

The role of trauma scoring systems and serum lactate level in predicting prognosis in thoracic trauma

✉ Eray Cinar, M.D.,¹ ✉ Eren Usul, M.D.,² ✉ Erdal Demirtas, M.D.,³ ✉ Anil Gokce, M.D.¹

¹Department of Thoracic Surgery, Ankara City Hospital, Ankara-Turkey

²Department of Emergency Medicine, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara-Turkey

³Department of Emergency Medicine, Dokuz Eylül University Faculty of Medicine, İzmir-Turkey

ABSTRACT

BACKGROUND: Chest trauma constitutes 10% of admissions due to trauma and causes 25–50% of trauma-related deaths. It is important to evaluate the level of thoracic trauma in patients accurately and early, start the correct treatment, predict the need for intensive care and mortality, and prevent complications that may develop. In this study, the predictive efficiency of the serum lactate level, shock index, and scoring systems regarding the prognosis in patients with major thoracic trauma were compared.

METHODS: The files of the 683 patients who applied to the emergency department of our hospital due to trauma, between 2014 and 2020, were analyzed retrospectively. Patients with isolated thoracic trauma were included in the study.

RESULTS: A total of 683 patients were included in the study. Of the patients, 34 (5%) were in the non-survivor group and 649 (95%) were in the survivor group. There was no statistically significant difference between the systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, or shock index in either group ($p>0.05$). The Glasgow Come Scale (GCS) score in the non-survivor group was significantly lower than that in the survivor group ($p=0.000$). The lactate level, revised trauma score (RTS), injury severity score (ISS), and New ISS (NISS) in the non-survivor group were significantly higher than those in the survivor group. A significant difference was found in terms of age, lactate level, and the GCS, RTS, ISS, and NISS ($p<0.05$). In logistic regression analysis, it was found that a 1 unit increase in the lactate value increased the mortality rate by 1.19 times in terms of the effect of the trauma scores and numerical change in the lactate level on mortality.

CONCLUSION: In patients with thoracic trauma, the NISS may be a useful factor that can be used in emergency rooms when a quick decision is required. However, increases in blood lactate levels during patient follow-up may also be a blood parameter that the clinician should pay attention to. In addition, further studies should be conducted on scoring in patients with thoracic trauma.

Keywords: Mortality; serum lactate; thoracic trauma; trauma scoring systems.

INTRODUCTION

Trauma patients are commonly admitted to emergency services. Chest trauma constitutes 10% of admissions due to trauma and causes 25–50% of trauma-related deaths.^[1] It is important to evaluate the level of thoracic trauma in patients accurately and early, start the correct treatment, predict the need for intensive care and mortality, and prevent complications that may develop.^[2]

Many studies have been conducted to evaluate the factors predicting mortality and morbidity in thoracic trauma patients, and some of these have been transformed into scoring systems.^[2] The most commonly used trauma scoring systems are the injury severity score (ISS), revised trauma score (RTS), new ISS (NISS), and Glasgow Come Scale (GCS).^[3] In addition, serum lactate levels are used in patients with trauma to predict the severity of the disease.^[4] Moreover, the shock index, which is also a simple calculation, may be used as a

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Address for correspondence: Eren Usul, M.D.

Dışkapı Yıldırım Beyazıt Eğitim ve Araştırma Hastanesi, Acil Tıp Kliniği, Ankara, Turkey

Tel: +90 312 - 596 24 70 E-mail: usuleren7@hotmail.com

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prognostic factor predictor in trauma patients.^[5] The severity of thoracic trauma in patients in emergency departments should be assessed accurately without wasting time. Emergency doctors and related specialists should use all of the assessment tools and it is important to know the sufficiency of both the scoring systems and parameters.^[6]

In this study, the predictive efficiency of the serum lactate level, shock index, and scoring systems regarding the prognosis in patients with major thoracic trauma were compared.

