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Epidemiology and Treatment Outcomes of Head Injury in Bangladesh: Perspective from the Largest Tertiary Care Hospital

Sukriti Das[1] Bipin Chaurasia[2] Dipankar Ghosh[1] Asit Chandra Sarker[1]

[1] Department of Neurosurgery, Dhaka Medical College and Hospital, Dhaka, Bangladesh
[2] Department of Neurosurgery, Neurosurgery Clinic, Birgunj, Nepal,

Address for correspondence Sukriti Das, FCPS, MS, FRCS, Department of Neurosurgery, Dhaka Medical College and Hospital, Dhaka 1000, Bangladesh (e-mail: sukriti66@yahoo.com).

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Abstract

Background Traumatic brain injury (TBI) is one of the leading causes of mortality and morbidity. Economic impact is much worse in developing countries like Bangladesh, as victims are frequently male, productive, and breadwinners of the families.

Objectives The objective of our study was to highlight the etiological pattern and distribution of varieties of head injuries in Bangladesh and give recommendations regarding how this problem can be solved or reduce to some extent at least.

Methods From January 2017 to December 2019, a total of 14,552 patients presenting with head injury at emergency got admitted in Neurosurgery department of Dhaka Medical College and Hospital and were included in this study.

Results The most common age group was 21 to 30 years (36%: 5,239) with a male-to-female ratio of 2.6:1. Injury was mostly caused by road traffic accident (RTA [58.3%: 8,484]), followed by fall (25%: 3,638) and history of assault (15.3%: 2,226). The common varieties of head injury were: acute extradural hematoma (AEDH [42.30%: 1,987]), skull fracture either linear or depressed (28.86%: 1,347), acute subdural hematoma (ASDH [12.30%: 574]), brain contusion (10.2%: 476), and others (6.04%: 282).

Conclusion RTA is the commonest cause of TBI, and among them motor bike accident is the severe most form of TBI. AEDH is the commonest variety of head injuries. Proper steps taken by the Government, vehicle owners, and drivers, and proper referral system and prompt management in the hospital can reduce the mortality and morbidity from TBI in Bangladesh.

Keywords
- traumatic brain injury
- RTA
- ASDH
- AEDH
- GOS
- contusion
- DC

Introduction

Neurosurgery department is the super specialized department in Dhaka Medical College and Hospital (DMCH) that has to face a huge number of neuro trauma patients every day. Neurotrauma is one of the leading causes of death in Bangladesh; the World Health Organization (WHO) estimated that it kills over 21,000 lives in the country annually.[1] Over five million people die due to head injury around the world each year despite no longer being perceived as unavoidable but largely preventable events.[2] Out of these huge number, 1.2 million cases are due to road traffic accident (RTA), 90% of which take place in low- and middle-income countries.[3,4] It is predicted that by 2020, RTA will become a major culprit in the total disease burden.[2,3] In India, there is an accident every minute and death every 8 minutes and

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significant variations also arise between different states of India.[5–7] Among the injuries that occur due to traumatic brain injury (TBI), the recorded deaths number > 50,000 yearly in the United States.[8] Each year ~370,000 new cases of TBI are hospitalized in the United States[9] and the figure is > 100,000 for Europe.[10] Young people are the most common sufferers of TBI, resulting in long-term disabilities that, in addition to the personal toll, affect both the work force and economy.[11] Expenditure on TBI-related costs in the United States alone is estimated to be $17 billion per year.[12]

TBI is defined as an alteration in brain function, or other evidence of changed brain pathology, caused by an external force to the brain.[13] Alteration in brain function generally means any period of loss or a decreased level of consciousness. However, not all blows or jolts to the head result in TBI.[14] TBI is one of the most common forms of severe injury with a high death toll or life-long disabilities seen among patients. It is estimated to cause an annual loss of $30 billion in developed countries.[15] It is also estimated that >1.7 million head injuries are encountered in the United States alone.[15] The incidence of TBI has been contained as >600/100,000 cases by the WHO,[16] leading to ~90/100,000 admission in the hospital.[17]

TBI is a traumatic acquired insult to the brain resulting from an external mechanical force.[18] This may be accompanied by loss or alteration in sensorium. It remains one of the leading causes of morbidity, mortality, and economic loss worldwide. TBI is the commonest cause of mortality below 45 years of age. Such an impact is much worse in developing countries where per capita income is low and dependence ratio is high. Moreover, illiteracy, poverty, and negligence frequently delay the acquisition of medical attention, which exacerbates the curse and complications.

