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Original Research Article

Factors Which Affect Mortality and Admission to Intensive Care in Penetrating Thorax and Abdominal Injuries

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Abstract: The purpose of this study is to examine the relationship between mortality and stay times in intensive care and hematocrit value as of the time of application with trauma scores and hemodynamic measurements in patients with thorax and abdominal injuries due to stab wounds in the intensive care unit.Sosyodemographic data, vital signs, blood parameters, characteristics of injuries recorded and GCS, RTS, PATI, ISS, shock index were calculated for each patient from hospital records. 661 patients included to the study. 342 patients (51.7%) were identified with only thoracic, 224 (33.9%) with only abdominal and 95 (14.4%) with both thoracic and abdominal injuries. 14 (2.1%) of the patients who applied to the emergency service were mortal, 255 (38.6%) were admitted in intensive care for observation. In the multiariate regression analyses made to determine if age, operation, shock index, systolic blood pressure, pulse, respiratory rate, first hematocrit, GCS, ISS, RTS, PATI and blood transfusion were independent indicators for mortality and admission in intensive care, none of these parameters were identified as an independent variable for mortality. In conclusion shock index, pulse, systolic blood pressure, ISS and first hematocrit values demonstrated differences in both mortal patients and patients admitted in intensive care, no independent variable was identified for mortality.
Keywords: Penetran trauma, mortality, intensive care admission

INTRODUCTION

Trauma is the leading cause of death in young adults and constitutes 10% of death in women and men [1]. In USA, 50 million people receive medical care due to trauma on annual basis and about 30% of total intensive care admissions are caused by trauma [2,3]. Apart from the military field, the ratio of death by penetrating injury is less than 15% of traumatic deaths across the world [4]. While most of the penetrating injuries in studies in South Africa and USA are caused by firearm injuries [5], the multicenter cohort study by Hastale *et al.* reported 70% stab wounds in Europe [5].

Posttraumatic uncontrolled bleeding is the result of 30-40% of total deaths [6]. Two widescale database analysis report severe bleeding, low GCS and advanced age in trauma patients as independent parameters related to mortality [7]. Many studies were made for triage, administration and mortality estimation of penetrating trauma patients using hemodynamic physiologic parameters and trauma scores and it was reported that systolic blood pressure can be used in mortality estimation as an independent variable [5].

The purpose of this study is to examine the relationship between mortality and stay times in intensive care and hematocrit value as of the time of application with trauma scores and hemodynamic measurements in patients with thorax and abdominal injuries due to stab wounds in the intensive care unit.

MATERIALS AND METHODOLOGY

Study design

This study was made with retrospective analysis of data for patients which penetrating thorax and chest injuries who applied to Dicle University Faculty of Medicine Hospital Emergency Unit, which is a third degree trauma center, between February 2003 - July 2006.

Selection of Patients

Patients over the age of 18 who applied to the emergency unit with stab wounds in the chest and/or thorax. Patients without hemodynamic parameters, trauma score and/or necessary information for calculation of the trauma score in their patient files, patients for whom one or more of the hematocrit values as of the initial application are missing and patients who were brought arrested to the emergency unit were excluded from the study.

Data Collection

Patients' age, gender, reason for and type of incident, time of application, number of injuries, time for operation, hematocrite value at the first application, arterial blood pressure, pulse rate, respiratory rate, consciousness, additional injury, area of penetration in the body (only thoracic, only abdominal, both thoracic and abdominal), injured organs and severity, treatment rendered (surgical, medical observation), blood transfusion number, intraabdominal bleeding amount, if applicable, paracentesis positivity, presence of omentum evisceration, closed thorax drainage (CTD), bleeding amount from CTD, thoracotomy status, cardiac injury, if applicable, anatomic localization of cardiac injury, presence of pericardial effusion, major vascular injury (thoracic or abdominal), period of hospitalization, period of stay in intensive care, mortality, if applicable, were recorded. GCS, RTS, PATI, ISS, shock index were calculated for each patient.

Statistical analysis

Frequency, percentage, means, SD values were used for sociodemographic data of the patients in the study. Chi-square test (χ^2) was used for categorical variables and Student's t test was used for continuous variables in univariate analyses to determine risk factors for mortality and admission in intensive care. Multivariate analyses were made using the Backward Stepwise Wald Logistic Regression method. $P<0.05$ values were considered statistically significant.

