ORIGINAL ARTICLE

OUTCOME OF TRAUMATIC HEAD INJURY IN CHILDREN AND ITS COMPARISON WITH SEVERITY

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ABSTRACT

Background: Head injury (HI) is a leading cause of morbidity and mortality in children in Pakistan. The King's Outcome Scale for Childhood Head Injury (KOSCHI) has been developed to measure outcomes following HI in children.

Material and Methods: This case series study was conducted at the Department of Pediatrics in Ziauddin University Hospital, Karachi from March 2017 to September 2017. A total of 181 patients with head trauma were included. Severity of head injury was assessed using the Glasgow coma score. Outcomes of head injury were assessed at 2 months using KOSCHI. Descriptive statistics were calculated. Comparison was done using chi square test with p-value ≤ 0.05 was taken as significant.

Results: There were 69.6% male and 30.4% female patients. Mean duration of head injury was 2.08 ±1.02 hours. The mean comma score was 12.41 ±3.61. 65.2% injuries were mild, 15.5% were moderate, and 19.3% were severe. By KOSCHI, 9.9% of the cases were expired and 1.1% were vegetative. Severe disability was observed in 4.4% of the cases, moderate disability in 8.3%, and 76.2% of the cases were observed as good recovery.

Conclusion: Children with mild HI had moderate disability and those with severe injury had high mortality rate and severe disability at follow up

KEYWORDS: Outcome, Traumatic Head Injury, Traumatic Head Injury Severity

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INTRODUCTION

Traumatic Brain Injury (TBI) is a critical international concern which requires immediate recognition. As one of the leading causes of death and morbidity, statistics reveal that every year about 10 million TBIs lead to hospitalization and in worse cases, death. Around 57 million individuals have been recorded to have been hospitalized affected by one or more injury directly due to TBIs[1], however, the extent of people living with TBIs related disability is not fully documented. Data reveals that TBI is the principal reason of lifelong disability or death in children and young adolescents[2-4].The leading causes of TBI are falls, followed by traffic accidents, struck by or against events, and assaults respectively.[5] Sports and recreational activities also amount for a major share of TBIs which, including concussions. These figures are extremely underestimated with the data available in national data sets. The groups which are most susceptible to TBIs are between 0-4 years and 15-19 years old, out of which boys are twice as much affected as girls[6]. For children, head trauma is not limited to result in persistent cognitive and neurobehavioral deficits but also causes academic, intellectual, family, stress and personality adjustment issues[7].

Therefore TBI is one of the most disabling injuries. 15.7% of injury related efficiency failure caused by

TBI is 14 times of that caused by spinal cord injury[8], this accounts for a fair share of the disabling condition. Due to limited data collection of TBIs at different healthcare settings, as well as cases which are missed or not treated at all, the exact figures of individuals living with TBI related disability is quite higher than recorded. TBIs are also an important risk factor for other health conditions. A population survey indicates that after 1 – 3 years of injury, individuals with TBI, in comparison to the general population, are 1.8 times more likely to involve in binge drinking9, 7.5 times more likely to die and 11 times more likely to suffer from epilepsy[10].

Studies have shown that sport related TBIs which involve loss of consciousness, range between 8%[11] to 19.2%.[12] This means that out of 1.6 – 3.8 million sports-related TBIs that are reported innumerous go unrecognized, and for many no medical care is sought, which clearly shows that estimates are low compared to actual injuries. TBIs often result in continuing and sometimes lifetime cognitive, behavioral, physical and emotional consequences[13]. It is estimated that around 19%[14] to 89%[15] of childhood head injuries are caused by falls. However, other reports suggest the figures to hover between 50% and 70%. The incidents dwindle with age with infants (less than one year of age) and toddlers shown to be at the greatest risk[2]. Adults, unlike children, have a fully developed cen¬tral nervous system (CNS), and thus TBIs prognoses in children varies a great deal due to their different skull structure, difference in CNS development stage and different mechanism of the injury[15]. From 2012 to 2013, 34932 episodes of head injury were recorded in hospitals of England for children under 15, this comes to an estimate of 400 per 100000 (International Classification of Diseases, 10th Edition (ICD-10) S00–09). Essentially, the great share of head injuries are less, however, about 5% of those affected have intracranial complications, morbidity, and long term disability not limited to intellectual, personality and behavioral problems. In extreme cases death is also common.[2, 16, 17]

Although numerous studies have been published a reliable and simple method, or a measuring tool, that can be used for direct comparative studies is not available. No measuring tool found to be equal to GOS in children, until recently when the King's Outcome Scale for Childhood Head Injury (KOSCHI) was introduced, which is largely based on GOS with extra sensitivity at the milder end of disability range[18].

