Original Article

What do You Expect from Patients with Severe Head Trauma?

Abstract

Background: Head trauma is one of the most common mortality and morbidity causes in adolescent. Numerous studies have been conducted on changes in laboratory results and mortality and morbidity prognostic factors; however, the obtained results have been varied and controversial. The aim of this study is to evaluate changes in laboratory findings and arterial blood gas (ABG) analyses test at admission and investigation of the relation between these changes with outcomes in patients with traumatic brain injury. **Materials and Methods:** In this study, laboratory and metabolic variables were compared in patients with severe brain trauma and normal subjects. Laboratory and metabolic variables and ABG were measured on admission in patients with severe brain trauma and then compared with normal values. At last, the correlation between these variables with the prognosis in the patients was studied. **Results:** Of 93 studied patients, 82 were male and 11 were female with the mean age of 30.54 years. Among the studied variables, prothrombin time (PT), partial thromboplastin time, international normalized ratio (INR), creatinine (Cr), blood sugar, sodium (Na+), potassium, white blood cell, and blood urea nitrogen increased while hemoglobin and platelet decreased significantly. Regarding the ABG results, the difference in $PaCO_2$, HCO_3, and SO_2 at values was significant; whereas there were no statistical significant difference between the discharged and expired patients. In contrast, PT, INR, Cr, and Na had significant difference comparing the discharged and expired patients. **Conclusion:** Laboratory variables do change in patients with severe brain trauma; these changes are influential on patient prognosis, especially in case of PT, INR, Cr, and Na.

Keywords: *Arterial blood gas, laboratory test, severe head trauma, trauma, traumatic brain injury*

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Introduction

Traumatic brain injury (TBI) is the main cause of death and disability in people younger than 40-year-old. The prevalence of TBI is 67–317/100,000, and the death rate is about 4%–8% in moderate traumas and 50% in severe head trauma. TBI is defined as head trauma caused by external forces, direct hit, sudden accelerations, and decelerations; penetrating objects such as bullet or waves caused by explosions. The initial evaluation of these patients is based on airway/breathing/circulation/disability instructions, neurological evaluation to determine Glasgow Coma Scale (GCS) and after stabilizing the patients, laboratory tests, investigation of brainstem, motor function, and other examinations done.[1] Some studies demonstrated that prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), serum glucose level, platelet (Plt) count, hemoglobin (Hb), and coagulation factors at admission can predict prognosis in patients with TBI.[2-5] This study can help those who initially visit patients with head trauma at trauma centers. They can predict changes in laboratory tests and arterial blood gas (ABG) parameters. According to the referenced articles, there is not enough information about changes in routine laboratory tests, so the aim of this study is to evaluate changes in laboratory findings and ABG test at admission and investigate the relation between these changes with outcomes in patients with TBI.

Materials and Methods

In this prospective cross-sectional study, subjects contain all patients with severe head trauma (GCS ≤8) who were admitted in Imam Khomeini Hospital during 24 months (January 2012–December 2013). The methods of this study were approved by the Ethics Committee of Urmia University of Medical Sciences. Written informed consents were obtained from patients' accompanying family member/guardian before enrollment. Inclusion criteria were GCS ≤8 at admission, patients without major trauma, not having diabetes, and not

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having pulmonary and metabolic disease. Exclusion criteria were chest and abdomen major trauma and patients referred from other hospital. In this study, age, gender, underlying cause of head trauma, medical history, laboratory findings (Hb, Plt, PT, PTT, INR, blood urea nitrogen [BUN], white blood cell [WBC], creatinine, potassium [K+], and sodium [Na+]), ABG finding at admission, duration of hospital, and Intensive Care Unit stay, and GCS investigated at admission and compared with at discharge.

Statistical analysis

Data are given as mean ± standard deviation. Independent sample's *t*-test (numerical data) and Mann–Whitney for quantitative and Spearman qualitative data were used for comparisons. Statistical analysis was performed using SPSS 22 software (USA). $P \leq 0.05$ was regarded statistically significant.

Results

In this study, 93 patients with severe head trauma during 2 years investigated. At last, 62 (%66.7) patients finished the study and 31 (%33.3) patients expired. The mean age was 30.54 ± 15.49 (maximum = 76, minimum = 5) and the mean duration of hospitalization was 18.92 ± 16.55 [Table 1]. A total of 82 (%88.2) patients were male and 11 (%11.8) patients were female. The final diagnosis in patients is shown in Table 2. The mean GCS range was 6.53 ± 6.21 [Table 3]. Glasgow Outcome Scale range was 2.82 ± 1.61 at discharge. Laboratory findings are shown in Table 4. ABG parameters are shown in Table 5. Comparison of standard laboratory parameters and laboratory findings at admission in patients with severe head trauma showed a significant difference [Table 6]. Comparison of standard ABG and ABG findings at admission except pH and PaO_2 demonstrated a significant difference [Table 7]. Investigation of outcome based on ABG findings at discharge with expired patients showed no significant differences [Table 8]. Investigation of outcome based on laboratory findings at discharge with expired patients showed in Table 9. There was a significant relation in some laboratory findings such as Na+, Cr, and PT with outcome at discharge. Comparison of GCS in different period between discharged and expired patients at the time of admission showed in Table 10. Comparison of GCS demonstrates that there is a significant relation between GCS and outcome in patients with severe head trauma.