RESULTS

661 patients in total were included in the study. 635 of them were male (96.1%). 342 patients (51.7%) were identified with only thoracic, 224 (33.9%) with only abdominal and 95 (14.4%) with both thoracic and abdominal injuries. Considering the patients in terms of reasons for injury, 10 (1.5%) applied to the emergency unit for suicide attempts, 14 (2.1%) for accidents and 636 (96.4%) for violent stab wounds. While 14 (2.1%) of the patients who applied to the emergency service were mortal, 255 (38.6%) were admitted in intensive care for observation.

When the patients are grouped in terms of absence of mortality and admission in intensive care, age, physiologic and hemodynamic parameters as well as trauma scores are provided in Table 1. Comparing survivor and mortal patients, shock index, systolic blood pressure, pulse, first application hematocrit value, ISS, RTS, PATI and GCS varied between groups. Similar parameters varied between those who were and were not admitted to intensive care and age and RTS trauma score did not show statistical difference between groups.

In the multiariate regression analyses made to determine if age, operation, shock index, systolic blood pressure, pulse, respiratory rate, first hematocrit, GCS, ISS, RTS, PATI and blood transfusion were independent indicators for mortality and admission in intensive care, none of these parameters were identified as an independent variable for mortality. Age, operation, systolic blood pressure, ISS, RTS and blood transfusion were identified as independent indicators for admission in intensive care and the highest odds rate was obtained in RTS with 19.5 (Table 2).

In ROC analysis made to evaluate the mortality estimation of the first hematocrit with trauma scores and physiologic parameters, AUC was 0.970 for shock index and 0.903 for ISS (Table 3). In ROC analyses made to evaluate the estimation for admission in intensive care, AUC was 0.726 for shock index and 0.823 for ISS (Table 4, Figure 1).

Injury had passed the visceral pleura in 198 of the patients with thorax injury. While thoracotomy was applied in 43 patients, closed thorax drainage was applied in 183 patients. 21 (10.6%) of the patients had cardiac injury, 10 patients had injury in the right ventricle, 9 patients in the left ventricle, 1 patient in the right atrium and 1 patient in the left atrium. 15 of the patients had cardiac tamponade and 5 patients with cardiac injury resulted in mortality.

153 of the patients with abdominal injury were connected to the abdomen. 23 patients had omentum evisceration, 7 patients had retroperitoneal hematoma, and 18 patients had diaphragm injury. The most frequently injured intraabdominal organs were the small intestine (n: 30), colon (n: 28), and liver (n: 21). 32 of 117 patients who were rendered laparotomy had negative laparotomy.

Table-1: Distribution of age and physiologic parameters and scores by survival and admission in intensive care

	Admitted in intensive care (n:255)	Not admitted in intensive care (n:406)	p	Survivor (n: 647)	Dead (n:14)	p
Age	24.56 ± 10.6 23.25 – 25.88	24 ± 10.9 22.93 – 25.06	.513	24.1 ± 10.7 23.3 – 24.9	28.6 ± 14.7 20.1 – 37.1	.121
Shock Index	1.03 ± 0.44 0.98 – 1.08	0.84 ± 0.45 0.79 – 0.88	.000	0.87 ± 0.32 0.85 – 0.90	2.6 ± 1.5 1.7 – 3.5	.000
Systolic Blood Pressure	100 ± 16.8 97.94 – 102.1	107.8 ± 15.9 106.2 – 109.3	.000	105.9 ± 14.5 104.8 - 107	52.1 ± 25.6 37.3 – 66.9	.000
Pulse	96.75 ± 15 94.9 – 98.6	85.1 ± 12.5 83.9 – 86.3	.000	89 ± 12.9 88 - 90	114 ± 43.4 89 - 139	.000
Respiratory rate	17.8 ± 3.4 17.4 – 18.3	15.8 ± 5.4 15.4 – 16.4	.000	16.6 ± 4.6 16.3 – 16.9	17.1 ± 9.4 11.6 – 22.5	.734
First hematocrite	37.5 ± 6.1 36.7 – 38.3	39.3 ± 4.9 38.8 – 39.8	.000	38.9 ± 4.8 38.6 – 39.3	22.1 ± 9.8 16.4 – 27.8	.000
ISS	20.2 ± 6.5 19.4 – 21.0	11.5 ± 5.9 10.9 – 12.1	.000	14.6 ± 7.3 14.1 – 15.2	26.5 ± 4.6 23.8 – 29.2	.000
RTS	11.7 ± 0.59 11.7 – 11.8	11.8 ± 11 11.7 – 11.9	.269	11.9 ± 0.4 11.87 -11.93	6.9 ± 3.1 5.1 – 8.7	.000
PATI	3.9 ± 6.9 3.1 – 4.8	0.35 ± 3.15 0.04 – 0.66	.000	1.4 ± 4.1 1.1 – 1.7	18.2 ± 16.4 8.7 – 27.7	.000
GCS	14.6 ± 0.81 14.49 – 14.7	14.78 ± 1.36 14.65 – 14.91	.052	14.8 ± 0.5 14.8 – 14.89	8.3 ± 3.5 6.2 – 10.4	.000

