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Original Research Article

Current Trends in the Management of Paediatric Head Injuries and Their Outcome

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Abstract

Background: The leading cause of death and disability in children is Traumatic brain injury (TBI). Pediatric TBI is associated with several distinctive characteristics that differ from adults and are attributable to age-related anatomical and physiological differences, pattern of injuries based on the physical ability of the child, and difficulty in neurological evaluation in children.

Aim: To study the current trends in the management of paediatric head injuries and to study the outcome with the current management guidelines and followup status of the patients.

Materials and Methods: This study was a prospective observational study and all patients diagnosed with head injury in Department of Neurosurgery, Osmania General Hospital, Hyderabad**.** This study was conducted between November 2014 to February 2017. 205 patients were selected in this study.

Results: The commonest age group of paediatric head injuries is 11-14 years with the incidence rate of 39.5% i.e. 81 patients with the mean age group of 7 years. The male to female ratio is 4:3 with a male preponderance. The commonest mode of mechanism of injury is due road traffic accident with an incidence rate of 60% followed by fall. The commonest complaint the patients presented are the loss of consciousness for a period of more than 30 minutes to 24 hours with an incidence rate of 70% followed by altered sensorium with an incidence rate of 62%. Most of the patients admitted are with mild head injury with the incidence rate of 43.4%, followed by moderate and severe head injuries with the incidence rate of 37.5% and 19.02% respectively. The commonest type of injury is EDH with incidence rate of 26.8%.The patients with duration of stay less than 7 days are 180 i.e. 87.8% and the patients with duration of stay more than 7 days are 25 i.e. 12.19 %. Most of the patients admitted are managed conservatively i.e. 170 patients and only 35 patients are operated. The patients admitted in the study underwent various surgical procedures like craniotomy and evacuation of EDH, wound debridment and elevation of depressed fracture segment, endoscopic repair of fistula for traumatic csf rhinnorea, craniotomy and evacuation of SDH and decompressive craniotomy. The patients with good recovery had a incidence rate of 75.1% i.e. 154 patients and 189 cases of GOS >/=5 the patients expired are 11 with a mortality rate of 5.3%.

Conclusion: In the present study, a number of interesting recent reports in the field of clinical research in pediatric TBI were studied. We believe that the field is moving forward at an accelerated pace since the publication of the first guidelines document, and that valuable innovations in our understanding of the pathophysiology, diagnosis, and monitoring have been made, along with some progress in defining optimal therapy.

Introduction

Head injury is one of the most important public health problems today. The incidence of head injuries is steadily increasing all over the world and our country has the dubious distinction of having the highest incidence in the world of head injuries due to road traffic accidents per 1,000 vehicles or deaths per 1,000 accidents. The World Health Organization predicts that TBI and road traffic accidents will be the third greatest cause of disease and injury worldwide by 2020. TBI is a heterogeneous condition in terms of etiology, severity, and outcome. The care of head injured patients forms an important part of neurosurgical management in all countries. The modernization of industries as well as modes of transport have increased the incidence and the severity of injuries [1]. Out of all head injury encountered in clinical practice of neurosurgeons, pediatric traumatic brain injury (TBI) is one, which needs skilled and prompt management to overcome high morbidity and

mortality [2,3]. Due to increase in the number of motor vehicle, household articles, and concrete road and houses, the incidence of pediatric head injury is quite significant among all head injury. Neurosurgeons face difficulties in proper assessment of severity of injury and management accordingly. Currently, no effective TBI therapy exists, with paediatric patients treated through a combination of surgery, rehabilitation and pharmacological agents managing post trauma conditions such as depression. Evidence-based guidelines and management protocols help to guide target-driven care and are associated with better outcome. Continuous attempts have been made worldwide to discover the best possible treatment, but an effective treatment method is not yet available. Evidence-based intensive care management strategies improves outcome. The most definite benefits in terms of survival after TBI come from admission to a specialist neurosurgical centre, with goal-targeted therapy and intensive care services. Early detection and objective characterization of abnormalities in TBI are important objectives of modern neuroimaging. Improved treatment will come through understanding the physical changes in the brain that occur at the microscopic and molecular levels when the brain is subject to trauma. Novel achievements in neuroprotection are now expected from developing antiapoptotic agents, from more potent antioxidants, cholinergic agents, alpha blockers, from researching various physiological substances, advances in molecular medicine including stem cell and gene therapy. A more analytical approach to understanding the complex array of factors that influence the incidence, severity, and outcome of TBI is essential. Future therapies that are currently under investigation hold promise [4].

