ORIGINAL RESEARCH

An Epidemiologic Study of Traumatic Brain Injuries in Emergency Department

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Abstract

Introduction: Traumatic brain injuries (TBI) are one of the most important causes of death in patients under the age of 25 years and is responsible for one third of total deaths caused by trauma. Therefore, knowing its epidemiologic pattern in different populations seems vital. Therefore, this study aims to examine the epidemiologic pattern of TBI in emergency department. **Methods:** In this cross-sectional study, the profiles of 1000 patients affected by TBI were selected using simple random sampling. The examined variables in this study included demographic, season, mechanism of injury, accompanying injuries, level of consciousness, hospitalization duration, computed tomography (CT) scan results, needing surgery, admission to intensive care unit, and outcome of the patient. In the end, independent risk factors for the death of patients were determined. **Results:** 1000 patients suffering from were studied (81.8% male; mean age 38.5±21.7 years). The frequency of their referral to hospital in spring (31.4%) was more (p<0.01). 45.9% of the patients had a level of consciousness less than 9 based on the Glasgow Coma Scale (GCS). Subdural (45.9%) and epidural bleeding (23.7%) were the most common findings in CT scans in this study (p<0.001). Finally, 233 (23.3%) of the patients were dead. Over 60 years of age, falling and motorcycle accidents, intracranial hemorrhage accompanied by brain contusion, subdural bleeding, a GCS of less than 9, and the need to be admitted to intensive care unit were independent risk factors of death in TBI. **Conclusion:** Age Over 60 years, falling and motorcycle accidents, intracranial hemorrhage accompanied by brain contusion, subdural bleeding, a GCS of less than 9, and need to be admitted to intensive care unit were independent risk factors for the death in TBI patients.

Key words: Brain injuries; head injuries; epidemiology; mortality; risk factors

Introduction:

Trauma, as 1 of the 5 major causes of death and disability in the world, leads to about 5 million deaths per year or 16 thousand deaths daily (1). In Iran, accidents are the leading cause of death in the youth and the major reason for years of potential life lost (2). Traumatic brain injuries (TBI) are among the worst consequences of these accidents and are the major causes of death in patients under the age of 25 years (3). It is also the leading cause of trauma related coma and disabilities (4). In developed countries the rate of deaths induced by head injury has been about 21% (in the first month) and this rate goes up to 50% in developing countries (5, 6). TBI occurrence is increasing as motor vehicles are being more widely used in the developing countries (7). In its last report, the world health organization (WHO) has stated the need for more research on the epidemiologic pattern of accidents in low and middle-income countries to determine the dimensions of the problem and identify susceptible people. Despite the valuable efforts made in the past few years to determine the epidemiology pattern of trauma and their outcomes in Iran, available data still seems insufficient (8). As TBI are one of the most common and dangerous outcomes of accidents, the present study aims to determine the epidemiologic pattern of TBI in emergency department. The results from this study will be of help to identify the pattern of accident type, age, and sex distribution and the prevalence of other clinical and practical factors in traumatic brain injuries.

Methods:

Study design and setting

This cross-sectional, retrospective study was aimed to determine the epidemiologic pattern of TBI in the emergency patients admitted to Poorsina Hospital, Rasht, Iran

from 2012 to 2013. Poorsina Hospital is one of the most important trauma center of Northern Iran, admitting about 18 thousand patients annually (9). This study has been approved by the ethics committee of Gilan University of Medical Sciences and the researchers have adhered to the principles of the Helsinki declaration.

Participants

The sample population consisted of all of the patients admitted to emergency department of Poorsina Hospital, who were diagnosed as TBI. Simple random sampling was used. In the beginning, all of the TBI patients' profiles were sorted alphabetically. Then, using a web based random number table, 1000 profiles were chosen randomly and were studied. Exclusion criteria included incomplete profile, no final decision recorded, no recorded CT scan result and making a final decision using tests other than CT scan. To reach the minimum number of samples required considering the 21% death rate in TBI (5), 95% confidence interval (α=0.05), 90% statistical power (β=0.1) and 1% accuracy (d=0.01), 865 samples were sufficient.

