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The association between laboratory findings and level of consciousness in patients with traumatic brain injury

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ABSTRACT

Background: Traumatic brain injuries cause 14% of mortality in Iran. In this study we want to determine the relationship between laboratory findings and level of consciousness in patients with traumatic brain injury.

Methods: In this descriptive cross-sectional study, the data were collected by convenience sampling. 100 patients admitted to the emergency department of the 5th Azar Hospital in Gorgan, were diagnosed with brain trauma. Blood samples were taken from these patients up to 24 hours after injury, and the demographic characteristics of the patients were collected in a checklist. Data were analyzed by SPSS16 software.

Results: The mean age of the patients was 26 ± 0.4 years. Laboratory findings in 100 patients included 73% leukocytosis, 60% increase in creatine phosphokinase (CPK), 82% increase in lactate dehydrogenase (LDH), 33% increase in ESR and 73% increase in protein acute phase (CRP). There was a significant and inverse relationship between the level of consciousness and the level of leukocytosis and creatine phosphokinase. Also, there was a significant relationship between the level of consciousness and acute phase proteins.

Conclusion: There was a significant correlation between the increases of three variables of parameters: leukocytes, creatine phosphokinase and acute phase proteins in patients with traumatic brain injury with decreased consciousness. Also, patients with higher level of consciousness and lower age had better prognosis. Due to the relationship between the level of consciousness and the Glasgow Outcome Scale, some laboratory findings can be used to estimate the level of consciousness and to determine the prognosis of traumatic injuries.

Keywords: Altered level of consciousness, Clinical laboratory tests, Traumatic brain injuries.

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Introduction

Stroke is one of the main causes of death and disability in the world (1) and causes many health, economic and social problems around the world (2) incidence of stroke varies according to age, sex, geographical region and other factors (3). In terms of severity, concussion is divided into three categories: mild, moderate and severe (4). The Glasgow Coma Scale/Score (GCS) is a very common system for dividing the severity of brain injury based on the patient's level of consciousness according to the verbal response, motor response and eye response in response to the stimulus, divided into 3-15 points (5). According to the study of the World Health Organization, it is 70-90% of mild brain injuries (6); Every year, the rate of mild stroke is between 60-100 people per 100 thousand people, although it is difficult to determine this rate (7).

Prognosis worsens with increasing severity of concussion (8), with permanent disabilities occurring in 10% of mild brain injuries, 66% of moderate brain injuries, and 100% of severe brain injuries (9). Most mild brain injuries heal within three weeks, and almost all of these people are able to continue living independently. More than 90% of people with moderate brain damage can continue living in a non-dependent way, and only a percentage of these people need help to perform some daily activities (10). While severe brain injuries in many cases lead to death or severe physical and mental disabilities (1).

Glasgow Outcome Scale (Glasgow Outcome Scale) is a diagnostic criterion for stroke victims to determine the patient's condition during discharge; which are: death, permanent vegetative life, severe disability with consciousness, moderate disability and mild disability (11). Changes in blood parameters and biomarkers are diagnostic factors in determining the severity of brain injury in patients (12).

In a study, factors such as blood glucose level, partial thromboplastin time (PTT) and prothrombin time (PT) played a predictive role in determining the severity of traumatic brain injury, while the level of some factors, such as the number of white blood cells and serum cortisol level, did not play a role (13). The present study was designed to determine the changes in laboratory parameters in brain injury victims and the association between these changes with GCS and GOS of patients.

Methods

In this cross-sectional study, sampling was done as convenience. 100 patients who were admitted to the emergency room of Panj Azar Hospital in Gorgan city with the diagnosis of brain injury were included in the study. Blood samples were taken from these patients up to 24 hours after the injury, and the demographic characteristics of the patients were collected in a checklist designed for this purpose. Diagnostic tests included white blood cell count (WBC), creatine phosphokinase (CPK), lactate dehydrogenase (LDH), erythrocyte sedimentation rate (ESR), and acute phase proteins (CRP).

Other information and characteristics of the injured include: gender, age, severity of injury, time interval between injury and patient hospitalization, CT scan findings, Glasgow clinical outcome score (GOS) and Glasgow Coma Score (GCS) with the opinion of an emergency physician or a neurosurgeon. It was recorded in the checklist that was designed for this purpose. CT scan findings were divided into three groups: diffuse brain injury, mass lesion that can be removed by surgery, and mass lesion that cannot be removed by surgery.

