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TRAUMATIC BRAIN INJURY IN CHILDREN: A COMPREHENSIVE STUDY OF EPIDEMIOLOGY, TREATMENT, AND OUTCOMES IN GUNTUR, ANDHRA PRADESH

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Abstract

Background: However, the precise occurrence of traumatic brain injury (TBI) in India is unknown, even though it is widely recognized as the leading cause of illness and death in infants and children. Furthermore, the types of injury, damage mechanisms, and management differ significantly compared to those in adults. Aim and objective: The purpose of this study was to investigate the occurrence, distribution, management, and outlook of traumatic brain injury (TBI) in children, as well as the different symptoms exhibited by children with TBI at a specialized hospital in Guntur, Andhra Pradesh. Materials and Methods: Between August 2022 and March 2023, our health facility conducted a cross-sectional study on all children under the age of 16 who presented to the neurosurgical emergency department with TBI. We reviewed the case records and collected data on clinical history, age, sex, injury mechanism, CT scan, management, morbidity, and mortality. The outcome of a traumatic brain injury (TBI) was defined by the findings of residual neurological abnormalities at the time of discharge. Results: Hospitalized were 54 cases of juvenile traumatic brain injury (TBI), with 36 males (67%) and 18 females (33%). The average age of the patients was 5.5 years. We classified the majority of cases as mild (65%), with a smaller proportion as intermediate (15%) and severe (20%). The primary cause of injuries was road traffic accidents, accounting for 43.8% of cases, followed by falls at 27.2% and slips at home at 26.4%. The symptoms seen were as follows: loss of consciousness (50%), vomiting (78%), and headaches (18.5%). The CT scans revealed a range of injuries, with 59.2% of cases exhibiting skull fractures. The treatments administered exhibited a range of proportions: 41% of cases necessitated mere monitoring, 31.4% necessitated medical intervention, 5.5% required surgical procedures, and 22.1% necessitated the use of mechanical ventilation. The mortality rate stood at 5.26%. Out of the individuals that survived, 50% did not have any lasting impairments. The remaining survivors reported symptoms such as headaches, weakness on one side of the body, partial weakness, seizures, and other medical issues. We found a strong correlation between residual impairments and the severity of the injury ($p = 0.067$), but found no significant correlation between the mechanism of damage and the outcome ($p = 0.96$). The mean duration of hospitalization was 5 days, with 65% of patients staying for less than 4 days. Conclusion: Parents and caretakers can prevent most of these injuries during infancy and childhood by ensuring proper vigilance and tender care. Parents must adhere to safe driving techniques when traveling with their children in their motor vehicles. We need to focus on grading the severity of TBI rather than on factors like age, mode of injury, and the presence or absence of external injuries.

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Introduction

The medical and educational professions are becoming increasingly concerned about the high occurrence of traumatic brain injuries (TBIs) in children and teenagers as the globe continues to grow more urbanized and mechanized. When injuries received by adults and children are compared, it is evident that there are major differences in the type of many illnesses, the severity of those illnesses, and the therapy that is administered for them.

Traumatic brain injury (also known as TBI) is one of the top causes of death and disability as well as handicap among children all over the world. The most recent Global Burden of Disease report indicates that India accounts for about 25% of all trauma-related fatalities worldwide [1, 2]. An estimated 20–30% of all cases of brain injuries occur in children younger than 15 years old, who make up over 35% of India's population [3, 4]. The leading and most common cause of death in children and infants is head trauma [5]. Additionally, adults and children respond differently to different types of accidents and damage, and approach different problems in different ways [6, 7].

Background Pedestrians are the most vulnerable road user category, and a substantial proportion of hospital emergency department road traffic accidents (RTAs) presentations. The reported mortality is between 10% and as high as 60% [8, 9, 10, 11]. Injuries TBI data is limited almost to the level of individuals, but in India as well as in national high-income countries [12].