The objective of this study is to determine the outcomes of traumatic head injury in children and their comparison with the severity at a tertiary care hospital.

METHODS

This case series study was conducted at the Department of Pediatrics, Ziauddin University Hospital, Karachi, from March to September 2017. Non probability consecutive sampling technique was used for this study. Total 181 children between 1 year to 14 years of age, of either gender, admitted directly within 6 hours of traumatic head injury were included in the study. Children with superficial or facial injuries and pre or co-existing genetic, physical, or neurologic disorders were not included. Ethical approval was obtained from the institutional ethical committee and an informed consent was also taken from the parents or the caretakers of the patient.

Initial assessment was made on the basis of history, physical examination and necessary radiological investigations. CT scan findings were categorized as normal (no abnormality reported in CT scan) and abnormal (isolated skull fracture or intracranial injury (ICI) to the brain on extra-axial structure) at the time of admission. Injury severity was determined by Glasgow Coma Scale (GCS) scores using the classification of mild (13-15 points), moderate (9-12 points), or severe (3-8) head injury. All patients received initial treatment for head trauma. After treatment of head injury, the outcomes were assessed at 2 months of treatment using King's Outcome Scale for Childhood Head Injury (KOSCHI) in terms of 'Death', 'Vegetative', 'Severe disability', 'Moderate disability', and 'Good Recovery'. The effect modifiers and biasness were controlled by strictly following the inclusion and exclusion criteria. Patients data were compiled and analyzed through statistical package for Social Sciences (SPSS). Frequencies and percentages were computed for qualitative variables like gender, cause of head injury, severity of head injury and outcome using KOSCHI. Mean ±SD was calculated for quantitative variables i.e. age, Glasgow Comma Scale, and duration of head injury. Comparison of outcomes with severity of injury was done using Chi Square test. Stratification was done on gender, age, duration of head injury, cause of head injury, severity of head injury, and Chi-square test was used to to see the effect of these modifiers on outcomes. P value ≤ 0.05 was considered as significant in all analysis.

RESULTS

There were 126 (69.6%) male and 55 (30.4%) female patients. Head injury to children was mostly caused by fall from a height, 92 (50.8%), followed by motor vehicle accidents, 74(40.9%). As far as severity of injury is concerned, 118 (65.2%) injuries were mild, 28 (15.5%) were moderate, and 35 (19.3%) were severe. Mean age was 5.33 ±3.81 years. The mean

duration of head injury was 2.08 ±1.02 hours. The mean comma score was 12.41 ±3.61. Age and duration of injury were further stratified in groups and percentages of patients belonged to these groups are presented in Graph-1 and Graph-2.

By king's outcome scale for childhood head injury it was observed that 18 (9.9%) study subjects were expired, 2 (1.1%) were vegetative, severe disability was observed in 8 (4.4%) cases, moderate disability was observed in 15 (8.3%) cases, and 138 (76.2%) cases were observed with good recovery. The results showed that there is significant association of outcomes of head injury by KOSCHI with severity of injury (p=0.000).

