An Analysis of 885 Cases of Traumatic Brain Injury

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The main objective of this study is to explore the epidemiology of traumatic brain injury (TBI), its prognosis and outcome on the basis of inpatients records in the last 8 years in the first affiliated hospital of medical college of Xi'an Jiaotong University.
A retrospective study was designed to analyze data from the inpatients from January 1, 2003 to January 1, 2010. We included all inpatients during this 7 years period and it was followed by epidemiologic statistical analysis.
The total number of cases of TBI was 885, male being 688 cases and female 194 cases. Age ranged from 1 month to 88 years, average age being 44 years. Male female ratio was 3.4:1. Adult children ratio was 4.53: 1. There were 134 cases with unfavorable outcome comprising 15% of total cases.
Road traffic accident (RTA) was the most common cause of TBI and it was found to be associated with higher rate of mortality and morbidity. Moreover, the burden of TBI due to RTA was highest in most productive age group i.e. 30-40 years. Hence focus should be laid on promotion of traffic safety rules and regulations so as to decrease RTA and consequently TBI.
Key words: Epidemiology, Outcome, Traumatic Brain Injury

Traumatic brain injury (TBI), a form of acquired brain injury, occurs when a sudden trauma causes damage to the brain. [20] TBI is a leading cause of death and disability around the globe and presents a major worldwide social, economic and health problem.[12] It plays the leading role in disability due to trauma and is the leading cause of brain damage in children and young adults.[4]

Epidemiological data shows that TBI often occurs in children and elderly and its incidence in males is twice that of females.[5, 10] The annual incidence of TBI is more than 100/10 million in China, which is almost near to the level of western countries i.e. 150-200/10 million.[24] TBI is a critical public health problem affecting more than 10 million people worldwide and is set to surpass many diseases as the leading cause of mortality and morbidity by the year 2020. [26] The causes of TBI include Road Traffic Accidents (RTA), fall injury and violence. Over the past decade, rapid economic development and consequent urbanization, which tend to accompany the rise in vehicles and high buildings, have resulted in alteration of life style, and such changes might have increased the risk of traffic accidents and high level falls.[1] TBI has already been the main cause of death in various accidents.

This paper describes the outcome of 885 patients with TBI treated in a single neurosurgery unit, department of neurosurgery, the first affiliated hospital of medical college of Xi'an Jiao tong University.

Materials and methods

This study is a retrospective hospital-based study that included all cases of mild, moderate and severe TBI who

	Favourable outcomes (751)	Unfavourable outcomes (134)	OR (95%CI)	p value
Age				
<=40	460	61	Ref (Reference)	
40-60	199	41	1.55 (1.01, 2.39)	0.044
>=60	92	32	2.62 (1.62, 4.25)	0.001
Sex				
Female	186	31	Ref	
Male	565	103	1.09 (0.71, 1.69)	0.686
Complications				
No	708	103	Ref	
Yes	43	31	4.99 (2.99, 8.22)	0.001
Cerebrospinal fluid leakage(CSF)				
No	694	128	Ref	
Yes	57	6	0.57 (0.24, 1.35)	0.001
GCS score				
3-8(severe head injury)	94	117	Ref	
9-12(moderate)	139	10	0.058 (0.028, 0.12)	0.001
13-15(mild)	518	7	0.011 (0.0049, 0.024)	0.001
Pupils reactivity				
normal	666	44	Ref	
Non-reactive bilateral mydriasis	14	60	64.87 (33.63, 125.11)	0.001
Non-reactive unilateral mydriasis	28	11	5.95 (2.78, 12.73)	0.001
Bilateral unequal	26	15	8.73 (4.32, 17.67)	0.001
Undeterminable	17	4	3.56 (1.15, 11.04)	0.028
Seizure				
No	725	127	Ref	
Yes	26	7	1.54 (0.65, 3.62)	0.325
Shock				
No	735	120	Ref	
Yes	16	14	5.36 (2.55, 11.26)	0.001
Associated extra cranial lesions				
No	558	85	Ref	
Yes	193	49	1.67 (1.13, 2.46)	0.01
Epidural hematoma				
No	620	119	Ref	
Yes	131	15	0.60 (0.34, 1.05)	0.075
Subdural hematoma				
No	626	68	Ref	
Yes	125	66	4.86 (3.29, 7.17)	0.001
Cerebral contusion				
No	498	67	Ref	
Yes	253	67	1.97 (1.36, 2.85)	0.001
Diffuse axonal injury				
No	724	103	Ref	
Yes	27	31	8.07 (4.63, 14.07)	0.001
Sub-arachnoids hemorrhage				
No	569	56	Ref	0.001
Yes	182	78	4.35 (2.97, 6.38)	

Table 1: Single factor analysis of prognosis of TBI.