The management of severe head injury is a major challenge to neurosurgeons and basic neuroscientists, as the consequent mortality and morbidity is depressingly high. There is a need for an extensive multidimensional effort to improve the prognosis of head-injured patients and provide them a better quality of life.

Hence, this study was performed to evaluate prospectively various causes, clinical presentations, investigations and the current trends in the management of paediatric head injuries and their functional outcome. The data so collected and analyzed would enable us to successfully frame guidelines for future understanding and effective treatment.

Materials and Methods

This study was a prospective observational study and all patients diagnosed with head injury in Department of Neurosurgery, Osmania General Hospital, Hyderabad**.** This study was conducted between November 2014 to February 2017. 205 patients were selected in this study. All pediatric age group (0-14Y) presented with head injury were included, all the patients were clinically examined and CT scan brain plain was taken preoperatively. In all operated patients, post operative CT scan was taken were the inclusion criteria. Pediatric patients with birth injury and spontaneous intracranial bleeds were excluded from the study. CBP, ESR, CUE, Serum electrolytes, renal function tests, PT, APTT, BT, CT, blood grouping and RH typing, ECG, X ray chest, X ray skull, X ray limbs, USG abdomen and chest, CT brain, CT abdomen and chest, CT cisternography, MRI brain are the investigations which all patients should undergo. The patients admitted are diagnosed after thorough investigative workup and distributed according to the age, sex, mode of presentation and injury, GCS, type of surgery done and outcome according to the GOS and follow up and statistically evaluated by chi-square test, t- test and p- values. Patients are managed conservatively and surgically. Initially the patients are resuscitated according to the ABC protocol and haemodynamically stabilized. Surgical management is indicated in patients with skull fractures that are both open and depressed.

When the fractured piece is greater than or equal to 5 mm below the neighboring skull, the fragment is elevated. Other reasons for elevation included underlying bleeding, dural tear or significant contamination. Delayed surgical repair was performed in the skull fractures resulting in a prolonged, persistent leakage of CSF. The patients with EDH and SDH with an estimated 25 ml haematoma, haematoma measuring 40 ml regardless of neurologic status, haematoma measuring 25 ml in a critical region such as posterior fossa, midline shift 0.5 cm with a neurologic change, increase in the volume of the haematoma on repeat imaging. DC in those with medically refractory intracranial hypertension or patients with neurologic deterioration and signs of herniation who have an intracranial lesion have been evacuated. A craniectomy is done in which the bone flap is fully removed and a duroplasty performed.

Observations and Results

Table 1: Demographics such as age distribution, sex distribution

Age	No. of Patients (%)
0-2 Y	25 (12.19%)
3-5 Y	42 (20.48%)
6-10 Y	57 (27.8%)

11-14 Y	81 (39.5%)
Sex	No. of Patients(%)
Males	114
Females	91

Table 1 shows that the patients age group ranges from birth to 14 years children with the mean age group of 7 years. The commonest age group of paediatric head injuries is 11-14 years with the incidence rate of 39.5% i.e. 81 patients. The male to female ratio is 4:3 with a male preponderance.

Table 2: Distribution based on mechanism of injury, presenting complaint

Mechanism Of Injury	**0-2 Y**	**3-5 Y**	**6-10 Y**	**11-14 Y**	**Total (%)**
RTA	8	20	38	57	123(60%)
Fall	15	15	15	17	62(30.2%)
Assault	1	5	3	4	13(6.3%)
Household Injury	1	2	1	3	7(3.41%)
Complaint	0-2 Y	3-5 Y	6-10 Y	11-14 Y	TOTAL (%)
Loc	10	25	32	81	143(70%)
Vomitings	5	15	31	51	102(50%)
Altered Sensorium	12	28	32	65	127(62%)
Ear Bleed	3	5	7	16	31(15%)
Seizures	4	6	14	26	52(25%)
Paralysis	0	1	3	6	10(5%)

Table 2 shows that there are various causes of head injuries in paediatric patients. The commonest mode of mechanism of injury is due road traffic accident with an incidence rate of 60% followed by fall which include fall from height, fall during play etc. with an incidence rate of 30.2%. The patients presented to the emergency department with various chief complaints, the commonest complaint the patients presented are the loss of consciousness for a period of more than 30 minutes to 24 hours with an incidence rate of 70%. The other common presenting complaints are altered sensorium with an incidence rate of 62%.

