Yonsei Medical Journal
Vol. 45, No. 2, pp. 229 - 232, 2004

Head Injuries from Falls in Preschool Children

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Falls are a leading cause of morbidity and mortality among children. We performed a retrospective analysis of pediatric patients under 7 years of age admitted to our department after a fall from January 1994 through December 1999 to describe the characteristics of fall-related head injury and to determine the clinical parameters influencing outcome.

The patients were divided into two groups according to age: group I(babies and toddlers, 0-3 years) and group II(preschool children, 4-6 years). Falls were classified as low and high level. Sixty-eight cases were identified and falls accounted for 35.2% of head injuries. There were more boys than girls, and more low-level falls(LLF) than high-level falls (HLF), particularly in group I. Although more common in HLF, significant intracranial injuries were also sustained from LLF. Calvarial fractures were the most frequent type of head injury and were more common in LLF than HLF. Admission Glasgow Coma Scale score, types of head injury and hypoxia on admission were significantly correlated with Glasgow Outcome Scale score, but age, sex, extracranial injury and height of fall did not influence clinical outcome.

From this study, we concluded that the height of fall should not limit the evaluation of patients and that aggressive management is mandatory to improve outcome even in patients with poor prognostic factors.

Key Words: Fall, head injury, age, height of fall, glasgow coma scale

INTRODUCTION

Falls are the major cause of pediatric head trauma, particularly in children 4 years of age or younger.[1] Considering all pediatric trauma, falls are the most common cause of an emergency department visit and in two American studies they accounted for up to 25 to 34 per cent of all pediatric trauma admission in major urban trauma centers.[2,3] In another American study, falls represented the seventh leading cause of traumatic death in all children but the third leading cause of death in children 1 to 4 years old.[4] Falls accounted for 5.9% of pediatric traumat deaths.[4] In order to suggest methods of decreasing morbidity and mortality related to falls, it may be necessary to understand the characteristics of fall-related head injuries. We undertook an analysis of pediatric falls in preschool children under 7 years of age to describe the epidemiology of fall-related head injuries and to determine demographic variables for prediction of clinical outcome.

MATERIALS AND METHODS

A retrospective review of pediatric patients (age 0 to 6 years) admitted to our department from 1994 through 1999 after sustaining a fall was performed. Patients who suffered a fall as a result of child abuse or motor vehicle accident were excluded.

Sixty-eight cases (35.2%) of fall-related head injury were identified among 193 cases of head injury under 7 years of age. Variables such as age, sex, height of fall, type of head injury, admission Glasgow Coma Scale (GCS) score and Glasgow Outcome Scale (GOS) score were all reviewed. The population was divided into two groups according to age: group I(babies and toddlers, age 0 to 3 years) and group II (preschool children, age

Received July 14, 2003
Accepted February 3, 2004

This research was supported by the Hallym Academy of Science, Hallym University, Korea, 2001

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4 to 6 years). Falls were classified as low level fall (LLF) or high level fall (HLF). LLF is a fall from short distance such as chair, bed, table or sofa, under 1 meter, and HLF is a fall from more than 1 meter, such as window, balcony or stairs. The height of fall was determined by witnesses or paramedics.

Statistical analyses using chi-square test were performed to compare numerical parameters in the two groups and to determine the prognostic variables. Differences were considered significant at $p<0.05$.

RESULTS

Patient data, stratified by age, are summarized in Table 1. Falls accounted for 35.2% (68 cases) of the pediatric admissions under 7 years of age due to head injury (193 cases). Of the 68 patients with fall-related head injury, 40 were boys and 28 were girls. There were 52 patients in group I and 16 patients in group II with boys predominating in group I. Group I patients sustained more LLFs than HLFs (61.5% vs. 38.5%) whereas group II patients sustained more HLFs than LLFs (62.5% vs. 37.5%). There was no correlation between age group and GOS, and the distribution of GOS was similar between patients in both groups.

All patients underwent brain CT scanning, 46 sustained a calvarial skull fracture including depressed fractures and 6 a basal skull fracture. There were 16 patients with an epidural hematoma, 8 with a subdural hematoma, 11 with cerebral contusion and 11 with cerebral concussion. Eighteen patients sustained a calvarial fracture with intracranial hemorrhage (ICH). Skull fractures were present in 18 (75%) of the 24 patients with ICH. Twenty-two patients required a craniotomy for hematoma evacuation and 8 for depression of skull. Patients with calvarial fracture only had more favorable outcome than those with ICH (Table 2) and type of head injury was correlated with clinical outcome ($p<0.05$).

Of the 38 patients with LLF, 19 had calvarial skull fracture without ICH and 7 had ICH, but of the 30 patients with HLF, 9 had calvarial skull fracture without ICH and 17 had ICH (Table 3). LLF had a higher incidence of significant skull fractures and HLF of significant ICHs ($p<0.05$). The presence of extracranial injuries was significantly higher in HLFs than in LLFs ($p<0.05$) (Table 3). But height of fall was not correlated with GOS (Table 2).

