Original Research Article

International Journal of Neurology and Neurosurgery
Volume 10 Number 3, July - September 2018
DOI: http://dx.doi.org/10.21088/ijnns.0975.0223.10318.5

Clinicopathological Study of Pediatric Head Injuries

G. Vidyasagar

Abstract

Aim: Current study aimed to analyze the clinical and radiological presentation of severe head injury in pediatric population and the outcome and their comparison with that of adult severe head injury. *Methods*: This is a prospective study consisting of 764 children with head injury admitted in the period of 5 year duration. All children under 14yrs of age were included in the study. In all the children variety of clinical and radiological parameters were collected and analyzed Glasgow outcome scale was noted in all these patients at the time of discharge and at the end of 3 months and the outcome is compared with adults with severe head injury. *Results*: Out of 764 children, 156 had severe head injury. Documentation and analysis of various clinical factors was done and the results were compared with adults with severe head injury. In this study majority of patients were < 3 yrs old. But incidence of severe head injury was more in the 9-14 yrs age group i.e., 56.4%. In this study, 64% were male children and 35.9% are female children. Most common cause was fall from height 63.35%, followed by RTA 27.2%. In 132 cases managed conservatively, out of which, diffuse brain injury (56), Small SDH (28), Small EDH (24), Contusions (12), SAH (8), Skull fracture (40). Surgery was done for all compound depressed fracture and for significant intracranial hematomas. Thirty children with head injury needed surgical intervention (3.93%). In adults 9.69% (612 out of 6316 admissions) cases were managed surgically. Post-Operative Complications-Wound infection noted in 5 (16.7%), CSF leak in 3 (10%), post-Operative Seizures in 3 (10%), Meningitis in 2 (6.7%) and one patient (3.3%) developed acute hydrocephalus who underwent ventriculoperitoneal shunt. In children with severe head injuries, 20.5% mortality rate was noted and good recovery is noted in 58% at the time of discharge and 64% at the end of 3 months. *Conclusions*: Good recovery is noted in 58% of children compared to 47% in adults with severe head injury. Poor GCS at presentation, presence of shock, presence of diffuse cerebral edema on CT scan where the factors found to be associated with poor prognosis. Though age less than three years and pupillary abnormality were associated with increased mortality they were not found statistically significant in this series. Most of the accidents and deaths from head injury are preventable, what we need is caution, prevention is the best way to decrease this morbidity.

Keywords: Pediatric Head Injuries; GCS Scale; Mortality.

Introduction

Accidents are the leading cause of death in children younger than 14 yrs of age. In this group, head injury is most common cause of mortality [1,2]. Because of the frequency of this condition in pediatric population, it is important that it should be handled appropriately and effectively. The outcome in head injury, in many cases, is directly related notonly to the severity of injury, but also to how well the injury is managed [3,4]. The outcome in these patients is distinctive because of the unique biophysical properties of the child's skull and brain [5]. The factors affecting the outcome in children with head injuries have been studied by various authors [6,7].

Several studies have highlighted the importance of age and clinical factors such as GCS (post resuscitation) score, ocular movements, pupillary size, etc., in the prediction of outcome in these patients [6-9]. However, the outcome in these studies varies widely with a mortality ranging from 9% to 75% (In severe head injury) [8].

Author's Affiliation: Associate Professor, Department of Neuro Surgery, Narayana Medical College & Hospital, Chintharedypalem, Nellore, Andhra Pradesh 524003, India.

Corresponding Author: G. Vidyasagar, Associate Professor, Department of Neuro Surgery, Narayana Medical College & Hospital, Chintharedypalem, Nellore, Andhra Pradesh 524003, India.

E-mail: sagarguntur@yahoo.co.in

Received on 13.07.2018, **Accepted on** 28.07.2018

The present study was undertaken with a view to predict the outcome and analyze factors affecting the outcomein children with severe head injury.

