviewed for each patient, in addition to other factors that could affect the mortality and morbidity of patients, including admission lactate level and the clinical department of referral.

Statistical analysis

Data were analyzed using SPSS for Windows version 24.0 (IBM Corp. Released 2016, Armonk, NY: IBM Corp.). Descriptive data were expressed as frequency (n), percentages, mean (standard deviation (SD)), maximum, and minimum. Normal distribution of data was assessed using both analytical (Shapiro-Wilks test) and visual (histogram plots) methods. Independent groups were compared using Mann-Whitney U test. Variables found significant on univariate analysis were further analyzed using Multivariate Analysis. A *p* value <0.05 was considered significant.

Results

A total of 155 patients comprised 119 (76.8%) men and 36 (23.2%) women with a mean age of 37.9 (15.5) years. Of all patients, 90.3% had been referred from the emergency service, 8.4% from operating theatres, and 1.3% from inpatient clinics. Most of the patients (89.7%) had no comorbidities (Table 1).

A percutaneous tracheostomy was performed in 6.5% of the patients due to prolonged mechanical ventilation. Brain death occurred in 7.1% of the patients. Mean time from admission to enteral feeding initiation was 30.1 (12.2) hours, mean duration of mechanical ventilation was 12.3 (28.6) days, mean duration of ICU stay was 8.5 (20.7) days, and the mean duration of hospital stay was 12.9 (21.7) days. Mean admission lactate level was 2.9 (3.6) mmol/L (Table 2).

Table 1: Demographic characteristics

Variables	Total (n=155)
Age (Mean(SD))	37.9(15.5)
Gender n (%)	
Male	119 (76.8)
Female	36 (23.2)
Clinical department of referral (%)	
Emergency service	90.3
Operating theater	8.4
Inpatient clinic	1.3
Comorbidities (%)	
No	89.7
Yes	10.3

SD: Standard deviation

Table 2: Clinical characteristics

Variables	Mean(SD)	min	max
Time from admission to enteral feeding initiation (hours)	30.1(12.2)	24	72
Duration of mechanical ventilation (days)	12.3(28.6)	0	163
ICU stay (days)	8.5(20.7)	1	163
Hospital stay (days)	12.9(21.7)	1	163
Admission lactate level (mmol/L)	2.9(3.6)	0,7	26

SD: Standard deviation, ICU: Intensive care unit

Among 155 patients, 123 (79.4%) were discharged (surviving group) and mortality occurred in the remaining 32 (20.6%) patients (non-surviving group). The non-surviving group comprised 24 (68.6%) men and 11 (31.4%) women with a mean age of 35 (range, 18-65) years. In this group, no significant relationship was found between mortality, age, and gender (*P*=0.986). Additionally, the mean duration of ICU stay was 8 (range, 1-163) days and prolonged ICU stay was associated with increased mortality (*P*=0.002). In the same group, the mean admission lactate level was 4.55 (range, 2.6-26) mmol/L and a significant relationship was found between increased lactate concentration and mortality (*P*=0.001). On the other hand, the median APACHE-II score was 25 (range, 18-35) and a significant relationship was found between increased APACHE-II score and mortality (*P*=0.001). Similarly, the median RTS score was 7 (range, 1-9) and the median GCS score was 4 (range,

3-9), and a significant relationship was found between reduced RTS and GCS scores and mortality ($P=0.001$ for both) (Table 3).

Multivariate analysis indicated that a single unit increase in RTS score decreased the mortality risk by 94% (Odds Ratio [OR]: 0.06; 95% Confidence Interval (CI): 0.02-0.25), a single unit increase in GCS score decreased the mortality risk by 69% (OR: 0.31; 95% CI: 0.02-0.25), a single unit increase in admission lactate level increased the mortality risk by 9-fold (95% CI: 3.92-21.38), prolonged ICU stay increased the mortality risk by 1.08-fold (95% CI: 1.03-1.13), and a single unit increase in APACHE-II score increased the mortality risk by 2.45-fold (95% CI: 1.52-3.94) (Table 4).

