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Accidental Head Injuries in Children: Experience of Suez Canal Teaching Hospital

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Abstract

Background: **Accidental head injuries in children represent a significant public health problem. However, there is a paucity of data regarding rates, modes and age-related risks of these injuries especially in developing countries.** ***Aim:*** **To define the etiology, clinical aspects, interventions, and the clinical outcome of accidental head injuries in children presented to Suez Canal teaching hospital.** ***Patients and Methods*****: Prospective analysis was conducted on children admitted to emergency department/Suez Canal teaching hospital for treatment of accidental head injuries. Data included patient`s demographics, etiology & mechanism of injury, severity of injury using pediatric Glasgow coma scale, clinical aspects, treatment received, and the final functional outcome using King's Outcome Scale for Childhood Head Injury.** ***Results:*** **Two hundred and six injured children aged 18 years or less were admitted to hospital in the period from January 2014 to June 2015. Male/Female ratio was 1.3/1. Falls were the commonest mode of injury (61%), followed by Road traffic accidents (18%), and home injuries (14%). Most injuries were of mild severity (83%). CT brain revealed skull fracture in 11%, and intracranial bleeds in 7%. Fourteen patients were operated upon. The mean length of hospital stay was 4.3 days. Final assessment revealed good recovery in 89% of children, moderate to severe disability in 8.5%, and a mortality rate of 2.4%.** ***Conclusion:*** **Children aged 2-5 years were more frequently present with an accidental head injury. Most injuries were mild, and falls were the commonest mode of injury. Most children required simple management without need for surgical intervention. Good recovery was the rule in most children with low disability and mortality rates.**

Keywords: Pediatric, Head injury, Outcome.

Introduction

Head injury in children accounts for a large number of emergency visits and hospitalizations each year[1], and remains a major cause of death and disability in children due to the consequent physical and mental impairments.[2] Primary injury occurs at the time of injury, followed by secondary injury, which develops in the initial minutes to weeks following primary injury (as a complication), and is potentially avoidable and is amenable to treatment[3,4]. Children have substantial differences relative to the adults including the high head/ body mass ratio, the thin pliable skull bones, and the weaker neck musculature which place the child at greater risk for accidental head injury than in adulthood[5]. However, children are tradi-

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tionally known to have a greater potential for neurological recovery following head injury than adults due to their neuronal plasticity[6]. Moreover, open sutures and fontanelles can prevent early and rapid rise of the intracranial pressure related to brain swelling or hematomas, which in turn can minimize secondary brain damage[7]. These structural properties can influence the management or the decision to operate on these injured children[8]. The clinical aspects and sequelae of accidental head injury vary in different stages of childhood[9]. During infancy and early childhood, the higher water content, and less myelinated brain makes children vulnerable to a more diffuse pattern of brain distortion. The elastic skull of children is more able to absorb the energy of physical impact than in adults, which also in turn minimize the development of cerebral contusions and decrease the incidence of lateralization signs in children[10]. With increasing age, the potential meningeal spaces develop. Therefore, lesions such as epidural, and subdural hematomas become more prevalent following head injury[11]. Despite the urgency of this pressing health problem among children, it has been difficult to obtain accurate statistics regarding the incidence and prevalence of accidental head injuries, especially in the developing countries where childhood safety options are lacking, and accident rates are increasing and exceed those of developed countries[12]. The aim of the current study was to describe the epidemiology, clinical aspects, management, and clinical outcome of accidental head injuries in children admitted to Suez Canal teaching hospital, a high flow tertiary hospital in Egypt.

Patients and Methods

Children aged 18 years or less, and presented with accidental head injuries in the period from January 2014 to June 2015 were involved in a prospective cross-sectional review. We excluded children with no clear history of accidental injury as the primary event, children who declared dead on arrival, or children presented with birth-related head injury. All children were subjected to initial trauma survey in ER (unless cases with isolated head injury), followed by neurological examination focused mainly on assessment of head injury. Children were categorized according to age into three groups; <2 years, 2-5 years, and >5 years old. Beside demographic characters, the data included etiology & mode of injury, severity of injury, and the clinical presentation (level of consciousness, external signs of trauma, signs of increased intracranial pressure, neurological deficit, and associated injuries). Severity of injury was based on the initial score on pediatric Glasgow coma scale[13]. Children received CT brain scan (involving review of bone anatomy) according to the presence of any of the criteria for CT brain suggested by Canadian CT head rule for head injury (failure to reach GCS of 15 within 2 hours, suspected open skull fracture, any sign of basal skull fracture, vomiting >2 episodes, or dangerous mechanism of injury)[14].