Materials and Methods

This is a prospective study consisting of 764 children with head injury admitted in the period of 5 years duration at Narayana medical college and hospital, Nellore, Andhra Pradesh, India. All children under 14yrs of age were included in the study. Birth injuries and significant extra cranial injuries were excluded from the study. In all the children variety of clinical and radiological parameters were collected and analyzed. We specially looked for outcome in relation to the following parameters Age, Sex, Mode of injury (etiology), Clinical Presentation, Clinical presentation, (Vomiting, Loss of consciousness, Convulsions, Ear, nose bleed, Altered scalp, surface anatomy (laceration, scalp contusion, deformities), Altered level of conscious, Focal neurological deficits, Shock, Severity of injury (post resuscitation GCS), Radiological features- X-rays, CT scan, Management protocols, Outcome and related scales.

All the individual's parameters were correlated with mortality and morbidity. Glasgow outcome scale was noted in all these patients at the time of discharge and at the end of 3 months and the outcome is compared with adults with severe head injury.

Results

Out of these 764 children 156 had severe head injury. Documentation and analysis of various clinical factors was done and the results were compared with adults with severe head injury.

In this study majority of patients were < 3 yrs old. But incidence of severe head injury was more in the 9-14 yrs age group i.e., 56.4%. In this study, 64% were male children and 35.9% are female children. Showing male predominance, in the incidence of severe head injury.

Mode of Injury

The cause of head injury in our series was as follows. Most common cause was fall from height 63.35%. Followed by RTA 27.2%. Assault was the least common (2.6%) etiology.

Clinical Presentation

The clinical presentation in our series was as follows. Most common presentation in children with head injury was vomiting (57.9%) followed by altered scalp surface anatomy (41.4%) (Table 1).

Severity of Injury

Using GCS (post resuscitation) the severity of head injury divided into 51.83% mild, 27.74% moderate and 20.41% had severe head injury.

Nature of Injury

All the patients underwent CT scan brain with bone windows, using CT scan findings, the nature of injuries were classified as following (Table 2).

Conservative Management

Total no of cases managed conservatively was 132, out of which diffuse brain injury (56), small SDH (28),

Table 1: Clinical presentations during admission

	No of cases	%
Vomiting	442	57.9%
Loss of consciousness	294	38.5%
Convulsions	124	16.2%
Ear, nose bleed	74	9.7%
Altered scalp surface anatomy (laceration, scalp contusion, deformity)	316	41.4%
Altered level ofconsciousness	140	18,3%
Focal neurological deficits	64	8.4%
Pupillary abnormality	24	3,1%
Shock	12	1.6%

Table 2: Nature of injury

Skull fractures	106	Acute subdural hematoma	30
Linear	54	Intracerebral hematomas/contusion	14
Compound	18	Subarachnoid hemorrhage	8
Basal, orbital	12	Diffuse brain injury	56
Intracranial hematomas		Extradural hematoma	32

small EDH (24), contusions (12), SAH (8), Skull fracture (40). Most of the conservatively managed cases were diffuse brain injury.

Surgery Management

Surgery was done for all compound depressed fracture (wound debridement, elevation of depressed fragment, dural repair etc.,) and for significant intracranial hematomas (those with mass effect/with, focal neurological deficits). Depressed fractures (18), EDH (8), SDH (2), Contusion (2), Total (30). Thirty children with head injury needed surgical intervention (3.93%).

The 156 children with severe head injury were assessed at the time of discharge and at the end of 3 months using Glasgow outcome scale. Poor GCS, presence of shock and presence of diffuse cerebral edemawere the prognostic factorsfound to be statistically significant (Table 3).

In children with severe head injuries, 20.5% mortality rate was noted and good recovery is noted in 58% at the time of discharge and 64% at the end of 3 months. (Table 4)

Discussion

Present study analyzed 764 children with head injury who were treated at Narayana medical college hospital, Nellore over a period off our years four months. This study has shown an overall mortality of 20.5%. Various studies quoted 14-57% mortality in children with head injuries.

40% of India's total population belongs to children 0-14yrs age group. Head injuries have been found to be the common cause of death between ages 0-14.

