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CORRELATION OF COMPUTED TOMOGRAPHY AND INTRAOPERATIVE FINDINGS WITH CLINICAL SYMPTOMS IN HEAD TRAUMA PATIENTS

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SUMMARY

Background: Hematoma in different parts of the brain is one of the most important complications of head injury and is associated with high mortality and morbidity rate. The aim of this study was evaluation of the relationship between Computed Tomography (CT) and intraoperative findings with clinical symptoms in head trauma patients.

Material/ Methods: In this study 95 patients with cerebral hemorrhage due to head trauma, referred to Taleghani Hospital in Kermanshah were studied. After an initial clinical examination, the level of consciousness determined according to the Glasgow Coma Scale (GCS) was recorded. All patients underwent brain CT scan and findings were recorded, including size and location of the hematoma. Patients in all treatment such as surgical procedures under the supervision, and the information on their status was recorded until discharge or death.

Results: It was found that most patients (38%) were between 40-20 years: 73% of patients were male, while 27% were female. The outcome of 35 patients (35.4%) were normal, 12 patients (12.3%) had moderate disability, 9 patients (9.2%) had severe disability, 11 patients (10.8%) vegetative state and 31 patients (32.3%) died. There was a significant association between location of the hematoma and hematoma in CT scan and outcome of patients with cerebral hemorrhage caused by trauma (P<0.05). We also found a significant association between size of the hematoma and midline shift in CT scan with outcome of patients with cerebral hemorrhage caused by trauma (P<0.05).

Conclusions: The prognosis of patients with traumatic brain injury depends on location of the hematoma; volume of hematoma, midline shift in CT scan and length of trauma to surgery more than 4 hours.

Key words: head trauma, hematoma, CT scan, disability, outcome

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INTRODUCTION

After the cardiovascular diseases and cancer, head trauma is the third cause of death [1]. Traumatic Brain Injury (TBI) is one of the most common reasons of death and disability under forty years-old. On the other hand, most of the survivors of this lesion, tolerate different disabilities which has the high social and economic burdens [2]. Almost, most of TBI patients can be treated at an emergency center and a small percentage of them should be hospitalized [3]. On the other hand, in recent years, due to progress in the medical and health care, the rate of mortality from the severe head injuries was reduced [4, 5]. The early and accurate diagnosis of the brain and skull lesions is very important in the acute trauma, and will decrease the complications [6].

One of the most common complications of the head injury is the intracranial hematoma which is divided into two main categories of the epidural hematomas and the intradural hematomas. The intradural hematomas themselves are also divided into two categories of the subdural hematomas and the intracerebral hematomas [7]. Despite the dynamic and innovative progressions in the brain neuroimaging, CT scan is usually selected method in order to initially evaluate all the patients with the acute head injury who need hospitalization and care in the hospital. CT scan can present the quick evaluation of the brain pathology and the accurate diagnosis of the position, description and the range of injury [8, 9]. Although the results of the CT scan can effect on predicting the patient survival, this method cannot provide enough information in order to accurately predict the long-term performance improvement caused by the TBI. Finding a comparable connection between CT scan results and the performance consequences of the patient is very difficult [10,11]. However, surgery in the intracerebral hemorrhage (ICH) is always debatable and the response to surgery is depended on some medical and personal factors like age, GCS, surgical start time, initial hematoma volume and the initial hematoma depth are the important predictors [12]. Considering the fact that the brain CT scan as an introductory method has a major role in making decisions about the surgery in the patients of the head trauma, therefore the purpose of this study is to analyze the relationship between the volume amount and the location of the hemorrhage caused by trauma in CT Scan and the surgery and also, analyze the relationship between the hemorrhage volume and the GCS at the beginning of entering the hospital and the complications and the fate of the patients with the head trauma.

MATERIAL AND METHODS

In order to obtain the studied population of the patients with head trauma, we referred to Taleghani Hospital in Kermanshah. Patients with fractures in their other organs and other problems which needed the surgery such as the internal hemorrhage, visceral rupture and the severe chest trauma were excluded from the study. In this stage, along with the initial procedures required by the patient, the complete history was obtained and the accurate examinations were provided.

