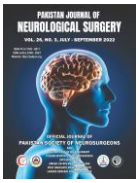

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Original Article

Pattern and Outcome of TBI in Children: An Observational Study at the Children Hospital Lahore

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ABSTRACT

Objective: TBI is one of the leading causes of mortality. To prevent these deaths and injuries epidemiological evidence is required in individual areas. The study aims to understand the common causes of TBI in children in a localized area of Pakistan.

Material and Methods: This is a descriptive study that enrolled 720 children with head injuries aged 0 to 14 years from September 2021 to June 2022 at UCHS/CHL. Demographic variables like age and gender were noted. Moreover, presenting features of the wound/injury, the cause behind the injury, the severity of the wound, as well as operative procedures that were undertaken, were all recorded.

Results: Mean age of the children was 5 years. Most of them were boys (69.25%). Many of the head injuries were caused due to falls (78.94%) followed by RTA (20.7%). 62.32% of the patients arrived via ambulance. The mortality rate among severe head injury was 65.09%, moderate head injury was 26.31% and mild head injury was 8.52%. It was observed favorable outcomes were noted in patients who presented to the hospital within four hours of injury. (The p-value is .0026).

Conclusion: Head injuries among children in Pakistan are primarily due to falls and road accidents. There is a need for betterment in the architecture of housing and road traffic management to prevent TBI-related mortalities. Awareness and logistics need to be provided for the quick transfer of patients with trauma to neurosurgical emergencies.

Key Words: GCS, Fall, Head injury, RTA, GOS, Mortality, Cerebral edema.

Abbreviations: LMIC; Low and Middle-Income Countries, TBI; Traumatic Brain Injury, GCS; Glasgow Coma Scale, UCHS; University of Child Health Sciences, CHL; The Children's Hospital Lahore.

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INTRODUCTION

TBI, sometimes known as the "hidden pandemic," affects the lives of 69 million people annually throughout the world. In third-world countries, the incidence of TBI is three times greater than in wealthy nations. [1] It was demonstrated that brain injuries resulting from automobile accidents were rather prevalent in LMICS. The World Health Organization (WHO) predicts that TBI will be the third greatest cause of death and disability worldwide in 2020.[2] Due to their great hyperactivity and lack of threat awareness; it should not be a surprise that children are more susceptible to brain injury. In addition, their skulls are proportionally bigger than the rest of their bodies, making them more susceptible to harm than adult heads. Traumatic brain injury (TBI), an illness that may afflict children all over the world, poses a significant threat to global public health. Globally, the reported incidence of pediatric traumatic brain injury (TBI) varies considerably, with the majority of countries reporting a range of 47 to 280 cases per 100,000 children.[3] Traumatic brain injury (TBI), which accounts for 5% of all pediatric hospital admissions and is the most prevalent cause of acquired impairment in childhood, causes around 280 per 100000 children in the United Kingdom to be confronted with traumatic brain injury, and many of these are diagnosed each year with a serious new neurological or cognitive handicap.[4] Even in the absence of physical abnormalities, the repercussions can have a wide range of effects, with behavioral and academic problems commonly being among them. The incidence rate in the United States of America is 180 occurrences per 100,000 people.[5] They are more likely to sustain catastrophic brain injuries (TBI). More than half of all adolescent deaths are still attributable to traumatic experiences in prosperous nations. This rate is 18 times more prevalent than the prevalence of brain tumors. This study will examine the epidemiology causes, prognosis, and effects of traumatic brain injury in children at UCHS/CHL. These two establishments are in Pakistan. Traumatic brain injury refers to damage to the brain, skull, or scalp caused by a force that is either blunt or penetrating (TBI). Mild traumatic brain injury may result from extra or intracranial hematomas, skull fractures, concussions, or any combination of these (mild TBI). The degree of a traumatic brain injury can range from minor to severe based on variables such as the Glasgow coma scale and the findings of radiological examinations.

If GCS is 14 – 15 it is mild TBI if, between 9 – 13, it is a moderate head injury, and if GCS is ≤ 8 it is severe head injury. Due to the increase in urbanization road traffic accidents are on the rise and due to a lack of precautions at home TBI is a medical and educational challenge all over the world.[6] In this study, we will analyze epidemiological factors, management, and outcomes in children after traumatic brain injury at the University of Child Health Sciences (UCHS), Children Hospital Lahore (CHL).

MATERIALS AND METHODS

Study Setting

The study was conducted at the University of Child Health Sciences/Children Hospital Lahore, which is the largest children's hospital in the province of Punjab and caters to the population from surrounding areas. The emergency departments provide 24-hour emergency services. Neurosurgical interventions are provided by pediatric neurosurgeons and radiological imaging done by the department of radiology is read by radiologists. Our hospital has a dedicated pediatric neurosurgery ward with an additional dedicated 8-bed neurosurgical ICU.