We are very sorry to say that unfortunately the epidemiological data of TBI in our region are scarce. The objective of this study is to highlight the pattern and distribution of TBI to enhance trace research, improve treatment strategies, and update and rectify the Government policy to reduce RTA mortality and morbidity.

Materials and Methods

The prospective study was conducted in the department of Neurosurgery, DMCH, from January 2017 to December 2019. A detailed history regarding age, sex, types of vehicle, types of victims affected, mode of injury, examination regarding Glasgow Coma Scale (GCS) scores, and associated injuries was prepared, and relevant investigations like computed tomography (CT) scan of head were performed. Data were collected every day by using structured questionnaires. In this way, 14,552 emergency patients were admitted and included in the study.

TBI was classified by GCS scores at presentation as: (i) Mild, with GCS score 13 to 15; (ii) Moderate, with GCS score 9 to 12, with or without loss of consciousness >5 minutes, posttraumatic amnesia >30 minutes, or focal neurologic deficit; and (iii) Severe, with GCS score 3 to 8. Patients with mild TBI with normal CT scan findings were discharged after proper initial emergency managements. All the remaining patients with moderate to severe TBI were adequately resuscitated and prepared immediately (some of them) for emergency surgical intervention.

Results

Over the 3-year study period, 14,552 patients were included in this study, where 72% were male and remaining 28% were female (►**Fig. 1**). The mean age at presentation was 29.9 years (range: 4 months to 75 years). The most common age group was 21 to 30 years with 36% (5,239) patients followed by 24% (3,492) patients in 31 to 40 years age group (►**Table 1**).

All the patients with history of head injury with some neurological findings and CT scan findings were offered admission for observation and management. RTA is the

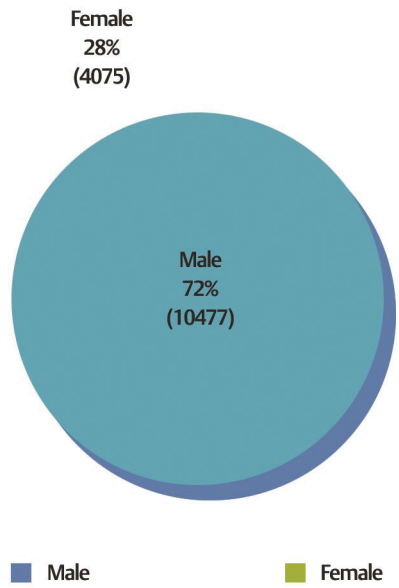

Fig. 1 Gender distribution of study population.

Table 1 Distribution of age ($n = 14,552$)

Age group	Number of patients
≤10 y	2% (291)
11–20 y	14% (2,038)
21–30 y	36% (5,239)
31–40 y	24% (3,492)
41–50 y	12% (1,746)
51–60 y	8% (1,164)
≥60 y	4% (582)

Table 2 Etiological pattern of head injury ($n = 14,552$)

Etiological pattern		Frequency	
Categories	Subcategories	Percentage	Number of patients
Road traffic accident		58.3	8,483
	Car/bus/truck	34	2,884
	Motor bike	44	3,733
	Train/others	1.5	127
	Pedestrian	20.5	1,739
Fall from height		25	3,638
	Roof-top/balcony	35	1,273
	Stairs	40	1,455
	From tree	18	655
	Over vehicle	7	255
Assault		15.3	2,226
	Blunt	80	1,781
	Sharp	14	312
	Firearm	6	133
Others		1.4	204

commonest (58.3%: 8,483 cases) cause of TBI among which motor bike accidents were in 44% (3,733) cases, bus/car/truck accidents were in 34% (2,884), pedestrian accidents were in 20.5% (1,739), and accident by train and others were found in only 1.5% (127) cases. Fall from height scored 25% (3,638) including fall from stairs in 40% (1,455), fall from roof-top/balcony in 35% (1,233), and fall from trees in 18% (655) cases. TBI following assaults is in 15.3% (2,226 cases) including blunt assaults in 80% (1,781) and sharp assaults in 14% (312) cases (►**Table 2**).

