Pattern of presentation of traumatic brain injury in pediatric emergency unit of a tertiary care centre

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Abstract

Background: The head injuries are unique in the pediatric age group, owing the distinctive characteristics in the anatomy and physiology of the brain, characterized by neuroplasticity. Several factors like physiological changes, etiology, management and its outcome pertaining to TBI needs to be evaluated to probe the potential for being a preventable risk factor. This study was carried out to assess the pattern of presentation of Traumatic Brain Injury (TBI) among pediatric age group visiting the emergency room. **Methods:** This cross-sectional study was carried out among 175 pediatric patients visiting the emergency room with a diagnosis of traumatic brain injury. Patient with moderate to severe traumatic head injury within 72 hours and those aged 1 - 15 years were included. Glasgow coma scale was used to assess and grade the severity of the TBI. **Results:** Majority of the participants (70.9%) belonged to moderate TBI and 29.1% belonged to severe TBI. Motor vehicle accidents were predominantly associated with severe injury (50%), fall from a height was associated more with moderate TBI. This association was found to be statistically significant (p<0.0005). **Conclusion:** Considering the impact of specific causes of TBI namely motor vehicle accidents and fall from height, there is a need for implementation of rigorous legislations which can minimize the risk for such accidents involving the pediatric age groups.

Keywords: Glasgow coma scale, Pediatrics, Traumatic brain injury, Motor vehicle accidents, Time lapse
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Introduction

The most common acute emergencies encountered in the pediatric age group are injuries. These injuries are often trivial consisting predominantly of falls. In some situations, the fall is often serious, resulting in head trauma associated with brain injury. Traumatic Brain Injury (TBI) though fairly less common in the pediatric age group, was found to be the leading cause of death in children aged 1-15 years amounting to 1.6 million head injuries annually in the United States [1]. Pediatric head trauma in developing countries contributes approximately 20 to 30% among all the head injuries [2].

The head injuries are unique in the pediatric age group, owing the distinctive characteristics in the anatomy and physiology of the brain, characterized by neuro-plasticity. Also, neck muscles in the children are weak as compared to adult. Therefore, any trauma disturbs

cranio-cervical stability affecting the vertebrae [3]. The impact of TBI is intense and can affect the neurophysiological functioning in the children. A significant role is being played by the pattern of injury, timing of health care accessed, age of the child and many more. Accurate diagnosis facilitated by technical advancements like imaging goes a long way in preventing complications and has held credit for long term outcomes. Several factors like physiological changes, etiology, management and its outcome pertaining to TBI needs to be evaluated to probe the potential for being a preventable risk factor. Moreover, such evaluation is essential for the better prediction of outcome in traumatic brain injury in the Emergency Room. A thorough analysis of these factors will help in long run to devise preventive strategies and programs for early detection, which can minimize the impact of the traumatic brain injury on the child, decrease in hospital stay duration and complications associated with TBI.

Objectives

This study was carried out to assess the pattern of presentation of Traumatic Brain Injury (TBI) among pediatric age group visiting the emergency room.

Methodology

Study setting and participants- This cross-sectional study was carried out among the pediatric patients visiting the emergency room with a diagnosis of traumatic brain injury for a period of 32 months from January 2016 to August 2018.

Inclusion criteria

- Patient with moderate to severe traumatic head injury within 72 hours

- Patients age 1-15 years old.

Exclusion criteria

- Mild head injury

- Patient admitted due to causes other than trauma are excluded.

- Patients with previous neurological problems were excluded.

- Patients who presented beyond 72 hours

- Patients <1 and >15 years of age.

- Patients whose parents/guardians refuse to consent for the study.

Ethical approval and informed consent: Approval was obtained from the Institutional Ethics Committee prior to the commencement of the study.

Each participant's parents/ guardian were explained in detail about the study and informed consent was obtained prior to the commencement of data collection.

Sample size calculation and sampling: Based on the available literature, it was observed that the overall prevalence of TBI among children and young adults was 30% [2].

At 95% confidence limits and 7.5% absolute precision, the sample size was calculated as 143. Accounting 10% for refusals, the sample size was calculated as 158 and was rounded off to 175.

All patients admitted to the Emergency department of our hospital who fulfill selection criteria were selected for the study. The participants were selected by purposive sampling technique.

Data collection: A structured interview schedule was used to obtain information regarding demographic data and history regarding the trauma. Clinical examination was carried out to evaluate the external wounds and other associated injuries. Glasgow coma scale was used to assess and grade the severity of the TBI.
Glasgow Coma Scale [4].

The scale measures the motor response, verbal response and eye-opening response with these values:

I. Motor Response

   6 – Obeys commands fully

   5 – Localizes to noxious stimuli

   4 – Withdraws from noxious stimuli

   3 – Abnormal flexion, i.e. decorticate posturing

   2 – Extensor response, i.e. decerebrate posturing

   1 – No response

II. Verbal Response

   5 – Alert and Oriented

   4 – Confused, yet coherent, speech

   3– Inappropriate words and jumbled phrases consisting of words

   2 – Incomprehensible sounds

   1 – No sounds

III. Eye Opening

   4 – Spontaneous eye opening

   3 – Eyes open to speech

   2 – Eyes open to pain

   1 – No eye opening

The final score is determined by adding the values of I+II+III.