Table 1: Distribution of mode of injury by different age groups

Mode of Injury	< 2 Years	2-5Years	> 5 Years	Total	p value
Fall	32 (76%)	53 (61%)	41 (53%)	126	<0.05
Road Traffic Accident	3 (7%)	13(15%)	21 (27%)	37	<0.01
Home Injury	4 (10%)	16 (18%)	9 (12%)	29	<0.05
Other / Unknown	3 (7%)	5 (6%)	6 (8%)	14	<0.05
Total	42 (100%)	87 (100%)	77(100%)	206	--

Operative data in case of surgical intervention, and length of hospital stay were documented. At final follow up, functional outcome was assessed using King's Outcome Scale for Childhood Head Injury (*KOSCHI*) scale[15].

Table 2: Clinical findings in overall children

Clinical Finding	No.	%
Assured Loss of Con-	64	31
Level of Consciousness(GCS)		
GCS 15	127	62
GCS 14-13	44	21
GCS 12-9	25	12
GCS ≤ 8	10	5
External Signs of Head Injury		
Scalp Hematoma	23	11
Scalp Wound CSF leakage Orbital/Retro-auricular Ecchymosis	31 5 14	15 2 7
Associated Injuries		
Maxillo-facial Injury	6	3
Chest Injury	7	2
Abdominal Injury Limb Injury / Fracture	2 17	1 8
Neurologic Deficits		
Limb Weakness Cranial Nerve Palsy	7 5	3 2
Aphasia	2	1
Headache/ Repeated Vomiting	47	23
Abnormal pupillary response	13	6
Post traumatic seizures	7	3
Total number of patients	206	100

*****More than one finding in one patient.*

Results

The study included 206 children, with mean age of 4.29 years (range: 9Ms-16Ys), and a male\female ratio equaled 1.3/1. Falls were the mode of injury in 61% of children, and were from furniture mainly (beds, highchairs), followed by falling from caretaker's arms or falling downstairs. Falls were frequently recorded in children aged 2-5 years. Next to falls, Motor vehicle accidents were the mode of injury in 18% of children. Most accidents occurred for pedestrians who were struck by moving vehicles, and less frequently for car occupants. Most accidents were recorded in children older than 5 years old. Home injuries were the mode of injury in 14% of children. It comprised hit by pulled object onto self, or running into walls or furniture. Home injuries were also frequent in 2-5 years old children. Other modes of injury including sport activity, accidental blow to head, or unknown mechanisms were recorded in 7% of children (table 1). Clinical examination revealed scalp wound in 31 patients (15%) involving 9 patients with skull fracture. Scalp hematoma was present in 23 patients (11%), four of them required blood transfusion owing to drop of haemoglobin level below 8g/dl. CSF leakage per ears or nose was noted in 5 patients (2%), while orbital/retro-auricular ecchymosis was noted in 14patients (7%). Associated injuries included maxillo-facial injuries in 6 patients, chest injury in 7 patients, and blunt abdominal injury in 2 patients. Limb injuries included 11 patients with variable wounds, and 6 patients with bone fractures. Assessment of head injury severity revealed that most patients (83%) had mild head injury including 127 (62%) fully conscious patients at presentation, while 12% had moderate injury, and 5% had severe injury (table 2). CT brain was performed according to definite criteria in about 2/3 of children (134, 65%). CT brain was normal in 45% of scanned children. Findings included skull fracture (fissure or depressed) in 23 patients, followed by intracranial bleeding (extradural, subdural, intracerebral, or subarachnoid hemorrhage) in 14 patients, brain edema in 12 patients, brain contusion in 8 patients, and multiple findings in 17 patients. The rate of positive CT brain findings was 45% for mild injuries, 76% for moderate injuries, and 100% for severe injuries (table 3).

Table 3: Frequency Distribution of CT Brain Findings

CT Brain Finding	Severity of Head Injury			Total	
	Mild	Moderate	Severe	No.	%
Intracranial Bleeding	3	5	6	14	10%
Diffuse Brain Edema	5	6	1	12	9%
Skull Fracture	19	4	0	23	17%
Brain Contusion	4	3	1	8	6%
Multiple Findings	14	1	2	17	13%
Normal Study	54	6	0	60	45%
Total	99	25	10	134	100%

Based on clinical and radiological findings, most children (87%) were put under neuro-observation and symptomatic treatment then discharged on instructions, whereas 6% were critically ill, and required admission to the intensive care unit. The overall mortality rate in this study reached 2.4%; three patients with severe head injury (non-surgical lesions) died in ICU 3 to 8 days after admission, one patient died during surgery for evacuation of posterior fossa extradural hematoma due to uncontrollable transverse sinus bleeding, and another patient died one day after admission because of the associated lung injury. Neurosurgical interventions were indicated in 14 patients (6.7%).