Table-2: Multivariate logistic regression analysis

	Mortality				Admission in intensive care			
	Sig	Exp (B)	%95 CI Lower	%95 CI Upper	Sig	Exp (B)	%95 CI Lower	%95 CI Upper
Age	.987	3.761	.000	-	.024	.966	.938	.996
Operation	1	.007	.000	-	.012	.058	.006	.540
Shock index	.995	.000	.000	-	.091	19.6	.621	618.5
Systolic BP	.981	2.339	.000	-	.026	1.04	1.005	1.075
Pulse	.998	1.636	.000	-	.506	1.02	.962	1.082
Respiratory rate	.996	2.895	.000	-	.191	1.03	.986	1.074
First hematocrit	.991	1.204	.000	-	.710	.999	.995	1.003
GCS	.984	.000	.000	-	.473	1.373	.578	3.263
ISS	.987	6.009	.000	-	.000	1.258	1.193	1.328
RTS	.995	.000	.000	-	.002	19.5	2.937	129.5
PATI	.979	18.33	.000	-	.203	.934	.841	1.038
Blood transfusion	1	.004	.000	-	.000	2.82	1.65	4.798

Table-3: Variables in mortality estimation (Area under the Curve)

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
GCS	,012	,007	,000	,000	,024
Systolic BP	,035	,022	,000	,000	,077
First Hematocrit	,083	,043	,000	,000	,168
ISS	,903	,028	,000	,849	,958
RTS	,044	,041	,000	,000	,125
PATI	,792	,082	,000	,631	,953
Shock index	,970	,013	,000	,944	,996

Table-4: Variables in intensive care admission estimation (Area under the Curve)

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
GCS	,388	,023	,000	,342	,433
Systolic BP	,337	,022	,000	,293	,380
First hematocrit	,408	,023	,000	,363	,453
ISS	,823	,016	,000	,791	,854
RTS	,422	,023	,001	,376	,468
PATI	,667	,023	,000	,622	,712
Shock index	,726	,021	,000	,686	,766