MATERIALS AND METHODS

This was a retrospective cohort study, and it was approved by the local ethics committee for research studies of the Education and Research Hospital (Date: 14 December 2020, No: 100/10). The files of the 683 patients who applied to the emergency department of our hospital due to trauma, between 2014 and 2020, were analyzed retrospectively. Patients with isolated thoracic trauma were included in the study. Patients younger than 18 years of age, those with major injury other than thoracic trauma (head trauma, pelvic injuries, and major bone injuries), those using drugs that cause increased lactate, and patients who were alcoholic admission were not included in the study. Demographic data (age and gender), blood pressure, pulse rate, respiratory rate, GCS, RTS, ISS, and NISS values, and shock indices were examined. The patients were divided into two groups, as the survivors and non-survivors. Patients with major trauma other than thorax were excluded from the study with the specified criteria. When calculating the NISS, ISS, and other trauma scoring

systems, since the patient group did not have extra-thoracic trauma, the scoring of other region traumas was made similarly and had no effect on the result. Using these data, the predictive efficacy of serum lactate levels, shock indices, and scoring systems were compared in terms of prognosis in patients with major thoracic trauma.

Statistics

The data were analyzed using IBM SPSS Statistics for Windows 25.0 (Armonk, NY, USA) and MedCalc 15.8 (MedCalc Software bvba, Ostend, Belgium) statistical package programs. The Chi-square test was used to compare the qualitative data and descriptive statistical methods (frequency, percentage, mean, standard deviation, median, and min-max). The receiver operating characteristic (ROC) curve analysis was used to determine the distinctiveness of the variables, and the binary logistic regression test was used to determine the risk ratios. Statistical significance was accepted as $\alpha=0.05$.

RESULTS

A total of 683 patients were included in the study. Of the patients, 578 (84.6%) were male and 105 (15.4%) were female. The mean age of patients was 41.8 ± 18.5 years. Mortality was seen in 34 (4.9%) patients. Of the patients, 34 (5%) were in the non-survivor group and 649 (95%) were in the survivor group.

There was no difference between the groups with regards to gender. The mean age in the non-survivor group ($64.0 [26.3-75.8]$ years) was higher than in the survivor group (38.0

Table 1. General characteristics of the study group and prognostic evaluation according to survival

	Total (n=683)	Survival status		p-value
		Survival (n=649)	Expiry (n=34)	
Gender, n (%)				
Female	105	97 (14.9)	8 (23.5)	0.268 ^a
Male	578	552 (85.1)	26 (76.5)	
Age*	41.8±18.5	38.0 (25.0–53.0)	64.0 (26.3–75.8)	0.002 ^b
Systolic*	115.3±19.7	110 (110.0–128.5)	110 (90.0–132.5)	0.139 ^b
Diastolic*	70.5±13.1	70.0 (60.0–80.0)	70.0 (57.5–80.0)	0.832 ^b
Pulse*	90.3±17.0	88.0 (80.0–99.0)	92.0 (71.5–111.3)	0.383 ^b
Respiratory rate*	19.2±4.5	19.0 (15.0–22.0)	20.0 (15.0–25.0)	0.388 ^b
Glasgow Come Scale*	14.4±2.0	15.0 (15.0–15.0)	10.0 (5.0–15.0)	0.000 ^b
Lactate*	3.3±2.9	2.3 (1.8–3.5)	3.6 (2.0–8.8)	0.000 ^b
Revised trauma score*	7.6±0.7	7.8 (7.8–7.8)	6.0 (5.0–7.8)	0.000 ^b
Injury severity score*	14.9±10.0	10.0 (9.0–18.0)	33.0 (17.0–41.0)	0.000 ^b
New injury severity score*	18.9±13.6	16.0 (9.0–25.0)	41.0 (32.8–48.0)	0.000 ^b
Shock Index*	0.8±0.3	0.8 (0.7–0.9)	0.8 (0.6–1.2)	0.254 ^b

*Median (IQR), ^aChi-Square Test, ^bMann-Whitney U Test.