Table 3: Prognostic factors

Risk factors	No of patients with Severe Head injury	Mortality	
Age			$X^2 = 0.8742$
< 3 yrs	20	6(30%)	P≤1
3y-8yrs	48	10(20.8%)	Statistically
8yrs-12yrs	88	16(18%)	Not significant
GCS (post resuscitation)			$X^2 = 7.0672$
3-5	36	15(41.7%)	P≤0.01
6-8	120	17(14.2%)	Statistically significant
Pupillary abnormality			$X^2 = 3.4773$
Present	24	14(58%)	P≤0.1
Absent	32	38(28.7%)	Statistically Not significant
Shock			$X^2 = 8.367$
Present	12	8(66.7%)	P≤0.01
Absent	144	24(16.7%)	Statistically significant
Diffuse Cerebral Edema			$X^2 = 11.805$ P≤0.001
Present	56	22(40%)	Statistically
Absent	100	10(10%)	significant

Table 4: Glasgow Outcome Scale in Children

Grade	At the time of discharge	At the end of3months
I death	32(10.5%)	-
II Vegetative state	6(3.9%)	6(3.9%)
III Severe disability	10 ((5.4%)	8(5.1%)
IV moderate disability	20(12.8%)	\7 (7.7%)
V Good recovery	90 (57.7%)	100(64.1%)

The newly born infant certainly faces the risk of head injury, either from being dropped, or being battered. Playground and domestic environment are not safe and have their own hazards for children in 1-5 years age group, in the next five years, as the range of activity increases (walking climbing, sliding, riding etc), the risk of head injury alsoincreases, in another 5 yrs, same risk continue but danger of assaults and sporting injuries adds up. The risk of road traffic accidents is much higher in age 9 - 14yrs of age group. Behrman has supported this domestic predominance followed by road traffic accidents.

Sieben et al., 1971, pandae CD et al. , 1979, Valley et al. 1981, Chadwick et al. 1991, Musemeche et al. 1991 10-14 and National pediatric trauma registry 1995, have studied the etiology of pediatric head injury and found that fall from height to be responsible for most of the pediatric head injuries. In our study also we found fall from height is the common cause of head injury in children 63.35% followed by RTA i.e., 27.2% and assault constituting 2.6% is the least common cause. Fall from height is the major cause of head injury in 0 - 3 years age group compared to 9 - 14 years age group in whom Road Traffic Accidents is the common cause.

Male predominance is seen in studies by Sieben et al. 1971, Pandae et al. 1979, Chadwick et al. 1991, Behrman 2000.

Incidence of severe head injury in male and female children in study from Agarwal et al. was 58.7% and 41.3%.

In present study the incidence of severe head injury in male children was 64.1% and 35.9% in female children.

In the present study we analyzed five factors like age, GCS (post resuscitation), pupillary abnormality, shock and diffuse cerebral edema and try to correlate these factors with the outcome.

Sieben et al. 1971, Chadwick et al. 1991, Behrman 2000 reported mortality from head injury was higher in 0-5 year's age group. Semple PL et al. (Red Cross Hospital Cape town) 4615 also found age less than 3 years is associated with poor prognosis.

Suresh et al. intheir study found age less than 2 years has higher mortality (27%). In the present study mortality in less than 3 years age is 30%, in 3 to 8 years 20% and in 9 to 14 yearsis 18% showing highest mortality in less than 3 years age group. The higher mortality in less than 3 years age group is due to younger children suffer greaterincidence of diffuse injury then their older counter parts, higher incidence of sub dural hematomas, bilateral non-reactive pupils and hypotensionin these patients

Those patients in coma with a GCS score of 8 or less have a significant probability of death or major neurological deficits. Decerebration carries 60% mortality.

Semple PL et al. shown GCS 3 to 4 following resuscitation is associated with poor outcome.

Suresh et al. (NIMHANS) 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 recover exist. Lai - choong quoted that low GCS did not always accurately predict the outcome in absence of hypoxia or ischemia.

In our study we found 41.7% mortality in children with GCS 3 to 5 and 14.2% mortality in children with GCS 6 to 8 ($p = 0.01$) showing significant impact of GCS on outcome. Pupillary light reflex, which required the afferent link of the optic nerves and tracts to be intact as well as the parasympathetic occulomotor outflow for the efferent link. For the direct light reflex, to be present the mesencephalon must be functionally preserved, the light reflex is an excellent indexes of mid brain function, assuming that afferent are is intact. The pupillary fibers in die third nerve fray also be compressed in the transetentorial hernation syndrome, leading to dilatation, due to the external location of these nerve fibers on the surface of the nerve.

Harold et al. stated that pupillary response is not a good predictor for outcome.

Levin et al. described the main effect of GCS and papillary reactivity and their interaction. Suresh et al. described in their study, 14.3% children with abnormality of pupillary size and reaction had poor outcome.