Table 3: Distribution based on GCS

GCS	**0-2 Y**	**3-5 Y**	**6-10 Y**	**11-14 Y**	**Total (%)**
Severe (<9)	5	7	10	17	39(19.02%)
Moderate (9-12)	10	20	22	25	77(37.5%)
Mild (13-15)	10	15	25	39	89(43.4%)

Table 3 shows that the patients presenting to the emergency department had variable conscious level and neurologically assessed by Glasgow coma scale and categorized into mild, moderate and severe cases according to the GCS. Most of the patients admitted are with mild head injury with the incidence rate of 43.4%, followed by moderate and severe head injuries with the incidence rate of 37.5% and 19.02% respectively.

Table 4: Distribution based on type of injury, associated injury

Type of Injury	**0-2 Y**	**3-5 Y**	**6-10 Y**	**11-14 Y**	**Total (%)**
EDH	6	12	11	26	55(26.8%)
DAI	3	5	9	9	26(12.6%)
Acute SDH	2	4	7	7	20(9.7%)
Contusion	2	3	10	13	28(13.6%)
Diffuse Cerebral Oedema	2	6	6	6	20(9.7%)
DF With P	1	3	2	3	9(4.3%)
DF With C	0	2	3	4	9(4.3%)
DF With No Dura	2	3	0	2	7(3.4%)
Misc	2	1	2	6	11(5.3%)
Associated Injury	0-2 Y	3-5 Y	6-10 Y	11-14 Y	Total (%)
No. OF U/L	1	1	2	6	10(4.87%)
No. OF L/L	1	2	4	7	14(6.82%)
Chest	0	1	1	2	4(1.95%)
Spine	0	0	0	2	2(0.97%)

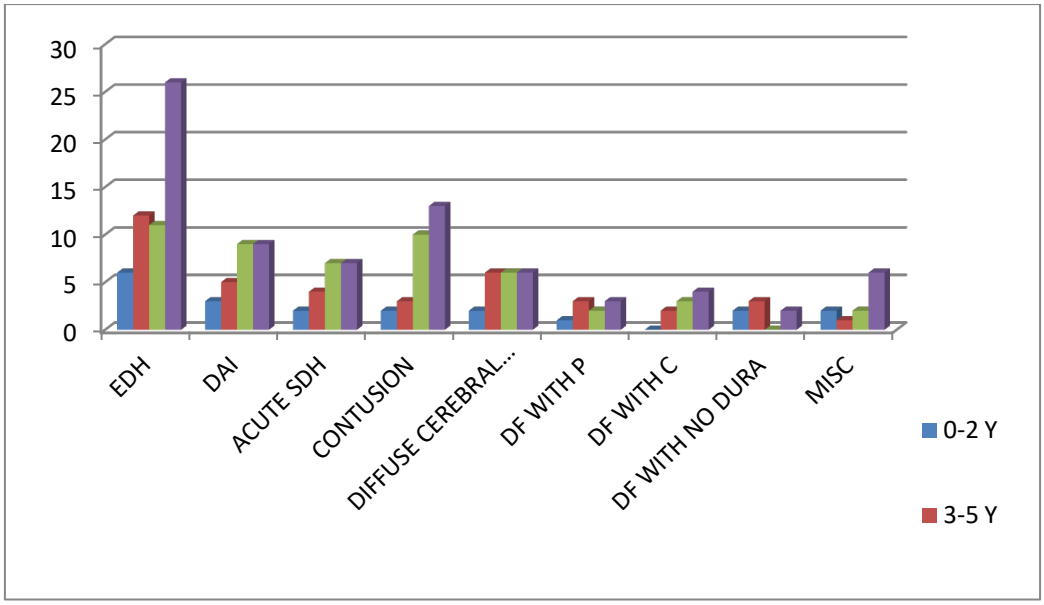

Figure 1: Distribution according to type of injury

Table 4 shows that the patients admitted through the emergency department underwent various investigational procedures and diagnosed with various types of injuries. The commonest type of injury is EDH with incidence rate of 26.8%. The patients admitted through emergency department underwent neurological and complete systemic examination and diagnosed with fracture of upper limbs, lower limbs, ribs, chest and spinal injury.

