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Abusive head trauma in young children: characteristics and medical charges in a hospitalized population[☆]

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Abstract

Objective: To describe the presenting characteristics, hospital course, and hospital charges associated with hospital admissions for head trauma in young children at a regional pediatric trauma center, and to examine whether these factors differ among abused and non-abused subjects.

Method: Comparative case series study involving a retrospective medical record review of children less than 3 years of age admitted to Children's Hospital of Pittsburgh from January 1, 1995 to December 31, 1999. Subjects ($n = 377$) were identified on the basis of ICD-9-CM codes for head injury. Subjects were classified as abused or non-abused based on standard criteria using information about the type of injuries, the history provided by the caretaker, and physical and radiographic findings.

Results: Eighty nine (23.6%) subjects were classified as abused and 288 (76.4%) were classified as non-abused. Abused subjects were more likely than non-abused subjects to be <1 year of age (vs. >1 year of age) (OR: 9.8; 95% CI: 5.0, 19.2), covered by Medicaid (vs. commercial insurance) (OR: 2.8; 95% CI: 1.7, 4.8), and admitted to the ICU (OR: 3.5; 95% CI: 2.1, 5.8; $p < .001$). The caretakers of abused subjects were more likely to give a history of no trauma or minor trauma compared to the caretakers of non-abused subjects (97% vs. 54%, $p < .001$). Length of stay was significantly greater for abused subjects versus non-abused subjects (mean: 9.25 days vs. 3.03 days, $p < .001$). Hospital charges (1999 dollars) were significantly higher for abused (mean \pm SD: \$40,082 \pm \$58,004) versus non-abused (mean \pm SD: \$15,671 \pm \$41,777) subjects.

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Conclusions: These results highlight the differences in the demographics, presenting characteristics and economic impact of abusive head injuries compared to non-abusive head injuries.

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Introduction

Child maltreatment is a significant public health burden in the United States. There were 2.6 million reports of suspected child maltreatment in 2002. Based on these reports, 896,000 children were identified as victims of child maltreatment. Almost 20% of these children were victims of physical abuse (US Department of Health and Human Services, 2003). Abusive head trauma (AHT), the most serious form of physical abuse, is the most common cause of death from child abuse (Alexander, Levitt, & Smith, 2001). AHT is the cause of injury in approximately 25% of all children less than 2 years of age hospitalized with head injuries (Duhaime et al., 1992); among infants, the proportion of head injuries attributed to AHT is even higher, with up to 95% of severe head injury in infants being the result of abuse (Billmire & Myers, 1985).

The precise incidence of AHT is difficult to calculate since many cases go unreported or unrecognized. Two population-based studies from the United Kingdom estimate the incidence of AHT to be 24.6 per 100,000 children less than 1 year of age (Barlow & Minns, 2000) and 10.13 per 100,000 children less than 2 years of age (Jayawant et al., 1998). A recent study of severe and fatal AHT in the United States showed an incidence of 29.7 per 100,000 children less than 1 year of age (Keenan et al., 2003). This incidence is about 10 times higher than the incidence of acute lymphocytic leukemia, the most common type of leukemia in children.

The mechanism of injury in AHT is controversial, though it likely involves a combination of shaking, blunt trauma, and asphyxia/hypoxia (Alexander et al., 2001). Clinically, AHT is characterized by subdural and/or subarachnoid hemorrhages (SDH/SAH), retinal hemorrhages, and little or no evidence of external cranial trauma (Caffey, 1972). The majority of AHT victims are less than 6 months of age (Starling, Holden, & Jenny, 1995), though the clinical findings seen in AHT, particularly the findings associated with shaking, have been documented in children as old as 5 and in adults (Pounder, 1997).

Outcomes among children with AHT are poor. Mortality rates range from 15% to 38% (Alexander, Sato, Smith, & Bennett, 1990; Benzel & Hadden, 1989; Goldstein, Kelly, Bruton, & Cox, 1993; Jenny, Hymel, Ritzen, Reinert, & Hay, 1999; Kivlin, Simons, Lazoritz, & Ruttum, 2000; Starling et al., 1995). The majority of survivors suffer significant disability and neurologic impairment. Ten to 15% have a good outcome (Ewing-Cobbs et al., 1998; Goldstein et al., 1993; Kivlin et al., 2000; Starling et al., 1995).

Given the frequency of AHT and severity of the injury, it is clear that AHT places a heavy burden on the health care system. However, health care utilization and its associated costs in this population have not been well documented. Previous studies have reported high costs for medical treatment of child abuse in general (Irazuzta, McJunkin, Danadian, Arnold, & Zhang, 1997; Rovi, Chen, & Johnson, 2004), though in these studies, children with AHT represented only a small subset of the subjects. Irazuzta et al., for example, was limited to patients admitted to a pediatric intensive care unit, included only 13 cases of AHT and did not use standardized criteria for identifying abuse (Irazuzta et al., 1997). A recent

publication by Libby and colleagues specifically compared the cost of abusive and non-abusive head trauma. This study, however, was limited by the methodology: the diagnosis of AHT was based on ICD-9-CM (International Classification of Diseases Version 9—Clinical Modification) and E-codes in a large administrative database. This system depends on the proper coding of child abuse and therefore has the potential to falsely label patients with AHT as having non-abusive head trauma and vice versa (Libby, Sills, Thurston, & Orton, 2003).