Statistical analysis

After coding the data and entering SPSS16 software through tables and graphs, the numerical indicators were described and with the help of parametric and non-parametric tests, Pearson correlation, Kruskal-Wallis, Mann-Whitney and chi-square were subjected to statistical analysis. According to the 14% prevalence of head trauma leading to death in the country, according to the following formula, the sample size was calculated to be about 100 people. alfa=0.05, p= 0.14, d=0.07, Z1-a/2=1.96

$$n = \frac{z^{2}_{1-\frac{\alpha}{2}}\, pq}{d^{2}}$$

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Results

In this study, among 100 examined patients, 78 were men and 22 were women. The average age of the patients was 26±0.4 years and the average time between the occurrence of the accident and the time of referral was 96±12 minutes. The cause of stroke in these patients: 46 people car accident (46%), 12 people motorcycle accident (12%), 10 people riding a motorcycle (10%), 19 people falling from a height (19%) and 13 people (13%) was hit on head. According to the Glasgow Coma Scale (GCS), 81 people had a mild level of consciousness (81%), 14 people had a moderate level of consciousness (14%) and 5 people had a severe level of consciousness (5%) (Table 1).

According to the clinical outcome criteria (GOS), 80 people recovered (80%), 14 people had moderate disability (14%), 3 people had severe disability (3%) and 3 people died (3%). There was a statistically significant relationship between the decrease in level of consciousness based on GCS and the clinical outcome of patients based on GOS ($p<0.0001$). (Table 1) Also, there was a statistically significant relationship between age and clinical results of patients based on GOS ($p<0.03$) (Table 2). Among the investigated laboratory variables, leukocytosis in 37 people (37%), increased CPK in 60 people (60%), increased LDH in 82 people (82%), increased ESR in 33 people (33%) and positive CRP in 73 people (73 %) of the patients.

According to the Pearson correlation test, there was an inverse linear relationship between the presence of leukocytosis and a decrease in the level of consciousness based on GCS ($p<0.05$ and $r=-0.208$) and there was an inverse linear relationship between the increase in CPK and a decrease in the level of consciousness based on GCS ($p <0.01$ and $r=-0.335$) and according to Spearman's correlation test, there was a statistically significant relationship between the presence of positive CRP and the decrease in level of consciousness based on GCS ($p<0.05$). Also, no statistically significant relationship was found between the investigated laboratory variables and the clinical outcome of patients based on GOS.

Table 1. Frequency distribution of variables according to level of consciousness based on GCS

Decreased level of consciousness (GCS)		Mild Number (%)	Moderate Number (%)	Severe Number (%)	Total Number (100%)	P value
variables						
Laboratory finding	Leukocytosis (WBC> 11.0x10^9/L)	30(81)	4(11)	3(8)	37	<0.05
	CPK*	47(78)	8(13)	5(10)	60	<0.01
	LDH **	67(82)	11913)	4(5)	82	>0.05
	ESR ***	25(75)	7(21)	1(4)	33	
	CRP ****	56(77)	13918)	4(5)	73	<0.05
Glasgow Outcome Scale (GOS)	Death	2(67)	-	1(330	3	0.0001
	Moderate disability	6(43)	5(390	3(210	14	
	Severe disability	1(50)	-	1(50)	2	
	Improvement	71(86)	9(11)	-	81	
gender	Male	63(81)	3(4)	13(170	78	>0.05
	Female	19(86)	2(9)	1(5)	22	
Age	> 10 years	16(80)	3(15)	195)	20	>0.05
	10-29 years	38(76)	10(20)	2(4)	50	
	30-49 years	14(93)	-	1(7)	15	
	50> years	13(87)	1(6.5)	1(6.5)	15	

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Decreased level of consciousness (GCS)		Mild Number (%)	Moderate Number (%)	Severe Number (%)	Total Number (100%)	P value
The cause of concussion	Car accident	31(67)	12(26)	3(70	46	>0.05
	Motorcycle accident	11(92)	-	198)	12	
	Cyclist	8(80)	1(10)	19100	10	
	Falling from a height	18(95)	1(5)	-	19	
	Hit on head	13(100)	-	-	13	
CT scan findings	Normal	67(93)	4(6)	1(1)	72	0.0001
	Diffuse brain injury	8(57)	4(28)	2(140	14	
	Drainable lesion	5(50)	4(40)	1(10)	10	
	Undrainable lesion	1(25)	2(50)	1(25)	4	

*Creatine Phosphokinase >220 U/L

**Lactate Dehydrogenase > 222 U/L

***Erythrocyte Sedimentation Rate >15 mm/hr

****C-Reactive Protein+

Table 2. Frequency distribution of variables according to clinical outcome criteria based on GOS