►**Figure 2** shows that, among the total admitted patients, 67.94% (9,886) patients were treated conservatively and remaining 32.06% (4,666) patients underwent surgical intervention.

Total mild cases were 60% (8,731), out of which 94.73% (8,271) cases were treated conservatively and 5.27% (460) cases underwent surgical intervention. Moderate cases were 25% (3,638) out of which 36% (1.310) cases were treated conservatively and 64% (2,328) cases underwent surgical intervention. Number of severe cases were 15% (2,183) out of which 14% (305) cases were treated conservatively and 86% (1,878) cases underwent surgical intervention (►**Table 3**, ►**Fig. 3**).

Out of 14,552 admitted patients, 60% (8,731) patients had mild TBI with GCS score 13 to 15, 25% (3,638) patients had moderate TBI with GCS score 9 to 12, and remaining 15% (2,183) had severe TBI with GCS score 3 to 8 at presentation (►**Table 4**).

On the basis of CT scan of head, diagnoses of TBI were: acute extradural hematoma (AEDH) in 42.3% (1,974) cases, depressed skull fracture in 28.86% (1,347) cases, acute subdural hematoma (ASDH) in 12.3% (573) cases, brain contusion in 10.20% (476) cases, and subarachnoid hemorrhage (SAH) or combination in 6.34% (296) cases (►**Table 5**).

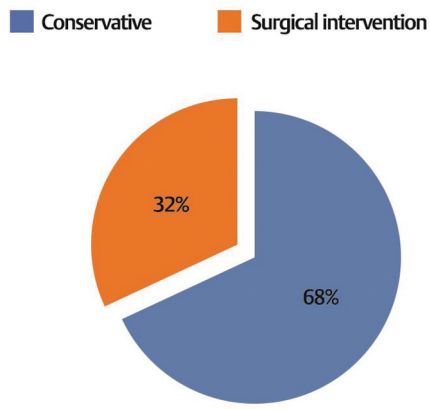

Fig. 2 Distribution of treatment advocated ($n = 14,552$).

Among the surgical procedures, craniotomy and evacuation for AEDH was done in 42.3% (1,974) cases, elevation of depressed fragment for depressed skull fracture was done in 28.86% (1,347) cases, decompressive craniectomy (DC)/craniotomy for ASDH was done in 12.3% (573) cases, DC/contusectomy for brain contusion was done in 10.2% (476) cases, and craniotomy/DC for SAH/combined conditions was done in 6.34% (296) cases (►**Table 6**).

Discharge was given from 3rd to 7th postadmission day (POD) in conservative patients and between 7th and 15th POD for surgical patients. ►**Table 7** shows outcomes at

Table 3 Distribution of surgical and conservative management based on severity ($n = 14,552$)

Severity	Conservative ($n = 9,886$)		Surgical ($n = 4,666$)	
	Number	Percentage	Number	Percentage
Mild (8,731)	8,271	94.73	460	5.27
Moderate (3,638)	1,310	36	2,328	64
Severe (2,183)	305	14	1,878	86
Total = 14,552	9,886		4,666	

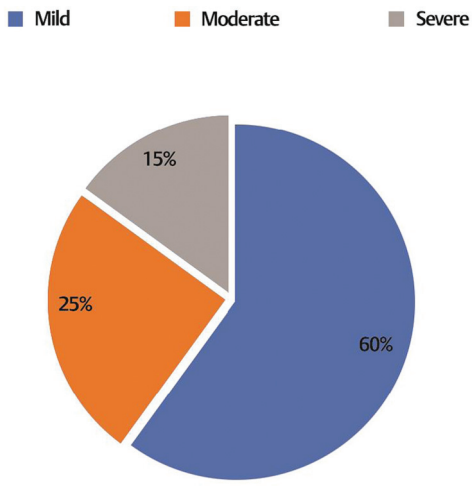

Fig. 3 Distribution of study population based on severity.