Table 4: Summary of Surgical procedures

Surgical Procedure	NO.	%
Elevation of Depressed Fracture	8	57%
Craniotomy for Extradural hematoma	3	22%
Craniotomy for Subdural Hematoma	1	7%
Suboccipital craniotomy	1	7%
Temporal Craniectomy	1	7%
Total	14	100%

Elevation and debridement of compound depressed skull fracture was performed in 6 patients, while elevation of simple depressed fracture was performed in two patients. Craniotomy for evacuation of intracranial bleeding was performed in 3 patients with frontal/temporoparietal extradural hematomas and in one patient with subdural hematoma. Sub-occipital craniotomy was done for one patient with extradural hematoma at the posterior cranial fossa, and temporal craniectomy was performed in one patient for evacuation of temporal lobe hematoma (table 4). The mean length of hospital stay was 5.3 days with a range between one day and 23 days. Follow up duration ranged from 4 to 9 months. Assessment of functional outcome revealed good recovery in 89% of children (*KOSCHI* score 5a or 5b), moderate disability (*KOSCHI* score 4a or 4b) in 8%, and severe disability (*KOSCHI* score 3b) in 3% (table 5).

Discussion

Accidental head injuries in children are common, but most are benign and require minimal medical intervention except for those following extensive falls or traffic accidents and cause significant physical disability[16]. Although long-term cognitive

and psycho-behavioral deficits are commonly seen after severe head injury, these deficits can develop after mild or moderate injuries and referred to as post-concussion syndrome[17]. Our series com

prised 206 children suffered accidental head injuries. There was some male preponderance (M/F=1.3/1). Many studies on pediatric head injury have confirmed a male preponderance[18-19].

Table 5: Final Functional Outcome in overall children

KOSCHI Score	Age Group			Total	P value
	< 2 Years	2-5 Years	> 5 Years		
Good Recovery	40 (95.2%)	76 (87%)	68 (88%)	184 (89.3%)	> 0.05
Moderate Disability	1 (2.4%)	9 (11%)	5 (6.5%)	15 (7.3%)	> 0.05
Severe Disability	0	1 (1%)	1 (1.5%)	2 (1%)	-
Death	1 (2.4%)	1 (1%)	3 (4%)	5 (2.4%)	> 0.05
Total	42 (100%)	87 (100%)	77 (100%)	206 (100%)	-

The higher incidence in males could reflect the differences in behavior between boys and girls as well as differences in exposure to hazards[20]. About 42% of our patients were in the (2-5 years) age group, resembling the largest age group in current study, which in keep with many previous studies[19,21]. This could be explained by the rapid physical and intellectual developments of this age stage which motivate children to roam exploring their environment independently. This increases the risk of injury as children may have not yet fully oriented with their surroundings[19]**.** Falls were the leading mode of injury and accounted for 61%, followed by road traffic accidents in 18%, and home injuries in14% of children. Falls were present in 76% of children younger than 2 years, while road traffic accidents were present in 27% of children older than 5 years, and in 15% of (2-5) years old children. Many studies of pediatric head injury cited falls as the most common mechanism of injury, ranging from 32% to 91%[22-23], especially in children below 3 years old[24]. Mckinlay *et al* stated that mode of injury varies with age, with falls being particularly prevalent among children under 3 years who are mostly confined indoors, whereas motor vehicle accidents being more likely for older children[25]. Shokunbi also found a positive relation between age increasing and prevalence of motor accident[26]. Most of our patients (83%) had mild head injury, while 12% had moderate injury, and 5% had severe injury. Statistical analysis revealed significant differences of head injury severity in different age groups. Adamo *et al*. reported that 86.5% of their patients with accidental head trauma had mild head injury, and 5.4% had severe head injury[18]. Tuna *et al.* found that 83.3% of their cases had mild head trauma, 6.8% had moderate and 9.9% had severe head trauma[27]. Altered level of consciousness was present in 38% of children, followed by transient loss of consciousness in 31%, headache/repeated vomiting in 23%, and neurological deficit in 6% of overall children. Review of literature revealed wide variation in the frequencies of presenting symptoms after pediatric head injuries. Sharma studied the mode and presentation of head injury in 312 children and found that loss of consciousness was present in 41% of children, signs of increased ICP included headache and vomiting in 33%, motor paresis in 3.5%, dysphasia in 2.3%, and seizures in 4% of children[28].