Table 1 (contd.): Single factor analysis of prognosis of TBI.

were treated in our hospital from January 1, 2003 to January 1, 2010. This study included 885 cases suffering from TBI. Pupil reactivity within the first 6 hours of trauma was classified as: undeterminable - if reactivity could not be assessed due to direct facial trauma, previous ocular injury; normal - if both pupils were of equal size and reactivity; non-reactive unilateral mydriasis or non-reactive bilateral mydriasis.[6] Bilateral unequal means the pupil diameter is not equal on two sides. Severity of TBI was assessed by Glasgow Coma Scale (GCS) [8] and classified as follows: severe, GCS score of 3–8; moderate, GCS score of 9–12 and mild, GCS score of 13–15. The GCS is a tool for measuring the degree of unconsciousness and is thus a useful toolfor determining severity of TBI. Final outcome was graded at the time of discharge from the hospital according to the Glasgow Outcome Scale (GOS) and clinical manifestations as:[9] cure, improvement; no cure, death. Cure and improvement were interpreted as favorable outcomes while no cure and death were considered unfavorable outcomes. The epidemiological, clinical, analytical, variables recorded within the first 6 h of trauma were: age, sex, cause of trauma (e.g. traffic accident, pedestrian accident–fall, fight, direct crushing or hit and others), presence of seizure and/or shock (any recorded episode of systolic blood pressure=<90 mm Hg) as well as complications during hospital stay.

The types of injuries included were epidural hematoma, subdural hematoma, cerebral contusion, diffuse axonal injury (DAI, including brain stem damage), sub-arachnoid hemorrhage (SAH) and associated extra cranial lesions of the body.

All variables were coded as qualitative or quantitative and introduced in a database for statistical analysis.

The association between variables was considered statistically significant when the probability (p) value was

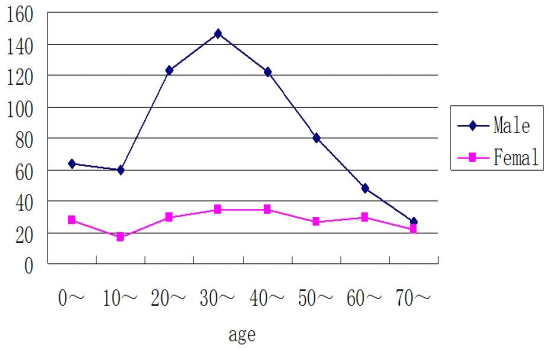

Figure 1: Graph showing number of TBI cases in differ ent sex in various age groups

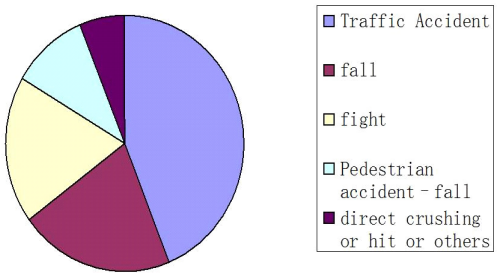

Figure 2: Pie chart showing causes of TBI

less than 0.05. Statistical analyses were performed with the Statistical Analysis Software (SAS) system statistical package (SAS Institute, Inc., Cary, NC, USA).

Results

It was observed that there were much more male patients than female with male-female ratio of 3.4:1. In female patients, there is uniform distribution of cases in various age groups, however in male patients TBI is more concentrated in the age group of 30-40 years.

Table 1 shows the single factor analysis of the prognosis of TBI. The prognosis was determined as favorable outcomes and unfavorable outcomes as discussed previously. Every variable was analyzed as single factor which contributed to the prognosis of TBI. The Odds ratio (OR) with their 95% Confidence interval (CI) were calculated and P value determined. The p value less than 0.05 were considered as statistically significant. It is seen that patients more than 60 years have the most unfavorable outcomes followed by 40-60 years. The patient having complication during hospital stay had more unfavorable outcomes and the common complications observed were pneumonia and intestinal infection and so on. Patients with CSF leakage have more unfavorable outcomes than those without CSF leakage. The patients with mild to moderate head injury (GCS >=8) have more favorable outcome than severe head injury. Pupillary light reflex was a good prognostic indicator for TBI as bilateral mydriasis showed the worst prognosis followed by unequal pupil then by unilateral mydriasis. Patients having shock and with associated extra cranial lesions had poorer prognosis. Presence of epidural hematoma did not show bad prognosis and was not statistically significant. The patients with subdural hematoma, cerebral contusions, diffuse axonal injury, and Subarachnoid hemorrhage all had poorer prognosis. The worst prognosis was seen with DAI. The prognosis of TBI on the basis of sex and concurrent seizure was not statistically significant.

