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Determining Prognostic Value of Serum Levels of Lactate, Bicarbonate, Base Deficit and Glucose in Mortality Rate of Trauma Patients Admitted to Emergency Department Imam Reza hospital of Tabriz,Iran, from January 2015 to January 2016

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ABSTRACT

Introduction: Trauma is of the most important health problems in the world and major factor leading to mortality and morbidity, especially in the first four decades of life in injured people. So, we decided to examine in this study clinical symptoms and laboratory parameters in trauma patients and predictive value in determining prognosis and mortality of these patients. **Materials and Method:** In this descriptive study, 150 cases of multi-trauma patients admitted to the emergency department of Tabriz Imam Reza hospital were enrolled in the study. Computerized block randomization method was applied to randomize the subjects The questionnaire containing basic information in the pre-hospital phase were recorded for selected patients. As well, injury severity score (ISS) and revised trauma score (RTS) were calculated. Then, blood samples were taken from patients for testing laboratory parameters, including serum lactate level, base deficit, blood glucose, serum bicarbonate levels, BUN and Cr. The data obtained were analyzed through descriptive statistics, frequency, percentage and mean difference test and chi-square test for qualitative variables examined using the software statistical SPSS v17. The P value<0.05 was considered statistically significant. **Results:** mean age of patients was equal to 37.05±1.58 years. 130 patients (87.8%) were discharged after treatment and recovery and 18 patients (12.2%) died. predictive values of serum lactate cut of point was 27.65 pg/ml for serum lactate with sensitivity of 80% and specificity of 48% on admission. **Conclusion:** It seems that the mentioned markers alone are unable to be potent prognostic factors as predictors of mortality.

INTRODUCTION

Trauma is one of the most important health problems in the world and major factor leading to mortality and morbidity, especially in the first four decades of life in injured people (1). The greatest cause of mortality under 24 years is attributable to brain injury, which imposes billion Rials annually on the healthcare system. In 2000, traffic accidents accounted for the second largest cause of disease and premature death, after AIDS, among men aged 24 and 15 years old (1-3). Therefore, early interventions are considered as the basic principle for reducing mortality rate and trauma-related disabilities (4, 5).

Some of these interventions include the application of specific scales to calculate injury severity and measure dynamic stability of the patient, which have a key role in determining the type of care provided and reducing the mortality rate (6).

Since several years ago, different scales such as Abbreviated Injury Scale (AIS) and the Trauma and Injury Severity Score (TRISS) have been employed in this regard to determine the severity of trauma in injured patients and have been already recruited in some countries for all trauma patients. These scales exploit anatomical and physiological criteria and sometimes a combination of them to detect the injury severity (7, 8).

Occult hypoperfusion (OH) has been defined as mortality predictor whose criteria have been based on measurement of serum lactic acid, but measuring these parameters is not possible in all trauma centers (9, 10).

Since no studies have been conducted so far in trauma center at Imam Reza hospital of Tabriz, Iran, regarding the predictive role of laboratory factors in trauma patients, as well as there is no precise information about taking good care of trauma patients and monitoring of acid-base disorders in the center, so we aimed to study the clinical symptoms and laboratory parameters in trauma patients and predictive value in determining prognosis and mortality of these patients.

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MATERIALS AND METHODS

In this descriptive study conducted in the emergency department of Imam Reza hospital of Tabriz,Iran, from January 2015 to January 2016, 150 cases of multi-trauma patients were enrolled according to the results of similar studies conducted on the predictive role of some laboratory parameters in the prognosis of multi-trauma patients and especially the study of Husain et al. (11) who evaluated serum lactate and base deficit as predictors of mortality and morbidity on 137 patients, as well as by taking a=0.05, p=95% and d=0.06. Exclusion criteria included trauma patients who had suffered cardiac arrest while being transported to the emergency department or inside the emergency department within 6 hours, patients who were exposed to fluid and blood resuscitation or any of surgery operation in other centers (receiving intravenous fluids and blood, and resuscitation actions in other centers were the confounding variables in this study), patients who required emergency surgery for any reason and patients with a stay less than 6 hours in the emergency department.