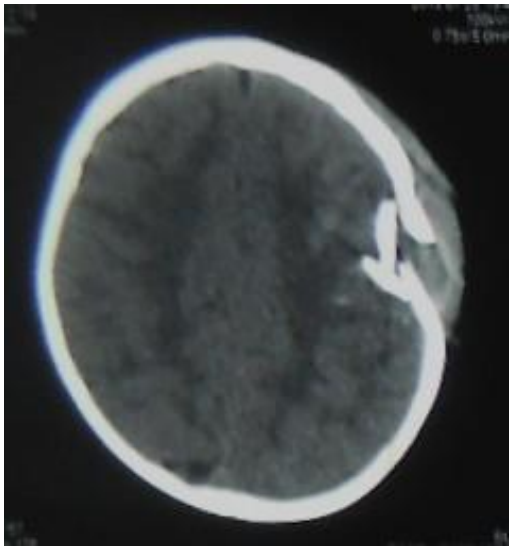

Figure 1: Left parietal compound depressed fracture in a 5 years old girl after falling downstairs.

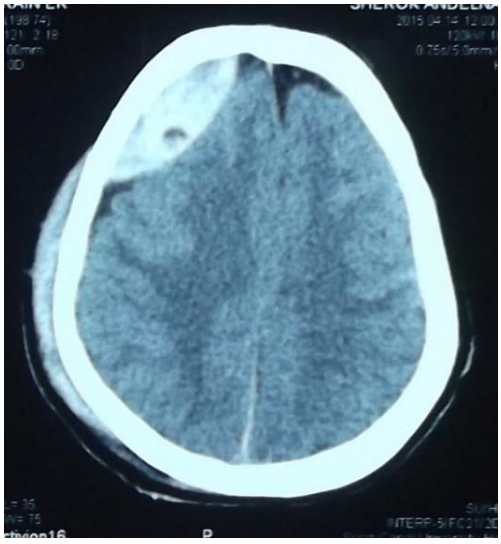

Figure 2: Right frontal extradural hematoma in an 11 years old boy involved in a road traffic accident.

Louise reported that common symptoms on presentation after head injury included vomiting in 28.6%, headache in 11%, altered consciousness in 14%, loss of consciousness in 12.2%, and seizures in 2.2% of children[29]. Local signs of head trauma were present in 35% of children in the form of scalp wound or hematoma mainly, while associated extremities or internal organ injuries were documented in 16% of children. These injuries have a great importance in children as minimal bleeding carries a higher risk for decreasing cerebral blood flow and worsening the outcome[30]. Moreover, many studies have demonstrated that local findings upon physical examination of the head like scalp hematoma, or contused lacerated wounds suggest an increased risk of intracranial injury, and represent statistically significant predictors of abnormal CT brain findings[31,32]. Abnormal CT brain findings were noted in 36%, while normal study was noted in 29% of overall children. Skull fracture was the commonest encountered finding (11%) especially in infants and toddlers mostly due to the relatively thin skull bone that can break easily after an impact. Other findings were intracranial bleeding in 7%, brain edema in6%, brain contusion in 4%, and multiple findings in 8% of overall children. CT brain is the investigation of choice to determine the extent of intracranial damage after head injuries especially with the low sensitivity of clinical predictors in pediatrics[33]. However, many studies conducted in trauma centers revealed that more than 90% of CT scans obtained in the alert child after minor head injuries are negative, suggesting that this modality is being overused, with its indications, benefits and side effects need to be studied[34,35]. Functional outcome, based on *KOSCHI* scale, revealed good recovery in 89% of children, moderate disability in 7%, and severe disability in 1% of children, with an overall mortality rate of 2.4%. Adamo *et al*. assessed clinical outcome based on the same scale. They had good recovery in 80.4% of patients with accidental trauma, moderate disability in 15.8%, and mortality in 0.6% of patients[18]. In our study, there were no association between patient's ages and the functional outcome. Crowe studied the age effect on outcome within

the pediatric age group and generally did not find better results among younger children[36]. Taylor concluded that the relation between childhood head injury and the outcome is complex, and to a large extent remains unexplained even after grouping children into traditional classifications according to their ages, or severity of their injuries[37].

Conclusion

This study showed that children aged 2-5 years were frequently affected following accidental head injury. Most injuries were mild, caused mainly by falls, and required simple management. Good recovery was reported in most children with a low disability and mortality rates. Management should focus on development of effective injury preventive and educational programs directed at both parents and children, combined with improvement of home and roads safety measures.

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