Table 5: Distribution based on course of hospital

Course	0-2 Y	3-5 Y	6-10 Y	11-14 Y	Total (%)
Operative	3	7	10	15	35(17.07%)
Conservative	22	35	47	66	170(82.9%)

Table 5 shows that most of the patients admitted are managed conservatively i.e. 170 patients and only 35 patients are operated. The patients with duration of stay less than 7 days are 180 i.e. 87.8% and the patients with duration of stay more than 7 days are 25 i.e. 12.19 %.

Table 6: Type of operations done

Type of Operation	0-2 Y	3-5 Y	6-10 Y	11-14 Y	TOTAL
Craniotomy and Evacuation of EDH	0	2	3	10	15
Wound Debridment and Elevation Of Depressed Fragment	0	2	4	7	13
Decompressive Craniotomy	0	0	1	2	3
Endoscopic Repair of Fistula For CSF Rhinorrhea	0	0	0	1	1
EVD	0	0	1	0	1
Craniotomy And Evacuation of SDH	0	0	1	1	2

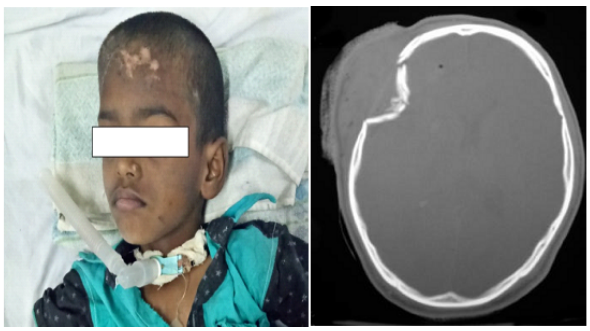

Figure 2: Tracheostomy & Rt Frontal depressed with pneumocephalus

Table 6 shows that the patients admitted in the study underwent various surgical procedures like craniotomy and evacuation of EDH, wound debridment and elevation of depressed fracture segment, endoscopic repair of fistula for traumatic csf rhinnorea, craniotomy and evacuation of SDH and decompressive craniotomy.

Table 7: Distribution according to outcome

Outcome	0-2 Y	3-5 Y	6-10 Y	11-14 Y	Total (%)
Good Recovery	17	30	43	64	154(75.1%)
Moderate Disability	3	5	8	6	22(10.7%)
Severe Disability	3	3	3	4	13(6.3%)
Vegetative State	0	1	2	2	5(2.4%)
Dead	2	3	1	5	11(5.3%)

Table 7 shows that the outcome of the patients admitted is measured with Glasgow outcome scale. The patients with good recovery had an incidence rate of 75.1% i.e. 154 patients and the patients expired are 11 with a mortality rate of 5.3%.

Discussion

Traumatic brain injury (TBI) is commonly used as synonym to head injury, acquired brain injury and brain injury. It is a common occurrence in the pediatric population and accounts for the largest cause of acquired disability in childhood. In this series, out of all head injury admitted to our institution, 205 (13.456%) are pediatric patients. In the present study, the number of pediatric head injury increases with increase in age (p-value < 0.001). The commonest age group of paediatric head injuries is 11-14 years with the incidence rate of 39.5% i.e. 81 patients. As the age increases, mobility and outdoor activities increases, such as, increased vehicular usage, playing outdoor games, and increase in child labor, etc., which increases the likelihood of sustaining a head injury. In a study by Parslow RC et al5 the incidence of head injuries in the paediatric patients is 37% in the age group of children >13 years which is consistent and supportive to the present study. The head injuries in our study is common in male gender with male preponderance and male to female ratio of 4:3. Male preponderance (p-value < 0.001) in the present study is also comparable with other studies such as Schutzman [6] described that boys are twice as likely to be injured as compared with girls. In the present study, most common mechanism of injury was road traffic accident (RTA) (60%), next to it was fall due to various causes which includes fall from height, fall due to play etc., (30.2%) (p-value < 0.001). RTA being common cause of head injury in pediatric is also similar to other series of studies like Shahrokh Yousef zadeh et al [7] and Parslow et al5 but fall from height is described in many articles as the most common mechanism of head trauma. Taking pediatric age group as 0 to 18 years may be one of the possible cause to explain the significance in our favor.

