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Analysis of Various Prognostic Factors in Paediatric Head Trauma

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Abstract
Background: *The outcome in children with traumatic brain injury is distinctive because of the different biophysical properties of the skull and brain, and their reaction to injury.*
Methods: In this prospective study of 403 children with traumatic brain injury, managed over a period of two years, at SKIMS, the factors influencing outcome were analysed .
Results: *Out of 403 children 252(63%) were males and 151(37.75%) were females. Most of patients 161/403(40%) were under 5 years of age. Fall was most common mode of injury in 228/403(56.60%) followed by Road traffic accidents.229/403(57.30%) patients presented with GCS 13-15, 122/403(29.80%) with GCS OF 9-12 and 52/403(13%) with GCS of 8 and less. 330/403(81.9%) were found normal on follow up, 41/403(10.17%) has disability, 9/403(2.2%) remained in vegetative state and 23/403(5.7%) died during hospital stay.*
Conclussion: *Fall was most common mode of injury followed by Road traffic accident. Age, sex, mode of trauma does not have significance in terms of outcome. The various prognostic factors associated with poor outcome were low GCS, Abnormal papillary size and reaction, Midline shift on CT scan.*

I. Introduction

Traumatic brain injury (TBI) in children is a significant cause of morbidity and mortality worldwide[1]. Falls are the most common type of injury, followed by motor-vehicle-related accidents.[2] Furthermore, child abuse remains a major cause of head trauma in children under 2 years of age. The percentage of each contributing factor differs between studies, and the distribution varies according to age, group, and sex. Infants and young children are more vulnerable to abuse because of their dependency on adults[3]

The uncertainty that exists about the likely outcome after traumatic brain injury (TBI) is encapsulated in the Hippocratic aphorism: "No head injury is so serious that it should be despaired of nor so trivial that it can be ignored." Today, physicians estimates of prognosis are still often unduly optimistic, unnecessarily pessimistic, or inappropriately ambiguous.[4,5,6,7.]. In practice, relatively few features have been found to contain most of the prognostic information.[8,9,10.] These include the patient age, clinical indicies indicating the severity of brain injury(e.g., the depth and duration of coma and other neurological abnormalities), and the results of investigations and imaging studies. The Glasgow Coma Scale (GCS) score[11] is the universal tool for the rapid assessment of the consciousness level of injured children. A modified verbal and motor version has been developed to aid in the evaluation of consciousness level in infants and young children. Traumatic brain injury in children is classified as mild (GCS 13-15), moderate (GCS 9-12), or severe (GCS 3-8) .The PGCS was developed for children younger than 5 years of age as a more accurate tool to avoid errors that occur when the GCS is applied to children and infants with limited verbal skills. A PGCS of 13-15 represents minor injury, 9-12 is moderate injury, and 8 or less than 8 is severe injury.

Aims
The Aims of our study were
1. To study epidemiological factors in traumatic brain injury in paediatric population.
2. To analyse various prognostic factors in traumatic brain injury in

II. Material And Methods

Four hundred three (403) patients with traumatic brain injury, eighteen years or less in age were managed in Department of Neurosurgery, SKIMS, Srinagar over a period of two years from august 2011 to September 2013.

The patients were evaluated on the basis of predetermined proforma. Detailed history of the patients were taken(including patient`s bio data,age, mode of injury,etc).patient were subjected to detailed general physical examination,systemic examination,and CNS examination including GCS and pupil size and papillary reaction. Based on GCS Patients were divided into mild head injury(GCS13-15), moderate head injury(GCS 9-

12) severe head injury(GCS ≤8) .All the patients were subjected to plain CT scan head with bone window and CT findings were noted.

After the preliminary resuscitation and work up, patients were managed conservatively or surgically as per indications. The outcome of all these patients were assessed by Glasgow outcome scale and divided into good (normal and moderate disability) poor (severe disability, vegetative state and dead) outcome. Outcome was assessed in relation to age, sex, GCS, pupil size and reaction, CT scan features, intervention, and associated injuries.