Computerized block randomization method was applied to randomize the subjects who were included in the study based on numbers of medical records. One of the emergency personnel performed concealed randomization and announced to the investigator.

The questionnaire containing basic information such as age, gender, cause of trauma (vehicle, falling, etc.), vital signs (blood pressure, SPO_2, RR, HR) and GCS (Glasgow Coma Scale) of patients on admission, transferor of patients to the hospital and primary lifesaving measures in the pre-hospital phase were recorded for selected patients. As well, injury severity score (ISS) and revised trauma score (RTS) were calculated and recorded for the patients.

Then, blood samples were taken from patients for testing laboratory parameters, including serum lactate level, base deficit, blood glucose, serum bicarbonate levels, BUN and Cr. Lactate, bas deficit and blood sugar were assessed on admission and 6 hours after admission in the emergency department. To avoid bias, all tests were performed only in a laboratory of Imam Reza hospital (AS) and using the same lab kit.

The GCS and mortality were recorded 6 and 24 hours after the accident. If the patient left emergency in the hours mentioned or if clearance, follow-up would have conducted by telephone.

During this study, no interference was done in the routine course of diagnosis and treatment of trauma patients in the emergency department. Moreover, no additional cost was imposed to the patient for tests or any other diagnostic and therapeutic actions. Adequate knowledge was given to all patients (in case of loss of consciousness and the patient's age under 18 years) about the purposes of this study. Methodology of this study was performed according to guidelines suggested by Deputy of Research at Tabriz University of Medical Sciences. It should be noted that all information of patient records was kept strictly confidential.

The data obtained were analyzed through descriptive statistics (Mean ± SE), frequency, percentage and mean difference test for independent samples for quantitative variables and chi-square test for qualitative variables examined using the software statistical SPSS™17. The P value<0.05 was considered statistically significant.

RESULTS

Initially, 150 patients were enrolled in the study, but two patients were excluded from the study because of incomplete data and the impossibility of complete the requirements. Therefore, information was collected on 148 multiple trauma patients. The mean age of patients was equal to 37.05±1.58 years (Max=90 and Min=1). Of 148 patients, causes of trauma were the accident in 113 cases (76.4%), falling in 27 cases (18.2%) and hitting with heavy object in 8 patients (5.4%). Furthermore, 112 patients (75.7%) by EMS (Emergency Medical Services) (108 (73%) by land EMS and 4 (2.7%) by air EMS) and 36 patients (24.3%) by relatives were transferred to the emergency department (Table 1).

Finally, of 148 patients, 130 patients (87.8%) were discharged after treatment and recovery and 18 patients (12.2%) died. According to the objectives of the study, the outcomes of patients' vital status on admission and laboratory findings at different ranges were presented based on final status. The mean age of the discharged and deceased patients was respectively 35.68±1.62 and 45.5±5.23 years, which showed no statistically significant difference (P=0.22) (Tables 2 and 3).

In studying predictive values of serum lactate in mortality of multi-trauma patients, cut of point was 27.65 pg/ml for serum lactate with sensitivity of 80% and specificity of 48% on admission as well as was 24.15 pg/ml for serum lactate after 6 hours with sensitivity of 100% and specificity of 50%. In studying predictive values of HCO_3 in mortality of multi-trauma patients, cut of point was 16.15pg/ml for HCO_3 on admission with sensitivity of 98.6% and specificity of 60%, as well as was 16.5pg/ml for HCO_3 after 6 hours with sensitivity of 93.7% and specificity of 40%.