Table 2. Trauma scores and ROC analysis results in terms of the effect of the numerical change in the lactate level on mortality

	AUC	Cut-off	Sensitivity	Specificity	Youden Index	95% CI	p-value*
Glasgow Come Scale	0.825	≤14	70.6	90.5	0.610	0.794–0.853	0.000
Lactate	0.684	>6.6	38.2	92.8	0.310	0.647–0.719	0.000
Revised trauma score	0.756	≤7.55	70.6	89.7	0.603	0.722–0.788	0.000
Injury severity score	0.867	>24	70.6	84.0	0.546	0.840–0.892	0.000
New injury severity score	0.876	>27	85.3	80.7	0.660	0.848–0.899	0.000

ROC: Receiver operating characteristic; AUC: Area under curve; CI: Confidence interval.

Table 3. Logistic regression analysis in terms of the effect of the numerical change in lactate level and trauma scores on mortality

Risk factor	OR (95% CI)	p-value
Glasgow Come Scale	0.78 (0.65–0.94)	0.010
Lactate	1.19 (1.08–1.31)	0.000
Revised trauma score	0.70 (0.41–1.20)	0.196
Injury severity score	1.05 (1.01–1.08)	0.016
New injury severity score	1.05 (1.02–1.09)	0.001

CI: Confidence interval; OR: Odds ratio.

[25.0–53.0] years), with a statistically significant difference ($p=0.002$). There was no statistically significant difference between the systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, or shock index in either group ($p>0.05$). The GCS score in the non-survivor group was significantly lower than that in the survivor group ($p=0.000$). The lactate level, and RTS, ISS, and NISS in the non-survivor group were significantly higher than those in the survivor group ($p=0.000$) (Table 1).

There was no significant difference in mortality with regard to gender, systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, or shock index ($p>0.05$). A significant difference was found in terms of age, lactate level, and the GCS, RTS, ISS, and NISS ($p<0.05$) (Table 1).

In the study, the adequacy of the RTS, ISS, NISS, GCS, and lactate values in predicting mortality of patients with thoracic trauma was compared. Area under the curve (AUC) levels of GCS, lactate, RTS, ISS, and NISS cutoff values according to ROC analysis are shown in Table 2. According to the results of the study, the NISS had the highest sensitivity (85.3%) and the blood lactate value had the highest specificity (92.8%) in predicting mortality (Table 2).

In logistic regression analysis, it was found that a 1 unit increase in the lactate value increased the mortality rate by 1.19 times in terms of the effect of the trauma scores and

numerical change in the lactate level on mortality. It was also determined that the changes in the other trauma scores were significant in terms of the effect on mortality (Table 3).

DISCUSSION

Nowadays, traumas are one of the most important health problems that cause mortality. The rate of mortality and morbidity in thoracic injuries is quite high. Thoracic trauma is the cause of mortality in 25% of all trauma-related deaths and one of the factors contributing to mortality in 25%.^[7] While hospital mortality is 4–8% in isolated chest trauma, the mortality rate increases to 13–15% in cases where an additional system is affected, and 30–35% in cases where two or more systems are affected.^[8] In the series here in, the mortality rate was 5% and was compatible with the literature. The ratio of male/female patients with thoracic trauma was reported as 6.5/1 in the literature.^[9] In the series here in, 84.6% of the patients were male, 15.4% were female. The ratio of our male/female patients with thoracic trauma was 5.5/1. It was close to the literature. It was reported in the literature that thoracic trauma is more common in the 2nd–5th decades than in other decades.^[10] In the series here in, the mean age was 41.8 years, and most of the patients were in the 3rd–4th decades, and it was considered that this was due to the high number of young people in Turkey.