Study Design and Duration

It was a cross-sectional study carried out among TBI (traumatic brain injury) patients of the pediatric age group for 3 months, including a 6-

month follow-up. Children satisfying the inclusion criteria were included in the study. A nonprobability consecutive sampling technique was used for the sample size.

Inclusion Criteria

Patients under the age of 16 years having TBI were included in the study, even though they were managed surgically or conservatively.

Exclusion Criteria

Patients with TBI having a poly-trauma-like abdominal injury or skeletal fractures or any medical illness like bleeding disorders were excluded from this study.

Study Variables

The following variables included: age, gender, mode, and mechanism of trauma, GCS score upon admission, mode of arrival and pre-hospitalization delay, and altered level of consciousness. Data on symptoms collected for example, seizures, vomiting, bleeding from the ear, nose, or throat, CT scan findings, any surgical intervention, family's social status, and GOS. SPSS version 26.0 was used for the analysis of the data.

Classification of TBI

Detailed classification is as follows: mild TBI is post-traumatic amnesia of ≤ 30 min or LOC (loss of consciousness) without fracture of the skull, moderate TBI is post-traumatic amnesia or LOC lasting 30 min to 24 hours along with a fracture of the skull (and not meeting criteria for severe TBI), severe TBI is more than 24 hours of post-traumatic amnesia or LOC or brain contusion, intracerebral hematoma.

Data Collection and Procedure

After IRB approval, all patients who came to the Pediatric Neurosurgical Emergency Department were evaluated. Patients who satisfied the study's inclusion criteria were enrolled after receiving their informed consent in writing. After being hospitalized via, the emergency room, each patient got a comprehensive physical examination, and their medical histories were properly documented. In addition, the size and responsiveness of the patient's pupils as well as their degree of consciousness (as measured by the Glasgow Coma Scale-GCS) were evaluated. To identify any potential neurological impairment, a regular neurological evaluation was conducted. The imaging technique that proved most useful was computed tomography (CT) scanning. To visualize the patient's bone state, a standard CT scan of the patient's brain with bone window slices was prescribed.

The provision of primary care involves the administration of intravenous fluids, the administration of analgesics, and the prescription of antibiotics. The routine examinations included biochemical tests including hemoglobin levels, full blood count, serum electrolytes, liver function tests, renal function tests, blood sugar levels, blood grouping, and cross-matching. As required a cervical spine X-ray and a chest PA view were all conducted. Additionally, chest and abdominal ultrasonography were conducted as necessary. Children with serious head injuries were admitted to the intensive care unit, where they received necessary ventilation. In the event of an increase in intracranial pressure, mannitol was administered intravenously for 6 – 8 hours to reduce and minimize cerebral edema (ICP). Surgical procedures were only performed when indicated.

After leaving the hospital, patients were observed for at least six months to assess any outcomes or complications. According to the Glasgow outcome scale, the postoperative course of a patient was deemed successful if it was uneventful, and it was deemed unsuccessful if the patient experienced any residual focal neurological deficits, posttraumatic seizure

disorders, vegetative state, or died in the hospital while receiving treatment.

RESULTS

Gender Distribution

Males were disproportionately impacted in our research. Data showed that Among 722 subjects 500 (69.3%) were male and 222 (30.7%) were female from the age group we included in our study (Table 1).

Age Distribution

There were 179 (24.8%) patients below the age group of 4 years, 275 (38.1%) aged 4 – 8 years, and 268 (37.1%) aged 8 – 16 years (Table 1). The mean age of patients presenting with TBI was 5.09 years.

Sociodemographic Characteristics

Our study was conducted from September 2021 to June 2022 and during that period there were a total of 2250 patients that landed in the emergency room due to TBI which makes it around 25 patients per day. Of these 25 on average 17 were discharged and 8 were admitted to the ward making up 722 admissions during the study period. 46 patients expired as well. Most of the patients belonged to the poor socioeconomic class i.e., 62.3%, while 37.7% were from the middle class (Table 1).

Pattern and Mechanism of TBI

The main culprit for TBI was falling which accounted for 568 (78.7%) cases followed by 150 (20.8%) cases of RTA (road traffic accidents) and 2 (0.6%) cases of injury due to stray bullets. Regarding the time of presentation 122 (16.9%) patients presented within 1 hour of injury while 530 (73.4%) presented within 24 hours and 70 (9.7%) after 24 hours. Among them, 450 (62.3%) patients came to the hospital via ambulance, 218 (30.9%) on personal transport, and 54 (7.4%) on public transport.