Discussion

This is an important study which provides epidemiological data on the patterns, prognosis and outcomes of TBIs. The personal, social and financial consequences of TBI are compounded by the fact that most people with TBI are young and previously healthy. Our study is consistent with other TBI epidemiological studies conducted locally [3] and internationally[16-18] in terms of size of study and its result. It is observed that there are much more male patients than the female patients with male-female ratio of 3.4:1. Walter Mauritz, et al also obtained similar results. [23] However, in a study by Hardman et al. it was reported males prevailed over females with a ratio of 2:1 and had a 4-fold risk of fatal head injury. [20] A similar proportion was found in a study done in Brazil, [13] where 83% were males with the most frequent age group being 21–30 years. In contrast, among Mexicans [7] who were hospitalized as a result of TBI every year, only 68% of them were males. In female patients, there is uniform distribution of cases in various age groups. In 1982, Turkka Tunturi, et al [22] gave the similar result. However in male patients TBI is more concentrated in the age group of 30-40 years. Lee K K, et al. also obtained similar results. [11] It may be because men are more likely to engage in activities that make them more vulnerable to acquired traumatic brain injury. The young men are also the main labor force of the society which can make them more vulnerable to labor related accidents causing the TBI. The government should strengthen traffic rules through education and also increase safety measures to protect labors in order to decrease the incidence of TBI. As mentioned earlier the causes of TBI are Road traffic accident (RTA), fall injuries, injuries due to fight and pedestrian accident fall and others. The topmost three causes are the RTA, fall injuries and injuries due to fight. In China, traffic accidents (60.9%) were the major cause of TBI in all age

