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Original Article

Morbidity Audit of 704 Traumatic Brain Injury Cases in a Dedicated South Indian Trauma Center

Abstract

Background: In the era of evidence-based health care, protocol of intervention in traumatic brain injury (TBI) cases help decide more easily and safely about patients and prevent unnecessary transfer of patients to other centers. **Objectives:** The objective of this study is to provide protocol-based intervention and evaluate the epidemiological, clinical characteristics of TBI cases. **Methods:** This prospective study was conducted on 704 patients who were suspected of TBI at the Department of Neurosurgery, Narayana Medical College and Hospital, followed by protocol-based intervention assessed and reassessed repeatedly. **Results:** Overall, TBI involved 569 (80.82%) adults in the productive age groups (21–60 years); among males 81.47%. Among males, highest (23.15%) cases were in the age group of 31–40 years while in females, majority (27.04%) was among 41–50 years. Road traffic accidents were the most common (54.12%) mechanism of injury followed by fall (21.31%) and two-wheelers (15.20%). More than half sustained mild TBI (51.42%) while 26.28% moderate TBI and 22.30% severe TBI; among males, severe TBI victims 102 (18.82%) were in the productive age group. Loss of consciousness was almost a universal and significant observation (95.45%); vomiting was next common finding (76.42%). Bleeding from the ear-nose-throat (ENT) region was more in males (33.58%) than females (20.75%). Glasgow coma scale was significantly related with loss of consciousness (91.08%), vomiting (63.06%), and ENT bleeding (44.59%) in severe, moderate, and mild injuries. **Conclusion:** A rational clinical acumen with judicious use of diagnostic protocol leads to better management of TBI without unnecessary imaging and thus reduce total health-care costs.

Keywords: *Outcome, prediction, traumatic brain injury*

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Introduction

A century ago, Hippocrates predicted, "No head injury is too severe to despair of, nor too trivial to ignore." Globally, 10 million people suffer traumatic brain injury (TBI) per year to become the third most important cause of mortality and disability by the year 2020, and injury is likely to outshine other noncommunicable diseases by the next decade. Among injury continuum, TBI is the most important missing link of morbidity, mortality, and disability in the trauma management needing protocol-based outcome models for prediction on admission and dedicated neurosurgical care with the instruments such as Glasgow coma scale (GCS) and Glasgow outcome scale (GOS) to provide convincing predictions after 24 h.[1-5] India is in the rapid rebuilding of injury care system embracing all disciplines against this growing load of TBI as the hidden iceberg for which we need to systematic plan out for methodical approaches with futuristic models on prevailing actuality.[6-9] In India, we need a holistic move toward the progress of TBI care with a nationwide program connecting multidisciplinary comprehensive response system blended by a vision and mission.[10] Each country needs holistic researches to predict the projectile magnitude and sociodemographic distinctiveness of TBI for a systematic approach for effective prevention, policy development, and plan to guarantee good enough health care for the citizens at the time of real needs. These demanding painful soul-searching ultimately give birth to protocol-based outcomes of victims of TBI.[11-15]

The purpose of this study was to examine the contribution of risk factors on the types of lesions encountered in relation to the cases with TBI. It was hypothesized that TBI primary care guidelines, based

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on regional risk factors in remote areas, help improve outcomes even with the unavailability of computerized tomography (CT) and of state-of-the-art neurosurgical facilities.

Methods

This prospective study was conducted on the study participants who were consecutive patients at the Department of Neurosurgery, Narayana Medical College and Hospital, were suspected of TBI and underwent CT scan of the brain for confirmation of diagnosis and followed by protocol-based intervention, thereby as it was judged from time to time by the experts in the field. The present study was an observational, descriptive cross-sectional study conducted during November 2013–October 2015. The study tool was a predesigned and pretested questionnaire. The situational detailed analysis of all the study participants was recorded in a pretested semi-structured data collection tool that included sociodemographic profile (age, gender, occupation, and location), details of injury (injury mechanism, place of injury, and alcohol intake), precise clinical features including GCS score on admission, pupillary reflexes, hemodynamic variables, and CT findings.