Vomiting i.e. 602 (83.4%) was the major symptom at presentation, while 482 (66.8%) had an altered state of consciousness at the time of arrival. Further, 120 (16.6%) and 68 (9.4%) patients had ENT bleed and seizures respectively. Regarding TBI, 470 (65.1%) patients had a mild injury, 190 (26.3%) had a moderate injury and 62 (8.6%) presented with severe injury.

Table 1: Social and demographic data of pediatric TBI.

Variable	Category	Number (n)	Percentage %
Age (Years)	< 4 Years	179	24.8
	4 – 8 – Years	275	38.1
	8 – 16 Years	268	37.1
Gender	Male	500	69.3
	Female	222	30.7
Social Status	Poor	450	62.3
	Middle Class	272	37.7

CT Scan was done on arrival which reported linear skull fracture in 160 (22.2%) patients while 22 (3.0%) depressed skull fractures. 116 (16.1 patients had brain edema. The intracranial hematoma was documented in 130 patients: with Extra Dural hematoma in 68 (9.4%) cases, Sub-arachnoid Hemorrhage in 40 (5.5%) cases, Sub Dural Hemorrhage in 16 (2.2%) and Intraventricular Hemorrhage consisting of 6 (0.83%) cases. Additional CT findings are given as; Contusion 64 (8.8%), Pneumocephalus 6 (0.8%), Infarction 6 (0.8%), and Hydrocephalus 2 (0.3%).

Management and Outcome

Most of the patients i.e., 652 (90.3%) were managed conservatively. Only 70 (9.7%) underwent surgical intervention which included elevation of depressed fractures in 17 patients, craniotomy for EDH (epidural hematoma)

evacuation in 40 patients, craniotomy for SDH (subdural hematoma) evacuation in 6 patients, craniectomy and evacuation of PFEDH (posterior fossa epidural hematoma) in 5 patients, and wound debridement in 2. Antiepileptics were advised in 178 (24.7%) patients during admission and 37 (5.1%) on follow-up later. It is to be noted that a total of 122 patients presented within four hours of injury and out of them 118 had favorable outcomes on discharge.

Table 2: Pattern and mechanism of TBI.

Characteristics of TBI	Subclassification	N (%)
Mechanism of injury	Falls	568 (78.7)
	RTA	150 (20.8)
	Stray Bullets	4 (0.6)
Time of Arrival	< 1 Hour	122 (16.9)
	1 – 24 Hours	530 (73.4)
	> 24 Hours	70 (9.7)
Place of occurrence	Home	300 (41.6)
	Outdoor	272 (37.7)
	Pedestrian	30 (4.2)
	Occupant of vehicle	120 (16.6)
Mode of Arrival	Ambulance	450 (62.3)
	Personal	218 (30.2)
	Public	54 (7.5)
Symptoms	Altered State of Consciousness	482 (66.8)
	Vomiting	602 (83.4)
	Seizures	68 (9.4)
	ENT Bleed	120 (16.6)
Severity of TBI	Mild	470 (65.1)
	Moderate	190 (26.3)
	Severe	62 (8.6)
Head CT scan	Subarachnoid Hemorrhage	40 (5.5)
	Cerebral Edema	116 (16.1)
	Skull Fracture (Linear)	160 (22.2)
	Skull Fracture (Depressed)	22 (3.0)
	Extra Dural Hemorrhage	68 (9.4)
	Sub Dural Hemorrhage	16 (2.2)
	Contusion	64 (8.8)
	Pneumocephalus	6 (0.8)
	Intra ventricular Hemorrhage	6 (0.8)
	Hydrocephalus	2 (0.3)
	Infarction	6 (0.8)

DISCUSSION

In our study, boys, and children with a mean age of 5.09 years were predominantly affected by TBI. Concerning the cause of injury, falls are most common, followed by RTA which is in line with data available from developing countries.[7-11] Traumatic brain injury is also related to gender as it is more prevalent in male children as compared to female children.[3] In our study, 69.3% of the children were boys, thus in line with these previous observations. Another important consideration is motorbike accidents, and the use of motorcycles is prevalent in developing countries, especially Asian countries.[3] Teenage driving bikes and met accidents in Low-income countries need strict laws and their implementation to reduce these cases. However, according to our results, falling from a roof was the primary reason for children coming in with head injuries followed by road traffic accidents. Fall from bed unprotected because neonates or infants are handled by teenagers and they fall from the lap of kids, therefore we should not let them handle neonates.

An important pattern is that fall injuries are common in reports from developing countries as well as in our study. This highlights the need for improved architecture of houses, public spaces, and roads in these countries and should be dealt with as a public health problem.[12-14]

Though most of the patients reached the hospital within 24 hours of injury and had a mild TBI there was a mean delay of 2.64 hours noted. An interesting observation noted in our study was that only 62.3% of the patients arrived at the emergency room via ambulance while 30.2% and 7.8% via personal and public transport respectively. This can be attributed to delayed ambulance response and meager emergency services availability, especially in poorly developed areas of Pakistan.[15] Moreover, some spine injuries our during the shifting of the

patient as there is a lack of Basic life support training in the general public in our society.