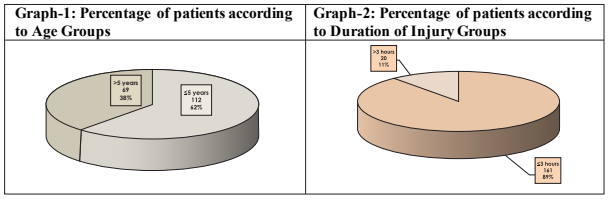

Figure1: Percentage of Patients

Table-1: Comparison of severity of head injury with outcomes

Total (n=181)		Death n (%)	Vegetative n (%)	Severe Disability n (%)	Moderate Disability n (%)	Good Recovery n (%)	P-value
Severity of Injury	Mild	1 (5.6)	0 (0)	0 (0)	0 (0)	117 (84.8)	<0.01
	Moderate	3 (16.7)	0 (0)	2 (25)	4 (26.7)	19 (13.8)	
	Severe	14 (77.8)	2 (100)	6 (75)	11 (73.3)	2 (10.4)	
	Total	**18**	**2**	**8**	**15**	**138**	

The results also showed that there is a significant association of outcomes of head injury by KOSCHI with age (p=0.047) and duration of head injury (p=0.024), while no significant association was found with gender (p=0.125) and mode of injury (p=0.430). The detailed results are presented in Table-2.

Table-2: Comparison of outcomes with gender, age, duration of injury, and mode of injury

Total (n=181)		Death (n=18) n(%)	Vegetative (n=2) n(%)	Severe Disability (n=8) n(%)	Moderate Disability (n=15) n(%)	Good Recovery (n=138) n(%)	P-value
Gender	Male	10 (55.6)	1 (50)	3 (37.5)	10 (66.7)	102 (73.9)	0.125**
	Female	8 (44.4)	1 (50)	5 (62.5)	5 (33.3)	36 (26.1)	
Age	**≤5 years**	10 (55.6)	1 (50)	5 (62.5)	4 (26.7)	92 (66.7)	0.047*
	>5 years	8 (44.4)	1 (50)	3 (37.5)	11 (73.3)	46 (33.3)	
Duration of Injury	**≤3 hours**	12 (66.7)	2 (100)	8 (100)	13 (86.7)	126 (91.3)	0.024*
	>3 hours	6 (33.3)	0 (0)	0 (0)	2 (13.3)	12 (8.7)	
Mode of Injury	**Fall from height**	7 (38.9)	2 (100)	1 (12.5)	8 (53.5)	74 (53.6)	**0.430****
	Motor vehicle accident	8 (44.4)	0 (0)	7 (87.5)	6 (40)	53 (38.4)	
	Sports	1 (5.6)	0 (0)	0 (0)	0 (0)	4 (2.9)	
	Others	2 (11.1)	0 (0)	0 (0)	1 (6.7)	7 (5.1)	

** Significant at 0.05 levels using Chi Square test*
*** Not significant at 0.05 levels using Chi Square test*

DISCUSSION

There are definite physiological differences between pediatric and adult brains which have direct effect on management and outcome of head trauma. In newborns with open fontanelles, normal intracranial pressure is between 1.5-6 mm Hg. In young children, it is 3-5 mm Hg. Brain water content is 90% in children and 75% in adolescents. Myelination is absent at birth and slowly increases until adolescence. Cerebral blood flow is less than 50% that of an adult until age 3-4 years and reaches adult levels in adolescence. Post-traumatic seizures are more likely to occur within the first 24 hours in children than in adults. Children have lower chances of having a surgical lesion compared to adult head injury patients. As a group, children fare better than adults with head injury[19].

Majority of the patients in a study presented with mild head injury and survived on conservative treatment, while in our study 65.2% of the patients suffered from mild head injury. The bulk of their patients were in the 7-12 years age group[20]. In our study, majority of the patients (62.0%) were in the ≤5 year age group. Fakharian et al. reported that infant (under 2 years of age) His (Head injuries) comprised 20.8% of all His in children under 15 years of age[21]. Another study finding has been reported by Daniëlle van Pelt et al[22] in the Netherlands, which found that infants account for 26% of all children (under 15 years) with His. Crowe et al[23] reported that 20% of HIs in children less than three years will be hospitalized for further observation or treatment.