Although thoracic traumas cause various difficulties for the clinician in emergency departments, an accurate evaluation is important in planning the treatment and predicting the complications that will develop. Therefore, the use of various scoring systems and markers in the initial evaluations benefits the clinician.^[11] In the study of Orhon et al.,^[12] in which they evaluated trauma scoring systems, and the study of Bouzat et al.,^[13] in which they evaluated the effect of trauma scoring systems on hospital mortality, it was stated that the trauma scoring systems were highly effective in planning correct treatment and reducing the rate of mortality.

Many studies have been conducted that have examined the predictivity of scoring systems in trauma patients. In the study of Smith et al.,^[14] it was reported that the NISS was more successful than the ISS in predicting mortality, in comparison

with the NISS and ISS in penetrating traumas. As a result, they stated that the NISS was a better predictor of mortality than the ISS in penetrating traumas. In a study where the ISS and trauma mortality prediction model (TMPM) were compared and large case series were examined, it was suggested that the NISS could be used for a quick evaluation, and as the ISS is now an old method, the TMPM might provide better results.^[15] In the study of Tohira et al.,^[16] it was stated that the NISS appeared to be better than the ISS in predicting mortality in blunt trauma. In a study comparing the ISS, NISS, RTS, and Trauma and ISS (TRISS) in predicting mortality in elderly trauma patients, they stated that the scoring systems may be used in emergency services in elderly patients, but the TRISS had higher predictive ability than the other scores.^[17]

In the study of Mommsen et al.,^[11] various thoracic trauma scores were compared in predicting complications and outcomes after blunt thoracic trauma. In the ROC analysis of the Pulmonary Contusion Score, Wagner score, and Thoracic Trauma Severity score, it was stated that additional thoracic scoring systems were needed for blunt chest injuries. The results in the current study were similar to the results in these studies. In the current results, the NISS had the highest AUC (0.876) when compared to the other scores in predicting mortality. Although, the ISS had an AUC that was similar to the NISS, the low sensitivity (70.6) was a factor that should be carefully considered. In addition to the blood pressure, respiratory rate, GCS, and other trauma scoring systems, the shock index may be used in trauma cases to categorize the patients and plan the treatment of the emergency department. In the study of Chung et al.,^[18] 409 patients were studied, it was stated that in trauma patients with a shock index >1.0, mortality rates were higher and the shock index would contribute to the emergency department triage criteria. In the study of McNab et al.,^[19] 16,269 patients were analyzed, and it was stated that the high pre-hospital shock index for trauma patients was associated with mortality. In the study of Olaussen et al.,^[20] it was reported that the prediction of massive bleeding in patients and in treatment planning was very important in case of a shock index >0.9. In the study of Singh et al.,^[21] 9860 patients were analyzed, and more effective results were achieved by adding the diastolic pressure and calculating the shock index. In the current study, the mean shock index was found to be 0.8. However, unlike the literature, it was not found to be significant in terms of survival and it was considered that this situation was caused by the lower number of patients with bleeding in the study group.

To evaluate the mortality of the trauma patient, studies were carried out on scoring systems and many laboratory parameters. Tissue hypoxia level is important in predicting mortality. The parameter used in determining tissue hypoxia is blood lactate level. Recently, blood lactate level measurement has become fast, cheap, and easy. Lactate level measurement can be performed arterial, capillary or venous. Blood lactate level is normally between 0.5 and 1.8 mmol/L in terms of produc-

tion and recovery. While most patients with blood lactate levels below 2 mmol/L are alive, most patients with blood lactate levels approaching 10 mmol/L die.^[22,23] In the study of Raux et al.,^[22] the prognostic significance of the blood lactate value and base deficit in trauma patients was compared. It was stated that the blood lactate value may be preferred in evaluating the severity of trauma patients. In the study of Régnier et al.,^[23] the lactate values and lactate clearance of the patients were compared, and in the ROC analysis, the lactate value was found to have an AUC of 0.78. In the current study, it was determined that the lactate level has an AUC of 0.684 in the ROC analysis to predict mortality. Although this result was statistically significant, it was found that it had a poor discrimination ability due to the low sensitivity.

