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Original Article

Pattern and Outcomes of Traumatic Brain Injury in Pediatric Patients

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ABSTRACT

Traumatic brain injury (TBI) is the leading cause of mortality and permanent impairment in children. **Objective:** To investigate the pattern and outcomes of TBI in pediatric patients. **Methods:** A descriptive cross-sectional study was conducted at Holy family Hospital Rawalpindi from June 2021 to February 2022 in the Department of Emergency. We included 141 children with no prior history of neurological deficits, who had a CT scan immediately following their presentation. All children were monitored throughout their hospital stay to determine the in-hospital mortality and any neurological deficits. SPSS Version 24 was used for data analysis. **Results:** Male patients were 86 (61%). The majority of patients were between the ages of 5 and 10 years. There were 35 male patients and four female patients who were involved in a road traffic accident. Only 20 of the patients who had hypotension on admission showed recovery. The p-value was significant in 46 hypotensive patients out of which 23 died. The hospital had to treat 11 patients who had been hospitalized for more than a month. Only 31 of the 96 patients with depressed mentation had surgery, compared to other patients with no neurological deficit. **Conclusions:** TBI in pediatric patients was affected by gender, age, time of arrival after injury, and presenting conditions in our study. More needs to be done in the area of public health. The hospital and perhaps the country would benefit from a trauma registry system.

INTRODUCTION

Traumatic brain injury (TBI) is a type of brain injury that develops as a result of a hit to the head, a fall, a bullet, a high-speed crash, or an explosion. TBI can be open (penetrating) or closed (non-penetrating) [1]. Given its role in high childhood mortality and long-term impairments, childhood injury requires rapid treatment. Injury accounts for 5.4% (265,000–348,000) of all childhood deaths each year [2]. TBI is expected to affect 69 million people worldwide every year. TBI burdens are three times higher in low- and middle-income countries (LMICS) than in high-income nations. Head injuries caused by vehicles were found to be prevalent in LMICS. TBI is expected to become the third greatest cause of death and injury in the world by 2020 [3,4]. An early tear, shear, or bleeding occurs in primary brain damage. Following a primary injury, secondary injuries frequently include a cascade of biological processes that might be targeted for intervention. These changes in the brain include cellular, chemical, tissue, and blood vessel changes, all of which lead to further brain tissue destruction [5,6]. The Glasgow coma scale (GCS) is used to grade the severity of TBI, which is divided into mild (13–15), moderate (9–12), and severe (8) categories. The GCS can also help with determining the outcome of TBI cases. TBI mortality rates in Western settings ranged from 8% to 21.2 percent in underdeveloped regions [7,8]. Madaan et al., in a study on the spectrum and

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outcomes of TBI in children, reported mild injury in 64%, moderate in 11%, and severe injury in 25% of patients. While they reported in-hospital mortality in 9.0% of patients [9]. While Bedry & Tadele reported mild TBI in 72.9%, moderate in 19.2% and severe in 7.9% of patients. While they reported mortality in 3.2% of patients [10]. The goal of our research is to determine the pattern and effects of TBI in pediatric patients. Because the pattern of TBI varies from region to region due to differences in lifestyle and playing habits of children. The results of this study will help us to decide which type of injury is more common in our population and how much the mortality rate is there in these patients.

METHODS

A descriptive cross-sectional study was conducted in the Department of Emergency at Holy Family Hospital Rawalpindi from June 2021 to Feb 2022. The sample size for this study was calculated to be 141 patients using the Raosoft sample size calculator with a margin of error of 5%, a confidence interval of 90%, and having incidence to be 163 [11]. The method utilized was a non-probability, consecutive sampling strategy. All children having age 1 to 14 years presenting with TBI, with no previous history of neurological deficit whose CT scan was done immediately after the presentation were included in our study. Children with a history of neurological deficits & whose parents did not give consent were excluded from our study. A total number of 141 children presented in the accident and emergency department of Holy family Hospital Rawalpindi, fulfilling the inclusion criteria of the study. After describing the study's goals to each child's guardian, they signed a consent form. Data regarding child age, gender, and mechanism of injury were collected for each patient. The GCS score was calculated for each child to determine the pattern of TBI. All children were followed till their stay in the hospital to determine the in-hospital mortality and any neurological deficit to assess the outcomes. All the study relevant information was noted on a pre-designed Proforma. Data analysis was carried out using SPSS Version 24. The demographic variables' mean and standard deviation were determined. Gender, injury source, injury pattern, and other parts of the questionnaire were presented using frequency and percentage. Stratification was used to regulate effect modifiers such as age, gender, and injury source. The correlation of these effect modifiers with a pattern of injury and in-hospital mortality was determined using a post-stratification chi-square test. P-value <0.05 was considered a significant effect.