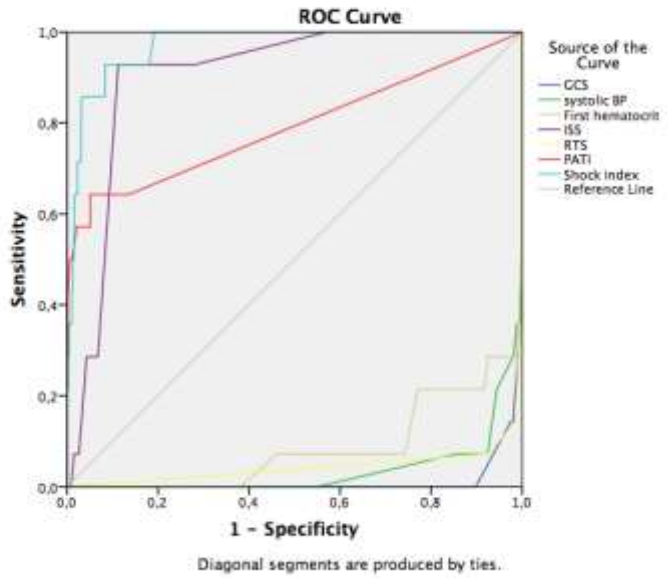

Fig-1: ROC Curve of mortality estimation

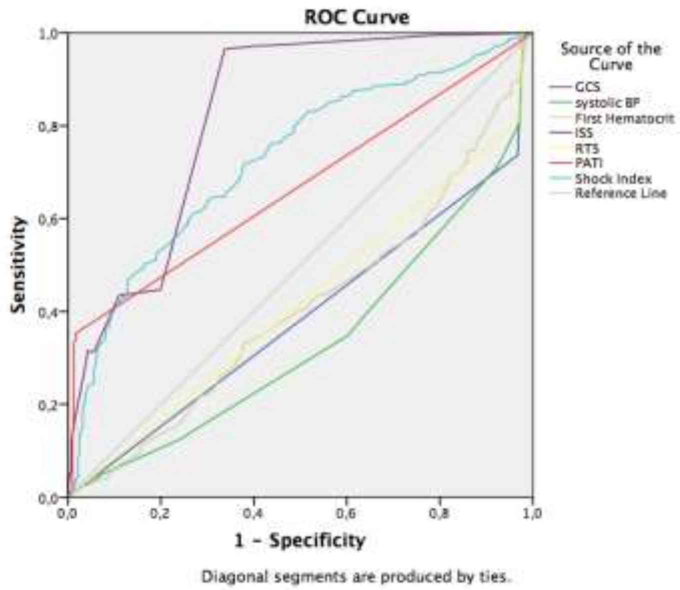

Fig-2: ROC Curve of intensive care admission estimation

DISCUSSION

This study, which evaluated efficiency of scoring systems, hemodynamic parameters and hematocrit levels in the first application in estimating mortality and admission in intensive care in penetrating thorax and abdominal injuries, demonstrated that, despite differences in these parameters between survivor and mortal groups and those admitted and not admitted in intensive care, the regression analysis reported none of these parameters were independent risk factors for mortality and systolic blood pressure, ISS, RTS and blood transfusion were independent risk factors for admission in intensive care.

Christensen *et al.*[8], in their study in UK, reported 1365 patients applied for penetrating trauma in 6 years and these patients constituted 3.6% of all trauma patients. In USA, it was reported that 30% of all trauma were caused by penetrating injuries [9]. Again in USA, it was reported 2799 people died of penetrating injuries and 64.000 people were treated for nonfatal penetrating injuries in 2004 [10]. It is stated that, in South Africa, 80% of emergency surgical procedures are applied for penetrating injuries [11,12]. All of the cases in our study were comprised of patients with stab wounds, 53% of the patients had penetration in the chest or abdomen and the mortality rate was 2,1%. Minifio *et al.*[10] reported 4,1% mortality rate while Hemmati *et al.*[13] reported 4,3% in blunt and penetrating injuries and 2,2% in only penetrating thorax trauma. While the results of our study are similar to the mortality rates in the literature, we believe discrepancies are a result of patient selection and differences between patient groups.

In a study of Lu *et al.*[14] that evaluated using noninvasive hemodynamic monitoring in prognosis estimation in trauma patients, mortality in patients with penetrating injury was 11% and ISS was higher, GCS was lower, hematocrit was lower, systolic blood pressure was lower and heart rate was higher in mortal patients compared to survivors and statistical significance was determined in comparisons. AUC was 0.874 for systolic blood pressure in the analyses made for survival probability with data in the first four hours. Some studies reported in patients with low ISS, patients with penetrating injury had higher rate of mortality compared to patients with blunt injury and this difference was a result of injury of multiple organs in injuries in a single anatomical area in penetrating injuries [15,16]. Hasler *et al.*[5], in their study to evaluate 30 day mortality in patients with major penetrating injury, reported that systolic blood pressure below 110 mmHg was related to increased mortality independently from age, gender ISS and GKS and while the odds ratio between SBP 90-110 was 3.03, the odds ratio was 36.1 when SBP< 70 mmHg and 31.0 when ISS>25. In our study, shock index, pulse, ISS and PATI were higher and systolic pressure and first hematocrit were lower in mortal patients compared to survivors and in patients who were admitted compared to those not admitted in intensive care. While GCS was significantly lower in mortal patients, no difference was observed between those admitted and not admitted in intensive care. In the multivariate analysis, the parameters evaluated in our study were not identified as independent variables for mortality estimation. In ROC analysis for mortality estimation, while AUC was 0.970 for shock index, it was 0.035 for SBP. While AUC was 0.726 for shock index, it was 0.823 for ISS in estimation of admission in intensive care. Although the findings of our study are similar to other studies, while Hasler *et al.*[5] identified SKB as an independent variable for mortality estimation, no independent variable was identified for mortality estimation in our study. It is assumed this difference is a result of the fact that our study only included thorax and abdominal stab wounds while Hasler's study included all penetrating injuries with serious trauma. The fact that AUC for SBP was higher in the study of Lu *et al.*[14] and lower in our study is a result of differences between study methodologies and selected patient groups. While our study only covered patients with penetrating thorax and abdominal injuries, the other study included all patients with both penetrating and blunt injury.

CONCLUSION

Trauma patients are frequent cases in emergency units and patients with serious injuries should be closely monitored and intervened with rapidly. At this point, trauma scores, hemodynamic parameters and laboratory examinations are important. In conclusion, while shock index, pulse, systolic blood pressure, ISS and first hematocrit values demonstrated differences in both mortal patients and patients admitted in intensive care, no independent variable was identified for mortality and age, operation, SBP, ISS, RTS and blood transfusion were identified as independent variables for admission in intensive care.

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