In studying predictive values of pH in mortality of multi-trauma patients, cut of point was 7.19 for pH with sensitivity of 90.1% and specificity of 60% on admission as well as was 7.26 for pH after 6 hours with sensitivity of 81% and specificity of 80%. In studying predictive values of BE (Base Excess**)** in mortality of multi-trauma patients, cut of point was 8.25 for BE with sensitivity of 90.2% and specificity of 80% on admission as well as was 6 for BE after 6 hours with sensitivity of 81.8% and specificity of 80%. In studying predictive values of BS (blood sugar) in mortality of multi-trauma patients, cut of point was 147.5 for BS on admission with sensitivity of 100% and specificity of 67.6%, as well as was 137.5 for BS after 6 hours with sensitivity of 100% and specificity of 69.8%. In studying predictive values of GCS in mortality of multi-trauma patients, cut of point was 9.5 for GCS on admission with sensitivity of 88% and specificity of 80%, as well as was 6.5 for GCS after 6 hours with sensitivity of 84.5% and specificity of 100% (Figures 1-4).

In studying predictive values of RTS in mortality of multi-trauma patients, cut of point was 6.5 for RTS on admission with sensitivity of 98.6% and specificity of 60%. In

studying predictive values of ISS in mortality of multi-trauma patients, cut of point was 33.5 for ISS on admission with sensitivity of 80% and specificity of 62.2% (Figure 5).

DISCUSSION

The aim of this study was to determine the prognostic value of serum lactate, bicarbonate, base deficit and glucose in mortality rate of trauma patients admitted to the emergency department. The present study evaluated 148 multi-trauma patients with the mean age of 37.05 ± 1.58 years. The mean age of the discharged and deceased patients was respectively 35.68 ± 1.62 and 45.5 ± 5.23 years, which showed no statistically significant difference (P = 0.22). As can be seen, this difference was not statistically significant despite higher mean of deceased group compared to discharged patients. However, Tornetta, Demetriades and Jameel et al. have pointed out the significant role of age in mortality of trauma patients, so that these studies have reported that all cases of morbidity and mortality in trauma patients were increased with age (12-14). Our study also showed no statistically significant differences in spite of about 10-year difference in mean age of discharged and deceased subjects. Nevertheless, it is not possible to definitively reject the theory of other studies, because naturally an increase in mortality rate in older patients is not unexpected given the types of complications following aging and reducing the possibility of non-invasive and invasive interventions.

In a study of Ehsaei et al. on mortality in different age ranges, it was observed that the highest mortality rate was in the age range of 21-40 years of trauma patients and the age ranges of 0-20, 61-80, 41-60, and >80 years, respectively, were in the next ranks (15).

The highest mortality rate in our study was in the range of 21-40 years, and the ranges of 0-20, 61-80, 41-60 and >80 years were in the next places. The reason for this difference can be attributed to the mechanism of trauma in patients of all ages, because falling in the study of Ehsaei et al. was the causes of trauma only by 15% of patients in the age group of 20-60 years old (15). However, in our study, 44.4% of the trauma was caused by falling in which 59.2% of subjects were in the age ranges of 0-20 and 61-80 years old that are the most vulnerable to direct trauma.

In this study, the patient's vital signs with regard to final status indicated that the patients who had died on admission to the emergency department had lower systolic blood pressure, more heart rate, and lower breathing rate and ultimately lower arterial oxygen saturation than patients who were alive and discharged. Variables of systolic blood pressure, respiratory rate and SPO2 had statistically significant differences between the two groups.

Regnier and colleagues studied 586 trauma patients with mean age of 38 ± 16 years. In this study, the mortality rate was 13% (14) that is similar to our study. Of 148 patients in the present study, 130 patients (87.8%) were discharged after treatment and recovery and 18 patients (12.2%) died. Regnier et al. examined serum lactate level and stated that lactate level in the early hours of trauma (hours 0 to) in deceased patients was significantly higher than survived patients (16).

In a study of 137 SICU patients by Husain and colleagues regarding the serum level of lactate and base deficit, in line with the study of Regnier et al., significant increase was reported in serum lactate levels on admission and the first 24 hours in deceased patients (11).