Studied variables

The studied variables in this study included demographic (age, sex, marital status, level of education, occupation, place of residence), season, mechanism of trauma, presence of accompanying injuries, level of consciousness based on the Glasgow Coma Scale (GCS), hospitalization duration, CT scan results, needing surgery, needing admission to intensive care unit and the final outcome of patient. Patient outcome was divided into 3 groups: discharged or returned to baseline health characteristics, death, or referred to another hospital. The data were recorded by a trained physician in a checklist designed for this study.

Statistical analysis

The data set was analyzed using the SPSS version 21. The qualitative variables were stated in percentage and quantitative variables were input as mean ± standard deviation. To evaluate the statistical difference of the studied factors between subgroups of each variable multinomial logistic regression was used. To determine the factors playing a role in patients' death, after defining probable risk factors based on chi square, Fisher's exact (for verbal qualitative variables) and Kruskal–Wallis test (for qualitative numerical variables), multivariable regression model was used. In all analyses p<0.05 was considered as significance level.

Results:

1000 patients suffering from TBI were evaluated (81.8% male; mean age 38.5 ± 21.7 years). Frequency of individuals affected by head trauma in people aged 20-60 (p < 0.001) and in spring (31.4%) was higher (p < 0.01). Motorcycle accidents were the most common trauma mechanism in this study with 48.5% prevalence

(p<0.001) and the least common mechanism was intentional damage (1.5%) (Table 1).

The mean GCS of patients was 9.94 ± 3.78 and 45.9% of them had a GCS of less than 9 (p<0.001). Subdural hemorrhage (45.9%) epidural hemorrhage (23.7%) and intracranial hemorrhage accompanied by brain contusion (17.1%) were the most common findings of brain CT scans (p<0.001). The mean hospitalization duration was 7.52 ± 6.62 days. 721 (72.1%) patients were hospitalized for between 1 and 10 days, 194 patients between 11 and 20 days and 3 patients between 31 to 40 days. finally,

Table 1: Demographic and basic variables of the patients in study

Variable	Frequency (%)	p
Age		
0-20	211 (21.1)	<0.001
21-40	312 (31.2)	ref
41-60	286 (28.6)	0.29
61-80	162 (16.2)	<0.001
Over 80	29 (2.9)	<0.001
Sex		
Male	818 (81.8)	ref
Female	182 (18.2)	<0.001
Place of residence		
The county	522 (52.2)	ref
The city	478 (47.8)	0.02
Level of education		
Uneducated	147 (14.7)	<0.001
Less than high school	258 (25.8)	<0.001
High school diploma	465 (46.5)	ref
University degree	130 (13.0)	<0.001
Marital status		
Single	435 (43.5)	ref
Married	547 (54.7)	<0.001
Occupation		
Self-employed	389 (38.9)	ref
Unemployed	266 (26.6)	<0.001
Employee	207 (20.7)	<0.001
Housekeeper	86 (8.6)	<0.001
Other	52 (5.2)	<0.001
Reference season		
Spring	314 (31.4)	ref
Summer	250 (25.0)	0.007
Fall	225 (22.5)	<0.001
Winter	211 (21.1)	<0.001
Mechanism of damage		
Motorbike rider	485 (48.5)	ref
Car accident	99 (9.9)	<0.001
Bike accident	21 (2.1)	<0.001
Falling	268 (26.8)	<0.001
Same level falling	112 (11.2)	<0.001
Intentional damage	15 (1.5)	<0.001
Accompanying injuries		
Negative	591 (59.1)	ref
Positive	409 (40.9)	<0.001

Table 2: Level of consciousness and CT scan findings in the studied patients

Variable	Frequency (%)	P
Level of consciousness (GCS score)		
3-8	459 (45.9)	ref
9-12	244 (24.4)	<0.001
13-15	297 (29.7)	<0.001
CT scan findings		
SDH	459 (45.9)	ref
EDH	237 (23.7)	<0.001
Diffuse axonal injury	114 (11.4)	<0.001
ICH and brain contusion	171 (17.1)	<0.001
Simultaneous SDH and EDH	19 (1.9)	<0.001