Ethical clearance was obtained from the Institute Ethics Committee. All the eligible patients received verbal and written information in their vernacular about the purpose of the study and provided their written informed consent to participate in the study. Patients were admitted for either observation or definitive (i.e., evacuation of intracranial hematomas) as and when indicated. In the latter situations of surgical indications, a high-risk operative consent was also obtained after proper explanation of intraoperative and postoperative predictable and unpredictable elements with hazards of anesthesia as a standard operative procedure. All the findings were collected by observation and interrogation of individual eligible participant by the principal investigator personally when the events and decisions were noted in a predesigned pro forma. Data were stored safely, used only for scientific research purposes and not for the patient care. All the data were cross-checked with the original documents for to ensure consistency, reliability, and accuracy. All consenting consecutive cases suspected with the diagnosis of TBI of all age groups who attended acute care were included in our study. Nonconsenting participants were excluded from the present study.

The results of CT were considered abnormal if there were signs of any of acute traumatic injury (hemorrhage, edema, and skull fracture). CT showing only extracranial injury neither was considered pathological nor was findings correlated with the acute head injury. CT scans were interpreted according to the International standard clinical practice based on the imaging findings of cases and categorized in groups as described in the grading system of original publication by Marshall *et al*.[16] A complication was defined as deterioration due to the head injury that necessitated neurosurgical intervention, medical treatment, or intensive care. The outcome of the patients at discharge was categorized according to GOS.[17] Data were checked thoroughly and entered into MS Excel sheet and were analyzed using standard statistical techniques using StatsDirect version 3.0.150 (StatsDirect statistical software, http://www.statsdirect.com, England: 2015). The sociodemographic data were analyzed using descriptive analysis. The associations between the clinical parameters, initial and follow-up CT scan of the brain, and the outcomes were determined using Pearson's Chi-square test; $P < 0.05$ was taken as the alpha level of significance.

Results

Age

In our study, the TBI involved mainly young adults as majority of the cases (23.15%) were in age group of 31–40 years, followed by same magnitude in two close age groups 21–30 and 41–50 years (22.58%) while in 51–60 years, there were 88 cases (12.50%). Altogether in the productive age group (21–60 years), there were overwhelming majority of 569 (80.82%) cases among all the TBI victim cases. In elderly populations above 60 years, TBI cases were 56 (7.95%) only in our study period.

Gender

In our series, an overwhelming majority, i.e., 545 (77.41%) were male in all the age groups. Of them, majority (25.32%) were in 21–30 years age group, followed by 23.30% in 31–40 years age group, followed by 21.28% in 41–50 years age group. Hence, among male TBI cases, altogether 81.47% were in the productive age groups. Among female victims, majority (27.04%) were in 41–50 years age group, followed by 22.64% in 31–40 years age group, followed by 25 (15.72%) in 51–60 years age group. The male to female ratio of 3.4:1 was noted among TBI victims.

Mode of injury

Road traffic accidents (RTAs) were the most common (54.12%) mechanism of injury responsible for TBIs followed by fall (21.31%) and two-wheelers (15.20%). In the productive age groups, main cause (44.89%) of TBI was RTAs (males 262, females 54). Among male victims, RTAs by the fall from two-wheelers were 74 (13.65%); in more than 80 years, all TBI were caused by falls.

Severity of injury

More than half in our series sustained mild TBI (51.42%) while 26.28% moderate TBI and 22.30% severe TBI. Below the age of ten and above 80 years of age, there was no report of severe TBI though 27 (16.98%) among females had such level of injury. Among males, severe TBI victims 102 (18.82%) were in the productive age group.

Clinical presentations

Loss of consciousness was almost a universal clinical presentation in our series with 672 (95.45%) with more among males 521 (96.12) than females 151 (94.97%) though this difference was not significant. Vomiting was the next common finding (76.42%) with more among females 125 (78.62%) than males 413 (76.20%) though this difference was also not significant.