Falls were the main cause of HIs in infants[21], consistent with previous studies[23]. In our study, 50.8% of the patients was reported to suffer from injury due to falls. In a recent study, motor vehicle accidents (MVAs) caused 32.4% of HIs in infants, of which car occupants composed 26.7%. But in Crowe et al's[21] study, MVAs were responsible for only 1.7% of HIs in infants. However, Ciurea et al[24] in Romania reported a figure of 23.72%. On the other hand, 65.1% of infants were injured in home events and the incidence showed a decreasing trend. In our study, 40.9% of the patients were hospitalized due to being injured from MVAs. In some studies, home events used to be the largest accident group (75%) but traffic accidents became the leading cause over the years. The incidence of MVA-induced HI in infants steadily increased during those years. It seems that this high incidence of HI of infants in Kashan, Iran is due to Iran having the highest rates of MVAs worldwide[25].

This is a major public health problem and needs wider attention and more effective prevention.
Hawley et al.[26] conducted a study with the aim of performing a follow-up of all children admitted with a head injury to a single hospital centre to compare outcomes between different severity groups using the KOSCHI. Their study included 419 children with mild HI (according to the GCS), 58 with moderate and 29 with severe head injury. They included 27 children as controls. Four children with severe HI (8.2%) had severe disability at follow up. Overall, 252 children (47.9%) had moderate disability following HI, and of these 181 (43.2%) had mild HI. Greater injury severity was associated with worse outcomes. In terms of severity it was observed that in children with mild head injury, the KOSCHI showed 181 (43.2%) to have moderate disability and 238 (56.8%) to have good recovery. In children with moderate head injury, the KOSCHI showed 37 (63.8%) had moderate disability and 21 (36.2%) had good recovery. In severe head injury children, the KOSCHI showed 4 (8.2%) had severe disability, 34 (69.4%) had moderate disability and 11 (22.4%) had good recovery. After a period of less than one year, these patients were examined again and included 79 patients with mild HI, 15 with moderate HI and 12 with severe HI. In patients with mild HI, the KOSCHI showed 33 (41.8%) with moderate disability and 46 58.2%) with good recovery. In moderate head injury children, the KOSCHI showed 12 (80%) with severe disability while good recovery was observed in 3(20%) children. In severe head injury children, the KOSCHI showed 2 (16.7%) with severe disability, 8 (66.7%) with moderate disability and 2 (16.7%) with good recovery26. In comparison, our study had 65.2% patients with mild HI, 15.5% with moderate HI and 19.3% with severe HI. Of these patients the outcomes measured via the KOSCHI demonstrated that 8.3% had moderate disability and 76.2% had good recovery. In moderate head injury children, the KOSCHI showed 26.7% to have moderate disability and 13.8% to have good recovery. In severe head injury children, the KOSCHI showed 75.0% to have severe disability, 73.3% to have moderate disability and 10.4% to have good recovery.

The present study has some limitations. It was a single hospital-based study and included a non-randomized study design. A small sample size was used to conduct the study hence results may not be used to generalize for a larger population.

CONCLUSION

In conclusion the study results showed that a significant proportion of children admitted with mild HI were found to have moderate disability at follow up. Given the large numbers of children presenting with mild HI, this represents a high prevalence of persistent problems. Patients with severe injury had high mortality rate and severe disability at follow up.