III. Results

Table 1. Distribution of patients according to age and sex

Age in years	Male	Female	Total
<5	89	72	161
6-12	85	48	133
13-18	78	31	109

Table 2. Causes of traumatic brain injury

Road traffic accidents	138(34.24%)
Fall	228(56.58%)
Assault	10(2.48%)
Other	27 (6.70%)

Table 3. Relation of outcome with various variables

	Good outcome	Poor outcome	Total
Sex			
Male	231	21	252
Female	129	22	151
Age			
<5 years	145	16	161
6-12	121	12	133
13-18	94	15	109
Mode of Trauma			
RTA	115(83.3%)	23(16.6%)	138
Fall	210(92.1%)	18(7.8%)	228
Assault	10(100%)	0	10
Others	25(92.5%)	2(7.40%)	27
GCS			
13-15	223(97.3%)	6(2.62%)	229(57.3%)
9-12	119(97.5%)	3(2.45%	122(29.8%)
≤8	18(34.6%)	34(65.3%)	52(13%)
Total	360(89.3%)	43(10.6%)	403
Pupils			
Normal	338(95.4%)	16(4.51%)	354(87.7 %)
Fixed dilated	0	12(100%)	12(3 %)
Anisocoria	22(59.4%)	15(40.5%)	37(9.2 %)
Total	360(89.3%)	43(10.6%)	403
CT Findings			
SDH	26(74.2%)	9(25.7%)	35(8.7%)
Contusion or hematoma	85(86.7%)	13(13.2%)	98(24.3%)
EDH	63(95.4%)	3(4.5%)	66(16.4%)
Brain Edema	4(50%)	4(50%)	8(2%)
Normal	76(88.3%)	10(11.62%)	86(21.3%)
SAH	7(87.5%)	1(12.5%)	8(2%)
Fracture	87(97.7%)	2(2.24%)	89(22%)
Aerocel or pneumocephlus	12(92.3%)	1(7.69%)	13(3.2%)
Total	360(89.3%)	43(10.6%)	403
Midline shift			
No	335(91.5%)	31(8.5%)	366
Yes <3mm	19(86.3%)	3(13.7%)	22
Yes >3mm	6(40%)	9(60%)	15
Total	360(89%)	43(11%)	403

Table 4:- Relation between intervention and outcome

Intervention	Good outcome	Poor outcome	Total
Hematoma or contusion removal	35(92.1%)	3(7.89%)	38
Decompressive craniotomy	6(66.6%)	3(33.3%)	9
Fracture debridement or elevation	43(97.7%)	1(2.27%)	44
Contusion Removal and fracture debridement	11(91.6%)	1(8.33%)	12

Contusion Removal and decompressive craniotomy	15(71.4%)	6(28.5%)	21
Conservative	250(89.6%)	29(10.4%)	279
Total	360(89.3%)	43(10.66%)	403

Table 5:- Glasgow Outcome Scale(GOS)

Gos	No.	Percent.
Death(1)	23	5.7%
Vegetative(2)	9	2.2%
Severe Disability(3)	11	2.7%
Moderate Disability(4)	30	7.4%
Normal(5)	330	81.9%

IV. Discussion

This study was carried out in SKIMS, Srinagar over a period of 2 years and over this period; we admitted 403 children with traumatic brain injury. Although in the developed world, with the advent of highly specialized intensive care units and a high level of multi-disciplinary approach, the outlook of the traumatic brain injury has improved dramatically, it still continues to be a major challenge for the neurosurgery units in our part of the world.

In this study we analysed various prognostic factors in paediatric traumatic brain injury which determine outcome in these patients. In our series of 403 patients aged between 1day and 18 years with mean age of 8.4 years were admitted.

Most of patients were males 250 (62.5%) as compared to females 150 (37.5%) which is comparable to Astrand R. et al [12]. One group of reports has indicated that outcome tends to be better in children under ten years of age[13,14,15.] while others report that children under five have a higher mortality rate.[16,17,18,19.] Although in our series there is no difference in poor outcome in children below 5 years or above 5 years as was reported by Suresh HS et al.[20]although there is slightly higher poor outcome above 12 years not statistically significant. The importance of age as prognostic factor has been a subject of controversy. Luerssenet al[21]. have reported age as strongest factor for mortality and morbidity. Although literature supports age is the stronger factor of mortality and morbidity in severe head trauma but these studies compare adults with children .In our series we had compared only children and all grades of trauma taken into consideration.