Table 4 Types of TBI based on severity ($n = 4,666$)

Types of TBI on CT scan	Number of patients		
	Mild (60%)	Moderate (25%)	Severe (15%)
AEDH	3,693	1,539	923
Skull fracture	2,520	1,050	630
ASDH	1,074	447	269
Brain contusion	891	371	223
SAH/combination	553	231	138
Total	8,731	3,638	2,183

Abbreviations: AEDH, acute extradural hematoma; ASDH, acute subdural hematoma; CT, computed tomography; SAH, subarachnoid hemorrhage; TBI, traumatic brain injury.

discharge by means of Glasgow Outcome Score (GOS). Maximum patients in mild TBI (94.73%) were treated conservatively and remaining 5.27% cases underwent surgical intervention due to late deterioration. Almost all of them had favorable outcomes (98%; GOS 4–5). In case of moderate TBI, favorable outcomes (GOS 5 and 4) were observed in 88% cases with 10% unfavorable outcomes

Table 5 Types of TBI based on CT scan findings in surgical group ($n = 4,666$)

Types of TBI on CT scan	Number of patients	
	Percentage	Number
AEDH	42.3	1,974
Skull fracture	28.86	1,347
ASDH	12.3	573
Brain contusion	10.2	476
SAH/combination	6.34	296

Abbreviations: AEDH, acute extradural hematoma; ASDH, acute subdural hematoma; CT, computed tomography; SAH, subarachnoid hemorrhage; TBI, traumatic brain injury.

(GOS 2 and 3) with 2% (46) mortality (GOS 1). In severe TBI, 50% patients had favorable outcomes (GOS 5 and 4) with 50% unfavorable outcomes (GOS 2 and 3) including 19% (357) mortality (GOS 1). Mortality was 8.64% (403) among total surgical interventions (4,666).

►**Table 8** shows follow-up at the end of 3 months. We got 60.54% (2,581) patients for follow-up after 3 months, where 39.46% (1,682) patients were missing; among them some patients expired and some failed to attend the neurosurgery outpatient department (OPD).

Discussion

Head injury is considered as a Silent epidemic of the post-industrialization and urbanization era by some authors.[19] In our study, males in their third and fourth decades of life were the predominant victims of TBI, specially RTA, as they are out for their daily activities and account ~60% of total victims. Similar observations were reported by the study of Patil et al,[19] which showed that the people in their most active and productive age group are involved in RTAs, adding a serious economic loss to the community. In this study, it is observed that people aged <11 years and >60 years are affected by RTAs, which may be due to less activities and less movements of these age groups. Similar findings were observed by some other studies.[20–22] In our study, male-to-female ratio was found to be 2.57 (72%):1 (28%). Another study[19] shows male-to-female ratio of 4.6:1, which does not correlate with our observation probably due to presence of more female workers (i.e., garment workers and day laborers) in our community.

Our study showed that RTA is the commonest (58.3%: 8,483 cases) cause of TBI among which motor bike accidents were in 44% (3,733) cases, bus/car/truck accidents were in 34% (2,884), pedestrian accidents were in 20.5% (1,739), and accident by train and others were found in only 1.5% (127) cases, which is similar to the results of the study done by Patil et al.[19] Motor bike is a very popular, high speed, less stable two-wheeler with less control system used for hurried movements in very busy city traffic area and rural Bangladesh causing maximum of 44% (3,733) occurrence of the RTA. This may be due to high traffic density, lack of

Table 6 Types of surgery done based on severity ($n = 4,666$)

Name of surgery	Types of TBI	Number of patients based on severity			Total
		Mild (5.27%)	Moderate (64%)	Severe (86%)	
Craniotomy and evacuation of EDH	AEDH	195	985	794	1,974
Elevation of depressed fragment	Depressed skull fracture	133	672	542	1,347
DC/Craniotomy	ASDH	56	286	231	573
DC/contusectomy	Brain contusion	47	237	192	476
Craniotomy/DC	SAH/combination	29	148	119	296
Total		460	2,329	1,878	4,666

Abbreviations: AEDH, acute extradural hematoma; ASDH, acute subdural hematoma; DC, decompressive craniectomy; EDH, extradural hematoma; SAH, subarachnoid hemorrhage; TBI, traumatic brain injury.