It was observed also in our study. In this study, the mean serum lactate on admission was 35.59±2.9 in deceased patients and 30.7±1.14 in discharged patients, which shows a significant difference though this difference was not statistically significant (P=0.61).

Regnier et al. stated that the serum lactate has an important role in the future actions for patients and determining their final status, but low specificity was obtained for serum levels of lactate in predicting mortality of patients in our study despite almost acceptable sensitivity, so that in studying predictive values of serum lactate in mortality of multi-trauma patients, cut of point was 27.65 pg/ml for serum lactate with sensitivity of 80% and specificity of 48% on

Table 1. Results of basic vital signs on arrival to the emergency department on the final status of patients

Variable	Discharge	Death	P value
Systolic blood pressure	109.06±1.94	108.43±7.71	0.009*
Diastolic blood pressure	71±1.07	72.3±3.6	0.39
Heart rate	94.03±1.91	101.16±4.83	0.95
Respiratory rate	19.67±0.55	18.05±2.08	0.006*
SPO2	92.61±0.52	85.8±2.83	0.0001*

Data is presented as Mean±SE

Table 2. Results of laboratory markers on the final status of patients

Variable	Time	Discharge	Death	P value a
Lactate	Arrival	30.7±1.14	35.59±2.9	0.61
	6 hours	27.2±0.94	33.69±2.61	0.21
	P value b	<0.0001*	0.21	
PH	Arrival	7.32±0.007	7.2±0.02	0.03*
	6 hours	7.32±0.005	7.25±0.02	0.006*
	P value b	0.82	0.18	
HCO3	Arrival	21.86±0.25	20.36±0.94	0.04*
	6 hours	21.62±0.23	19.95±0.82	0.07
	P value b	0.3	0.52	
BE	Arrival	03.54±0.3	07.27±1.06	0.06
	6 hours	02.88±0.29	07.01±0.92	0.42
	P value b	0.01*	0.71	
BS	Arrival	145.64±4.95	176.33±18.11	0.27
	6 hours	138.37±5.19	167.94±17.72	0.72
	P value b	0.04*	0.28	
BUN	Arrival	17.25±0.46	18.3±1.16	0.47
Cr	Arrival	1.08±0.03	1.15±0.05	0.61

Data is presented as Mean±SE, P Value a: analysis of intergroup
P value b: inward group analysis, p value < 0.05

Table 3. Results scoring of GCS, ISS and RTS based on the final status of patients

Variable	Time	Discharge	Death	P value a
GCS	Arrival	13.5±0.19	9.83±0.57	0.11
	6 hours	13.007±0.31	6.55±0.8	0.5
	24 hours later	13.28±0.3	6.72±0.81	0.59
	P value b	0.24	<0.0001*	
RTS	Arrival	11.26±0.11	9±0.51	0.002*
ISS	Arrival	28.58±0.96	40.88±2.79	0.46
Died in the first 24 hours	Positive	0 (0)	%27.8 (5)	
	Negative	130 (100)	%72.2 (13)	

Data is presented as Mean±SE, P value a: analysis of intergroup, P value b: inward group analysis. p value < 0.05

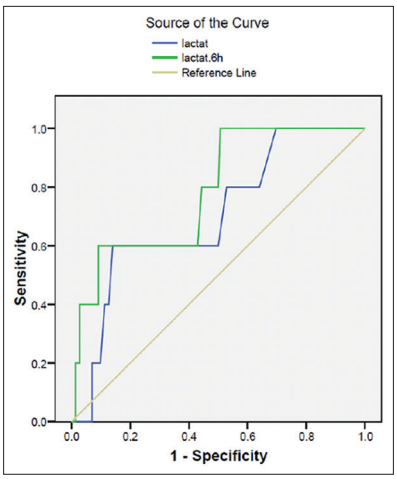

Figure 1: Sensitivity and specificity of admission Lactate score (Arrival, 6 hours) to study mortality in multiple trauma patients

