PEDIATRIC HEAD INJURIES, MECHANISM TO MANAGEMENT: EXPERIENCE OF A SINGLE CENTER

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ABSTRACT

INTRODUCTION

Head injury is very common in modern life. Patients of any age group may have head injury however mechanism of head injury, pathophysiology and outcome of head injury is quite different in adults as compared to children. Road traffic accident is a common mode of head injury in adults while fall from height and household abuse is common mode in children. In Western countries, there is a separate registry system for pediatric head injury but there is no such system exist in india. Our present study is focused on pediatric head injury and evaluation of factors that affect the final outcome in pediatric patients.

KEYWORDS

Pediatric, Traumatic Brain Injury.

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INTRODUCTION: Head injury is a leading cause of morbidity and mortality both in adults and children. Each year thousands of children reach to the emergency department after head injury. In United States of America around 1.3 Million children visit emergency department and amongst them around 0.75 Million patients admitted in hospital.(1)

But no such registry system present in India on child head injury. The mechanism of injury, presentation and management strategies in children are quite different as compared to adults because of different elastic property of skull.(2) As compared to adults, children have less subarachnoid space, hence the effect of externally applied force is more on pediatric head as compared to adult.(3) also there is less myelin in pediatric brain, hence it is more plastic. Especially pediatric patients are more susceptible for head injury due to thinner bones, large head to torso ratio, late development of air sinuses and their incapability of maintaining body temperature.(4) There is a very famous quote of Prof. McLaurin a famous pediatric neurosurgeon that "child is not a small adult." In long term more severe injuries in children correspond to delayed cognitive defect and neurologic deficit. There are several studies had been done in western countries(5,6) on final outcome on pediatric head injuries, but data are lacking in India. Our aim of doing present study is to provide basic framework to bridge this gap and determine the common mode, mechanism, management and final outcome and provide factor related to final outcome in pediatric head injuries.

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MATERIAL AND METHODS: Two hundred and thirty consecutive patients below 15 years of age, who were admitted in Department of Neurosurgery, Mahatma Gandhi Medical College from 2006 to 2015 were included in present study. All the patients were evaluated neurologically by Glasgow coma scale (after resuscitation whenever necessary). In children below 2 years of age, modified version of GCS was used.(7) Papillary reaction was noted in all patients. All patients were divided into mild, moderate and severe head injury depends upon GCS, i.e. more than 14, 9-13 and below 8 respectively. Non-contrast CT scan was done in all the patients and finding like linear or compound fracture, Extra-Dural Hematoma (EDH), Subdural Hematoma (SDH), Contusion and Intraventricular Hemorrhage (IVH) were noted. All the patients given standard treatment (medical and surgical) and final outcome were measured based on Glasgow outcome scale and divided into good (good recovery, moderate disability and severe disability) and poor (vegetative and death). This was done because patients usually improve after months of followup, as it has been shown in many studies.(8,9)

Final outcome were correlated with patient's age, mechanism of injury, GCS and papillary abnormality at the time of admission and finding on CT scan.

RESULTS: All the patients included in surgery were below 15 years of age. There were total 307 patients, out of which 18 patients were below 2 years of age. Poor outcome was seen in 27.77% of the patients below 2 years of age, 15.38% in 3-5 years of age group, 11.11% in 5-10 years and 13.84% in 10-15 years of age group and poor prognosis

below 2 years of age group children was found statistically significant (p value less than 0.05).

Glasgow coma scale was recorded in each and every patient before and after the resuscitation and best GCS response taken into consideration. About 40% patients having GCS below 8 found to have poor outcome as compared to patients of GCS group 9-13 and 14-15, in which poor outcome was seen in 20.83 and 1.7% patients respectively.

Papillary abnormality was also considered to be a good prognostic marker of pediatric head injury; 83.33% of patients had poor outcome with papillary abnormality as compared to 4.24% patients had poor outcome without papillary abnormality.

There were 49 patients having fracture on CT Scan of brain, EDH was noted in 79 patients, acute SDH was noted in 21 patients, contusion was in 60 and diffuse axonal injury or Intraventricular hemorrhage was noted in 98 patients. Poorest outcome was noted in patients with acute subdural hematoma (38.09%), while best outcome was noted in patients with fracture (6.1%) followed by EDH (6.32%).

