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A study on the Clinical Profile and outcome of 100 pediatric patients with Traumatic brain injury (TBI)in the Eastern Indian population

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ABSTRACT: Introduction:Traumatic brain injury (TBI) in pediatric population is a major potentially preventable neurological illness of epidemic proportions where till date no there is no definite approved therapies to treat. Fortunately majority of pediatric TBI cases that are encountered regularly usually have a good outcome. Falls are most frequent mode of getting injured followed by road traffic accidents (RTA) and other modes. This global public health concern, pediatric TBI, has marked geographical, societal, ethnic dissimilarities and the outcome is influenced by these factors.
Aims and Objectives:Elucidation of kindred modes of injury, severity of injury, factors affecting outcome, and complications in the Eastern Indian population were the aims and objectives of the present study.
Materials and Methods:Children (≤18years of age) sustaining TBI, managed in the Department of Neurosurgery, Bangur Institute of Neurosciences, Kolkata, India were prospectively studied over a period of twenty months. Detailed history, clinical examinations, assessment of pupillary status, Glasgow coma scale score was recorded. Severity of TBI was done based on GCS score for each case. Computed tomography (CT) scan of head without contrast was the initial mode of neuroimaging and findings were recorded diligently. Patients were managed according to standard indications with surgery or conservative measures as required. The final outcome was assessed and graded according to Glasgow Outcome Scale score. Outcome was assessed in relation to age group, gender, initial GCS score, pupillary status, CT findings, intervention and associated injuries. Simple statistical analysis was done.
Results: Among thetotal 100 patients aged between 1 day and 18 years [Mean age 7.75±6.25]most common modes of injury were fall in 60% followed by road traffic accidents (RTAs) 25%, assault 4%, and others in 11% . RTAs had a poor outcome in 12% while patients with fall had a poor outcome of 13.4%. poor outcome was associated with the highest (61.2%) being midline shift (MLS) >3 mm and it was 8.6% with MLS of <3 mm and it was 10.7% in patients with no MLS. It was noticed that chest, spinal, and multiple injuries were associated with a poor outcome

I. INTRODUCTION:

Traumatic brain injury (TBI) in children, when severe, remains one of the most unfortunate events leading to debility, inextricable suffering and often death [1]. In non-lethal severe cases, it snatches the victim's aspirations and promises of a life ahead and encumbers the family with an endless emptiness and dolorous despair [1]. Head injuries of varied severity are increasingly being recorded at emergency departments in pediatric population in recent times [2,3]. Albeit the etiology varies with age and geographic location, economic status, road traffic accidents (RTA), falls and child abuse account for most [1-4]. Dewan MC et al (2016) incorporated TBI data from 5 continents and concluded the global incidence of pediatric TBI to be in between 47-280 per 100000 children; it has a bimodal age distribution with very young children (0-2 years) and adolescents (15-18) more commonly injured; TBI in males are reportedly more common over the age of 3 years [3]. According to the same study, fortunately in most cases, pediatric TBI are mild in severity, neuroimaging-negative, and could be managed non-surgically and achieve a good clinical outcome at the end [3]. The rate of emergency-visits, hospital-admission and mortality however varies widely with geographic boundaries, national and personal income, public health policies and civil regulations [3]. Deciphering the geographical

variation in incidence of pediatric TBI, injuries are most commonly reported to occur in Africa, Middle East, Southeast Asian countries surrounding Indian Ocean [1,3].

Risk stratification and prognostication are integral part in the initial emergency management of childhood TBI and the strategies for modification of existing systems are ever-evolving and includes use of both clinical and neuroimaging findings [7-12]. Computed tomography (CT) scan of brain is the most commonly employed definitive way to assess the severity of TBI. It helps in decision-making and planning for operative intervention if required [11-14]. Most striking factors for prognostication are age of the child, clinical indices judging the severity of TBI, and results of CT scan and measurement of intracranial pressure [15]. With the rapid advancement of medical science, kindred novel biomarkers for diagnosis, prognostication and therapeutic monitoring of TBI will be available in near future [16]. But for now this remains beyond scope for this article.