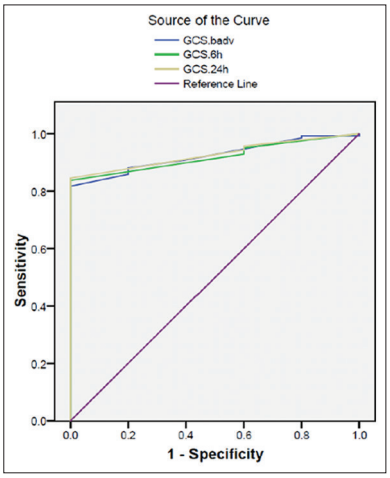

Figure 3: Sensitivity and specificity of admission GCS score (Arrival, 6 hours, 24 hours later) to study mortality in multiple trauma patients

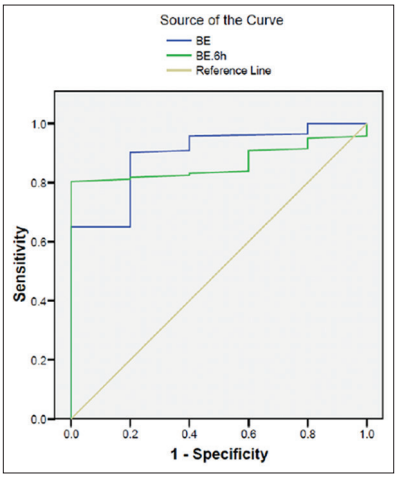

Figure 2: Sensitivity and specificity of admission BE score (Arrival, 6 hours) to study mortality in multiple trauma patients

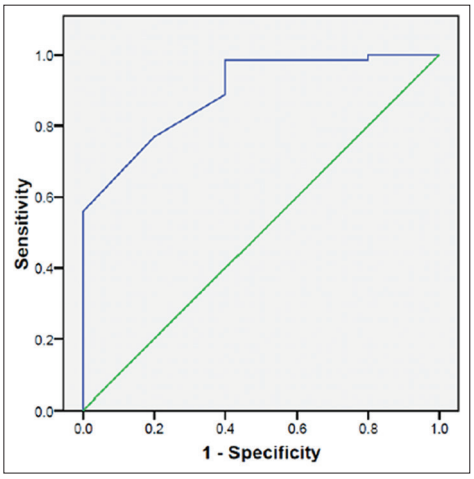

Figure 4: Sensitivity and specificity of admission RTS score to study mortality in multiple trauma patients

admission as well as was 24.15 pg/ml for serum lactate after 6 hours with sensitivity of 100% and specificity of 50%.

But in this study, no significant difference was observed between the deceased and discharged groups in terms of blood glucose, BUN and Cr in traumatic patients, unlike the pH and HCO_3.

Husain et al. concluded that a significant correlation exist between lactate levels and base deficit in the first 24 hours in trauma patients (11). Andel et al. also investigated the relationship between lactate levels and base deficit with mortality of traumatic patients. They found significant relationship between these two markers with mortality of trauma patients (17).

In some studies, such as study by Finelli et al., efficiency of base deficits has been shown to predict mortality and length of stay in the ICU (18).

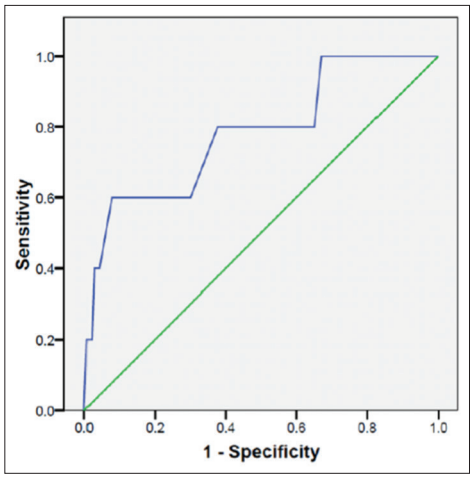

Figure 5: Sensitivity and specificity of admission ISS score to study mortality in multiple trauma patients

These results are in line with findings obtained by the current study as well. In this study, both pH and HCO3 variables had statistically significant difference between the two deceased and discharged groups on admission (respectively, P=0.03 and P=0.04).