Table 1: Distribution of age in patients

Age	*n* (%)
<18	16 (17.2)
18-65	75 (80.6)
>65	2 (2.2)

Table 2: The final diagnosis in patients with severe head trauma

Diagnosis	*n* (%)
Diffuse axonal injury	39 (41.9)
Acute subdural hemorrhage	22 (23.7)
Brain contusion	10 (10.8)
Acute subdural hemorrhage + intracranial hemorrhage + contusion	15 (16.1)
Epidural hemorrhage + diffuse axonal injury	5 (5.4)

Table 3: The mean range of Glasgow Coma Scale at discharge, after 24 h, 48 h, 1 week later, and at discharge

Time	GCS (maximum, minimum)
At admission	6.21±6.53 (8, 3)
After 24 h	6.53±1.69 (11, 3)
After 48 h	6.74±2.16 (14, 3)
After 1 week	8.4±3.30 (15, 3)
At discharge	9.20±5.14 (15, 3)

Data are presented as mean±SD. SD – Standard deviation; GCS – Glasgow Coma Scale

Table 4: Laboratory findings at admission

Variables	Mean±SD (maximum, minimum)
Hb	12.42±2.48 (19.20, 7.5)
Na^+	143±5.17 (170, 128)
K^+	3.99±0.73 (6.5, 0.8)
BUN	33.67±14.27 (82, 0.9)
Cr	0.98±0.30 (1.8, 0.3)
PTT	33.89±9.26 (73, 13)
PT	14.36±12.17 (24, 12.5)
INR	1.30±0.45 (3, 1)
WBC	24,906.63±3961.92 (17,900, 1008)

Data are presented as mean±SD. SD – Standard deviation; Hb – Hemoglobin; Na^+ – Sodium; K^+ – Potassium; BUN – Blood urea nitrogen; Cr – Creatinine; PTT – Partial thromboplastin time; PT – Prothrombin time; INR – International normalized ratio; WBC – White blood cell

Table 5: Arterial blood gas parameter at admission

Variables	Mean±SD
pH	7.28±0.55
$PaCO_2$	33.92±8.25
HCO_3	18.96±4.29
PaO_2	117.26±54.74
O_2 saturation	94.54±6.76

Data are presented as mean±SD. SD – Standard deviation

Discussion

In this study, 93 patients with severe head trauma enrolled to the study during 2 years. The mean age was 15.49 ± 30.54 that show more young people suffering from head trauma and TBI. We compare all laboratories and ABG parameters at admission with their standard range. The ratio of men to women was higher. Something that was interesting in this study was that all laboratories' parameters had a significant difference between their standard values. Based on ABG findings at admission, this difference was lower. This study can help those who initially visit patients with head trauma at trauma centers. They can predict changes in laboratory tests and

Table 6: Comparison of laboratory finding at admission and standard

Laboratory parameters	Mean±SD	*P*
PT		
At admission	15.47±2.24	0.001
Standard	12.80±0.24	
PTT		
At Admission	44.38±10.89	0.001
Standard	29.76±3.62	
INR		
At admission	1.66±0.55	0.001
Standard	1.07±0.10	
Hb		
Male		
At admission	11.10±2.19	0.001
Standard	14.57±1.02	
Female		
At admission	9.68±1.22	0.001
Standard	13.10±0.99	
Cr		
At admission	1.49±0.25	0.01
Standard	0.86±0.17	
Na^+		
At admission	146.06±4.48	0.001
Standard	139.11±2.85	
K^+		
At admission	5.28±0.40	0.001
Standard	3.88±0.61	
BUN		
At admission	36.75±9.36	0.001
Standard	19.93±5.79	

Data are presented as mean±SD. SD – Standard deviation; Hb – Hemoglobin; Na^+ – Sodium; K^+ – Potassium; BUN – Blood urea nitrogen; Cr – Creatinine; PTT – Partial thromboplastin time; PT – Prothrombin time; INR – International normalized ratio