Data analysis: Data was entered and analyzed using SPSS ver. 21 software. The prevalence of TBI was expressed in percentages.

The correlation between risk factors and Glasgow Coma Scale was analyzed using chi square test. A p value <0.05 was considered statistically significant.

Results

This study included 175 participants who were admitted to the Emergency Room following TBI. Majority of the participants were < 5 years of age (70.8%) and were males (60%). Most of the participants were brought to the ER within 1-2 hours of injury (28%). About 6.9% of the participants were brought beyond 4 hours of the trauma. (Table 1)

Table-1: Background characteristics

S. No	Characteristics	Frequency (N=175)	Percentage (%)
1	**Age**		
	1-5 years	124	70.8
	6-10 years	51	29.2
2	**Gender**		
	Male	105	60.0
	Female	70	40.0
3	**Time lapse**		
	<1 hour	42	24.0
	1-2 hours	49	28.0
	2-3 hours	42	24.0
	3-4 hours	30	17.1
	>4 hours	12	6.9

Table-2: Particulars related to the trauma.

S. No	Characteristics	Frequency (N=175)	Percentage (%)
1	**Mode of injury**		
	Fall from height	104	59.4
	Fall of object	19	10.9
	Motor vehicle accident	52	29.7
2	**Associated injury*(218)**		
	Maxillofacial	92	42.2
	Limbs	84	38.5
	Chest trauma	20	9.2
	Abdomen trauma	12	5.5
	Spinal	10	4.6
3	**Associated features*(125)**		
	CSF rhinorrhea	9	7.2
	CSF otorrhea	3	2.4
	Raccoon eyes	113	90.4
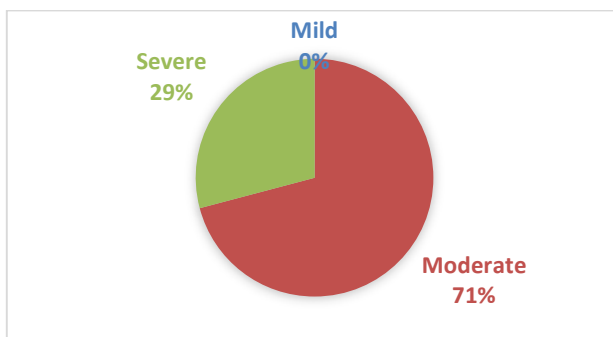
Figure-1 : Grading of number of participants of trauma as per Glasgow Coma Scale (GCS)

Table-3: Association between risk factors and grade of injury.

S. No	Characteristics	(N)175	GCS		Chi sq	P value
			Moderate	Severe		
1	Age (in years)					
	1-5 years	124	80(64.5)	44(35.4)	3.61	0.057
	5-10 years	51	25(49.1)	26(50.9)		
2	Gender					
	Male	105	73(69.5)	32(30.5)	0.22	0.639
	Female	70	51(72.9)	19(27.1)		
3	Mode of injury					
	Fall from the height	104	83 (79.8)	21 (20.2)	15.4	<0.0005*
	Fall of the object	19	15 (78.9)	4 (21.1)		
	Motor vehicle accident	52	26 (50.0)	26 (50)		
2	Associated injury*(218)					
	Present	92	61 (66.3)	31 (33.7)	1.9	0.163
	Absent	83	63 (75.9)	20 (24.1)		
3	Time lapse					
	<1	42	36 (85.7)	6 (14.3)		
	1-2	49	38 (77.5)	11 (22.4)		
	2-3	42	31 (73.8)	11 (26.2)	22.17	0.0001
	3-4	30	14 (46.6)	16 (53.4)		
	>4	12	5 (41.6)	7 (58.3)		

*statistically significant

It was observed that fall from a height was the most common mode of injury among the study participants (59.4%) followed by motor vehicle accident (29.7%). About 92 participants (42.2%) had associated injuries of which the most predominant injury involved maxillofacial region. Raccoon eyes were present in 90.4% of the participants (Table 2).

The grading of trauma as per Glasgow Coma Scale (GCS) among the study participants is given in Figure 1. Majority of the participants (70.9%) belonged to moderate TBI and 29.1% belonged to severe TBI.

In the present study, the association between the risk factors and grade of injury was evaluated. Mode of injury was found to be a significant risk factor for the grade of TBI. Motor vehicle accidents were predominantly associated with severe injury (50%), fall from a height was associated more with moderate TBI. This association was found to be statistically significant (p<0.0005). The present study showed a significant association between the time lapse and severity of TBI. The patients were observed when brought within one hour, the severity of TBI is predominantly moderate while the time lapse increases, the chances of having a severe TBI are greater. The observed difference was statistically significant (p<0.001) (Table 3).