SDH: Subdural hemorrhage; EDH: Epidural hemorrhage
ICH: Intracranial hemorrhage

Table 3: Final outcome of the patients

Variable	Frequency (%)
Final outcome	
Improved health	745 (74.5)
Deceased	233 (23.3)
Referral to another hospital	22 (2.2)
Need for surgery	
Yes	454 (45.4)
No	546 (54.6)
Hospitalization duration (days)	
1-10	721 (72.1)
11-20	194 (19.4)
21-30	82 (8.2)
31-40	3 (0.3)
Admitting to intensive care unit	
Yes	372 (37.2)
No	628 (62.8)

Table 4: The relationship of demographic factors with patient outcome

Factor	Survived	Deceased	P
Age			
Under 60	628(79.1)	117 (63.6)	<0.001
60 and over	166 (20.9)	67 (36.4)	
Sex			
Male	666 (81.6)	(82.6)	0.75
Female	150 (18.4)	32 (17.4)	
Level of education			
Uneducated	116 (14.2)	31 (16.8)	<0.009
Less than high school	199 (24.4)	59 (32.1)	
High school diploma	400 (49.0)	65 (35.3)	
University degree	101 (12.4)	29 (15.8)	
Marital status			
Single	439 (53.8)	14 (7.6)	<0.001
Married	377 (46.2)	170 (92.4)	
Place of residence			
The county	375 (46.0)	147 (79.9)	<0.001
The city	441 (54.0)	37 (21.1)	
Occupation			
Employee	230 (28.2)	57 (31.0)	<0.001
Self-employed	283 (37.4)	26 (14.1)	
Housekeeper	55 (6.7)	31 (16.8)	
Unemployed	248 (30.4)	18 (9.9)	
Other	0 (0.0)	52 (28.3)	

233 patients (23.3%) died while 745 (74.5%) recovered completely and were discharged. Univariate analyses showed that over 60 years of age (36.4% vs. 20.9%), education less than high school diploma (32.1% vs. 24.4), being married (92.4% vs. 46.2%) and residing in rural areas (79.9% vs. 46.0%) had more prevalence in the dead patients while the prevalence of self-employed (14.1% vs. 34.7%) in this population was less than those who survived (Table 4). In evaluating clinical factors, it was determined that motorcycle accidents and falling, a GCS of less than 9 (53.6% vs. 39.9%), needing surgery (54.9% vs.43.3%), subdural hemorrhage (54.5% vs. 44.6%) and intracranial hemorrhage accompanied by brain contusion (24.5% vs. 14.2%) were more common in the dead patients (Table 5). The results of multiple variable regression analysis showed that, more than 60 years of age, trauma due to falling and motorcycle accidents, presence of intracranial hemorrhage accompanied by brain contusion, presence of subdural hemorrhage, GCS of less than 9 and the need to be admitted to intensive care unit were independent factors affecting the patients' death (Table 6).

Discussion:
The results from this study showed the significant higher frequency of TBI in male, patients 20-60 years old, spring and motorcycle riders. It was seen that most patients had a decreased level of consciousness (GCS<9) and subdural and epidural hemorrhage were the most common findings of brain CT scan. Prevalence of death was 23.3% in the present study. More than 60 years of age, trauma due to falling and motorcycle accidents, presence of intracranial hemorrhage accompanied by brain contusion, presence of subdural hemorrhage and GCS of less than 9 were independent risk factors of death. Men's employment in places outside home, justifies the greater extent of TBI in this sex. This finding is in accordance with other studies that have reported the ratio of head injuries in men to women to be 3 to 1 (10). In addition, in various international and regional studies TBI in men were reported more than women. Although this ratio is changing in more recent studies and the percentage of women affected by TBI is rising. The reason is that women are using motor vehicles more than before and are participating in activities outside the house more