METHODS

There were 86 male patients (61%), whereas females made up a smaller percentage of the population (39%). The average age was 8.773 years in this study. The majority of patients in Table 1 were between the ages of 5 and 10 years, as shown in Table 1.

Gender	Frequency	Percent
Male	86	61
Female	55	39
Age		
Less than 5 years	29	20.6
5-10 years	63	44.7
10-14 years	49	34.8

Table 1: Patient Demographics

Male patients were more likely to be involved in a road traffic accident than female patients, with 35 male patients and four female patients involved. A fall from a height was reported by 51 female patients. Male patients were more likely than females to report a sports injury, with 17 reporting it and 34 reporting it, as shown in Table 2.

Variables		Gender		Total	P Value
		Male	Female		
Mechanism of Injury	Road traffic accident	35	4	39	0.00
	Fall from height	0	51	51	
	Sports injury	17	17	17	
	Baby assault	34	34	34	
Total		86	141	141	

Table 2: Association between Mechanisms of Injury & Gender

There were 17 partially improved male patients and 46 patients who went into a vegetative state, but there were also 23 people who died. There was a significant improvement in the outcomes of 31 female patients, while the p-value for 24 patients who had a partial improvement was 0.00. Patients under 5 years old had an improved outcome, while those between 5 and 10 years old had an improved state, 41 partially improved, and 20 were in a severe/vegetative state, respectively. In the age group 10-14 years, 26 patients were in a severe/vegetative state, compared to 23 who had died, as shown in Table 3.

Variables		Outcome				Total	P-Value
		Improved(Normal State)	partially improved	Severe	Death		
Gender	Male	0	17	46	23	86	0.00
	Female	31	24	0	0	55	
Age							
Less than 5 years		29				29	0.00
5-10 years		2	41	20		63	
10-14 years				26	23	49	

Table 3: Association of Gender & Age with Outcome

Thirty-one out of the improved patients did not report having hypotension on admission, whereas twenty of those with hypotension on admission improved. A significant p value was found in 46 hypotensive patients, 23 of whom died. On admission, only two hypoglycemic patients improved, while 41 partially recovered and 46 had a severe/vegetative outcome, and 23 died, as shown in Table 4.

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Variables		Outcome				Total	P value
		Improved(Normal State)	Partially improved	SevereV/egetative	Death		
Hypotension on Admission	Yes	0	20	46	23	89	0.00
	No	31	21	0	0	52	
Hyperglycemia Yes on admission.		2	41	46	23	112	0.00
No		29	0	0	0	29	

Table 4: Patients presenting with hypotension and hyperglycemia and its association with outcome

More than a third of the patients who came to the hospital within the last three days stayed for less than 24 hours. In contrast, 17 patients remained in the hospital for one to three days. 10 patients had to stay at the hospital for less than 24 hours, whereas 11 patients had to stay for a month because they had been injured for more than three days. After three days of injury, 23 patients were admitted to the hospital for more than a month, as shown in Table 5.

Variables		Time of Arrival After Injury			Total	P Value
		less than 24 hours	1-3 days	more than 3 days		
Duration of Stay	less than 24 hours	0	32	0	32	0.00
	1-3 days	27	17	0	44	
	4-7 days	21	0	0	21	
	8 days-01 month	10	0	11	21	
	more than 01 month	0	0	23	23	
Total		58	49	34	141	

Table 5: Duration of Stay in association with the arrival of patients after injury

In comparison, only 31 of the 96 patients with depressed mentation were managed surgically and only 14 of the 14 patients with no neurological deficit were managed conservatively (p-value 0.036). On admission, 112 patients had hyperglycemia, 14 had no deficit, and 98 had depressed mentation. There was a p-value of 0.045 for depressed mentation in 29 patients who did not report high blood glucose levels on admission, as shown in Table 6.