In the present study children with presence of pupillary abnormality shown 58% mortality, whereas children without pupillary abnormality shown 28.7% mortality ($p = 0.1$) which is statistically not significant. Diffuse cerebral edema was shown to be associated with poor out come in various studies.

Suresh et al. found poor out come in 25% patients with diffuse cerebral edema.

Feickert HJ et al., in their study shown primary areflexia and diffuse brain swelling are associated with grave prognosis.

Semple PL et al., in their study shown diffuse cerebralswelling is associated with poor outcome. In present study we had 56 children with diffuse

cerebral edema in whom 40% mortality was seen. Whereas in children without diffuse cerebral edema only 10% mortality is noted. Diffuse swelling of brain may develop more rapidly in children because of lack of CSF available for displacement. Diffuse brain swelling with or without diffuse axonal injury demonstrated by the first CT scan was related to high mortality. Thereafter the multifocal brain edema seems to occur and secondly increase in intracranial pressure is found. If these are controlled useful recovery will occur.

Zuearallo E et al., Studied 62 children with severe head injury. Overall mortality was 32%. [16].

Feichert HJ et al., Studied 150 children with severe head injury with median age of 6.6yrs. They reported 22% mortality and 39.3% had severe neurological impairment [17]. The most significant risk factors shown in this study were primary arefiexia, secondary brain edema and a low GCS score. Kimberly et al, studied 322 children with severe head injury and reported goodrecovery in 59% cases [18].

Suresh et al. (NIMHANS) studied 340 children with severe head injury; they reported 14.4% mortality in their study. They reported clinical features associated with poor prognosis are absence of ocular movements (50%), abnormal papillary size (49%) age < 2yrs (29%) 100 patients were with DBI with mortality of 25% [19].

In the present study out of 156 children with severe head injury good recovery was seen in n 58% of children, and mortality was 20.5%. In childrenwith diffuse braininjury satisfactory outcome was seen in 52% and mortality was 39%.

The factors, which affect the outcome significantly, were,

1. GC5 3-5 (post resuscitation)
2. Presence of shock
3. Presence of diffuse cerebral edema

Though age less than 3 years and presence of pupillary abnormality also associated with high mortality, they were not found statistically significant in the study.

Mortality is less (20.51%) in children compared to 33% in adult) and good recovery isseenin 57.7% compared to 46.9% in adult. Good recovery is seen in children with diffuse brain injury compare to adults (39% mortality in children 53% in adults).

Requirement of surgical intervention was also less compared to adults 3.9% compared to 9.7% in adults. This is due to less frequent occurrence of mass lesions in children and more number of cases was diffuse brain injury. The special attributes pediatric skull and brain account for their outcome being different from adults. The immature brain appears to tolerate anoxia and hypoxia better than adults.

Conclusions

Even though requirement of surgical intervention is less, conservative management has to be aggressive to reduce morbidity and mortality. Good recovery is noted in 58% of children compared to 47% in adults with severe head injury. Poor GCS at presentation, presence of shock, presence of diffuse cerebral edema on CT scan where the factors found to be associated with poor prognosis. Though age less than three years and pupillary abnormality were associated with increased mortality they were not found statistically significant in this series. Most of the accidents and deaths from head injury are preventable, what we need is caution, prevention is the best way to decrease this morbidity.

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International Journal of Neurology and Neurosurgery	Quarterly	10500	10000	820	781
International Journal of Pediatric Nursing	Triannual	5500	5000	430	391
International Journal of Political Science	Semiannual	6000	5500	450	413
International Journal of Practical Nursing	Triannual	5500	5000	430	391
International Physiology	Triannual	7500	7000	586	547
Journal of Animal Feed Science and Technology	Semiannual	78500	78000	6133	6094
Journal of Cardiovascular Medicine and Surgery	Quarterly	10000	9500	781	742
Journal of Forensic Chemistry and Toxicology	Semiannual	9500	9000	742	703
Journal of Geriatric Nursing	Semiannual	5500	5000	430	391
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Journal of Orthopaedic Education	Triannual	5500	5000	430	391
Journal of Pharmaceutical and Medicinal Chemistry	Semiannual	16500	16000	1289	1250
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