This is the key goal of management: to block the progression on either side or both and prevent further brain injury. In order to evaluate the epidemiological determinants, management, and outcomes of traumatic brain injury cases in children at a tertiary care center in Guntur, Andhra Pradesh, the goal of this study is to investigate these aspects.

Aim and Objective

In this study, the purpose and goals are: to study the clinical spectrum of pediatric traumatic brain injury cases received at a tertiary-care hospital; to evaluate etiology and severity for TBI (traumatic brain injury clinical pages), To evaluate the CTscans (brain) that are characteristic for TBI, To evaluate associated injuries, To evaluate the need for artificial ventilation and need for surgical intervention; To evaluate the spectrum of residual neurological deficits at the time of discharge in children with TBI.

Materials and Methods

This observational study lasted from August 2015 to July 2017. It was conducted at a tertiary care hospital, and all children with TBI less than 16 years of age coming to the emergency department were included. We got copies of all their records, and then, after the informed consent from their guardians or parents had been obtained, we reviewed them. We could hence obtain such information as clinical history, age, sex, initiating cause (mode of injury), neurological state as judged by the Glasgow Coma Scale (GCS), computed tomography scan findings or other diagnostic tests where necessary, follow-on operations such as surgery or decompression, as well as the morbidity number for those patients who were discharged alive.

The Glasgow Coma Scale (GCS) score at the time of admission determined the classification of traumatic brain injury (TBI) into three categories: mild, moderate, and severe. All the cases were initially revived and assessed in the casualty department before being transferred to the pediatric Intensive Care Unit (ICU). Individualized treatment regarding the actual clinical state, neurological status, and neuroimaging findings of each patient was applied. The remaining neurological deficit (at discharge) in patients with traumatic brain injury (TBI) was assessed for outcome. The statistical analysis assessed the use of injury (open or penetrating), degree of neuronal damage (severity or mild), and time for discharge from the hospital. All patients were followed in the outpatient clinic of our department after release from the hospital for a period of 6 months.

Result

A total of 54 pediatric cases of TBI were admitted during the period of August 2022–July 2023, with 36 males (67%) and 18 females (33%) with a male-to-female ratio of 2:1. The mean age of incidence in our study is 5.5 years. Out of 54 children with TBI, 65% had mild, 15% had moderate, and 20% had severe TBI (Table – 1) (Figure – 1).

Table 1: Distribution of traumatic brain injury (TBI) cases in the study group, categorized by severity.

Severity	No. Of Cases	Percentage (%)
Mild	35	65
Moderate	8	15
Severity	11	20
Total	54	100

Overall, RTA (43.8%) is the most common mode of injury, followed by fall from height (27.2%) and slippage in and around home (26.4%) (Table-2) (Figure – 2).

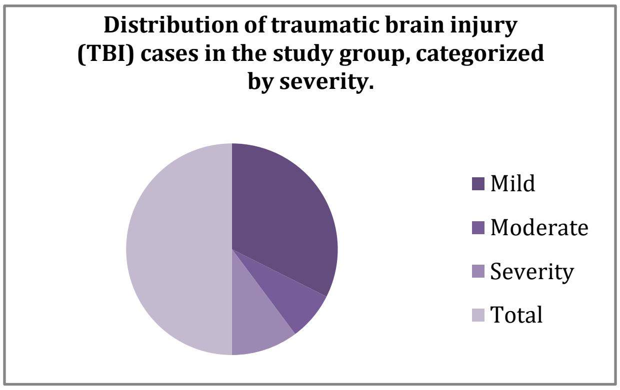

Figure 1: Distribution of traumatic brain injury (TBI) cases in the study group, categorized by severity.

Table 2: The study examined the distribution of cases of traumatic brain injury (TBI) based on the mode of injury.

