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Predictors of Early And Late Mortality in Multitrauma Patients

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Abstract

Trauma-related deaths are the third most common cause of death in all age groups, following cardiovascular diseases and cancer. Predicting mortality and morbidity is of vital importance for patient survival while evaluating trauma patients with a multidisciplinary approach, who account for a significant number of emergency admissions. This study aimed to investigate the parameters that may affect early (24 hours) mortality due to multitrauma. The mean RTS of the early deaths (n: 49) was 3.11 ± 2.19 and that of the late deaths was 5.32 ± 1.78; the ratio was statistically significant ($p < 0.0001$). The mean ISS of the early deaths (n: 49) was 59 ± 17.85 and that of the late deaths was 36.16 ± 12.43; the ratio was statistically significant ($p < 0.0001$).The mean admission APACHE II score of the early deaths was 27.22 ± 6.78 years; the ratio was statistically significant ($p < 0.0001$). The mean lactate values were 6.63 ± 3.43 for the early deaths and 3.98 ± 2.87 for the late deaths in late deceased patients and the difference was statistically significant. The mean base deficit (BD) of the early deaths was 11.5 ± 7.06 and that of the late deaths was -5.10 ± 7.15, thereby leading to a statistically significant difference ($p < 0.0001$). In conclusion, the GCS score, RTS, ISS, and APACHE II score are reliable to use for mortality prediction and high lactate and BD levels can also be used in early mortality prediction. We believe that aggressive treatment may make a positive contribution to survival in patients with high lactate and BD values.

Keywords: Predictors, Mortality

Introduction

Multitrauma refers to structural damage to multiple body areas or organ systems after physical external factors. Trauma is one of the most common causes of death in people under the age of 40 and causes more than 10,000 deaths per day worldwide[1]. Scoring systems have been developed to predict mortality and morbidity while evaluating trauma patients with a multidisciplinary approach, who account for a significant number of emergency admissions. Scoring systems are used as a follow-up parameter to evaluate the severity of injury and its response to treatment.

Serum lactate measures products of anaerobic metabolism and shows impaired oxygenation of tissues in shock patients[2].Base excess (BE) is calculated to determine the amount of strong acid or base required to balance the pH of the blood at 7.4[3]. BE is known to be influenced by lactic acidosis, ventilation rate, sodium bicarbonate, intravenous fluid and blood transfusion[4]. BE and serum lactate level are used in the post-trauma follow-up of patients. BE and serum lactate level have been reported to be associated with poor prognosis and post-trauma follow-up of patients[5].

This study aimed to investigate the parameters that may affect early (<24 hours) and late (>24 hours) mortality due to multitrauma.

Materials and Methods

This study retrospectively investigated multitrauma cases followed up in the emergency department of the University of Health Sciences Haydarpasa Numune Training and Research Center. All patients who survived the trauma and were discharged after the examination and treatment and patients with high levels of alcohol in their blood were excluded from the study.

The patients were divided into two groups: early (<24 hours) and late (>24 hours) mortality. Age, sex, mechanism of trauma, Glasgow Coma Scale (GCS) score on admission, Revised Trauma Score (RTS), Injury Severity Score (ISS), post-traumatic death time, organ damage and bone fractures after multiple trauma, blood pressure, pulse, hemoglobin, hematocrit, lactate and base excess values at the time of application were recorded.

Statistical analysis was performed using SPSS software Version 16.0. Continuous variables were analyzed using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to compare differences between groups and the Chi-square test was used to analyze categorical variables. A p-value less than 0.05 was considered statistically significant.

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Results

This study recruited 110 patients who were examined in our emergency clinic due to multitrauma and died during the follow-up. Among 110 patients, 85 (77.3%) were male and 25 (22.7%) were female. 49 (44.5%) patients died in the early period and 61 (55.4%) died in the late period. There was no statistically significant difference between sex and early and late mortality ($p > 0.05$).

The mean age was 44.57 ±21,93 years. The minimum age was 4 years and the maximum age was 91 years. With respect to trauma etiologies, the most common etiology was out-of-vehicle traffic accidents (39.1%). The other mechanisms of trauma were as follows: 26.4% falls from height, 12.7% in-vehicle traffic accidents, 9.1% motorcycle accidents, and 12.7% other causes. When the association between the mechanisms of trauma and the rate of early and late mortality was analyzed, a statistically significant correlation was found between falls from height and late mortality ($p < 0.05$).