In the surviving group, 89.4% of the patients had been referred from the emergency service and 10.6% from operating theatres. No significant relationship was found between the clinical department of referral and mortality ($P=0.219$). On the other hand, comorbidities were detected in 12.2% of the patients in the surviving group and in 3.1% of the patients in the non-surviving group. No significant relationship was found between the presence of comorbidities and mortality ($P=0.165$). Table 5 presents the distribution of the etiologies of trauma in our patients.

Mechanical ventilation was performed in 44 (35.8%) of the patients in the surviving group and no significant relationship was detected between using mechanical ventilation and mortality ($P=0.996$).

Table 3: Relationship between mortality and clinical characteristics and scoring systems

Variables	Total median (min-max)	Surviving group median (min-max)	Nonsurviving group median (min-max)	P-value
Age (years)	35 (18-75)	35 (18-75)	35 (18-65)	0.986
ICU stay (days)	3 (1-163)	3 (1-36)	8 (1-163)	0.002*
Hospital stay (days)	7 (1-163)	7 (1-78)	8 (1-163)	0.007*
Lactate level (mmol/L)	2 (0.7-26)	1.6 (0.7-4.2)	4.55 (2.6-26)	0.001*
APACHE-II score	12 (4-35)	11 (4-21)	25 (18-35)	0.001*
GCS score	15 (3-15)	15 (6-15)	4 (3-9)	0.001*
RTS score	11 (1-12)	12 (8-12)	7 (1-9)	0.001*

ICU: Intensive care unit, APACHE-II: Acute Physiology and Chronic Health Evaluation 2 (APACHE-II) score, GCS: Glasgow Coma Scale, RTS: Revised Trauma Score, *Mann-Whitney U test. * $p<0.05$

Table 4: Multivariate logistic regression analysis showing the relationship between prognosis and GCS, APACHE-II, RTS scores and lactate levels

Variables	OR	P-value	95% CI for OR	
			Lower limit	Upper limit
Age	1	0.986	0.97	1.03
GCS	0.31	0.001	0.18	0.54
APACHE-II	2.45	0.001	1.52	3.94
RTS	0.06	0.001	0.02	0.25
Lactate level (mmol/L)	9.16	0.001	3.92	21.38

OR: Odds Ratio, CI: Confidence Interval, GCS: Glasgow Coma Scale, RTS: Revised Trauma Score, APACHE-II: Acute Physiology and Chronic Health Evaluation 2 (APACHE-II) score

Table 5: Distribution of the etiologies of trauma in our patients

Etiology	n	%
Road traffic fatality	105	67.7
Fall	28	18.1
Gunshot wound	8	5.2
Assault	8	5.2
Penetrating stab wounds	3	1.9
Others	3	1.9
Total	155	100.0

Discussion

In our study, the mortality rate and the rate of trauma patients that were hospitalized in the ICU due to trauma were similar to those in studies conducted in Turkey. The results also indicated that traumatic injuries were more commonly seen among young and male individuals and increased admission lactate levels had an adverse effect on mortality. Additionally, it was revealed that APACHE-II, GCS, and RTS were significant scoring systems in the estimation of prognosis in trauma patients.

Road traffic fatalities and some other traumas constitute a major portion of cases hospitalized in ICU. It has been reported that trauma patients account for 15% of all ICU patients in USA [13]. A study conducted in Turkey revealed that trauma patients constituted 10.4% of 1,038 patients hospitalized in ICU [14], and another study reported this rate as 11.1% [15]. Similarly, the trauma patients included in our study constituted 10.9% of 1,418 patients hospitalized in ICU.

In our study, mortality occurred in 20.6% of the trauma patients included in the study. Among the studies conducted in Turkey, Adiyaman et al. [15] reported this rate as 18.9%, Unlu et al. [10] reported it as 35.8%, and Kara et al. [16] reported a similar rate of 19.4%.

Isik et al. [17] reported that road traffic fatalities accounted for 75% of their cases with head trauma. Similarly, Yucel et al. [18] reported that road traffic fatalities accounted for 37.3% of 748 cases with chest trauma. In our study, road traffic fatalities constituted 67.7% of the trauma patients hospitalized in ICU.