Variables		Management		Total	P Value
		Surgical	Conservative		
Neurological Outcome at Discharge	No Deficit	14	0	14	0.036
	Depressed Mentation	96	31	127	
Neurological Outcome at Discharge					
		No Deficit	Depressed Mentation	Total	P Value
Hyperglycemia on Admission Yes		14	98	112	0.045
No		0	29	29	

Table 6: Association of Neurological Outcome with Management in comparison to Hyperglycemia association with Neurological Outcome

DISCUSSION

Trauma or any incident can take place at any place and time without discriminating between genders and age groups. Meanwhile, in this, we focused primarily on TBI and its outcomes in children. To begin with, it was found that the males suffered greatly from roadside accidents, sports injuries, and baby assaults while females fall from height commonly (p=0.00), Dewan et al., also reported greater male victims of TBI [12]. In accordance with this, only male children suffered from mortality and a severe vegetative state. Another critical finding was that none of the cases of mortality and severe vegetative state was seen among children less than 5 years. In addition, presenting symptoms at the time of admission were found to be correlated with the outcomes. For example, the patients presenting with hypotension and hyperglycemia faced fatal consequences (p=0.00). Moreover, children who are unconscious and having convulsions were significantly subjected to hospital mortality. While individuals with raised ICP depicted a linear trend and reported no deaths [19]. Furthermore, the time of arrival after injury contributed enormously to the outcomes. As patients coming after 3 days of the traumatic insult underwent surgical management, also such patients were hospitalized for almost a month on average. All of These children had to depart from this world (p=0.00). Gupta et al., concluded similar discovery and highlighted the association of delay with mortality in TBIs [13]. Finally, the victims were examined for any underlying neurological deficits at the time of discharge, depressed mentation was seen in both groups either managed surgically or conservatively (p=0.036), and neurological deficits were a common finding of children sustained a TBI, a review conducted by Christianne durish supported the results [14]. Besides, a hyperglycemic state was associated with depressed mentation (p=0.045). On the other hand, a specific topic is tentative to a variety of approaches, as Karibe et al., discussed outcomes of TBIs in elderly population and presented the poor outcomes in the older individuals [15]. Dewan et al., offered epidemiological aspects of the TBIs and suggested that children whether in developing or developed countries were equally prone to traumatic insult to the brain [12]. To attain and achieve a precise conclusion a vast number of factors are needed to be assessed simultaneously. Pediatric TBI is more common in boys than girls, according to a study from the General Hospital in Douala, Cameroon. The study also found that the condition most commonly affects young children and pre-adolescents. Motorcycles were the most common means of transportation involved in road traffic accidents, while falls were the second most common mode of injury [16]. A review from the University of California states after a single or repeated brain damage in younger people, phosphorylated tau and beta-amyloid need to be monitored. When an athlete's career is just getting started, it's critical that they learn about the long-term effects of repeated TBIs and how they can aid those who have been affected [17]. Many of the injuries happened in private households, were caused by falls, resulting in fractures and

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got little or no pre-hospital care, according to a study conducted at Aga Khan University Hospital in Nairobi. Children with burns, brain injuries, or multiple trauma also had a high fatality rate [18]. A study concluded that children have a particular pathological response to TBI, with distinct neurological symptoms, and much research has been done to understand their pathophysiology. Furthermore, recent technological advancements in pediatric TBI diagnostic imaging have aided in precise diagnosis, suitable treatment, preventing complications, and predicting long-term results [20].

CONCLUSION

TBI in pediatric patients was affected by gender, age, time of arrival after injury, and presenting conditions in our study. Too many people suffer from a neuropsychological impairment, depression, and post-traumatic stress disorder. More needs to be done in the area of public health to encourage safe driving habits, such as wearing a helmet. The hospital and perhaps the country would benefit from a trauma registry system. This will allow for further investigation.

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