Table 7: Comparison of arterial blood gas finding at admission and standard

ABG parameters	Mean±SD	*P*
pH		
At admission	7.48±0.03	0.26
Standard	7.26±0.05	
$PaCO_2$		
At Admission	48.79±7.08	0.001
Standard	31.65±5.67	
HCO_3		
At admission	18.35±4.16	0.001
Standard	23.36±2.13	
PaO_2		
At admission	119.02±56.91	0.33
Standard	98.18±2.09	
O_2 saturation		
At admission	88.40±5.35	0.001
Standard	96.86±5.72	

Data are presented as mean±SD. ABG – Arterial blood gas; SD – Standard deviation

Table 8: Comparison of arterial blood gas finding in expired patients with discharged patients

ABG parameters	Outcome	Mean±SD	*P*
pH	Discharged	7.25±0.67	0.77
	Expired	7.31±0.13	
$PaCO_2$	Discharged	32.95±7.46	0.14
	Expired	35.72±9.43	
HCO_3	Discharged	19.36±4.37	0.24
	Expired	18.22±4.11	
PaO_2	Discharged	124.11±57.84	0.12
	Expired	104.52±46.74	
O_2 saturation	Discharged	95.50±5.96	0.09
	Expired	92.84±7.79	

Data are presented as mean±SD. ABG – Arterial blood gas; SD – Standard deviation

Table 9: Comparison of laboratory findings in expired patients with discharged patients

Laboratory parameters	Outcome	Mean±SD	*P*
PT	Discharged	14.04±1.92	0.04
	Expired	15±2.49	
PTT	Discharged	32.76±6.38	0.1
	Expired	36.12±13.07	
INR	Discharged	1.24±0.37	0.05
	Expired	1.43±0.56	
Hb	Discharged	12.18±2.38	0.19
	Expired	12.90±2.63	
Cr	Discharged	0.92±0.28	0.01
	Expired	1.09±0.33	
Na^+	Discharged	142.67±4.15	0.02
	Expired	145.22±6.50	
WBC	Discharged	32,869±1143	0.99
	Expired	35,2903±9900	
BUN	Discharged	32.86±11.43	0.31
	Expired	35.29±9.90	

Data are presented as mean±SD. SD – Standard deviation; Hb – Hemoglobin; Na^+ – Sodium; BUN – Blood urea nitrogen; Cr – Creatinine; PTT – Partial thromboplastin time; PT – Prothrombin time; INR – International normalized ratio; WBC – White blood cell

ABG parameters. Murray *et al*. in 2007 were introduced PT as a prognostic determinant agent.[2] They also demonstrated that there is a relation between Hb and blood sugar (BS) at admission and outcome in patients with severe head trauma. The role of PT in determining prognosis was confirmed although Hb was rejected. Salehpour *et al*. investigated some laboratory findings in 52 patients and demonstrated that PTT can predict outcome in patients with TBI; however, it was against our results.[3] Yuan *et al*. investigated GCS at admission in 203 patients with head trauma and demonstrated that it can be a prognostic factor.[6] The results of this study confirmed them. GCS score in different period was higher in expired patients than discharged in this study. ABG parameters at admission were another prognostic factor that could predict outcome in some studies.[4] However, our results are against them and confirmed Henzler *et al*. findings.[7]

Table 10: Comparison of Glasgow Coma Scale in different follow-up periods in discharged and expired patients

GCS	Outcome	Mean±SD	*P*
At admission	Discharged	6.64±1.21	0.001
	Expired	5.34±1.72	
24 h later	Discharged	6.69±1.24	0.001
	Expired	5.67±2.13	
48 h later	Discharged	7.64±1.50	0.001
	Expired	4.93±2.15	
1 weeks later	Discharged	9.43±2.71	0.001
	Expired	4.26±1.94	

Data are presented as mean±SD. SD – Standard deviation; GCS – Glasgow Coma Scale

Valadaka *et al*. showed that O_2 pressure of brain tissue at admission can effect on the prognosis of these patients.[8] Kushi *et al*. reported similar results based on arterial pH.[9] Dumont *et al*. demonstrated that arterial CO_2 pressure at admission has an important role in prognosis of TBI patients.[10] In this study, some factors such as PT, PTT, INR, Cr, BS, Na, K, WBC, and BUN increased significantly while Hb and Plt decreased. Regarding the ABG results, the difference in $PaCO_2$, HCO_3, and O_2 saturation at values was significant; whereas there were no statistical significance comparing the discharged and expired patients. In contrast, PT, INR, Cr, and Na+ had significant difference comparing the discharged and expired patients.

Conclusion

Based on laboratory findings, Cr, Na+, INR, PT, or GCS at admission can predict outcome in patients with severe head trauma. ABG parameters have no effect on these patients.

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Conflicts of interest

There are no conflicts of interest.

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