22 (31.9%) of the patients with head trauma died within the first 24 hours and 47 (68.1%) died after 24 hours ($p < 0.05$). Of head trauma patients with an Abbreviated Injury Scale (AIS) score > 3, 23 patients (34.8%) died in the early period and 43 patients (65.2%) died in the late period, thereby yielding a significant correlation between early and late mortality ($p < 0.05$). 23 patients (82.1%) with abdominal AIS score > 3 died within the first 24 hours and there was a significant correlation between early and late mortality ($p< 0.05$). Pelvic, femoral or extremity fractures, vascular-nerve injuries, vertebral fractures, and maxillofacial injuries did not lead to statistically significant differences between the early and late mortality groups.

Considering the trauma scores of the patients on admission, there was a statistically significant difference between the mean GCS score (5.12 ± 1.89) of the early deaths and the mean GCS score (7.93 ± 3.88) of the late deaths ($p < 0.05$).

The mean RTS of all patients (n: 110) was 4.33 ± 1.25. The mean RTS of the early deaths (n: 49) was 3.11 ± 1.19 and that of the late deaths was 5.32 ± 1.78; the ratio was statistically significant (($p < 0.05$).

The mean ISS of all patients was 46.32 ± 18.84. The mean ISS of the early deaths (n: 49) was 59 ± 17.85 and that of the late deaths was 36.16 ± 12.43; the ratio was statistically significant ($p < 0.05$). The mean admission APACHE II score of all patients was 22.98 ± 8.02. The mean admission APACHE II score of the early deaths was 27.22 ± 6.78 years; the ratio was statistically significant ($p < 0.05$).

Considering the admission lactate levels, the mean lactate level of the early deaths was 6.63 ± 2.43 and that of the late deaths was 4,01 ± 1.87; the ratio was statistically significant ($p < 0.05$).

Additionally, the admission lactate level was found to be > 4 mmol/L in 70 of the early deaths according to the first blood test in the emergency room. 35 (58.3%) of these patients died in the early period ($p < 0.05$).

The mean BE of the early deaths was -11.5 ± 4.06 and that of the late deaths was -5.10 ± 2.15, thereby leading to a statistically significant difference ($p < 0.05$).

Systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse, Mean Arterial Pressure (MAP), and Shock Index recorded at the time of emergency admission were statistically lower in the group of patients who died within the first 24 hours ($p < 0.05$). The hemoglobin and hematocrit values were similar between the two groups.

Discussion

Multitrauma continues to pose an important health problem worldwide due to the mortality or permanent disabilities it might cause. A great deal of previous research has shown that multitrauma affects especially the young population and men and this situation leads to socioeconomic problems due to the loss of labor force. With advances in technology, changes have been made in trauma management. Early interventions during the golden hour are known to be life-saving.

110 patients included in this study were in the 4-91 age range. Men (77.3%) were found to be more exposed to multitrauma. This result is consistent with trauma statistics of many previous studies[6]. Considering trauma etiologies, the most common cause was out-of-vehicle traffic accidents (39.1%). Factors such as the use of safety belts and compliance with speed limits in for car rides and the use of helmets and protective clothing for motorcycle rides, which all are more common today, can prevent high-energy accidents that may result in mortality. With respect to 49 patients who died within the first 24 hours, there was no statistically significant correlation between mortality and trauma mechanism. However, considering those who died in the late period, 71.4% of the cases of falls from height died after the first 24 hours ($p < 0.05$).

Various scoring systems have been used to predict mortality and evaluate prognosis in trauma management for several years. The GCS Developed by Jennett and Teasdale in 1974, is the most widely used scoring system in the assessment of the neurological status of head injuries worldwide[7]. It is simple and useful in assessing patient mortality and morbidity and shows a really good correlation with the severity of head trauma. In our study, the relationship between GCS score and mortality within the first 24 hours was statistically significant ($p <0.05$).

The Revised Trauma Score obtained through the combined assessment of the GCS score, systemic blood pressure, and respiratory rate is known to help make reliable survival estimates[8]. The mean RTS was 4.33 ± 1.25 for all the patients

included in this study. The mean RTS was 3.11 ± 1.19 for the patients who died in the early period and this value was found to be statistically significant ($p < 0.05$). Considering the GCS score, RTS, ISS, and APACHE II score, a significant difference was observed between the two groups, thereby suggesting that these scoring systems are reliable to use for the prediction of mortality in the early post-traumatic period. The similarity of hemoglobin (HB) and hematocrit (HCT) between the two groups supports the idea that HB and HCT values mislead clinicians during the emergency follow-up of multitrauma patients. Base excess (BE) is reported to predict pre-hospital and emergency room mortality in trauma patients. Previous studies on the association between BE and mortality have shown that higher arterial BE levels are associated with higher in-hospital mortality. Previous studies have also reported an increased mortality rate with increasing BE[9]. The mean BE of the early deaths was -11.5 ± 4.06 and that of the late deaths was -5.10 ± 2.15, thereby leading to a statistically significant difference ($p < 0.05$).