REFERENCES

1. Trefan L, Houston R, Pearson G, Edwards R, Hyde P, Maconochie I, et al. Epidemiology of children with head injury: a national overview. Arch Dis Child. 2015;0:1–6..
2. Myra L. Popernack, Nicola Gray, Karin Reuter-Rice. Moderate-to-Severe Traumatic Brain Injury in Children: Complications and Rehabilitation Strategies. J Pediatr Health Care. 2015;29(3):e1–e7..
3. Bansal S, Blalock D, Kebede T, Dean N, Carpenter J. Levetiracetam versus (fos)phenytoin for seizure prophylaxis in pediatric patient with intracranial hemorrhage. J Neurosurg:Pediatr. 2014;13(2):209–15.
4. Liesemer K, Bratton S, Zebrack M, Brockmeyer D, Statler K. Early post-traumatic seizures in moderate to severe pediatric traumatic brain injury: Rates, risk factors, and clinical features. J Neurotrauma. 2011;28:755–62.
5. Langlois JA, Rutland-Brown W, Thomas KE. Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths. Atlanta: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2004.
6. Thurman DJ. The Epidemiology of Traumatic Brain Injury in Children and Youths: A Review of Research Since 1990. J Child Neurol. 2016;31(1):20-7.
7. Ewing-Cobbs L, Miner ME, Fletcher JM. Intellectual, motor, and language sequelae following closed head injury in infants and preschoolers. J Pediatr Psychol 1989;14:531–7.
8. Finkelstein E, Corso P, Miller T. The Incidence and Economic Burden of Injuries in the United States. New York: Oxford University Press; 2006
9. Horner MD, Ferguson PL, Selassie AW, Labbate LA, Kniele K, Corrigan JD. Patterns of alcohol use 1 year after traumatic brain injury: a populationbased, epidemiological study. J Int Neuropsychol Soc. 2005;11(3):322–330.
10. Lucke-Wold BP, Nguyen L, Turner RC, Logsdon AF, Chen YW, Smith KE, Huber JD, at al. Traumatic brain injury and epilepsy: Underlying mechanisms leading to seizure. Seizure. 2015;33:13–3.
11. Nagahiro S, Mizobuchi Y. Current Topics in Sports-related Head Injuries: A Review. Neurol Med Chir (Tokyo). 2014;54:878–86.
12. Forbes JA, Zuckerman S, Abla AA, Mocco J, Bode K, Eads T. Biomechanics of subdural hemorrhage in American football: review of the literature in response to rise in incidence. Childs Nerv Syst. 2014;30:197–203.
13. US Dept of Health and Human Services. National Institutes of Health. Office of the Director. Rehabilitation of Persons with Traumatic Brain Injury: NIH Consensus Statement. October 26–28 1998. Bethesda, Md: National Institutes of Health; 16(1):1–41
14. Parslow RC, Morris KP, Tasker R. Group UPTBISS. Epidemiology of traumatic brain injury in children receiving intensive care in the UK. Arch Dis Child 2005;90:1182–7.
15. Ghajar J, Hariri RJ: Management of pediatric head injury. Pediatr Clin North Am 39:1093-1125, 1992 11.
16. Garcia D, Hungerford GM, Bagner DM. Topical Review: Negative Behavioral and Cognitive Outcomes Following Traumatic Brain Injury in Early Childhood. J Pediat Psychol. 2015;40(4):391–97.
17. Ovalle F, Xu L, Pearson WS, Spelke B, Sugerman DE. Outcomes of pediatric severe traumatic brain injury patients treated in adult trauma centers with and without added qualifications in pediatrics — United States. Injury Epidemiol. 2014;1:15.
18. Crouchman M, Rossiter L, Colaco T, and Forsyth R. A practical outcome scale for paediatric head injury. Arch Dis Childhood. 2001;84(2):120-124.
19. Meservy CJ, Towbin R, McLaurin RL. Radiographic characteristics of skull fracture resulting from child abuse. Am J Radiol 1987;149:173-5.
20. Siraj MU, Haq MU, Malik NA, Aziz A, Saeed R. Head injury in paediatric age group. J Surg Pak. 2010;15(4):190.
21. Fakharian E, Mohammadzadeh M, Behdad S, Babamohammadi A, Mirzadeh A, Mohammadzadeh J. A seven-year study on head injury in infants: the changing pattern. Trauma Monthly. 2015;20(Special Issue).
22. Daniëlle van Pelt E, de Kloet A, Hilberink SR, . The incidence of traumatic brain injury in young people in the catchment area of the University Hospital Rotterdam, TheNetherlands [J]. Eur J Paediatr Neurol 2011;15(6):519-26.
23. Crowe LM, Catroppa C, Anderson V. Head injuries in children under 3 years. Injury 2012;43:2141–5.
24. Ciurea AV, Gorgan MR, Tascu A, et al. Traumatic brain injury in infants and toddlers, 0-3 years old [J]. J Med Life 2011;4(3):234-43.
25. Bhalla K, Naghavi M, Shahraz S, et al. Building national estimates of the burden of road traffic injuries in developing countries from all available data sources: Iran [J]. Inj Prev 2009;15(3):150-6.
26. Hawley CA, Ward AB, Magnay AR, Long J. Outcomes following childhood head injury: a population study. J Neurol Neurosurg Psychiatry. 2004;75(5):737-42.