The state of the patient's consciousness was also measured and recorded using the GCS criterion (at the time of entering the hospital by the neurosurgery assistant). The brain CT scan was taken from the patients with the required routine arrangements. The criteria of inserting the samples into the study including the minimum age of 12 years old at the time of the accident, lack of having other dangerous trauma except the head trauma such as the internal hemorrhage, the systolic blood pressure less than 80 mmHg and the chest trauma should be hospitalized at the first 24 hours. On the other hand, they do not have the spinal cord trauma. The exclusion criteria are the lack of access to the sample or the information related to the patient. The patients who did not have the brain trauma and the measurable and visible clear hemorrhage were eliminated from the study. About the patients who had the conditions to stay in the study, the project executive and assistant recognized the hemorrhage location and measured and recorded its volume using the criteria of Peterson and Epperson. Making decisions about the surgical or medical treatment of the patient was provided by the neurosurgeon, the project executive and the related team. If the surgery was required, all the information obtained during the surgery like the location and volume of the hemorrhage were recorded by the surgeon collaborator.

In this stage, the patient was controlled either during the medical procedures until the death or the discharge and all the needed in formation of the project was recorded. The GCS criterion was utilized to evaluate the patients especially in ICUs. This criterion is consisted of three tests (eye, verbal and motor response) which are described at the following. A value was given to each test and the GCS value is the sum of the values give to each test. The maximum value was equal to 15 and it describes the complete consciousness of the patient. The minimum value is equal to 3 and it is observed in patients with brain death or deep coma.

The gathered data were analyzed by SPSS V22. First, the normality of quantitative variables was assessed based on Kolmogorov-Smirnov test and was not confirmed. Therefore, to investigate the relationship between two quantitative variables, Pearson or Spearman correlation coefficient test was used and to compare qualitative variables in multiple group chi-square or Fisher exact test was used. Also, to compare quantitative variables in multiple groups, ANOVA or Kruskal–Wallis test was used $p<0.05$ was considered significant

Ethical considerations

At first the required permissions were taken from Kermanshah University of Medical Sciences (KUMS) Vice-Chancellor for Technology Research with grant No. 96086 and the Ethics Committee of KUMS approved the study protocol with reference number. Before the study, the objectives and methods were explained to all of the participants, and they were assured that their responses would remain confidential. Written informed consent was obtained from all participants before the study.

RESULT

In this study, 98 patients with head trauma who has a clear, visible, and measurable brain hemorrhage on a CT scan stereotypes were included in the study. The age of the patients was between12-90 years with mean 45.34±22.75 years. 73% of patients were male, while 27% were female. The main cause of the trauma was car accidents (37 patients, 36.9%), and other causes: falling from the height for 27 patients (27.7%), occupational accidents (15 patients, 15.4%), in conflict (10 patients, 10.8%), and unknown (9 patients, 9.2%). GCS at admission to the hospital was between 3-15 and the mean was 8.69±3.81. GCS at entered the operating room was 3-15and the mean was 8.26± 3.64. The type of hematoma was that 50 patients (52.3%) had SDH, 27 patients (27.7%), had EDH, 11 patients (10.8%) had ICH and 10 patients (10.8%) had contusion. The location of the hematoma was that fronto-temporo-parietal area (23 patients, 23%), temporoparietal area (24 patients, 24.6%), frontoparietal area (21 patients, 20%), paritooxypital area (21 patients, 20%), and frontal area (9 patients, 9.2%).

The volume of hematoma in CT scan was between 10-20 cc and their mean and standard deviation was 19.34 ± 38.14 cc. The volume of hematoma in surgery was between 10-120 cc and their mean and standard deviation was 38.29±20.77 cc. The midline shift on CT scan was between 0-13 mm and their mean and standard deviation was 7.67±2.75 mm. The diameter on CT scan was between 4-15 mm and their mean and standard deviation was 10.46±2.96 mm. The duration of trauma to surgery was between 60-480 minutes and the mean and standard deviation was 181.17± 77.75 minutes. The outcome of 35 patients (35.4%) were normal, 12 patients (12.3%) had moderate disability, 9 patients (9.2%) had severe disability, 11 patients (10.8%) vegetative state and 31 patients (32.3%) died.

There was a significant relationship between hematoma volume in CT scan and hematoma volume in surgery in patients (r=0.944, P<0.001). We found a significant relationship between the type of hematoma in the CT scan with the GCS at admission to the hospital (P<0.05). We also found a significant relationship between the location of hematoma in the CT scan with the GCS at admission to the hospital (P<0.05) (Table 1).