There are very few original studies on this topic from India [4-6] and data from Eastern India is yet to be published. Hence the authors took up the study to unveil the basic epidemiology of pediatric TBI from a rural-based largest tertiary care setup from Eastern India.

II. MATERIALS AND METHODS:

100 cases of pediatric TBI (≤ 18years) were evaluated (on basis of pretested, predetermined proforma) and treated in the Department of Neurosurgery, Bangur Institute of Neurosciences (BIN), Kolkata, West Bengal, India over a period of twenty months from February 2019 to October 2020, were enrolled in this prospective observational study. Detailed history regarding demographic profile and mode of injury were recorded. All of them had undergone a detailed general survey, systemic examination followed by neurological examination with especial focus on Glasgow Coma Scale (GCS) score, pupil size and reaction to light. Based on GCS, the severity of head injury of the patients were divided into mild head injury (GCS 13–15), moderate head injury (GCS 9–12), and severe head injury (GCS ≤ 8) categories All the patients were subjected to CT scan of head without contrast and findings were documented. Following initial resuscitation and rapid investigations, the patients were managed either conservatively or surgically as per indications.

The outcomes of all these patients were assessed by Glasgow Outcome (GOS) Scale and divided into good (normal, moderate disability) and poor (severe, vegetative, death) outcome. Outcome was assessed in relation to age, gender, GCS, pupil size and reaction, features on CT scan, modes of intervention, and presence of associated injuries.

III. RESULTS:

A total of 100 patients aged between 1 day and 18 years with a mean age of 7.75 years with SD of 6.25 were included in the study comprising 70% males and 30% females [Table 1]. The most common modes of injury were fall 60% followed by road traffic accidents (RTAs) 25%, assault 4%, and others 11% which include sports injury, hit by some object on head, and firearm injury. RTAs had a poor outcome in 12% while patients with fall had a poor outcome of 13.4% [Table 1].

Majority of our patients had a GCS of 13–15 (mild head injury), 72% followed by 8 or less (severe head injury) 8%. In group of patients in the category of GCS ≤8, poor outcome was seen in 62.5% [Table 1].

Out of the 100 patients, 76% patients had normal pupils, 18% had anisocoria, and 6% patients had fixed dilated pupils. Fixed dilated pupil had poor outcome (100%) followed by anisocoria (22.3%) and normal pupils (15.8%), which was statistically significant. CT scan findings were noted as normal in 12% patients, isolated skull fracture in 20%, contusion or hematoma in 35%, extradural hemorrhage (EDH) in 10%, subdural hemorrhage (SDH) in 8%, pneumocephalus or aerocele in 6%, brain edema in 5%, and subarachanoid hemorrhage in 4%. Among the mode of injury, it is evident that diffuse brain edema had poor outcome in 40%, SDH in 25%, contusion in 14.3%, while in EDH, it was 10% [Table 2].

From our series, we inferred that poor outcome was associated with the highest (61.2%) being midline shift (MLS) >3 mm and it was 8.6% with MLS of <3 mm and it was 10.7% in patients with no MLS [Table 2]. Out of the 100 patients, 68% were managed conservatively and the rest were managed surgically. The various surgical procedures performed in patients include fracture debridement and elevation in 18%, hematoma or contusion removal in 8%), decompressive craniotomy in 6% [Table 3]. We followed up our patients for 10 days to 12 months, with a mean of 5 months.

While doing the survey for associated injuries, fractures of face were noted in 17%, limb fractures in 8%, chest trauma in 4%, multiple traumas in 10%), and isolated head trauma in 56%. It was noticed that chest, spinal, and multiple

injuries were associated with a poor outcome [Table 4].

