

Outcomes of traumatic brain injury among pediatric population presenting in emergency room

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Abstract

Background: Traumatic Brain Injury (TBI) is one of the most common cause of Emergency Room (ER) visits in the pediatric age group. Severe TBI can result in impairment of higher cognitive functions and can also limit physiological functions like motor, speech and emotional problems. This study was carried out to evaluate the outcomes of TBI among pediatric patients presenting in ER. **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. Glasgow Outcome Scale was used to grade the outcomes following TBI. **Results:** As per the Glasgow Outcome Scale (GOS), majority of the participants were graded with mild disability and good recovery (64%), while 6 patients were graded to be dead and 4.6% of the participants were graded to be in vegetative state. In this study, significant correlation between severity of the TBI and its outcome. Moderate TBI was associated with better outcomes compared to severe TBI. The association was found to be statistically significant ($p < 0.0001$). **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. It is essential to create safe public places, which are not only utility based, but also enable vulnerable age groups access them with minimal risk.

Keywords: Emergency Room, Traumatic Brain Injury, Glasgow Coma Scale, Glasgow Outcome Scale

Introduction

Traumatic Brain Injury (TBI) is one of the most common cause of Emergency Room (ER) visits in the pediatric age group. These injuries are often trivial, predominantly consisting of falls. While most of these children sustain minor injuries, some of the patients develop serious consequences resulting in physiological and neurological derangements. Studies have shown that TBI is the major cause of death and disability among children aged 1-15 years [1].

According to CDC estimates, mild TBI is witnessed in 70-80% of the ER visits while moderate and severe TBI are seen in 15% and 2% of the ER visits respectively [2]. Among the developing countries, pediatric head trauma is seen in 20-30% of all the head injuries [3].

In a pediatric setup, majority of TBI result from fall from height (50%) or road traffic accidents (42%) [4]. The complications that occur following TBI may be physiological, psychological or neurological. Based on Glasgow coma scale scoring (duration and intensity of loss of consciousness), traumatic brain injury can be categorized as mild or severe. Severe TBI can result in impairment of higher cognitive functions and can also limit physiological functions like motor, speech and emotional problems. Moreover, the pattern of injury has great impact on the general wellbeing and functioning of the child.

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. TBI has severe impact on not only the

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physical and physiological wellbeing but also on the social well-being of the patients.

The effects present a major social, economic and health problems during long stay in hospital, permanent neurological disability, long term rehabilitation facilities, complications associated with long hospital stay, straining the available resources and loss of earning power and death involving not only the patients but also the care providers. Several factors like physiological changes, etiology, management and its outcome are related with the traumatic brain injury in children. Every parameter has to be evaluated in depth,

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
- Patients with previous neurological problems.
- Patients who presented beyond 72 hours
- Patients <1 and >15 years of age.

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 was 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: On presentation at the ER, 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 [5]. Glasgow Outcome Scale was used to measure the outcome of TBI [6].

A grade of 1,2,3 were classified as poor outcome and 4,5 as good outcome.

Data analysis: Data was entered and analyzed using SPSS ver. 21 software. The prevalence of TBI was expressed in percentages. The correlation between Glasgow outcome scale and Glasgow Coma Scale was analyzed using chi square test. A p value <0.05 was considered statistically significant.

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 evaluate the outcomes following traumatic brain injury among pediatric population visiting the Emergency Room

Table-1: Glasgow outcome scale interpretation.

S. No	Disability	Characteristics	Scale
1	Mild	Good recovery with or without mild disability	5
2	Moderate	Loss of consciousness beyond 30 minutes	4
		Physical or cognitive impairment which may or may not resolve	
		Benefit from rehabilitation	
3	Severe		
	Coma	Unconscious state. No meaningful response; no voluntary activities	3
	Vegetative state	Sleep wake cycles	2
		Arousal, but no interaction with the environment	
		No localized response to pain	
	Persistent vegetative state	Vegetative state lasting longer than one month	
Brain death	No brain function	1	

Results

This study was carried out among 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 2).

Table-2: 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	Mode of injury		
	Fall from height	104	59.4
	Fall of object	19	10.9
	Motor vehicle accident	52	29.7

The grading and outcome of trauma among the study participants is given in table 3. As per the Glasgow Coma Scale grading, majority of the participants (70.9%) belonged to moderate TBI and 29.1% belonged to severe TBI. As per the Glasgow Outcome Scale (GOS), majority of the participants were graded with mild disability and good recovery (64%), while 6 patients were graded to be dead and 4.6% of the participants were graded to be in vegetative state (Table 3).

Table-3: Grading and outcome of trauma.

S. No	Characteristics	Frequency (N=175)	Percentage (%)
1	Glasgow coma scale		
	Mild	0	0.0
	Moderate	124	70.9
	Severe	51	29.1
2	Glasgow Outcome Scale		
	Death	6	3.4
	Vegetative state	8	4.6
	Severe disability	12	6.9
	Moderate disability	37	21.1
	Mild disability/Good recovery	112	64.0

In this study, significant correlation between severity of the TBI and its outcome. Moderate TBI was associated with better outcomes compared to severe TBI. The association was found to be statistically significant ($p < 0.0001$). (Table 4).