Table 1. Relationship between the type of hematoma in the CT scan with the GCS at admission to the hospital and GCS at entered the operating room

Variable	**Category**	**GCS at admission to the hospital**			*P_value*
		Mild N (%)	Moderate N (%)	Severe N (%)	
Type of hematoma	SDH	9 (37.5)	3 (18.2)	39 (68.4)	0.009
	EDH	10 (43.8)	6 (36.4)	12 (21.1)	
	ICH	2 (6.3)	3 (18.2)	7 (10.5)	
	Contusion	3 (12.5)	4 (27.3)	0 (0)	
Location of hematoma	Fronto-temporo-parietal	0 (0)	2 (9.1)	20 (35)	
	Temporoparietal	10 (42.8)	2 (9.1)	20 (35)	
	Frontoparietal	5 (21.4)	4 (27.3)	10 (17.5)	0.034
	Parito-oxy-pital	5 (21.4)	0 (0)	17 (27.5)	
	Frontal	4 (14.2)	6 (36.3)	10 (17.5)	
	Total	24 (24.6)	4 (27.3)	1 (2.5)	

There was a significant relationship between the type of hematoma in the CT scan with the GCS at entered the operating room (P<0.05). We also found a significant relationship between the location of hematoma in the CT scan with the GCS at entered the operating room (P<0.05) (Table 2).

There was also a significant relationship between hematoma volume in CT scan and GCS at admission to the hospital in patients (r= -0.331, P=0.009). We also found a significant relationship between hematoma volume in CT scan and GCS at entered the operating room in patients (r= -0.3, P=0.018).There was also a significant relationship between hematoma volume in CT scan and GCS at admission to the hospital in patients (r= -0.477, P=0.006). We also found a significant relationship between hematoma volume in CT scan and GCS at entered the operating room in patients (r= -0.525, P=0.002).There is a significant relationship between the types of hematoma in the CT scan with the outcome of patient (P<0.05). There was also a significant relationship between the location of hematoma in the CT scan with the outcome of patient (P<0.05) (Table 3).

There was a significant relationship between the volume of hematoma in the CT scan with the outcome of patient (P<0.05). We also found a significant relationship between the midline shift in the CT scan with the outcome of patient (P<0.05) (Table 4).

Table 2. Relationship between the type of hematoma in the CT scan with the GCS at admission to the hospital and GCS at entered the operating room

Variable	**Category**	**GCS at entered the operating room**			P_value
		Mild N (%)	Moderate N (%)	Severe N (%)	
Type of hematoma	SDH	6 (28.6)	3 (18.2)	43 (70)	0.003
	EDH	10 (50)	6 (36.4)	12 (20)	
	ICH	2 (7.1)	3 (18.2)	6 (10)	
	Contusion	3 (14.3)	4 (27.3)	0 (0)	
Location of hematoma	Fronto-temporo-parietal	0 (0)	2 (9.1)	19 (35)	0.025
	Temporoparietal	9 (42.8)	4 (27.3)	10 (17.5)	
	Frontoparietal	2 (7.1)	3 (18.2)	20 (27.5)	
	Parito oxy pital	7 (35.7)	3 (18.2)	10 (17.5)	
	Frontal	3 (14.2)	4 (27.3)	2 (2.5)	
	Total	21 (21.5)	16 (17)	61 (61.5)	

Table 3. Relationship between the types of hematoma in the CT scan with the outcome of patient

Variable	**Category**	**Outcome**					P_value
		Normal N (%)	Partial disability N (%)	Severe disability N (%)	Vegetative State N (%)	Death N (%)	
Type of hematoma	SDH	5 (13)	5 (37.5)	7 (83.3)	9 (85.7)	20 (61.9)	0.003
	EDH	20 (60.9)	3 (25)	0 (0)	0 (0)	4 (14.3)	
	ICH	5 (13)	3 (25)	0 (0)	0 (0)	6 (19)	
	Contusion	5 (13)	1 (12.5)	2 (16.7)	2 (14.3)	1 (4.8)	
Location of hematoma	Fronto-temporo-parietal	3 (8.7)	3 (25)	0 (0)	3 (28.6)	13 (42.9)	
	Temporoparietal	16 (47.8)	3 (25)	1 (16.7)	0 (0)	3 (9.5)	0.021
	Frontoparietal	5 (13)	0 (0)	1 (16.7)	6 (57.1)	9 (28.6)	
	Parito oxy pital	8 (21.7)	5 (37.5)	5 (55.5)	0 (0)	5 (14.3)	
	Frontal	3 (8.7)	1 (12.5)	2 (22.2)	2 (14.3)	1 (4.8)	
	Total	35 (35.4)	12(12.3)	9 (9.2)	11 (10.8)	31 (32.3)	