IV. DISCUSSION:

Even in this age of technological advancement in modern medical science, rural-based health-care setups in countries like India arguably lack well-equipped intensive-care-units and multidisciplinary approach while managing a case of pediatric TBI [4]. Henceforth, management of pediatric TBI in neurosurgical units in these setups has much scope for modification and renovation. Good prognosis in most cases is usual in childhood head-trauma cases [3]. Injuries are mostly sustained as a part of polytrauma and seldom in isolation and are approached in a similar fashion as done in cases of adulthood polytrauma [3,4, 17-20].

There remains conflicting opinions regarding relationship of age and prognosis of TBI in pediatric population [21-23]. No real difference in outcome in age groups above and below 5 years has been demonstrated by recent study by Wani AA and colleagues and Suresh HS and colleagues [4,24]. However, statistically insignificant poorer outcome was observed in relatively higher age group (13-18 years) similar to Wani AA et al and Suresh HS et al [4,24]. On the other side, age has been described as a definite factor for determination of morbidity/mortality by few old studies [25,26] and these results perhaps had been derived from comparison between adults and children with TBI. In the more recent studies [4,24] and in this study adult age group has been eliminated and inter-group comparison for outcome has been calculated in children only. This might be the possible reason for these discrepancies of conclusion regarding age group and their relation to outcome in old and recent studies.

Like in most previously reported series [3,4,24] fall followed by RTA remained the most common two modes of pediatric TBI and good outcome were seen in three-fourth of the cases.

Poor outcome expectedly were observed in TBI cases with low GCS score (≤8) and good outcome in those with initial GCS score of ≥9 at presentation similar to previous studies [3,4,24-27]. Initial GCS score has been shown to be the most statistically important clinical factor predicting outcome [27,28]. However, GCS score is not infallible in predicting prognosis as shown by Aldrich EF and Ong L and colleagues [29,30]. In absence of true hypoxia/ischemia GCS score may be inaccurate [29,30]. Delayed presentations to the emergency and utterly inadequate pre-hospital care are likely two main culprits for poorer prognosis in countries like India.

Abnormal pupillary response is another strong predictor of final outcome in cases of pediatric TBI [4]. Invariably poor outcome is seen in cases with dilated and fixed pupils [3,4,24,31,32]. Francel PC and colleagues disagreed to this finding [33]. However in this series of pediatric TBI, outcome was strongly related to pupillary size and reaction.

Brain edema followed by evidence of SDH and SAH on CT scan of brain had poorer outcome compared to evidences of EDH, Pneumocephalus, fracture and contusion on initial brain imaging. Patients will normal CT brain had invariably best outcome of the lot. This findings were similar to previous national and worldwide studies [3,4,24,33-35]. Unlike in adults, chance of developing an intracerebral hematoma in association with a fracture in the skull bone is less making the apparent paradox (fracture with good outcome) explainable in children [36] as described in our cases and previous relent studies [4,24].

EDH is rare in pediatric head trauma and can occur without skull fracture, compared to adults [33, 37]. Similar to the previous reports [4,24,32,33], cases of EDH in our study population had good outcome in significant majority. Compared to benign-appearing EDH, outcome of pediatric TBI cases with SDH on brain imaging was worse similar to previous studies [4,24,32,33] and this is apparently due to more extensive parenchymal damage in SDH. Even worse prognosis had been described by other studies [38,39].

Diffuse cerebral edema was associated with poorer outcome in our series like in previous studies [3,4,24,32-35]. When associated with diffuse axonal injury, these cases had higher mortality than when not.

Quantification of midline shift (MLS) on CT brain at admission was a good prognostic marker in cases with pediatric TBI [40,41] especially in those with single contusion or intracerebral hematoma rather than those with extra-axial hemorrhage or multiple lesions [41]. Bad outcome in patients with MLS>3mm was documented in our series which was similar to previously reported case studies [3,4,24].

Associated injuries were present in nearly half of the study population. Amidst the associated injuries, facial bone fractures followed by limb injuries were documented. This again went in tally with the result found in previous case studies [4,24,30-35]. Some dissimilarity in the distribution was observed when compared to other studies

[42,43]. This difference is because we had taken all patients into consideration irrespective of grade of injury, while others have taken severe TBI patients into consideration [42,43].