Mode of injury	No. of Cases	Percentage(n = 54)
RTA	24	43.8
Fall from height	15	27.2
Injury at home	14	26.4
Assault	1	2.6
Total	54	100

Clinical evaluation revealed loss of consciousness (LOC) in 27 (50%) patients, vomiting in 42 (78%) patients, headache in 10 (18.5%) patients, ENT bleeding in 14 (26%), and seizure in 19 (35.1%) patients; no external injuries in 30 (55.5%) patients; normal sensorium was found in 32 (59.2%) patients; 15 (28%) children were drowsy at presentation; and 14 (26%) children were unconscious. (Table -3) (Figure – 3) and (Figure – 4).

CT scan findings revealed no gross abnormality in (22.2%), extradural haemorrhage (EDH) (18.4%), subdural haemorrhage (SDH) (14.4%), subarachnoid haemorrhage (21%), fractured skull (59.2%), cerebral oedema, and contusion (46.2%) as the radiological injury patterns (Table – 4).

Out of 54 children, 22 (41%) are managed with only observation, 17 (31.4%) require only medical pharmacological treatment, 3 (5.5%) require surgical intervention, and 12

(22.1%) children require mechanical ventilation. Overall mortality is 5.26%. Thus, among the survivors (n = 50), 25 (50%) went home with no residual deficit, 5 (10%) had headaches, 5 (10%) had hemiparesis, 4 (8%) had monoparesis, 1 (2%) had hypertonia, 4 (8%) had seizures, 1 (2%) had hydrocephalus, 2 (4%) had facial palsy, 1 (2%) had vision impairment, and 2 (4%) had speech impairment (Table – 5) (Figure – 5).

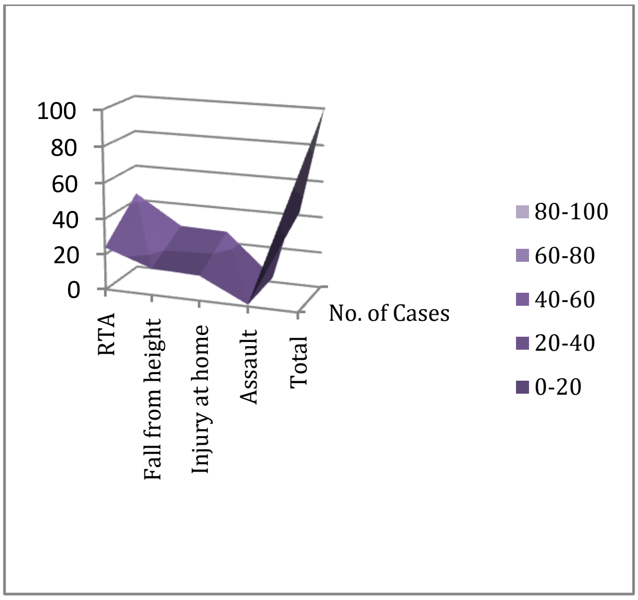

Figure 2: The study examined the distribution of cases of traumatic brain injury (TBI) based on the mode of injury.

Table -3: Manifestations, indications, and related traumas observed in instances of Traumatic Brain Injury (TBI) within the research group upon admission to the hospital.

Symptoms	No. of cases	Percentage(n = 54)
Loss of consciousness(LOC)	27	78
Vomiting	42	50
Seizures	19	35.1
Headache	10	18.5
Other symptoms	15	28
Signs and external injuries		
No external visible on head	30	55.5
Only abrasion on scalp	18	33.3
Only contusion on head	20	37
CLW on scalp	10	18.5
Normal Sensorium	32	59.2
Drowsy	15	28
Unconsciousness	14	26
Facial Injury	10	18.5
Bleeding from ENT	14	26
Ophthalmology injury	1	2
Limb injury	10	18.5