Previous studies conducted in Turkey reported that the incidence of trauma was relatively higher between the ages of 0-44 years and in male individuals [19,20]. Another study evaluated the ages of trauma patients hospitalized in ICU and reported that 65.9% of them were aged between 1-45 years [11]. Additionally, a recent retrospective study evaluated the medical records of 978 patients hospitalized in ICU between 2013 and 2016 and reported that 76.7% of 150 trauma patients were male [21]. Similarly, we also found that 68.3% of our trauma patients were aged between 18-45 years and 76.7% of them were male.

To date, numerous scoring systems have been developed for the determination of trauma severity and the estimation of mortality in trauma patients hospitalized in ICU [22,23]. Among these, APACHE-II, which is a physiological scoring system, is the most important and commonly used [24]. Sipahi et al. [25] found that the APACHE-II scores in the age groups of 30-39 years and 40 years or above established a significant correlation with mortality. Another study reported that increased APACHE-II scores were associated with increased mortality among trauma patients hospitalized in ICU [11]. Similarly, Kara et al. [16] and Yildirim et al. [24] reported that APACHE-II scores were significantly increased in the trauma patients that died in the ICU. In our study, the median APACHE-II score was 25 (range, 18-35) in the non-surviving group and 11 (range, 4-21) in the surviving group. Additionally, it was revealed that a single unit increase in APACHE-II score increased the mortality risk by 2.45-fold ($P=0.001$). These findings were consistent with those reported in the literature.

Revised Trauma Score (RTS) is a significant clinical and physiological scoring system used for the prediction of survival. When used in combination with GCS, RTS can also be useful in the prediction of mortality [26]. A previous study found that a RTS score of <6.2 was associated with increased mortality. The authors also found a significant relationship between RTS score, the duration of mechanical ventilation and mortality [11]. Eryilmaz et al. [27] reported that the mean RTS score was 6.0 (2.7) in the surviving group and 2.1 (2.1) in the non-surviving group. In our study, the median RTS score was 7 (range, 1-9) in the non-surviving group and 12 (range, 8-12) in the surviving

group. It was also revealed that a single unit increase in RTS score decreased the mortality risk by 94% and that the mortality rate increased as the RTS score decreased ($P=0.001$).

In our study, mean admission lactate level was 2.9 (3.6) mmol/L in all patients, which was 1.6 (range, 0.7-4.6) mmol/L in the surviving group and 4.55 (2.6-26) mmol/L in the non-surviving group. Additionally, multivariate logistic regression analysis indicated a significant relationship between increased lactate concentration and mortality (OR: 9.16; 95% CI: 3.92-21.38). Manikis et al. [28] suggested that increased serum lactate concentration is associated with organ failure and increased mortality. Similarly, Ouellet et al. [29] found that increased serum lactate concentration was an indicator of impaired tissue perfusion and associated with increased mortality. A study conducted in Turkey evaluated trauma patients hospitalized in the ICU and indicated that serum lactate levels were significantly higher in the non-surviving group and associated with increased mortality [15]. Moreover, Odom et al. found a significant relationship between increased lactate levels and mortality [30]. In line with the literature, we also found a significant relationship between increased serum lactate levels and increased mortality in our patients ($P=0.001$).

Mean duration of ICU stay was 8.5(20.7) days in our patients, which was 8 (range, 1-163) days in the non-surviving group and 3 (1-36) days in the surviving group. Grenrot et al. [31] and Dur et al. [12] reported a mean duration of 8.6 and 5(1) days, respectively. Similarly, Unlu et al. [11] evaluated 349 patients and reported that 37.8% of the patients had a mean duration of 1-3 days, 22.6% had a mean duration of more than 14 days, and the median duration of ICU stay for all patients was 5 (range, 1-139) days. On the other hand, another study conducted in Turkey found a significant difference between the surviving and non-surviving groups regarding the duration of ICU stay [16]. As consistent with the literature, we also found a significant relationship between prolonged ICU stay and increased mortality ($P=0.002$).

Limitations

One of the limitations of this study is its single-center design. It is limited to one regional ICU center and its patients in a period of four years. In addition, retrospective studies can potentially reduce data quality. Failure to record some patient data in archive records may cause lack of information. Although there was very little information on parameters in our archive records, we could still access most data.

Conclusion

We suggest that admission GCS, APACHE-II, and RTS scores and lactate levels could be useful predictors of mortality and guiding in the determination of prognosis in patients transferred to the ICU due to trauma.

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