Decreased level of consciousness (GCS)		Mild Number (%)	Moderate Number (%)	Severe Number (%)	Improvement Number (%)	Total Number (100%)	P value
variables							
Laboratory finding	Leukocytosis (WBC> 11.0x10^9/L)	1(3)	1(3)	8(21)	27(37)	37	>0.05
	CPK*	1(2)	2(3)	12(20)	45(75)	60	>0.05
	LDH **	3(4)	3(4)	11(13)	65(79)	82	>0.05
	ESR ***	3(9)	3(9)	7(21)	54(61)	33	>0.05
	CRP ****	3(4)	3(4)	13(18)	54(74)	73	>0.05
gender	Male	1(2)	2(3)	12(15)	63(80)	78	>0.05
	Female	2(9)	1(5)	2(9)	17(77)	22	
Age	> 10 years	1(5)	1(5)	2(10)	17(80)	20	<0.03
	10-29 years	-	-	2(13)	42(86)	50	
	30-49 years	-	-	7(14)	13(87)	15	
	50> years	2(13)	2(13)	3(20)	8(54)	15	
The cause of concussion	Car accident	2(4)	2(4)	6(14)	36(78)	46	>0.05
	Motorcycle accident	1(8)	-	2(16)	9(75)	12	
	Cyclist	-	-	4(40)	6(60)	10	
	Falling from a height	-	1(5)	2(10)	16(85)	19	
	Hit on head	-	-	-	13(100)	13	
CT scan findings	Diffuse brain injury	2(14)	7(50)	1(7)	4(29)	14	>0.05
	Drainable lesion	-	6(60)	1(10)	3(30)	10	
	Undrainable lesion	1(25)	-	1(25)	2(50)	4	

*Creatine Phosphokinase >220 U/L

**Lactate Dehydrogenase > 222 U/L

***Erythrocyte Sedimentation Rate >15 mm/hr

****C-Reactive Protein+

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Discussion

The present study was conducted in order to investigate the relationship between the level of consciousness and some laboratory findings in brain injured patients. The relationship between the decrease in level of consciousness based on GCS and the presence of leukocytosis, increased CPK and the presence of CRP was positive, and this relationship in the case of leukocytosis and increased CPK was an inverse linear relationship. There was no relationship between the studied laboratory variables and the clinical outcome of the patients based on GOS.

In Rovlias et al.'s study, the WBC count was significantly higher in patients with severe concussions than those with mild to moderate concussions. Among patients with severe brain injury, there was a significant relationship between WBC count and decreased level of consciousness based on GCS. Also, in this group of patients, WBC count was significantly related to adverse outcome. Multivariate analysis showed that the WBC count is an independent predictor for the clinical outcome of the patient (14). In a study in Turkey, there was a significant relationship between the number of WBC and the decrease in the level of consciousness based on GCS and the length of stay in the hospital, CT scan findings and finally the clinical criteria of patients based on GOS (15). While in a review study, serum LDH level and WBC count did not play a predictive role in the clinical outcome of patients (13). In the study of Srinivasan et al., the presence of leukocytosis had an independent and significant relationship with the level of consciousness of the patients, and positive CRP had a significant relationship with the clinical outcome measure (16). In Somer's study, it was emphasized that after a severe brain injury, an increase in the level of CPK, especially the CKBB isoenzyme, occurs (17). The findings of our study are consistent with some of the mentioned studies and in some cases these findings are not confirmed.

In this study, the most common cause of concussion was reported to be a pedestrian accident with a car and a motorcycle, and other causes of injury were falling from a height, hitting the head, and riding a motorcycle. While in the study of Farozan et al., the most common cause of brain injury in Ahvaz was falling from a height and a pedestrian accident with a car (18). The number of male patients was more than female in this study. In other studies conducted in Ahvaz (18) and Rasht (19), the frequency of male patients was higher. The average age of the patients in this study was 26 ± 0.4 years. This variable in other studies (18, 19) was mostly in the age range of 20-30 years. In this study, the average time from the accident to the emergency was between one and a half to two hours. In the study by Zamani et al. in Isfahan, the average time taken to bring patients to the hospital was 27 minutes, which was less than the average time obtained in our study (20).

In our study, 3% of patients died, while the mortality rate in Yusefzadeh et al.'s study was 13% and in Hanif et al.'s study, it was 1.6% (19, 21). In this study, the CT scan findings of the patients included: normal CT scan (72%) of cases, diffuse brain damage, resectable lesion and non-resectable lesion. In the study of Frouzan et al. (18), 94.7% of patients referred to the emergency room with brain injury had a normal CT scan.

Conclusion

Based on the results of this study, there was a significant relationship between the increase of three laboratory variables of leukocytosis, creatinine phosphokinase and acute phase proteins with the decrease in level of consciousness in brain injured. Also, the prognosis of patients with a higher consciousness level and younger age was better. Considering the relationship between the level of consciousness of patients upon entering the hospital and the clinical outcome criteria, some laboratory findings can be used to estimate the level of consciousness and determine the prognosis of patients with traumatic brain injury.

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Data availability: The data that supports the findings of this study are available from the corresponding author upon reasonable request.

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