Bleeding from the ear-nose-throat region (ENT) was more in males (33.58%) than females (20.75%) presented with TBI. However, seizures were reported only among ten male victims [Table 1]. We had analyzed to find the association of mode of injury with clinical presentations of the TBI cases. It was noted that in TBIs, the loss of consciousness was a hallmark finding and statistically significant observation in our study, namely, in RTAs (94.72%), in falls (96.73%), in RTA fall from two-wheelers (97.20%), in RTA hit by two-wheelers, and assault (100%). Vomiting was also significantly related with modes of injuries in our study. It was noted in majority cases of RTA (74.93%), in fall (78.43%), in RTA fall from two-wheelers (73.83%), in RTA hit by two-wheelers (84.61%), and assault (100%). Majority of cases did not present with bleeding from ENT region [Table 2]. GCS of TBI cases was correlated with the clinical presentations with severe health injuries, significant relation was noted with loss of consciousness (91.08%), vomiting (63.06%), and ENT bleeding (44.59%). In

Table 1: Distribution according to mode of injury, Glasgow coma scale, and clinical presentation

	Sex	Age (years)									Total
		<10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	
Mode of injury											
Road traffic accidents RTA	Male	1	39	79	81	69	33	4	7	0	313
	Female	0	10	8	16	18	12	2	2	0	68
Fall	Male	0	6	15	11	21	17	10	8	2	90
	Female	2	1	8	8	19	11	7	2	2	60
RTA fall from two-wheeler	Male	0	13	30	23	16	5	1	0	0	88
	Female	0	2	5	6	4	1	1	0	0	19
RTA hit by two-wheeler	Male	0	1	9	4	2	6	3	0	0	25
	Female	0	0	0	0	1	0	0	0	0	1
RTA hit by four-wheeler	Male	0	0	1	2	7	1	3	0	0	14
	Female	1	1	0	1	1	1	1	0	0	6
Assault	Male	0	1	2	6	1	0	0	1	0	11
	Female	0	0	0	4	0	0	0	0	0	4
Train accident	Male	0	1	1	0	0	1	0	0	0	3
	Female	0	0	0	1	0	0	0	0	0	1
Boat fan injury	Male	0	0	1	0	0	0	0	0	0	1
	Female	0	0	0	0	0	0	0	0	0	0
Grand total		4	75	159	163	159	88	32	20	4	704
GCS											
Severe head injury	Male	0	9	28	23	35	16	12	7	0	130
	Female	0	1	3	5	11	5	1	1	0	27
Moderate head injury	Male	1	18	36	41	31	14	4	3	2	150
	Female	1	4	4	11	3	7	3	2	0	35
Mild head injury	Male	0	34	74	63	50	32	4	6	0	263
	Female	2	9	14	20	29	14	8	1	2	99
Grand total		4	75	159	163	159	88	32	20	4	704
Clinical presentation											
Loss of consciousness	Male	1	57	135	121	115	59	19	12	2	521
	Female	3	13	21	34	41	23	10	4	2	151
Vomiting	Male	1	44	112	91	90	52	14	7	2	413
	Female	3	10	19	28	33	21	9	2	0	125
ENT bleed	Male	0	20	47	45	47	17	4	2	0	182
	Female	1	5	0	14	7	5	0	1	0	33
Seizures	Male	0	2	0	2	2	3	1	0	0	10
	Female	0	0	0	0	0	0	0	0	0	0
Any systemic injury	Male	0	6	25	23	18	12	3	6	0	93
	Female	0	1	0	4	4	6	0	0	1	16

GCS – Glasgow coma scale; RTA – Road traffic accident; ETN – Ear-nose-throat moderate and mild injuries also, a significant correlation was found with loss of consciousness, vomiting, and ENT bleedings [Table 3].

Discussions

In this prospective observational study, the clinical relevance of abnormal findings and identification of risk factors were analyzed.