Discussion

Traumatic brain injury is comparatively less common than any other injuries in pediatric age group. In the present study, majority of the participants suffered from moderate TBI (70.8%) while 29.2% suffered from severe TBI. Participants aged 6-10 years had more TBI than other group. Male children are more predominant than female, in our observation. Most common type of mechanism of injury is, fall from height. However, motor vehicle accident lead to severe TBI. Among

associated injuries, maxillofacial trauma is more than limb injuries. Raccoon eyes or periorbital ecchymosis is a sign of basal skull fracture, blood from skull fracture seeps into the soft tissue around the eyes.

It is highly suggestive of fracture, or most often associated with fractures of the anterior cranial fossa. In this study it was observed 64.5% had raccoon eyes in both moderate and sever TBI.

In this study, an association between traumatic brain injury severity and the injury pattern was explored. Severity of traumatic brain injury was well determined by the mode of injury, has been very important predicting factor. Motor vehicle accident has showed very high incidence in strong association with severe TBI (p<0.05). In studies done by Shah M showed that motor vehicle crashes are usually associated with other multiple injuries and exhibits the TBI severity [5]. Skull fractures and Sub-Dural hemorrhages were relatively associated with motor vehicle accidents. The time lapse between the injury and visit to the ER is a crucial component predicting the outcome of TBI. In the present study, majority of the participants reported to the ER within 1-2 hours of injury. More delay to arrive emergency room after head trauma, increases the morbidity and mortality associated with the outcome of TBI. This finding was reiterated in studies done by Gelernter et al [6].

Moderate TBI was more common among all the age groups. While 6-10 years were associated more with moderate TBI (76.5%), severe TBI was more prevalent beyond 6 years (p<0.001). Males had increased risk of moderate TBI (76.2%) compared to females (62.8%). The patients were observed within one hour, the severity of TBI is predominantly moderate while the time lapse increases, the chances of having a severe TBI are greater. The observed difference was statistically significant (p<0.001).

An important parameter which influences the presentation of TBI and also predicts the outcome is Glasgow Coma Scale (GCS). A GCS score of three at presentation has been associated with the significantly poor outcome. Due to the high mortality rate even approaching 100% when the score is associated with bilateral fixed and dilated pupils, questions have been raised as to whether the patient should be aggressively managed during the early acute phase of injury [7]. Therefore, an accurately early prediction of survival and functional outcome appears to be of paramount importance. This allows for informed counseling of relatives and helps the treating physician in deciding the aggressiveness of treatment. Overall, patients with isolated head trauma do better than those with multiple injuries. Infants with brain lesions generally fare worse than older children. Although the intact survivors fare well, they often are affected with minor physical and neural and behavioral deficits which require skilled evaluation and therapy. It is clear prevention of injury is best way of reducing the problems associated with head trauma.

Intensive literature review has proposed several presenting factors which have been implicated in predicting the outcome of the traumatic brain injuries. These factors include glucose levels, coagulation profile, hypotension, and presence of cerebral edema in Computerized Tomography (CT) scan. While hyper-glycemia is said to hasten up the recovery, hypercoagulation is said to be associated with poor outcomes. In brain injury induced hypercoagulation, there is an increasing plasma concentration of fibrin/fibrinogen degradation products and plasmin- α2-plasmin inhibitor [8].

Decrease fibrinogen levels are associated with a higher percentage of unfavorable outcomes for injury.

Hypercoagulable state has been reported in up to 76% of the patients following traumatic brain injury and they also end up in full blown disseminated intra vascular coagulation [9-11]. Hypotension is associated with poor outcomes and studies have shown that people with low systolic blood pressure have a fewer chances of survival following brain injury. Hypotension is associated with poor outcomes and studies have shown that people with low systolic blood pressure have a fewer chances of survival following brain injury in several published literature. Studies have demonstrated that cerebral swelling is present in up to 50% of the cases, especially in pediatric age group [12]. CT findings in many studies showed that mortality increases up to 61.9% when the midline shift more than 5 mm [13].

Limitations- Although in the present study has highlighted certain predictors of TBI, it is essential to evaluate the predictors at the molecular level. Further evaluation of these predictors may help in developing a predictive model, which may form the basis of developing a risk scoring which could help in prognosis at the earliest time point.

Conclusion

In the present study has elucidated that timing of arrival at the Emergency Room plays a key role in determining the prognosis of TBI. This indirectly emphasizes on the need for creating awareness regarding the responsibilities of parents, care takers, teachers and general public towards the providing emergency care following TBI. Considering the impact of specific causes of TBI namely motor vehicle accidents and fall from height, there is a need for implementation of rigorous legislations which can minimize the risk for such accidents involving the pediatric age (groups).

What the study adds to the existing?

Traumatic Brain Injury has been extensively evaluated by various researchers both at clinical and pathophysiological levels. However, the present study has been successful in evaluating the social predictors of prognosis with respect to the type and severity of the TBI and also the timing of accessing emergency point of care for early management and better outcomes following TBI.

Author's contribution

Dr. Karthick Jayapal: Data collection and analysis.
Dr. Manohar S: Conceptualization and manuscript drafting.

Declaration

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Ethical approval –Obtained

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