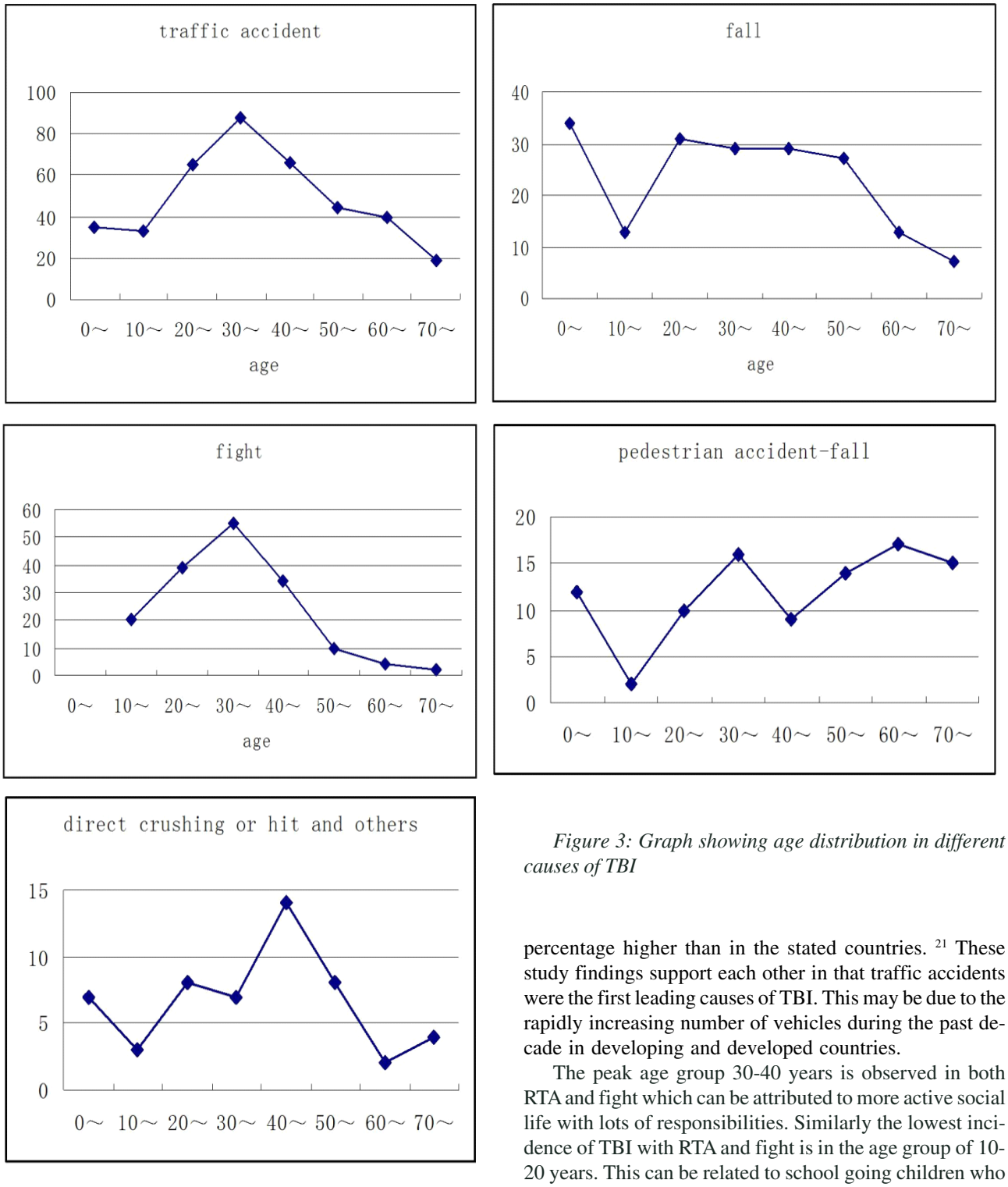

Figure 3: Graph showing age distribution in different causes of TBI

three causes are the RTA, fall injuries and injuries due to fight. In China, traffic accidents (60.9%) were the major cause of TBI in all age groups and the age group 35–44 years was the most vulnerable for traffic accidents. [25] Over 70% of TBIs in Taiwan are caused by traffic accidents, a percentage higher than in the stated countries. [21] These study findings support each other in that traffic accidents were the first leading causes of TBI. This may be due to the rapidly increasing number of vehicles during the past decade in developing and developed countries.

The peak age group 30-40 years is observed in both RTA and fight which can be attributed to more active social life with lots of responsibilities. Similarly the lowest incidence of TBI with RTA and fight is in the age group of 10-20 years. This can be related to school going children who are less active in social work. In case of fall injuries the highest incidence is found in the 0-10 years old. Falls, which represent the most frequent cause of TBI in the youngest, were observed in many studies.

In China, falls are the third leading cause of TBI, with a lower proportion (13.1%) and in Brazil (24%).[7] The younger age group of children are more prone to fall from bed and fall from heights while playing. The child has not yet de-

veloped cognitive hazard awareness and avoidance skills.[15] So this age group of children needs more supervision and protection. In case of the pedestrian accident fall injury, the more incidences are seen in 60-70 years followed by 0-10 years.

People over 60 years may have problems with vision and walking instabilities resulting in more pedestrian fall injuries. In the same way, children have less judgment abilities and carelessness resulting in more injuries. Hence both these age group of people and specially the elderly should be accompanied by the care takers for better protection. The prognosis of TBI is analyzed on various factors individually.

The unfavorable outcomes incorporated the patients with mortality and without cure whereas the favorable outcomes incorporated the patients with cure and improvements. It is seen that patients more than 60 years have the most unfavorable outcomes followed by 40-60 years. In the study conducted by Brown et al, the highest rates of mortality and hospitalization due to TBI are in people over 65 years old.[2] The patient having complication during hospital stay had more unfavorable outcomes and the common complications observed were pneumonia and intestinal infection and Urinary tract infection. Patients with CSF leakage have more unfavorable outcomes than those without CSF leakage.

The patients with mild to moderate head injury (GCS >=8) have more favorable outcome than severe head injury. It was found that moderate and severe injuries each account for on average 17% and 24%., with the rest mild injuries. The study in France reported similar proportion of severe injury (20%) and moderate injury (18%).[19] However A US study found lower proportion, 10% of TBIs was for severe and moderate injuries each.[14] Pupillary light reflex was a good prognostic indicator for TBI as bilateral mydriasis showed the worst prognosis followed by unequal pupil then by unilateral mydriasis. Patients having shock and with associated extra cranial lesions had poorer prognosis. Presence of epidural hematoma did not show bad prognosis but was not statistically significant.

The patients with subdural hematoma, cerebral contusions, diffuse axonal injury, and Subarachnoid hemorrhage all had poorer prognosis respectively. The worst prognosis was seen with DAI. The prognosis of TBI on the basis of sex and concurrent seizure was not statistically significant. So if any brain injury patient has one or several symptoms mentioned above, we must pay attention, and to give timely treatment to obtain more favourable outcomes.

Conclusions

TBI is associated with higher mortality and morbidity and is a common public health problem. The commonest cause of TBI is RTA followed by fall injuries. Moreover the burden of TBI due to RTA is highest in most productive age group (30-40) years. Hence focus should be laid on promotion of traffic rules and labor safety regulations so as to decrease RTA and fall injuries and consequently TBI. The prognosis of TBI depends on the severity of head injury with the degree of brain damage, other coexisting injuries and the complication during the hospital stay.

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