Age

In our study, TBI involved mainly young adults and majority of the cases (23.15%) were in age group of 31–40 years, followed by 21–30, and 41–50 years (22.58%); altogether in the productive age group (21–60 years), there were overwhelming majority of 569 (80.82%). In a study from central India, mean reported age of TBI cases was 32–64 years.[18] The International Mission for Prognosis and Clinical Trial (IMPACT) database on TBI through merging individual patient data from eight RCTs and three observational surveys observed that increasing age was strongly related to worse outcome in a continuous linear trend.[19] As described in the literature that the TBI most commonly involves the young adults in between 20 and 50 years, as we observed the reported incidence of TBI in the elderly was less by others also.[20,21] Published literature reported from India that up to two-thirds of TBI cases in different studies were in third, fourth, and fifth decades.[22-29] Reverdin reported that 60%–70% of incidence of TBI was among young adults.[30]

Gender

In our series, an overwhelming majority was males in all the age groups; altogether 81.47% were in the productive age groups. The male to female ratio of 3.4:1 was noted among TBI victims. Male gender was at more risk to sustain TBI in our study population. This was also reported the similar findings in the present series.[20] The male to female ratio of 3.4:1 was noted among TBI victims in our study. Bharti *et al.* reported 85% incidence in males and male to female ratio of 4:1.[21] It has been reported in literature by Indian scientists that among TBI patients majority were male.[22-29]

Mode of injury

In our study, RTAs constituted the most common cause of TBI, followed by falls, and injury from two-wheelers; in more than 80 years, all TBI were caused by falls. Many of the studies have reported RTA as the leading cause

Table 2: Association of mode of injury with clinical presentation

Mode of injury	Loss of consciousness		Vomiting		ENT bleed		Seizures		Any systemic injury	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
RTA	359	20	284	95	123	256	5	374	57	322
Fall	148	5	120	33	25	128	4	149	27	126
RTA fall from two-wheeler	104	3	79	28	41	66	1	106	15	92
RTA hit by two-wheeler	26	0	22	4	11	15	0	26	7	19
RTA hit by four-wheeler	19	1	16	4	11	9	0	20	3	17
Assault	15	0	15	0	3	12	0	15	1	14
Train accident	4	0	3	1	2	2	0	4	0	4
Boat fan injury	1	0	1	0	0	1	0	1	0	1
Total	676	29	540	165	216	489	10	695	110	595
χ^2	4.057		7.284		27.474		2.72		5.15	
df	7		7		7		7		7	
Significance	0.773		0.4		0.0001		0.91		0.642	

RTA – Road traffic accident; ETN – Ear-nose-throat; df – Degrees of freedom

Table 3: Association of Glasgow coma scale with clinical presentation

GCS	Clinical presentation									
	Loss of consciousness		Vomiting		ENT bleed		Seizures		Any systemic injury	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Severe head injury	143 (91.1)	14 (8.9)	99 (63.1)	58 (36.9)	70 (44.6)	87 (55.4)	3 (1.9)	154 (98.1)	30 (19.1)	127 (80.9)
Moderate head injury	179 (96.8)	6 (3.2)	147 (79.5)	38 (20.5)	67 (36.2)	118 (63.8)	4 (2.2)	181 (97.8)	25 (13.5)	160 (86.5)
Mild head injury	354 (97.5)	9 (2.5)	294 (81.0)	69 (19.0)	79 (21.8)	284 (78.2)	3 (0.8)	360 (99.2)	55 (15.2)	308 (84.8)
Total	676 (95.9)	29 (4.1)	540 (76.6)	165 (23.4)	216 (30.6)	489 (69.4)	10 (1.4)	695 (98.6)	110 (15.6)	595 (84.4)
χ^2	11.998		20.812		30.536		1.914		2.314	
df	2		2		2		2		2	
Significance	0.002		0.001		0.001		0.384		0.344	