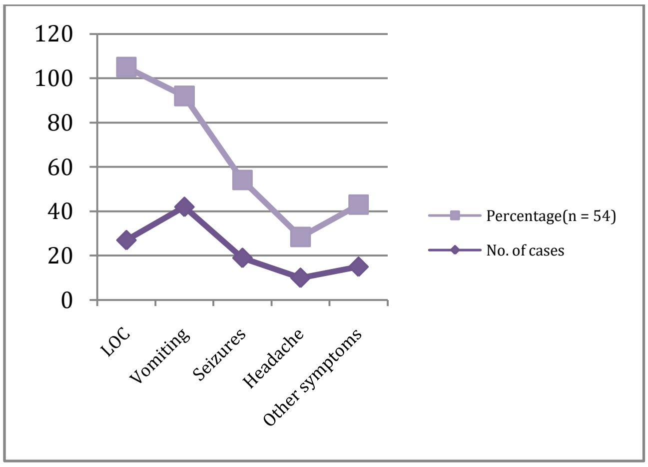

Figure 3: Symptoms in instances of Traumatic Brain Injury (TBI) within the research group upon admission to the hospital.

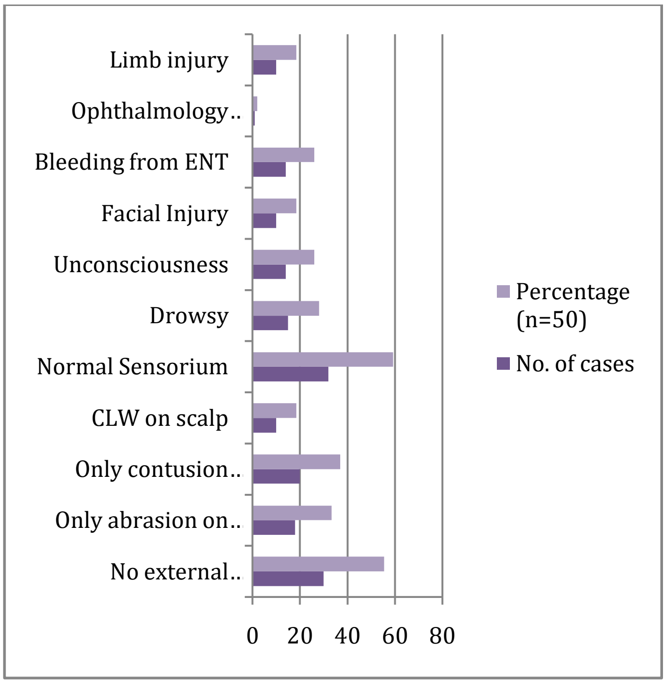

Figure 4: Signs and external injuries in instances of Traumatic Brain Injury (TBI) within the research group upon admission to the hospital.

Table 4: The study group's distribution of TBI cases according to CT scan brain findings

CT findings	No. of Cases	Percentage(n = 54)
No Abnormalities	12	22.2
Cerebral oedema and contusion	25	46.2
Intra cranial bleed	27	50
Fracture skull	32	59.2

**A few kids in the research group exhibited multiple kinds of abnormalities on their CT scans. Thus, the sum does not equal 100%.*

Table 5: Distribution of residual deficits/neurological abnormalities in relation to TBI cases among the study group's survivors (n = 50)*

Residual effect	No. of Cases	Percentage (n=50)
No residual deficit	25	50
Headache	5	10
Seizures	4	8
Hydrocephalus	1	2
Facial palsy	2	4
Hemiparesis	5	10
Vision impairment	1	2
Speech impairment	2	4
Monoparesis	4	8
Hypertonia	1	2