Table 7 GOS at the time of discharge ($n = 14,552$)

GOS	Mild ($n = 460$)	Moderate ($n = 2,328$)	Severity ($n = 1,878$)
GOS 5	95% (437)	72% (1,677)	34% (638)
GOS 4	3% (14)	16% (372)	16% (300)
GOS 3	2% (9)	7% (163)	15% (282)
GOS 2	0	3% (70)	16% (301)
GOS 1	0	2% (42)	19% (357)

Abbreviation: GOS, Glasgow Outcome Score.

Table 8 Follow-up GOS of discharged patients after 3 months ($n = 4,263$)

GOS	Mild ($n = 460$)	Moderate ($n = 2,328$)	Severity ($n = 1,878$)	Total
GOS 5	352	1,050	450	1,852
GOS 4	8	241	168	417
GOS 3	4	93	107	204
GOS 2	0	29	79	108
Missing	88	730	864	1,682

Abbreviation: GOS, Glasgow Outcome Score.

traffic rule awareness, and negligence of safety measures (i.e., lack of helmet use).

In case of RTAs by bus/car/truck, the percentage was 34% (2,884), which may be due to lack of training, traveling without seat-belts, badly shaped roads and vehicles, and alcohol intoxication during driving. Fall from height is another common cause for 25% (3,638) of TBI cases, especially in children and construction workers. Among fall, varieties of fall included fall from stairs in 40% (1,455), fall from roof-top/balcony in 35% (1,233), and fall from trees in 18% (655) cases. Common victims are children, females, and day laborers due to reasons such as fenceless roof-top working, playing and flying kites, fall from stairs, falling while climbing trees, and fall from electric poles (occupational).

TBI following assaults is also common (15.3%: 2,226 cases) in our country because of social unrest, relatively easy access to weapons, illiteracy, and poverty. The weapons may be blunt/sharp objects like bamboo, iron rods, Ram Dao, knife, or firearms (e.g., gun shot, blasts). Blunt assaults (80%: 1,781 cases) are usually associated with comminuted depressed skull fractures while sharp assaults (14%: 312 cases) are associated with compound depressed fractures; skull fracture itself is considered as an independent risk factor of mortality in severe TBI.[23]

On admission, all TBI patients are categorized on the basis of GCS scores and findings of CT scan and magnetic resonance imaging of the brain in late cases to see detail about brain damage. Among them, mild TBI with GCS score 13 to 15 was in 60% (8,731), moderate TBI with GCS score 9 to 12 was in 25% (3,638), and severe TBI with GCS score 3 to 8 was in 15% (2,183) of the cases. Out of these, 5.27% of mild cases (460), 64% of moderate cases (2,328), and 86% of severe cases (1,878) underwent surgical intervention and remaining 94.73% of mild cases (8,271), 36% of moderate cases (1,310), and 14% of severe cases (305) were treated conservatively (►**Figs. 4–6**).

On the basis of CT scan of head, diagnoses of TBI were AEDH in 42.3% (1,974) cases, depressed skull fracture in 28.86% (1,346) cases, ASDH in 12.3% (574) cases, brain

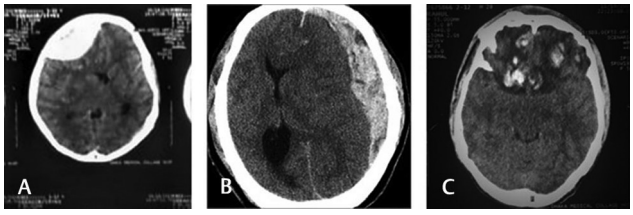

Fig. 4 Varieties of traumatic brain injury: (**A**) acute extradural hematoma; (**B**) acute subdural hematoma; (**C**) bifrontal contusion.