In our series, Most common mode of TBI were Fall 228(57%) with good outcome in 210/228(92%) patients followed by RTA 135(33.8%) with good outcome in 115/135(83%) followed by assault 10(2.4%) with good outcome in 100% followed by other modes (like hit by stone, sports injuries or firearm injuries) 27(6.7%) with good outcome in 92.5%. Astrand R. et al[12] reported 50% were injured due to RTA, 36% due to fall, assault 4% and others 10% and RTA had good outcome of 86% and fall had good outcome of 94% . Yi W et,al.[22]reported in their study fall were most common type of injury 73.2%,followed by RTA 16%, followed by assault 7% followed by others 3.6%.

In our series of 403 patients we have found low GCS had poor outcome. Most patients had a GCS (Glasgow coma scale) of 13-15(mild head injury), 57.3% (n= 229) of which poor outcome observed in 6 (2.6%), followed by GCS 9-12 (moderate head injury) 29.8% (n= 119) out of which poor outcome observed in 3(2.52%) followed by GCS of 8 or less(severe head injury) 13%(n=52) of which poor outcome observed in 34 (65.4%). Suresh HS et al.[20] reported poor outcome in GCS 3-5 had 58.5%,GCS 6-8 had 35.2%,GCS 9-12 had 11.4% and GCS 13-15 had 1.3 %.This differs from our series only in GCS 9-12 because most of patients were contusions or EDH who attain a good recovery after management and two patients of EDH in mild head injury GCS 13-15 develop SDH post operatively . Beca j et al.[23] andKuday found that the initial GCS score was the single most important factor affecting outcome ($p<0.00001$). Ong L, Selladurai BMet al[24] reported that low GCS did not always accurately predict the outcome in absence of hypoxia or ischemia. In our series we found a significant impact of GCS on outcome. This high poor outcome in severe head injury in our part of world is due to lack of pre hospital resuscitation and late presentation to hospital once secondary brain insult had already persued.

Out of 403 patients in our study 351(87.8%) patients have normal pupils, 37 (9.3%) have anisocoria and 12 (3%) patients have fixed dilated pupils. poor outcome in patients with normal pupils were 4.55% and patients with anisocoria pupils were 40.5% and fixed dilated 100%. Suresh HS et al.[20]reported poor outcome of49.3% in patients of abnormal pupils and 7.4% in normal pupils. In our series we found abnormal papillary response is strongest predictor of outcome.

Out of 403 patients in our series CT scan findings were noted as normal in 86 patients (21.3%) out of which 71/86(88 %) had good outcome and poor outcome in 11.6%. Van Dongenetal.[25]reported in their study normal CT in 12% patients with good outcome in 78% and poor outcome in 22%.Lobatoetal[26] in their study reported normal CT in 10% patients. Astrand R. etal[12] reported normal in CT in 7% patients.

The extent of a skull fracture is proportional to severity of brain injury clearly does not apply to the paediatric age group.[27] In our study patients with skull fracture (n= 89) 22%,out of which 97.8% had good outcome and 2.24% poor outcome .Suresh HS et al.[20] reported skull fracture in17% with good outcome in

94.1% and poor outcome in 5.4%.Astrand R et al.[12] reported skull fracture in 55%. The probability of associated intracranial hematoma with skull fracture in children is half of that of adults[28].

Extradural hematoma (EDH) is significantly less common in children than in adults and is even more rare in infants.[29] EDH can occur without fracture in children more commonly.[27] In our study patients with EDH (n= 66)16.4%, out of which 95.5% had good outcome and 4.5% had poor outcome . Suresh HS et,al[20] who reported 28% with poor outcome in 8.4%.Astrand R et,al.[12] reported 48% with good outcome in 98% and poor outcome in 2% .The mortality rate in children with EDH ranged from 7-15% as reported by Francel PC et al.[27]

In our series of 403 patients, out of which (n=98) 24.3% patients had Contusions/hematoma. 86.8% patients with contusion had good outcome and 13.2% had poor outcome. Suresh HS et,al[20] reported contusions in 16.7% with poor outcome in 18.2% .Lobato et,al[26] reported outcome was better in EDH and contusion. The outcome was unfavourable in patients with intracerebral hematomas and hemorrhagic contusions[30].