Table 5: The relationship of clinical factors with patient outcome

Factor	Survived	Deceased	P
Presence of accompanying injuries			
Yes	331 (40.6)	78 (42.4)	0.65
No	485 (59.4)	106 (57.6)	
GCS level			
3-8	221 (39.9)	238 (53.6)	<0.001
9-12	152 (27.4)	92 (20.6)	
13-15	181 (32.7)	116 (26.0)	
Need for surgery			
Yes	353 (43.3)	101 (54.9)	0.004
No	463 (56.7)	83 (45.1)	
CT scan findings			
Epidural hemorrhage	195 (26.2)	28 (12.0)	<0.001
Subdural hemorrhage	332 (44.6)	127 (54.5)	
Diffuse axonal injury	98 (13.2)	16 (6.9)	
Simultaneous epidural and subdural hemorrhage	14 (1.9)	5 (2.2)	
Intracranial hemorrhage and brain contusion	106 (14.2)	57 (24.5)	
The need to be admitted to intensive care unit			
Yes	283(38.0)	89 (38.2)	0.95
No	462 (62.0)	144 (61.8)	

Table 6: Independent risk factors for the death of patients

Factor	Odds ratio	95% confidence interval	P
Over 60 years of age	3.5	1.4-8.9	0.008
Falling	5.0	1.8-14.3	0.002
Motorcycle accident	9.4	5.4-17.5	<0.001
Presence of subdural hemorrhage	12.1	5.0-29.4	<0.001
Intracranial hemorrhage and brain contusion	6.1	2.2-16.7	<0.001
GCS of less than 9	2.5	1.2-5.3	0.02

than before (11-14). Plus, as stated before prevalence of TBI is more in the youth. This, is in agreement with the fact that generally, trauma and accidents in this group of age is more than other ages (2, 15). Though the statistics in this study is not similar to the developing countries, it shows the same pattern. While a study in Norway, showed that, the prevalence of TBI was more in people aged 0-4 years old and people older than 75 compared to other groups (13). This difference is due to the age distribution difference in the 2 countries, as average age in most developing countries is much less than that in developed countries and this can affect the pattern of epidemiologic characteristics of TBI. The pattern of trauma mechanism was also different in Norway. In the afore-mentioned study, the most important cause of trauma was reported as falling but the most important cause in Iran is road accidents. Not using helmets is the main reason for the high prevalence of TBI in motorbike riders. So more preventive laws are needed in this regard. The results from Wu et al. (11) and Masson et al. (16) also show that motorcycle accident has the most prevalence in TBI and intentional damages were the least common. Death prevalence in the studied patients was 23.3%. The statistics in other similar studies vary between 30-38% (17-19). Although, Roozenbeek et al. have reported that the prevalence of death in the patients with traumatic brain injury is between 31% and 51% in their review study. The researchers believe that this is due to differences in habits, lifestyle and health care in the populations. Like death prevalence, death risk factors are also vastly different in the available reports (3). For instance, Ducrocq et al. report that the existence of hypotension in the time of admission to the hospital, decreased GCS and higher injury severity score are independent risk factors for death in TBI (20). While Hukkelhoven et al. demonstrate that aging is an independent risk factor for death in these patients (21). In addition, Tohme et al. introduce a fall in blood pressure and pre-hospital hypoxia as independent risk factors of death (22). The reason for these differences is that each study has paid attention to a different aspect. For example, Tohme et al. have

concentrated on pre-hospital factors, while Hukkelhoven et al. have paid more attention to the hospital and clinical aspects. Therefore, each of the afore-mentioned studies (including this study) have missed some of the probable risk factors and more careful examination is needed in this field. A shortcoming regarding this study is that it was a retrospective study. Studies on patients' profiles is always accompanied by missed data due to a lack of records or careless recording of data. That is the reason why, many probable risk factors of death mentioned in the aforementioned studies like blood pressure level at the time of admission to hospital were not studied. But the simple random sampling used in this study makes it possible to generalize the findings to the whole population.

Conclusion:

This study's findings demonstrated that TBI are more prevalent in people aged 20-60, male, spring and motorbike riders. It was also shown that the injury has been severe in most of them and subdural and epidural hemorrhage have been the most common findings of brain CT scans. The prevalence of death was 23.3% in this study. Over 60 years of age, trauma due to falling and motorcycle accidents, presence of intracranial hemorrhage accompanied by brain contusion, presence of subdural hemorrhage and a GCS of less than 9 were independent risk factors for the death in these patients.

Authors' contributions:

All authors passed four criteria for authorship contribution based on recommendations of the International Committee of Medical Journal Editors.

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