Table 4. Relationship between the types of hematoma in the CT scan with the outcome of patient

Variable	Outcome					P_value
	Normal Mean±SD	Partial disability Mean±SD	Severe disability Mean±SD	Vegetative state Mean±SD	Death Mean±SD	
Volume of hematoma	22±10.3	31.6±6.8	37.6±12	39.1±17.1	52.1±37.5	0.043
Midline shift	6.83±5.26	7.37±1.7	7.2±2.58	8±1.73	8.21±1.84	0.027

Table 5. Relationship between duration of trauma until surgery with the outcome of patient

Variable	Category	Outcome					P_value
		Normal N (%)	Partial disability N (%)	Severe disability N (%)	Vegetative State N (%)	Death N (%)	
Type of hematoma	SDH	5 (13)	5 (37.5)	7 (83.3)	9 (85.7)	20 (61.9)	0.003
	EDH	20 (60.9)	3 (25)	0 (0)	0 (0)	4 (14.3)	
	ICH	5 (13)	3 (25)	0 (0)	0 (0)	6 (19)	
	Contusion	5 (13)	1 (12.5)	2 (16.7)	2 (14.3)	1 (4.8)	
Location of hematoma	Fronto-temporo-parietal	3 (8.7)	3 (25)	0 (0)	3 (28.6)	13 (42.9)	
	Temporoparietal	16 (47.8)	3 (25)	1 (16.7)	0 (0)	3 (9.5)	0.021
	Frontoparietal	5 (13)	0 (0)	1 (16.7)	6 (57.1)	9 (28.6)	
	Parito oxy pital	8 (21.7)	5 (37.5)	5 (55.5)	0 (0)	5 (14.3)	
	Frontal	3 (8.7)	1 (12.5)	2 (22.2)	2 (14.3)	1 (4.8)	
	Total	35 (35.4)	12(12.3)	9 (9.2)	11 (10.8)	31 (32.3)	

There was a significant relationship between duration of trauma until surgery with the outcome of patient ($P<0.05$) (Table 5).

DISCUSSION

This study was aimed to evaluate the relationship between Computed Tomography (CT) and intraoperative findings with clinical symptoms in TBI patients. The results demonstrated that most of the patients had the age range of 20-40 years old. The previous studies also demonstrated that the highest prevalence of brain injuries is related to people who are at the third and fourth decades of their life [13]. This problem is reasonable by being present in the society for a long time and observing the more dangerous behaviors in the group of this age. Most of the tested patients with the head trauma in our study were male, which is comparable with the results of the previous studies [14]. This problem is reasonable in this study because most of men spend their time including work outside of the house and the cultural while most of women, mainly because of the economic-social situation of the studied community, where spend their time at home. In our study, the greatest cause of trauma was related to the driving accidents and then, falling from the height. This findings are similar to the results of other studies [2,15,16]. In the study of Morgado et al. [15], the results are similar to the results of our study. These authors concluded that the greatest reasons of trauma were related to the driving accidents (52%) and then, falling from the height (21%). Based on previous studies, most of the road accidents were related to the ages from 15 to 29 years old [see also 17]. These statistics show a serious threat to the young and active people of the society. The traffic accidents were also in our study the most common reasons of the injury. It should be stressed, that over the world, more than 50 million people are annually injured because of the traffic accidents and 1.2 million people are killed that 90% of this amount is in the countries with low or medium incomes. While the decreasing trend of mortalities caused by traffic accidents in the countries with high incomes is still observed, the current and increasing trend of mortalities caused by traffic accidents in the countries with low and medium incomes is still continued [18,19]. Hence, it seems that paying attention to the problems which are preventing such accidents like observing the traffic laws, obligatory usage of the safety equipment and improving safety situation of the roads can have an important role in decreasing the traumatic injury. Based on the results of this study, the total rate of mortality was equal to 32.3%. Based on the previous studies, the range of the mortality rate in the patients with head trauma was equal to 13-21% [20]. This range difference in the studies can happen because of the racial and geographical differences, the society size and the way of choosing the studied people. In the study of Bakhshayesh et al. [21], the total rate of mortality in patients with the brain hemorrhage in Tehran was equal to 30.6-40%. And the study of Kim et al. [22] in Korea showed that the mortality rate caused by subdural is 42%. In the study of Yousefzadeh et al. in Rasht [23], 13% of the patients with TBI were died. In the study of Fazel et al in Kashan [24], 3.4% of the patients who were suffering from the head injuries were died. In the study of Shabiri et al. [25], the mortality rate of the patients with head trauma in Kermanshah was equal to 14.3%. With a glimpse at the mortality rate in various societies, it is considered that this rate is greater in the larger cities and since the main reason of trauma in the present study were the driving accidents, therefore it is required to present some solutions which can reduce the driving accidents especially in the large cities such as Kermanshah that the population is daily increased.