Group	Good outcome	Poor outcome	Poor outcome%
<2 n=18	13	5	27.77
3-5 n=39	33	6	15.38
6-10 n=120	108	12	11.11
11-15 n=130	112	18	13.84
GCS Group			
<8 n=43	26	17	39.53
9-13 n=96	76	20	20.83
14-15 n=168	165	3	1.785
Pupil			
Normal n=259	248	11	4.24
Abnormal n=48	8	40	83.33
CT Finding			
Fracture n= 49	46	3	6.1
EDH n=79	74	5	6.32
SDH n=21	13	8	38.09
Contusion n=60	46	14	23.33
IVH or diffuse injury n=98	70	28	28.57

Table 1

DISCUSSION: Pediatric skull is not synonymous with a small adult skull. There is a marked difference in biomechanical properties of pediatric skull as compared to adult skull and this difference creates a huge difference in pattern of injuries in between these two.[2] As compared to adult skull child skull is more pliable, having less subarchanoid space that causes reduced buffering capacity to externally applied biomechanical forces.[2]

Pediatric brain can tolerate hypoxia better than adults.[10] There is less edema formation in pediatric skull as compared to adult and at the same time it can clear edematous fluid more rapidly. Children usually have less blood pressure as compared to adults, hence have less perfusion pressure. As children brain have less myelin, neuroplasticity of pediatric brain is more as compared to adults.[3]

Increased mortality in pediatric patients can be explained by more common subdural hemorrhage, more papillary abnormality and more incidence of hypotension.[11] There have been a lot of controversy whether Age is related with poor prognosis, there are few studies that suggests that age is related with poor outcome.[12] but few ones conclude no relation in between.[11] however in our study we did not find any significant difference.

Patients with poor GCS had poor outcome as compared to those with GCS more than 8. Motor posturing results in poor outcome.[3] In the present study, patients with GCS less than 8 have more poor outcome (39.53%) as compared to patients with GCS more than 8 (8.71%), and it was found to be statistically significant (p value less than 0.00001). In the literature, there are many papers on outcome of pediatric patients on the basis of GCS. By and large there is good correlation in between poor GCS and outcome, but this is not always true. In many study, there is a lot of variation in final outcome on the basis of GCS.[5]

Pupillary response is not a good indicator of poor outcome.[3] If the brain stem reflex like oculocephalic movement or vestibulocephalic reflex are absent than there is likely to be 100% mortality, but even impairment of these reflexes results in poor outcome. Levins et al. describes effect of GCS and reaction of pupil to the light.[5] In our present study, almost 84% patients had poor outcome who had abnormal papillary reaction.

The extent of skull fracture and poor outcome is not well established in children as compared to adults.[3] Patients of childhood age having less chance of intracranial hematoma as compared to adults.[13] In our study almost 94% patients with skull fractures had good outcome that is consistent with other studies.[11]

Extradural hematoma is less common in children as compared to adults because dura is densely adherent to overlaying bone.[13,14] and patient outcome after EDH is usually good in most of the studies. In our study only 6% patients with EDH have poor outcome and this is consistent with other studies.[11,15]

In adults, EDH is often associated with the linear fracture of skull bone and it usually involves tear of middle meningeal artery, especially its anterior division as it is embedded in groove, but in children one may find more and more cases of EDH without skull fracture.[3]

Acute subdural hematoma is more common in children as compared to adults and more common in infant as compared to toddler.[3,11] Acute subdural hematoma often associated with contusion and this complex of acute SDH with underlying contusion is termed as "Burst Lobe" outcome in patients with acute subdural hematoma is poor as compared to skull fracture and EDH. Tomberg et al. found 17% patients with acute subdural hematoma and none of them had good outcome.[15] Biomechanics behind pathogenesis of acute subdural hematoma is rotational injury to skull, hence there may be involvement of deeper structures of brain involving brain stem and this leads to

poorer outcome. Most of the series on acute subdural hematoma reported about 40% mortality. In the present study we found poor outcome in 38% of the cases, while patients of EDH and fracture had poor outcome in only 6% of the cases and this is consistent with other studies.[11] Brain contusion represents gross disruption of brain tissue, which is typically seen at the apex of cerebral gyri and appears as hyperdense lesion on Non contrast CT scan. In brain contusion piamater is intact and if there is disruption of piamater then it is called brain laceration. Contusions and traumatic intracranial hematoma is having poorer outcome.[15] They are formed because direct blow to the skull or due to the internal collision of brain to the bone, e.g. petrous. Generally, the location of contusion is directly beneath the external impact (coup injury) or area of the brain at distant site, but not always just opposite to this. (Counter coup).

CONCLUSION: In the present study we found that children less than two years of age having poorer outcome, but this is not statistically significant. Patients with pupillary abnormality at the time of admission, poor GCS grade, intracerebral hematoma or contusion and acute subdural hematoma all were associated with poor outcome.

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