This increase in lactate, and decrease in pH and HCO3 were seen after 6 hours admission. Concerning the pH after 6 hours, the difference was statistically significant between the two groups (P=0.006), which is similar to the studies of Husain and Andel and colleagues.

In addition, considering similar results obtained in other studies, it is reported that the use of base deficit criterion has broad efficiency to evaluate the trauma patients, especially to estimate the shock, resuscitation efficiency and organization of medical resources (19-21). Some studies suggest that the changes in the base deficit even in normal range (2.55-3) in trauma patients can reveal decreased occult hypoperfusion and increased odds of death.

In justification of this, Butler et al. in relation to changes in base deficit noted that in trauma occurred in some people (like cachectic people, people with low muscle mass, elderly), a normal base deficit cannot lead to reasonable assurance about lacking severity of the trauma. These researchers argue that the most important source of lactate in trauma is skeletal muscle and because the amount of muscle mass in mentioned people is less than in the others, so base deficit may be within the normal range despite high trauma severity. In general, we can say that these markers have significant role in predicting the patient's condition and required actions. (22)

In our study, according to the mentioned results, in studying predictive values of pH in mortality of multi-trauma patients, cut of point was 7.19 for pH with sensitivity of 90.1% and specificity of 60% on admission as well as was 7.26 for pH after 6 hours with sensitivity of 81% and specificity of 80%. Furthermore, in studying predictive values of HCO_3 in mortality of multi-trauma patients, cut of point was 16.15 for HCO_3 on admission with sensitivity of 98.6% and specificity of 60%, as well as was 16.5 for HCO_3 after 6 hours with sensitivity of 93.7% and specificity of 40%.

Ehsaei et al. studied information of 15496 trauma patients using Information Center DRAs. In this study, 289 patients died, actually with mortality rate of 1.86 percent, as well as there was a significant association between the time of death and their ISS score on admission, so that the deceased patients at first hour of admission had ISS score with the mean of 70.2, while the mean score of ISS was 39 in deceased patients after 72 hours (15).

In our study, the mean admission GCS score of discharged and deceased patients was respectively 13.5±0.19 and 9.83±0.57. Also, the mean admission ISS score of discharged and deceased patients was 28.57±0.96 and 40.88±2.79, respectively. The difference was not significant statistically between the two groups despite clear difference in the scores. The small sample size compared to other studies with statistically significant results can be the reason for this case. Ehsaei et al. achieved a significant and reverse relationship between the ISS and GCS scores (P=0.03), so that the patients with low GCS scores had higher ISS scores than other patients (15). We found an inverse correlation between the admission GCS and ISS score in deceased patients, similar to the results of Ehsaei et al. (P> 0.0001, correlation = -0.14). In addition, in studying predictive values of GCS in mortality of multi-trauma patients, cut of point was 9.5 for GCS on admission with sensitivity of 88% and specificity of 80%, as well as was 6.5 for GCS after 6 hours with sensitivity of 84.5% and specificity of 100%. However, in studying predictive values of ISS in mortality of multi-trauma patients, cut of point was 33.5 for ISS on admission with sensitivity of 80% and specificity of 62.2%.

CONCLUSION

According to the results, sensitivity and specificity of conducted tests, it seems that the mentioned markers alone are unable to be potent prognostic factors as predictors of mortality as well as concurrent use of these markers will have high sensitivity and specificity. Therefore, it is suggested to be separated the cases at risk from the ordinary ones for intensive care using the base deficit criterion in analyzing arterial blood gas and serum lactate levels on admission of the patient to the emergency department. However, integration of above-mentioned outcomes with GCS and ISS can results in achieving useful therapeutic procedure for the patients.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interest in this study.

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AUTHORS CONTRIBUTION

This article has no authors contribution.

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