An important factor in making decisions about the initial treatments and the long-term complications is the initial consciousness state of the patients according to GCS criterion. In the results of this study, we found a relationship between the hematoma type in CT scan and the GCS at the time of entering the hospital and at the time of entering the surgery room in the patients with the traumatic brain hemorrhage. But, there was a relationship between the hematoma location in CT scan and the GCS at the time of entering the hospital and at the time of entering the surgery room in the patients with the traumatic brain hemorrhage. In the study of Morgado et al. [15], the results were also similar like in our study. The relationship between the GCS and the hematoma type using the CT scan results were also found in other study [26].

In the our study, there was a reverse relationship between the hematoma volume and the midline shift in CT scan and the GCS at the time of entering the hospital and at the time of entering the surgery room in the patients with the traumatic brain hemorrhage. Which is comparable with the results of the study of Rayhan et al. [27] and also, of the results of the study of Huang et al. [28], about the reverse relationship between the hematoma volume and the Glasgow coma scale. Shabiri et al. [29] also understood from their study that there is a reverse relationship between the hematoma volume and the midline shift in CT scan and the Glasgow coma scale at the time of entering the hospital and at the time of entering the surgery room in the patients with the traumatic brain hemorrhage Therefore, it can be told that if the rate of the hemorrhage volume or the rate of the midline shift is increased, then the Glasgow coma scale of the patient isreduced.

It should be considered that there was a significant relationship between the CT scan results in diagnosing and differentiating the hematoma volume and the results obtained from the surgery, which is comparable with the results of the studies of Shabiri et al. [25]. But, it should be mentioned that the hematoma volume in CT scan method was insignificantly less than the hematoma volume of the surgery. This difference can happen because of having the further hemorrhage or continuing the hemorrhage before the surgery. Also in the results of our study, there was a relationship between the hematoma type and the hematoma location in CT scan and the destiny of the patients with the traumatic brain hemorrhage. There was a relationship between the hematoma volume and the midline shift in CT scan and the destiny of the patients with the traumatic brain hemorrhage. There was a relationship between the occurrence time of trauma until the surgery happens and the density of the patients with the traumatic brain hemorrhage. So that, most of the deaths occurred at the time of trauma until the surgery for more than 4 hours. In the studies of Shabiri et al. [25] the results were comparable with our study and they noticed that there is a relationship between the hematoma location in CT scan and the density of the patients with head trauma and there is a relationship between the rate of midline shift in CT scan and the density of these patients. Furthermore, the hematoma volume in CT scan can predict the density of the patients that the surgery was performed on [25]. Similar to our study, Rathor et al. [29] understood that the response to the treatment and the performance status of the patients with ICH at the time of discharge has relationship with CT scan results. Nag et al. [30], in the results comparable with our study, deduced that according to CT scan results at the time of entrance, the mortality and morbidity are predictable after 30 days. The hematoma volume greater than 30 cubic centimeters, brainstem hematoma, intra ventricular hemorrhage and ventricle compression alone and the midline shift are related to the premature death because of ICH hemorrhage. Rayhan et al. [27] could get the results comparable with the present study that the best variables at the time of reception which can predict the surgery density of the patients with the brain hemorrhage are as follows: the hemorrhage volume and the hemorrhage location.

The limitations of the study

The limitations of the study are as they are mentioned in the following:

- the patients were not controlled with long term follow up and we did not found long term consequences, therefore the rate of morbidity and mortality were not analyzed.

- some of the risk factors of the brain hemorrhage, such as smoking and using alcohol, coagulation disorder, history of brain surgery, etc. weren't studied. the prognosis of patients with traumatic brain injury depends on location of the hematoma; hematoma, volume of hematoma, midline shift in CT scan and length of trauma to surgery more than 4 hours.
  Therefore, it is suggested to utilize these variables in the future studies.

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