Table- 4: Comparison between grade of TBI and outcome.

S. No	Characteristics	(N)175	GOS		Chi sq	OR	P value	CI (95%)
			Good outcome	Poor outcome				
1	GOS evaluation after 72 hours							
	Moderate TBI	124	115 (92.7)	9 (7.3)	19.4	6.4	<0.0001*	1.2-
	Sereve TBI	51	34 (66.7)	17 (33.3)				15.5

*Statistically significant

Discussion

Traumatic Brain Injury (TBI) occurs due to external mechanical force to the cranium and intra cranial structures resulting in temporary or permanent impairment, functional disability and psychosocial maladjustment. The impact of TBI results in two sets of damages – the primary injury which occurs at the moment of trauma and secondary injury which occurs immediately following trauma and produces effects which may last for a longer duration [7].

Although traumatic brain injury is fairly less common among adults, it is one of the leading causes of ER visit among the pediatric population. In our study among 175 patients, males were predominant and TBI was higher in the age group of 1-5 years. In a study done by Chaitanya K et al, the mean age of the affected participants was 5.5 years, similar to our study [8]. In our study, majority of the participants suffered from moderate TBI (70.8%) while 29.2% suffered from severe TBI. In this study, majority of the participants had favorable outcome, who had moderate TBI. Children who had moderate traumatic brain injury showed better outcomes than compared to other group with severe TBI ($p < 0.001$).

It's challenging to analyze the morbidity following traumatic brain injury in children. Early reports by Kraus et al observed that 97% of the children were discharged alive and well following TBI [9]. Another study by Falk et al observed that 4.3% of the children develop neurological symptoms beyond a lucid interval [10]. In a study done by Forsyth et al, 6% of the admissions with TBI were discharged with conservative management and rehabilitative measures [11]. However, very few studies have reported mild injuries following trauma. The brain of the child is constituted with 88% of water, thereby making them soft and vulnerable to external

damage. Head trauma in the pediatric age group causes rotational acceleration-deceleration of the head generating shearing forces that cause mechanical disruption of nerve fibres. As a consequence, there is diffuse axonal injury resulting in large subdural hematomas [12]. In cases where the child experiences direct blow causing linear fracture across meningeal arteries, epidural hematoma ensues further complicating the outcomes. [13].

Traumatic brain injury is followed by Neuro protective mechanism which is a natural rebound mechanism of the brain tissue. Neuroprotective mechanisms for acquired and chronic trauma have been based on the response from astrocytes, microglia, oligodendrocytes, and precursor cells [14]. These mechanisms play an important role in the therapeutic strategies which promotes recovery and functioning of the non-neuronal cells. The neuronal cell death the Neuro productive mechanisms may be described under neuronal cell death whose morphology may be based on intrinsic apoptosis, extrinsic apoptosis, regulator necrosis and autophage [15].

Considering the severity of the impact of TBI, it is essential to devise adequate guidelines and regulations for preventing TBI among pediatric age group. This should involve multi-sectoral participation including schools, parent groups, and public infrastructure planners. Strong policy decisions should be taken and effectively implemented to curb violations which result in fatal and near fatal accidents involving TBI. As a rehabilitative measure, there is a need for effective training and health education strategies for health care professionals to provide holistic management of TBI. It is essential to provide rehabilitation at all levels, including cognitive, behavioral and psychomotor components. There should be inclusive participation from the parents and other care providers during the

rehabilitative period in order to facilitate easy coping mechanisms for the children, so as to restore quality of life and normal childhood among these patients.

The lack of success of neuroprotective drugs clinically has led investigators to identify potential factors contributing to such failures. These include (1) inadequate understanding of secondary injury mechanisms; (2) insufficient preclinical testing in multiple injury models, strains, species (including gyrencephalic), genders and ages; (3) lack of thorough investigation of pharmacokinetics and therapeutic brain concentrations; (4) failure adequately to examine therapeutic window and clinically relevant behavioral outcomes; (5) use of heterogeneous patient populations; (6) inadequate sample size; and (7) inadequate functional outcome measurements and biomarkers [16].

Limitations: This study has been conducted on a limited sample of patients in a hospital setting. In order to facilitate generalization, this study needs to be replicated in the community.

Conclusion

Traumatic Brain Injuries (TBI) are associated with increased morbidity and mortality, especially in the pediatric age group. In spite of aggressive clinical and surgical management, TBI often results in physical and or neurological deficit. There are several molecular mechanisms underlying the neuronal cell death and damage. Considering the magnitude of impact caused by TBI, it is essential to analyze the key factors associated with the prognosis of 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. It is essential to create safe public places, which are not only utility based, but also enable vulnerable age groups access them with minimal risk.

What the study adds to the existing knowledge?

The present study has also been successful in engineering various hypotheses regarding the predictors of TBI at the molecular level which paves way for further research in the future

Author's contribution

Dr. Karthick Jayapal: Conceptualization and writing

Dr. Hassan Ali Mansour: Data collection and analysis

Declaration

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