Limitation

The main limitations of the study are that it is retrospective, the number of patients is not too large, and the study is not multicenter.

Conclusion

In patients with thoracic trauma, the NISS may be a useful factor that can be used in emergency rooms when a quick decision is required. In the follow-up of patients with thoracic trauma, blood lactate level is an important blood parameter that should be paid attention to by the clinician since it has a specificity of 92.8% in predicting mortality. In addition, further studies should be conducted on scoring in patients with thoracic trauma.

Ethics Committee Approval: This study was approved by the University of Health Sciences Diskapi Yildirim Beyazit Training and Research Hospital Local Ethics Committee (Date: 14.12.2020, Decision No: 100/10).

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ORİJİNAL ÇALIŞMA - ÖZ

Torasik travmada prognoz tahmininde travma puanlama sistemlerinin rolü ve serum laktat düzeyi

Dr. Eray Cinar,¹ Dr. Eren Usul,² Dr. Erdal Demirtas,³ Dr. Anil Gokce¹

¹Ankara Şehir Hastanesi, Göğüs Cerrahisi Kliniği, Ankara

²Dışkapı Yıldırım Beyazıt Eğitim ve Araştırma Hastanesi, Acil Tıp Kliniği, Ankara

³Dokuz Eylül Üniversitesi Tıp Fakültesi, Acil Tıp Kliniği, İzmir

AMAÇ: Toraks travmaları, travmaya bağlı başvuruların %10'unu oluşturmakta ve travmaya bağlı ölümlerin %25–%50'sine neden olmaktadır. Hastalarda göğüs travmasının düzeyini doğru ve erken değerlendirmek, doğru tedaviye başlamak, yoğun bakım ihtiyacını ve mortaliteyi tahmin etmek ve gelişebilecek komplikasyonları önlemek önemlidir. Bu çalışmada majör torasik travmalı hastalarda serum laktat düzeyi, şok indeksi ve skortlama sistemlerinin prognozla ilgili prediktif etkinliği karşılaştırıldı.

GEREÇ VE YÖNTEM: 2014–2020 yılları arasında hastanemiz acil servisine travma nedeniyle başvuran 683 hastanın dosyaları geriye dönük olarak incelendi. İzole göğüs travması olan hastalar çalışmaya dahil edildi.

BULGULAR: Çalışmaya toplam 683 hasta dahil edildi. Hastaların 34'ü (%5) sağ kalmayan grupta, 649'u (%95) sağ kalan gruptaydı. Her iki grupta da sistolik kan basıncı, diyastolik kan basıncı, nabız hızı, solunum hızı veya şok indeksi arasında istatistiksel olarak anlamlı bir fark yoktu ($p>0.05$). Hayatta kalmayan gruptaki GCS skoru, hayatta kalan grubunkinden anlamlı derecede düşüktü ($p=0.000$). Hayatta kalmayan gruptaki laktat seviyesi ve RTS, ISS ve NISS, hayatta kalanlar grubundakilerden önemli ölçüde daha yüksekti. Yaş, laktat seviyesi ve GCS, RTS, ISS ve NISS açısından anlamlı bir fark bulundu ($p<0.05$). Lojistik regresyon analizinde, laktat değerindeki 1 birimlik artışın, travma skorlarının ve laktat düzeyindeki sayısal değişikliğin mortaliteye etkisi açısından ölüm oranını 1.19 kat artırdığı bulunmuştur.

TARTIŞMA: Torasik travmalı hastalarda, NISS hızlı bir karar alınması gerektiğinde acil servislerde kullanılabilecek yararlı bir faktör olabilir. Ancak hasta takibi sırasında kan laktat düzeylerindeki artışlar da klinisyenin dikkat etmesi gereken bir kan parametresi olabilir. Ek olarak, torasik travmalı hastalarda skortlama konusunda ileri çalışmalar yapılmalıdır.

Anahtar sözcükler: Mortalite; serum laktat düzeyi; torasik travma; travma skortlama sistemleri.

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