It is stated that the increase in lactate shows the deterioration of tissue perfusion since the early period, and therefore it is a very important parameter in the diagnosis and follow-up of shock. Additionally, previous research has indicated that initial high lactate levels are more effective in predicting mortality in blunt trauma patients compared to initial BE levels[5]. Considering the initial (admission) lactate levels of the patients in this study, the initial lactate level was >4 mmol/L for 70 of those who died in the early period and 35 (58.3%) of them died in the early period ($p < 0.05$). Therefore, we believe that it is an important parameter for early mortality in trauma patients with high lactate levels and more aggressive treatment should be applied in these patients.

In conclusion, as it is an indisputable fact that the first intervention in the management of patients exposed to multitrauma contributes significantly to prognosis, similar studies have shown the value of trauma scoring systems in predicting mortality. GCS score, RTS, ISS, and APACHE II score are reliable to use for mortality prediction and high lactate and BD levels can also be used in early mortality prediction. Aggressive treatment may contribute positively to survival in patients with high lactate and BD levels.

Table1. Study population characteristics

	Total	EM (<24 h)	LM (>24 h)	P value
Demographics				
Age, y (mean SD)	44,57±21,93	44,48±21,83	44,74±21,45	> 0.05
Female	25 (%22,7)	11 (%22,4)	14 (%23)	> 0.05
Male	85 (%77,3)	38 (%77,6)	47(%77)	> 0.05
Blunt mechanism (%)				
Pedestrian struct	43 (%39,1)	20 (%46,5)	23 (%53,5)	> 0.05
Falls from height	28 (%26,4)	8(%28,6)	20(%71,4)	< 0.05*
In-vehicle traffic acc.	14 (%12,7)	8 (%57,1)	6(%42,9)	> 0.05
Motorcycle accidents	10 (%9,1)	4 (%40)	6 (%60)	> 0.05
Other causes	15 (%12,7)	8(%53,3)	7(%46,7)	> 0.05
Initial parameters (mean SD)				
Initial GCS	7,17±2,94	5.12 ± 1.89	7.93 ± 3.88	< 0.05*
RTS	4,33±1,25	3,11±1,19	5,32±1,78	< 0.05*
ISS	46,32±18,84	59±17,85	36,16±12,43	< 0.05*
APATCHE II	22,98±8,02	27,22±6,78	19,57±7,32	< 0.05*
Abdomen Trauma	n:34	26 (%76,5)	8 (%23,5)	< 0.05*
Abdomen AIS >3	n:28	23 (%82,1)	5 (%17,9)	< 0.05*
Head Trauma	n:69	22 (%31,9)	47 (%68,1)	< 0.05*
Head Trauma AIS>3	n:65	23 (%34,8)	3 (%65,2)	< 0.05*
Pelvic fractures	n:14	7 (%50)	7 (%50)	> 0.05
Femoral fractures	n:13	6 (%46,2)	7 (%53,8)	> 0.05
Maxillofacial injuries	n:11	3 (%27,3)	8 (%72,7)	> 0.05
Vascular-nerve injuries	n:11	7 (%63,6)	4 (%36,4)	> 0.05
Vertebral fractures	n:15	6 (%40)	9 (%60)	> 0.05
Extremity fractures	n:21	12 (%57,1)	9 (%42,9)	> 0.05
Lact level> 4mmol/L	n:70	35(%58,3)	25(%41,7)	< 0.05*
Lactate	5,17±2,38	6,63±2,43	4,01±1,87	< 0.05*
BE	-7,99±2,79	-11,5±4,06	-5,10±2,15	< 0.05*
SBP	87,72±35	57,57±22,26	111,93+41,25	< 0.05*
DBP	50,29±22,74	32,33±13,51	64,72±24,41	< 0.05*
MAP	62,78±29,52	40,76±18,43	80,46±30,97	< 0.05*
Pulse rate	116,55±32,93	133,06+31,95	103,28±27,4	< 0.05*
Shock Index	1,86±1,32	2,78±1,32	1,13±0,76	< 0.05*
Hemoglobin	10,77±2,82	10,33±2.99	11,12±2,66	> 0.05
Hematocrit	32,45±7,84	31,62±8,52	33,12±7,25	> 0.05

EM: Early mortality, LM: Late mortality, In-vehicle traffic acc.: In-vehicle traffic accidents, Lact level: Lactate level