Of the 68 patients, 5 died (overall mortality rate: 7.4%). There were no fatal extracranial injuries and the only cause of fall-related death was intracranial injury. Of the 5 mortalities, 3 had subdural hematoma and 2 severe contusion.

DISCUSSION

Falls are a common cause of head injury in

Table 1. Clinical and Demographic Data of 68 Patients with Fall-Related Head Injuries

	Overall	0-3 years	4-6 years
Number	68	52	16
Sex			
Boy	40	34	6
Girl	28	18	10
Height of fall			
Low level	38	32	6
High level	30	20	10
Glasgow outcome scale			
Good recovery	59	44	15
Moderate disability	4	4	0
Death	5	4	1

Table 2. Clinical Outcome in 68 Patients with Fall-Related Head Injuries

	Glasgow outcome scale		
	GR(%)[a]	MD(%)[b]	Death(%)
Type of head injury ($p<0.05$)			
Fracture[c]	27 (96.4)	-	1 (3.6)
ICH[d]	17 (71.8)	4 (15.4)	3 (12.5)
Height of fall ($p>0.05$)			
Low level	35 (92.1)	2 (5.3)	1 (2.6)
High level	24 (80.0)	2 (6.7)	4 (13.3)
GCS[e] score ($p<0.05$)			
13-15	51 (96.2)	1 (1.9)	1 (1.9)
9-12	8 (66.6)	2 (16.7)	2 (16.7)
<9	-	1 (33.3)	2 (66.7)

[a]GR, good recovery; [b]MD, moderate disability.
[c]Calvarial skull fracture without intracranial hemorrhage.
[d]ICH, intracranial hemorrhage; [e]GCS, glasgow coma scale.

Table 3. Incidence of Fall-Related, Intracranial and Extracranial Injuries in 68 Patients

	Low level fall(%) (n=38)	High level fall(%) (n=30)
Fracture[a]	19 (50.0)	9 (30.0)
ICH[b]	7 (18.4)	17 (56.7)
ECI[c]	6 (15.8)	24 (70.8)

[a]Calvarial skull fracture without intracranial hemorrhage.
[b]ICH, intracranial hemorrhage.
[c]ECI, extracranial injury such as extremity fracture or viscus injury.

children. In our study, falls accounted for 35.2% of traumatic admissions under 7 years of age, with most of the patients beingboys and children under.[4] This is similar to the results of previous studies.[2,3,5] Younger children, particularly boys, were more prone to sustain fall-related head injury from a low height than older children did. It was known that skull fractures occur less commonly in children than in adults because children's skulls are more elastic.[6] However, Berney et al.[7] found that low-energy accidents were much more frequent in babies and toddlers than in other age groups but that skull fractures were more common in the younger age group. In our study, skull fractures and ICH were slightly more common in the preschool children than in babies and toddlers but there was no significant difference in the incidence of skull fracture and ICH between the age groups (data not shown).

The height of fall can influence clinical outcome in adults[8] but significant intracranial injuries can occur in pediatric patients from LLFs as well as from HLFs.[5,13] Murray et al.[5] have found that patients who fell less than 15 feet had a higher incidence of intracranial injuries than patients who fell more than 15 feet, but that both groups had an identical incidence of skull fractures. They suggested the lack of time available to protect oneself by extending arm as a possible explanation for the higher incidence of intracranial injuries in falls from low levels. On the contrary, Duhaime et al.[9] showed that linear skull fractures were as likely to occur from a fall of less than 4 feet as from a fall of greater than 4 feet, but that no ICH except epidural hematoma was associated with falls of less than 4 feet. Our study showed

that patients with LLF sustained more calvarial fractures than patients with HLF and that patients with HLF sustained more ICH than patients with LLF, even though criteria of height of fall was different. We suggest that intracranial injuries might be correlated with the level of energy involved from the fall, threshold to injury and type of injury mechanism, but the higher incidence of calvarial fractures in LLF could not be explained with this suggestion. The mortality rate was higher in HLFs than in LLFs (13.3% vs. 2.6%) but the difference of overall outcome was not significant. However, HLFs had a significantly greater incidence of extracranial injuries than LLFs.

The patient outcome from falls has been somewhat controversial.[5,10-13] In our study, age group and height of fall were not correlated with outcome, but type of head injury and admission GCS score were. Subdural hematomas were largely responsible for worse outcome in the patients and patients with GCS score < 9 had the worst outcome.

There might have been some sampling errors or selection bias in our study. Patients who visited the emergency department after sustaining a fall, but who were not admitted to our hospital, were not included in this study. There might be a large number of minimally injured patients who were not evaluated at the emergency department but merely under observation at home. Further prospective studies including all patients who sustained falls are needed to get more detailed information about fall-related head injury.

In conclusion, pediatric patients with LLFs can be at risk for significant intracranial injury, leading to morbidity and mortality. Therefore, aggressive evaluation for the presence of intracranial injuries should be performed regardless of the height of fall, particularly in the patients with poor clinical predictor such as GCS score < 9.

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