GCS – Glasgow coma scale; df – Degrees of freedom; ENT – Ear-nose-throat of TBI. Bharti *et al.* reported that RTA was the mode of TBI in 64% of the patients.[21] In literature, RTA was reported as the major cause of TBI (ranging from 55% to 72%), followed by falls (20%–30%), and assaults (ranging from 1% to 10%).[31-36] As a result of the aging population of developed nations, the falls have been suggested as the frequent emerging cause of injury.[37] Indian studies indicated that road traffic injuries are the leading cause of moderate and severe reported in various parts of the country as well as in other parts of the world.[37-41]

Studies reported that pedestrians and motorcyclists are the most frequent victims of RTAs in India. By 2050, India will have the largest number of automobiles on the planet, leaving behind the United States.[42]

Severity of injury

More than half in our series sustained mild TBI (51.42%) while 26.28% moderate TBI and 22.30% severe TBI. Among males, severe TBI victims 102 (18.82%) were in the productive age group. IMPACT study outcome remained to be closely related with the impact of primary injury as shown by the initial GCS by exploiting the ordinal nature of the GOS and by relating the outcome obtained in individual patients to their baseline prognostic risk.[18,37,43] Low GCS at admission was associated with poor outcome. This finding is similar to many other reports from India and other parts of the world.[38] Conventionally, we assessed the severity of TBI by GCS score. Yet, researchers historically are not having unanimous opinion on the positive predictability of GCS on outcome analysis as it does not follow a normal distribution.[44,45]

Clinical presentations

We also observed that the loss of consciousness was the most common clinical presentation, followed by vomiting, ENT bleed, and posttraumatic seizures. Reported common clinical features of TBI included loss of consciousness, vomiting, headache, nasal/aural discharge, convulsions, shock, respiratory distress, and abdominal distension comparable to our study.[20]

Many studies have correlated clinical parameters to predict the outcome in TBI patients.[46-50] Other researchers worldwide also noted the history of loss of consciousness mostly in TBI victims with nasal bleed, ear bleed among associated injuries. Common clinical finding in TBI patient of vomiting was also reported.[44,51] Associated injuries play an additive role in TBI on the final outcome apart from age, sex, severity of injury, intracranial pathology, intracranial pressure, etc.[18] In an Indian hospital-based study, two-thirds of TBI cases had local injury on head and neck region and in suspected polytrauma, radiological evaluation of other body parts revealed evidence of injury was noted one in ten.

Strengths

Although TBI is a leading cause of mortality, morbidity, disability, and socioeconomic losses in the Indian subcontinent, there is a lack of dependable data in the Indian literature. We attempted to build up an indigenous data set from a dedicated center from South India. Using this study, there is a great potential to carry out a number of secondary analyses using multivariate techniques to evaluate the predictors of outcomes in TBI.

Limitations

We had several limitations. This was a single-center study. We, therefore, cannot generalize our findings for other trauma centers and all other settings of our country. Further, in all practical purposes, only a certain proportion of all TBIs will reach the hospital, and many of those with severe injuries may have died in the prehospital setting, and many with mild injuries may not have sought clinical care.

Future directions

We believe that the widespread use of this guideline will lead to better management of these patients, prevention of doing unnecessary CT scans, and reducing hospital costs. Application of this guideline in remote areas with unavailability to CT scan and neurosurgical facilities helps physicians decide more easily and safely about patients and prevents unnecessary patients transfer to other centers.

Conclusion

The present study revealed that there is an urgent need to develop ways for TBI registry and standard protocol of TBI intervention. This was only a revelation of the study of a single center. We need to find measures that should be helpful in providing optimal, low cost, and effective treatment to TBI patients. Knowledge about the causes, pattern, and distributions about TBI patients from this study will be extremely helpful in policy making, research, health management, and rehabilitation at the national level in our country and other developing nations.

Recommendation

- There is an urgent need to implement standard protocol for TBI at national level
- Capacity building in terms of training and reorientation program for the doctors and health-care facilities should be strengthened
- Regular monitoring should be done to evaluate adherence to the diagnostic and intervention guideline protocol.

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Conflicts of interest

There are no conflicts of interest.

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