**4 of the 54 youngsters in the study passed away. Thus, the survivors' remaining impairments were evaluated.*

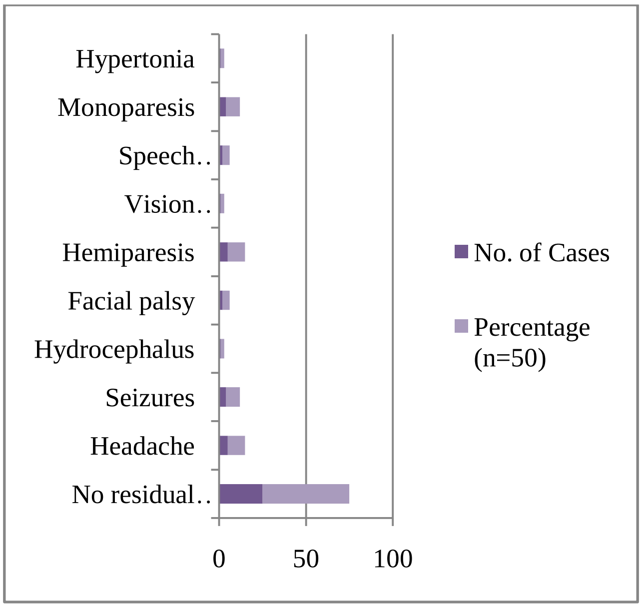

Figure 5: Distribution of residual deficits/neurological abnormalities in relation to TBI cases among the study group's survivors (n = 50)*

In our study, we found that there is a significant association between residual deficits and severity of injury (p = 0.067), but there is no significant association between mode of injury and outcome (p = 0.96). The mean duration of stay in the hospital was 5 days, but 65% of patients had stays of less than 4 days.

Discussion

Children's traumatic brain injuries (TBIs) are the primary cause of death [5]. Different types of injuries, what causes them, and how to treat certain diseases are very different in adults and children [10].

India's population is made up of about 35% of people between the ages of 1 and 15 [3]. According to studies, infants and young children die most often from head trauma [5]. While it comes to injuries, the way they are inflicted, and the way they are treated while they're sick, there are significant disparities between children and adults [9]. Traumatic brain injuries (TBI) are a big problem around the world. Every year, approximately 200 individuals out of every 100,000 experience a traumatic brain injury (TBI), leading to the death of 20 out of every 100,000 victims [13]. According to Gururaj G. et al. (2005), 150 out of every 100,000 people in India had a traumatic brain injury (TBI), 20 out of every 100,000 people had died, and 10% of those people had died [4]. Sambasivan's study on head injuries in kids found that boys and girls were equally likely to get them[23].Chiaretti et al. say that the fact that men have bigger heads and do more sports and physical activities than women may help explain why they are more likely to get traumatic brain injuries (TBIs) [14, 15]. Based on our data, there are more boys than girls. The higher incidence of traumatic brain injuries (TBIs) in males may be related to the theoretical concerns raised by Chiaretti et al., which we acknowledge in this work[15]

According to many research, children are most commonly injured in traumatic brain injuries (TBIs) caused by falls from great heights, followed by RTAs [1,8, 12,16,17].On the other hand, when looking at severe pediatric TBI across four years, Osmond et al. (18) found a higher frequency of road traffic accidents (RTA). Previous research has shown that road traffic accidents (RTAs) are the leading cause of traumatic brain injuries (TBIs) in children (10, 11). The current examination confirms these findings. The present research found that there may be a correlation between the increasing frequency of road traffic accidents among adolescents (those between the ages of 10 and 15), as well as their heightened interest in cycling and bike riding, as well as their vulnerability to physical assault. Multiple studies have shown that children who suffer from traumatic brain injuries (TBIs) as a result of road traffic accidents (RTAs) are really pedestrians [5, 8]. Assaults against children happen frequently. Our investigation revealed that 2.6% of injuries were caused by physical aggression. Consistent with previous studies, this one indicated that 65% of patients had mild traumatic brain injury (TBI), which is lower than the 65.3%,68.7% and 70% reported respective Kappmann N et al. [15], Satapathy Met al. [19], Gururaj G. et al. [4].

It's not necessarily a sign of something serious when kids puke up. While it's true that not all children experiencing vomiting as their initial symptom have brain damage, the likelihood increases when vomiting occurs after a head injury. The most prevalent symptom at presentation was vomiting, as compared to other trials that reported loss of consciousness [19, 22].