Our study focuses on the fact that patients presenting within an hour of injury had favorable outcomes. Hypotension, hypoxia, and hypothermia are the major killer in the first few hours, especially in the pediatric population. Therefore, they need to be managed as quickly as possible in the first golden hour to improve survival benefits. Research in Canada with 149 patients having acute traumatic subdural hemorrhage found that there was improved survival in patients transported within 1 hour of trauma.[9] Results were consistent with similar studies. It stresses potential implications for the prehospital delay. Et al Michael M. Dinh also quoted similarly findings in its study.

Table 3: Management and outcome of TBI in children.

Head Injury Characteristics	Subclassification	N = 722 (%)
Management Type	Surgical	70 (9.7)
	Conservative	652 (90.3)
Surgical Procedure	Craniectomy and evacuation of PFEDH	5 (0.7)
	Elevation of Depressed Fracture	17 (2.4)
	Craniotomy for EDH	40 (5.5)
	Craniotomy for SDH	6 (0.8)
	Wound Debridement	2 (0.1)
GOS on discharge	Death	46 (6.4)
	Coma	0 (0)
	Severe Disability	14 (1.9)
	Moderate Disability	20 (2.8)
	Routine Life	642 (88.2)
GOS at 3 Months	Death	2 (0.3)
	Coma	0 (0)
	Severe Disability	11(1.5)
	Moderate Disability	15 (2.1)
	Routine Life	648 (89.8)
GOS at 6 Months	Death	0 (0)
	Coma	0 (0)
	Severe Disability	8 (1.1)
	Moderate Disability	8 (1.1)
	Routine Life	658 (91.1)
Antiepileptic Medication	During Admission	178 (24.7)
	On Follow up	37 (5.1)

Table 4: Percentage of patients suffering different fall injuries

	Number of Patients (568)	Percentage %
Stairs	90	17.3
Roof	380	68.7
Table	28	4.9
Chair/Bed	40	7.0
Tree	20	3.5
Fall on ground	10	1.8

In addition to altered states of consciousness, seizures, bleeding from the auditory canal, and vomiting, patients exhibited other signs of elevated intracranial pressure. Other studies[8,12] have discovered evidence of comparable reports. Children's head traumas are a leading cause of mortality and disability.[16] As with other forms of trauma, the primary focus of our efforts should be on preventing these injuries by adopting the appropriate precautions. Male children were more likely to have head traumas than female youngsters.[3] Given that men tend to be more extroverted than women and, as a result, are more likely to engage in physical altercations and automobile collisions, it is apparent why this is the case. This is supported by research conducted by Bhargava et al and Agrawal et al.[17-18] According to this survey, falling was the action that resulted in head injuries the most frequently. According to research by Styrke et al, Agrawal A. et al, Bhargava et al, and Sirajet et al, falls were the leading cause of head injuries.[17-20] In most cases, head injuries caused by falls may be avoided. Always ensure that our windows are locked and that our children are safe on rooftops and other elevated locations. All of these preventive steps should be conveyed to parents,

who should also be held to stricter legal requirements. Through school health initiatives, children should be taught about safety precautions to take at home, when playing sports, and while driving on the highways. If we emphasize the importance of educating mothers and older siblings about possible risks in the house for young children, we can considerably minimize the number of child brain injuries. Moreover, there are financial implications for such injuries both for the patients and the public sector hospital. This results in straining the already burdened economy of the developing countries, in addition to that it adds an emotional burden to the family as well.

CONCLUSION AND RECOMMENDATIONS

The vast majority of head injuries in Pakistan were caused by falls. Even while moderate head injuries were the most prevalent and many patients recovered successfully, there is a substantial mortality risk associated with severe head injuries. Therefore, the government should enact kid safety rules that may be applied in homes, playgrounds, and along highways. Modes of transportation should be made efficient to transfer the patient with a head injury to the trauma center within the four-hour golden period.

Declaration of Conflicting Interests

In their declaration, the authors of this study affirm that there were no actual or prospective conflicts of interest during the research, writing, or publishing of this work.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
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Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Jamal Nasir	Study design, and methodology.
2.	Jamal Nasir & Ali Asad	Paper writing.
3.	Saba Benish	Data collection and calculations
4.	Faiq Sheikh & Jamal Nasir	Analysis of data and interpretation of results.
5.	Laeeq-ur-rehman & Lubna Ejaz	Literature review and referencing.