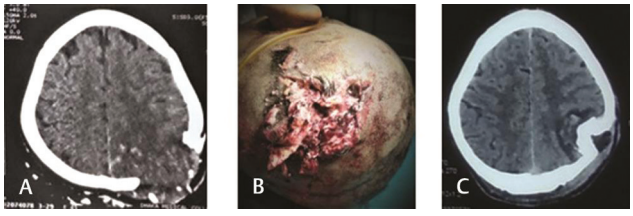

Fig. 5 Varieties of traumatic brain injury (contd.): (**A, B**) compound comminuted skull fracture with external brain herniation; (**C**) depressed skull fracture.

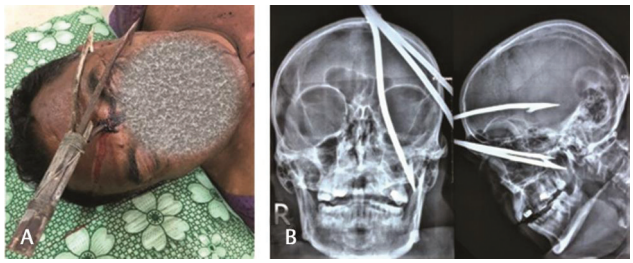

Fig. 6 Varieties of traumatic brain injury (contd.): (**A, B**) penetrating brain injury (by teta).

contusion in 10.20% (476) cases, and SAH or combination in 6.34% (296) cases of the total study population.

Among patients with extradural hematoma, those with clot thickness $\geq$1 cm or midline shift with deterioration of neurological status are candidates for surgical evacuation.[18] Patients with depressed skull fractures with neurological findings with risk of further complications are candidates for decompression and/or elevation of depressed fragments. The incidence of ASDH has been estimated as 12.3% and is directly correlated with preoperative GCS score and time interval between trauma and surgery.[6,24–26] Patients who had brain contusion (10.2%) were followed clinically and radiologically. Those who showed increase in size of contusion on repeat CT scan, mild midline shift, or brain becoming very tight with rapid neurological deterioration underwent DC or contusectomy. Penetrating injuries (1%) are commonly caused by indigenous weapons like teta, sharp weapons, and firearms, which carry a worse prognosis and higher mortality. They are managed with early surgical debridement and prophylactic antibiotics. Removal of foreign bodies from eloquent brain areas reduces the risk of postoperative epilepsy.

Regarding treatment, our study showed that among the total admitted patients, 67.94% (9,886) patients were treated conservatively and remaining 32.06% (4,666) patients underwent surgical intervention. Srinivas et al[27] show conservative treatment in 20% cases and surgical treatment in 80% cases. This study has similarity with our study. Maximum patients in mild TBI (94.73%) were treated conservatively and remaining 5.27% cases underwent surgical intervention. All of them (100%) had favorable outcomes. In case of moderate TBI, favorable outcomes were observed in 88% cases with 10% of unfavorable outcomes including 2% mortality. In severe TBI, 50% patients had favorable outcomes with 50% unfavorable outcomes including 19% mortality. We have 8.64% mortality in total. Mortality varies with severity of injury. We got 60.54% (2,581) patients for follow-up after 3 months, where 39.46% (1,682) patients were missing out of the total 4,263 surgically intervened patients at neurosurgery OPD.

Conclusion

In etiological pattern, RTA is the commonest cause, where motor bike accident is the commonest and severe most insult among RTAs. AEDH is the commonest type of TBI. Proper training, rapid resuscitation, and immediate definitive management can reduce mortality and morbidity. Proper steps like drivers' training, road maintenance, road visibility and lighting, vehicle fitness checking, rigid traffic rule following, compulsory wearing of crush helmet and seat-belts, road safety education to school children, and strong legislation and law enforcement, all these can reduce RTAs and thereby reduce morbidity and mortality. Roadside trauma center, advanced trauma life support training of service provider, rapid resuscitation facilities, good referral system, and immediate definitive management facilities, all these are also required to reduce morbidity and mortality.

Conflict of Interest
None declared.

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