In the present study, fall from height is the most common mode of injury in children of the age group 0 to 2 years which is comparable with other studies. [8,9] It is also found that the most common presenting features is loss of consciousness seen in 143 (70%) cases, followed by altered sensorium seen in 127 (62%) cases, then the vomiting that accounts for 102 (50%) cases. Paresis is found as presenting features in 10 cases. Found more in age group of 11–14 years that is 6 cases. In one case of 4yrs the paresis was due to parietal lobe infarction developed after trauma. Loss of consciousness requires either loss of the function of both cerebral hemispheres or of the reticular activating system. Several plausible hypothetical mechanisms have been proposed for the alteration of consciousness that occurs with TBI. These include the reticular, pontine-cholinergic system, centripetal, and convulsive hypotheses. The reticular activating system (RAS) resides in the brainstem reticular formation which extends from the top of the spinal column to the rostral midbrain with extensions into the thalamus and hypothalamus. The RAS is excited by input from surrounding sensory tracts and transmits this excitation to the cortex to induce generalized cortical and behavioral arousal. In the absence of input from the RAS, consciousness is impaired. This is also supported by the fact that External forces that affect head movement cause mechanical stress within the brain tissue, producing a sudden electric discharge or depolarization of nerve cells throughout the brain. LOC can occur from this effect alone. This electric depolarization leads to an outpouring of neurotransmitters in the brain, and a cascade of neurochemical changes results in excitatory and damaging effects on the nerve cells. These presenting complaints are comparable with other study conducted by Dunning J and Daly JP et al [10]. The patients admitted to the emergency department after head injury were categorized into mild, moderate and severe head injuries by glasgow coma scale. Most of the patients admitted are with mild head injury i.e. 102 (43.4%) cases and with severe head injury are 35

(19.02%) cases. After the patients are categorized they are clinically examined and investigated in detail and managed accordingly. The patients with GCS of 8 or less have a significant probability of death or major neurological deficits. Decerebrate rigidity carries 60% mortality. Sample PL et al [11] shown GCS 3 to 4 following resuscitation is associated with poor outcome. Suresh et al [12] also found more number of children (58.5%) with GCS 3 to 5 were either died or persisted in vegetative state where as higher proportion of children with GCS 6 to 8 attained a good recovery. Despite the relation between the depth of the coma and outcome, a wide range of GCS scores among children with good recovery exist.

Lai-choong quoted that low GCS did not always accurately predict the outcome in the absence of hypoxia or ischemia. In the present study we found mortality in children with severe head injury and mortality in children with moderate ($p < 0.01$) head injury showing significant impact of GCS on outcome. Due to scarcity of resources, in the present study, ICP monitor was not used in any case to measure the ICP. Although some recent studies support the use of ICP monitor in traumatic brain injury and consider it as beneficial. Several studies have demonstrated that ICP monitoring reduced the overall mortality rate of severe TBI. Other studies have not shown any benefits from ICP monitoring. Moreover, a few studies have demonstrated that ICP monitoring was associated with worsening of survival. Potential complications of ICP monitoring include infection, hemorrhage, malfunction, obstruction, or malposition. In the Cochrane database, a recent systematic review found no randomized control trials that can clarify the role of ICP monitoring in acute coma whether traumatic or nontraumatic. Nevertheless, there is evidence, and most clinicians agree, to support the use of ICP monitoring in severe TBI patients at risk for intracranial hypertension. In a recent larger study done by Alkhoury and Kyriakides described that despite current Brain Trauma Foundation guidelines, ICP monitoring is used infrequently in the pediatric population. The data suggest that there is a small, yet statistically significant, survival advantage in patients who have ICP monitors and a GCS score of 3. However, all patients with ICP monitors experienced longer hospital length of stay, longer ICU stay, and more ventilator days compared with those without ICP monitors [13]. It is also seen that EDH and hematoma was the most common CT finding in the patients of pediatric head injury found in 61 (26.8%) cases. Second to EDH, parenchymal contusion or hematoma is the leading cause. But if the patients with compound fracture with under lying contusion (9 cases) taken together with the isolated contusion of 28 (13.6%) cases it accounts to 37 (17.9%) cases becoming the most common intracranial pathology. A total of 74 cases shows fracture of skull with 26% cases of EDH shows at least a single linear skull fracture. Diffuse axonal injury was found in 26 (12.6%) cases. In our study, it is seen that 62.8% of head injury can occur without a skull fracture.