SDH is seen six times more often in the infants than in toddlers.[27] The outcome of patients with SDH is significantly worse than that of patients with EDH, mainly because of the underlying brain damage accompanying SDH and the resultant intracranial hypertension. In our study we reported SDH in 35 (8.7%) patients and out of which poor outcome was noted in 25.7%.Suresh HS etal[20] reported SDH in 10.33% out of which poor outcome in 35.3%. Yi Wetal.[22] reported SDH in 25%.Tomberg's series had SDH in17.1% of the patients out of which none had good recovery.[30]

Diffuse brain swelling occurs in approximately 50% of children with severe head injury. The outcome is significantly better in children as compared to patients with operable mass lesion.[30] Diffuse swelling of brain may develop more readily in children because of the lack of CSF available for displacement. Children with CT scan indicating of diffuse axonal injury but without diffuse cerebral edema generally did not have sustained increased intracranial pressure and more than two-thirds attained a favourable outcome. Diffuse brain swelling with or without diffuse axonal injury demonstrated by the first CT scan was related to high mortality. In our series diffuse brain edema in 8(2%) with poor outcome in 4(50%) patients. Suresh HS et al.[20] reported diffuse brain edema in 30%with poor outcome in 25%.Yi W et,al.[22] reported diffuse brain edema in 1.7% .

.In our series, tSAH in 8 (2%) patients with poor outcome in 12.5% patients. Yi W et al[22] reported tSAH in 3.6% .Jagannathan J,et al[1] reported tSAH in 68%patients. Nilesh S et al.[31] reported tSAH in 33% patients. Suresh HS et al.[20] reported tSAH in none .SAH is low in our series because others reported SAH in severe TBI patients only with GCS< or 8.

Quattrocchi, et al.[32] found a prognostic significance of the presence or absence of midline shift on the admission CT. Athiappan et al.[33] (1993), found the prognostic value of midline shift more important in patients with single contusions or intracerebral hematoma than for those with multiple lesions and extraaxial or subdural hematoma. In our series we found poor outcome in 8.5% and good outcome in 91.5% patients without midline shift , patients with MLS<3mm had poor and good outcome of 13.7% and 86% respectively and patients of >3mm with poor outcome and good outcome of 60% and 40% respectively. The presence of midline shift was associated with a poor outcome in 50% of cases, whereas the absence of midline shift was associated with a poor outcome in only 14% of cases ($p < 0.05$)[32] .Lobato et,al[26] reported positive predictive value of 68% when MLS>1.5cm.

The mean clinical follow-up duration was 4.6 ± 2.3 months (range10 days-12 months) with mode and median of 6. During follow up 64.5% who survived does not show any abnormality, 11.3% children showed behaviour abnormalities 6.8% had residual neurological deficits.

The total clinical outcome ,according to the Glasgow coma scale (GOS) in our study were 82%(n=330) had good recovery, 7.4%(n=30) had moderately disabled, 2.7%(n=11) had severe disabled, 2.2% (n=9) remained in vegetative and 5.7%(n=23) were dead. . Yi W et al.[22] reported GOS of 37 (77.1%) good recovery, 4 (8.3%) moderately disabled, 1 (2.1%) vegetative and 6 (12.5%) dead.

V. Conclussion

Paediatric brain injury is very common in this part of world with male being most commonly invoved and fall being the most common cause of trauma. Age , sex and mode of trauma does not have any significance in terms of outcome where as GCS, Pupil size and reaction, midline shift on CT scan are significant prognostic factors. CT Scan findings like brain edema, SDH, SAH , hematoma/ Contusion had poor outcome as compared to Skull fracture and EDH. We find behavioural change followed by neurological disability as most common problem after traumatic brain injury in paediatric population.

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