Final outcome as assessed by GOS scale, revealed death in only 12% cases and completely normal outcome in 55% cases and 14% had severe disability.

V. CONCLUSION AND LIMITATIONS:

Pediatric traumatic brain injury is an important cause of mortality and morbidity worldwide. The most important prognostic factors regarding the injury are GCS at presentation, pupillary status, associated injuries and CT scan findings. The patients with

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Tables:

Table 1. Relationship of age, gender, mode of trauma, and Glasgow Coma Scale score with outcome

	Good Outcome (%)	Poor Outcome (%)	Total (%)
Age group (Years)			
≤5	35 (77.7)	10 (22.3)	45
6-12	22 (73.3)	8 (26.7)	30
13-18	15 (60)	10 (40)	25
Gender			
Male	62 (88.5)	8 (11.5)	70
Female	24 (80)	6 (20)	30
Mode of trauma			
RTA	22 (88)	3 (12)	25
Fall	52 (86.6)	8 (13.4)	60

Assault	3 (75)	1 (25)	4
Others	8 (72.7)	3 (27.3)	11
GCS score			
≤8 (severe)	3 (37.5)	5 (62.5)	8
9-12	17 (85)	3 (15)	2
(moderate)	68 (94.4)	4 (5.6)	72
13-15 (mild)	88	12	100
Total			

RTA: Road Traffic Accidents; GCS: Glasgow Coma Scale; Others (i.e. sports related injuries, hit by an object on head, firearm injury)

Table 2. Relationship of pupillary status, computed tomography findings, and midline shift with outcome

	Good Outcome (%)	Poor Outcome (%)	Total (%)
Pupils			
Normal	64 (84.2)	12 (15.8)	76
Fixed and dilated	0	6 (100)	6
Anisocoria	14 (77.7)	4 (22.3)	18
Findings on CT brain			
SDH	6 (75)	2 (25)	8
Contusion	30 (85.7)	5 (14.3)	35
EDH	9 (90)	1 (10)	10
Brain edema	3 (60)	2 (40)	5
Normal	12 (100)	0	12
SAH	3 (75)	1 (25)	4
Fracture	18 (90)	2 (10)	20
Pneumocephalus	6 (100)	0	6
Midline shift			
No	42 (89.3)	5 (10.7)	47
Yes <3mm	32 (91.4)	3 (8.6)	35
Yes >3mm	7 (38.8)	11 (61.2)	18
Total	81	19	100

CT: computed tomography; SDH: subdural hematoma; EDH: extradural hemorrhage; SAH: subarachnoid hemorrhage

Table 3. Relationship of mode of treatment with outcome

Intervention employed	Good Outcome (%)	Poor Outcome (%)	Total
Decompressivecraniectomy	4 (66.6)	2 (33.4)	6
Fracture debridement and elevation	15 (83.3)	3 (16.7)	18
EDH evacuation	7 (87.5)	1 (12.5)	8
Conservative	60 (88.2)	8 (11.1)	68
Total	86	14	100

Table 4. Relationship of associated injuries with outcome

Associated Injuries	Good Outcome (%)	Poor Outcome (%)	Total
None	50 (89.2)	6 (10.8)	56
Facial bone(s) fracture(s)	15 (88.2)	2 (11.8)	17
Abdominal visceral injuries	2 (66.6)	1 (33.4)	3
Limb fracture(s)	7 (87.5)	1 (12.5)	8
Spinal injuries	2 (100)	0	2
Chest injuries	3 (75)	1 (25)	4
Multiple injuries	8 (80)	2 (20)	10

Total	87	13	100

Table 5. Glasgow Outcome Scale (GOS) score in the study group

GOS Score	n (%)
5 (Normal)	55
4 (Moderate disability)	17
3 (Severe disability)	14
2 (Vegetative state)	2
1 (Death)	12