In the present study, there were 30 patients admitted with associated injury out of which 17 cases are in the the age group of 11 to 14 years. Most common injury associated is limb injury in 24 cases and next to it is chest injury in 4 cases, spinal injury in 2 cases, and finally blunt trauma abdomen in 1 case. This pattern of injury is comparable with other study such as Parslow et al [5]. The mean duration of hospitalization in our study is 4.0615 days but most of the patients are spending 3 to 7 days in the hospital with 87.8% of patients staying <7 days (p-value < 0.001). The children of the age group 13 to 18 years are spending more days than any other group. But it is of importance that the high school and intermediate college going children loses significant number of days due to head injury. This is comparable with the study by Tabish SA et al [14]. Total numbers of cases operated were 35 and 170 (p-value < 0.001) patients got conservative medical management. In our study, it shows that operative intervention is relatively low as compared with conservative treatment which is also comparable with other series study by Amaranath E.Jeevaka et al and Thiessen M et al [15, 16]. The patients after admission were resuscitated and investigated with al workup process and after diagnosing with the type of injury, in our study most of the patients are managed conservatively by IV fluids, hypothermia, analgesia, mannitol therapy, hypertonic saline, and operative procedures. The children managed with hypertonic 3% NaCl improved well with less complications as seen with manniton therapy. The patients also underwent decompressive craniotomy improved dramatically but one patient of age 12 years expired as he sustained other injuries and developed infarction of the brain. This is comparable with other studies by Hejazi et al and NFigaji AA et al. A patient with post traumatic CSF rhinorrhea was operated by endoscopic technique and was successful [17, 18]. A total of 35 (17.07%) cases are operated of which craniotomy and evacuation of extradural haematoma is done in 15 patients, wound debridment and elevation of depressed fragment is done in 13 cases, decompressive craniotomy is done in 3 cases of which 1 patient of age 12 years expired, and external ventricular drainage is done in a case of traumatic intraventricular bleed but the patient expired as he presented to us with a GCS of 5. A total of 189 cases out of 205 cases are discharged with GOS of 5 and 5 number of cases remain persistent vegetative (GOS-2). This high number of good recovery suggest that majority of head trauma are mild-to-moderate in severity. The better survival

outcome may be due to the anatomic characteristics of a pediatric head (open fontanelle and skull stability is dependent upon ligamentous structures than bony structures) allow it to tolerate raised ICP better than adults. On the contrary the brain of a child is more vulnerable to these insults, which could explain the fact that the functional outcome is often unpredictable and depends on age at injury, injury severity, and time since injury, premorbid child characteristics, family factors, and the families' socioeconomic status, Lack of comorbid factors such as alcoholism hypertension, diabetes mellitus, and other age-related risk factors are also responsible for good outcome in pediatrics. Also, early recognition and timely intervention yields good results. The mortality rate in our study is 5.3% which is comparable with the other studies by Pratap Chandra Nath et al [19]. In the present study of 205 patients, the children are followed up at 1month, 3months and 6 months interval. Out of 205 patients 121 cases came for regular followup. Out of 156 patients with good recovery according to Glasgow outcome scale 100 cases followed up, and the patients with moderate and severe disability of 17 cases and 4 cases of vegetative state followed up. During the period of follow up the patients presented with headache as the most common complaint followed by altered sensorium, seizures, hemiparesis and irritability. These complaints are evaluated and managed conservatively. Tracheostomy care and physiotherapy are advised regularly for severe disability and vegetative state patients.