The most common findings on CT scans in this investigation were skull fractures, contusions, and cerebral edema. In contrast, Mahapatra et al. [1] confirmed PranshuBetal's conclusion by reporting contusion as the most common finding [12]. The most common finding in Satapathy M. et al.'s research was EDH [19]. The results of our analysis showed that 22.2% of cases had normal CT scans, which is higher than the 13.48% and 16.3% found in the studies by Mahapatra et al. [1] and Satapathy M et al. [19], respectively. While a study by Bahloul Metal [21] found that 25% of patients needed neurosurgical intervention, a study by Satapathy et al. [19] found that only 5.5% of individuals needed this procedure. For 60% of the children in this trial who needed surgery and had EDH and SDH in different locations, we considered decompressive craniotomy; for the remaining 40%, we emptied the blood clots using a burr hole.

The signs and symptoms, both immediate and delayed, can manifest in children who have experienced traumatic brain injuries. Diabetes insipidus, hemiparesis, seizures, cranial nerve palsy, difficulties with speech, and the syndrome of incorrect antidiuretic hormone secretion are among the early complications that can occur. Muscle contractures, memory loss, impairment, meningitis, hydrocephalus, and post-traumatic epilepsy are all possible late consequences. Fifty percent of patients continued to experience neurological issues following surgery, as shown in this study. Comparatively, this is greater than the 14% recorded by Ji-Yao Jiang et al. [20], the 15% by Bahloul M et al. [21], and the 9% by Satapathy M et al. [19].

In this study, the use of conservative therapy is much more prevalent than craniotomies due to the high number of cases involving moderate traumatic brain injury (GCS 13–15). Overall, 7.4% of patients died, and 92.6% of those patients had a full recovery; these numbers are in line with those of previous studies done in India [8, 12, 19].

The current investigation revealed a direct correlation between the Glasgow Coma Scale (GCS) at the time of presentation and the severity of brain injury. This severity is closely linked to both morbidity and death rates, and inversely associated to a favourable outcome. These findings are consistent with prior studies [8, 12, 19].

We were unable to comment on the long-term results regarding neurocognitive impairment following discharge because our study was limited to the hospital stay and the six-month follow-up period. However, none of the children experienced neurocognitive impairment at the time of discharge or during the six-month follow-up period. Those with speech and vision impairments showed improvement.

Our study only included the hospital stay and the six-month follow-up period, so we were unable to comment on the long-term results regarding neurocognitive impairment following discharge. However, none of the children experienced neurocognitive impairment at the time of discharge or during the six-month follow-up period. Those with speech and vision impairments showed improvement. The current study discovered that severe intracranial damage was discovered on CT scans in 26% of children who had no visible external injuries; therefore, the lack of external injuries does not rule out traumatic brain injury. Our series' overall mortality rate of 7.4% was comparable to other Indian studies, and we achieved satisfactory recovery in 92.6% of cases. According to previous reports, 8.85% of our patients experienced a seizure [8,9]. Severe head injuries have a death rate of 20–50%, Mortality and improved prognosis are inversely proportional to the degree of brain injury [1].Children with DAI had the greatest fatality rate because their injuries were so severe[8,9]. Factors contributing to mortality in our study include patients' low socioeconomic position, their tardiness to our center, and their lack of readiness for surgery.

Conclusion

The prognosis is usually good if a pediatric neuron trauma center receives a child's traumatic brain injury (TBI) early on and treats it separately to heal the initial lesion. This treatment aims to prevent the persistent biomechanical, physiological, and pathological sequel caused by TBI. A severe head injury can be used to predict a poor prognosis. Parents and caregivers can prevent the majority of these injuries in infancy and childhood by maintaining proper monitoring and delicate care. In adolescents, it is possible to avoid these injuries by participating in safe driving practices, wearing helmets, and receiving counselling for maladaptive behavioural patterns. It is possible to achieve a favourable outcome through timely evaluation to determine the presence of cerebral disease and early surgical surgery. Even within the young brain, there appear to be reactions that are dependent on age following traumatic brain injury in children.

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Conflict of Interest

Not required.

Informed Consent

All the information was gathered by the informed consent by the patients.

Ethical Statement

Not required.

Author Contribution

All authors contributed equally.

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