Conclusion

This study evaluated prospectively various causes, clinical presentations, investigations and the current trends in the management of paediatric head injuries and their functional outcome. In the present study, a number of interesting recent reports in the field of clinical research in pediatric TBI were discussed.

It was believed that the field is moving forward at an accelerated pace since the publication of the first guidelines document, and that valuable innovations in our understanding of the pathophysiology, diagnosis, and monitoring have been made, along with some progress in defining optimal therapy. Although substantive challenges to these trials such as difficulty with patient enrollment and the need for rather large sample sizes to appropriately test therapies exist, we are excited that important progress is beginning to be made in pediatric TBI.

References

1. Mahapatra AK, Jaiswal A. Epidemiology of head injury. Neuroscience Today. 2003;7:29−32.
2. Tabatabaei SM, Seddighi A. Paediatric head injury-review article. Iran J Child Neurol Feb-2007:7–13.
3. Lee KW, Hwang SK, Sung JK, Hamm IS, Park YM, Kim SL. Paediatric head injury. J Korean Neurosurg Soc 1999;28(1):42–47.
4. Tabish SA, Syed N (2015) Recent Advances and Future Trends in Traumatic Brain Injury . Emerg Med (Los Angel) 5: 229.
5. Parslow RC, Morris KP, Taskar RC, Forsyth RJ, Hawley CA. Epidemiology of traumatic brain injury in children receiving intensive care in the UK. Arch Dis Child 2005;90:1182–1187.
6. Schutzman SA, Greenes OS. Pediatric minor head trauma. Ann Emerg Med 2001;37:65–74.
7. Yousef zadeh Chabok S, Ramezani S, Kouchakinejad L, Saneei Z. Epidemiology of paediatric head trauma in Guilan. Arch Trauma Res 2012;1(1):19–22.
8. Mitra B, Cameron P, Butt W. Population based study of paediatric head injury. J Paediatr Child Health 2007;43:154–159.
9. Luerssen TG, Klauber MR, Marshall LF. Outcome from head injury related to patients age. A longitudinal prospective study of adult and pediatric head injury. J Neurosurg 1988;68:409–416.
10. Dunning J, Daly JP, Lomas JP, Lecky F, Batchelor J, Mackway-Jones K; Children's head injury algorithm for the prediction of important clinical events study group. Derivation of the children's head injury algorithm for the prediction of important clinical events decision rule for head injury in children. Arch Dis Child 2006;91(11):885-91.
11. Sample PL: Bass DH: Peter JC: Severe HI in children a preventable but forgotten epidemic. South African Med. Jr. 1998: Vol. 88. 455-465.
12. Suresh HS, Praharaj SS, Indiradevi B, Sukla D, Sastry Kolluri VR, Prognosis in children with head injury, an analysis of 340 patients. NIMHANS. 2003, Vol 51, Issue 1, P 16-18.
13. Saul TG, Ducker TB. Effect of intracranial pressure monitoring and aggressive treatment on mortality in severe head injury. J Neurosurg 1982;56:498–503.
14. Tabatabaei SM, Seddighi A. Paediatric head injury-review article. Iran J Child Neurol Feb-2007:7–13.
15. Amaranath E.Jeevaka, Ramanan Mahesh, Reagh Jessica, et al. Epidemiology of traumatic head injury from a major paediatric trauma centre in New South Wales, Australia. ANZ J Surg 2014; 84:424–428.
16. Thiessen M, Woolridge D. Paediatric minor closed head injury. Pediatr Clin North Am 2006;53:1–26.

17. Hejazi N, Witzmann A, Fae P: Unilateral decompressive craniectomy for children with severe brain injury. Report of seven cases and review of the relevant literature. Eur J Pediatr 161:99, 2002.
18. Figaji AA, Fieggen AG, Peter JC: Early decompressive craniotomy in children with severe traumatic brain injury. Childs Nerv Syst 19:666, 2003.
19. Pratap Chandra Nath et al . Spectrum of Pediatric Head Injury with Management and Outcome: A Single Tertiary Care Center Study. Indian J Neurotrauma 2015;12:10–18.