Therefore, the objectives of this study were to: (a) describe the characteristics of all cases of AHT seen over a 5-year period at a major regional pediatric hospital using individual chart review, (b) describe the hospital charges associated with the initial hospitalization of these cases, and (c) examine whether these characteristics differ between AHT and non-abusive head trauma.

Methods

Setting

Children's Hospital of Pittsburgh (CHP) is a 235-bed regional pediatric referral center serving western Pennsylvania and the surrounding regions of Ohio, West Virginia, and Maryland. Located in Allegheny County, CHP is the only accredited Level 1 Pediatric Regional Resource Trauma Center in western Pennsylvania and one of only two such centers in the state. The study was approved by the institutional review boards of the University of Pittsburgh and CHP.

Study design

A comparative case series study using a medical record review.

Subjects

The medical records of children less than 3 years of age admitted to CHP from January 1, 1995 to December 31, 1999 were reviewed. All admissions with the following ICD-9-CM diagnostic codes were examined to identify head trauma events: intracranial hemorrhage following injury (852.00–852.59, 853.00–853.19); skull fracture, excluding fracture of face bones (800.00–800.99, 801.00–801.99, 803.00–803.99, and 804.00–804.99); intracranial injury of other and unspecified nature (854.00–854.19); unspecified head injury (959.01); and shaken baby syndrome (995.55). These criteria are similar to those previously used to identify traumatic brain injury events (Thurman & Guerrero, 1999), except that cases of concussion, cerebral laceration, and contusion were excluded from the study. Admissions coded as concussions were excluded because the identification, evaluation and treatment of concussion in young children is not standardized and as a result, the decision whether to hospitalize a patient is often more the result of institution-specific guidelines than a measure of injury severity. Isolated cerebral lacerations and contusions in the absence of any other head injury are rare in this population and were excluded. Use of these diagnostic codes resulted in inclusion of subjects with a code for intracranial injury, but who appeared clinically to have concussions with both negative cranial computer tomography (CT) scans and normal neurologic exams.

Three hundred and eighty-five records were identified through the diagnostic code review. Seven records were excluded because head injury occurred during the hospitalization ($n = 3$), head injury had

been treated in a previous medical care visit ($n = 1$), intracranial hemorrhage was not due to external trauma ($n = 1$), or no head injury was identified in the medical record ($n = 2$).

Classification of subjects

Each medical record was reviewed by one of the authors (R.P.B.) who categorized patients into groups based on a combination of historical, radiographic, and physical examination information. Using the criteria of [Duhaime et al. \(1992\)](#) injuries were classified as “presumptive abuse” or “suspicious for abuse.” In cases where there was not enough information in the medical record to determine whether the injury was “presumptive abuse” or “suspicious for abuse,” it was classified as “suspicious for abuse.” For example, a head injury in combination with either unexplained long-bone fractures or inflicted soft tissue injury would be classified as “presumptive abuse,” whereas a skull fracture with a reported history of minor trauma and a developmentally incompatible or changing cause of injury per caretaker(s) would be classified as “suspicious for abuse.” Head injuries that did not fit into the Duhaime criteria were classified as “not abuse.”

Measures

Medical and billing records were abstracted for all eligible subjects. Information gathered from the medical record included demographic information, injuries sustained, initial stated cause of injury, time/date of injury, discharge status (dead, rehabilitation institute, home, foster care), length of stay (LOS), insurance status (Medicaid, commercial insurance, or self-pay), and whether or not a child abuse report was filed with child protective services.

The initial stated cause of injury was defined as the mechanism of injury initially reported by the caretakers at presentation to the hospital. Causes of injury were classified as major trauma (transport-related, falls ≥ 4 feet, struck by object) or no trauma/minor trauma (falls < 4 feet, stair falls, struck by object, shaking, no history of trauma). Transport-related events included motor-vehicle crashes and pedestrian versus motor vehicle incidents. “Shaking” was classified as minor trauma because the initial histories provided by the parents/caretakers of these five children described a relatively mild shaking of the child and was not described as a hard or violent shaking motion. The decision to classify falls less than 4 feet and stair falls as minor trauma was based on previous literature that suggests that these types of falls are unlikely to result in significant intracranial injury ([Chadwick, Chin, Salerno, Landsverk, & Kitchen, 1991](#); [Helfer, Slovis, & Black, 1977](#); [Joffe & Ludwig, 1988](#); [Williams, 1991](#)).

Hospital charges were identified from associated UB-92 forms ([National Uniform Billing Committee, 1996](#)) for all identified events. The UB-92 form is a standard financial form accepted by the Health Care Financing Administration. Only charges associated with the acute event (initial hospitalization) were included. If the patient was admitted from an emergency department (ED) visit at CHP, the charges associated with this visit were also included in the estimate of hospital charges, but when patients were transferred from outside hospitals, the ED visit was not included. Charges were adjusted to 1999 dollars using the Medical Care Component of the Consumer Price Index ([US Bureau of Labor Statistics, December 2000](#)).

Table 1
Patient characteristics by classification of head trauma ($n = 377$)

Characteristic	Abused subjects ($n = 89$), no. (%)	Non-abused subjects ($n = 288$), no. (%)	p -value ^a
Males	53 (59.6%)	169 (58.7%)	.982
<1 year of age	78 (86.7%)	121 (42.0%)	<.001
Race ($n = 367$)			.626
White	69 (80.2%)	234 (83.3%)	
Non-white	17 (19.8%)	47 (16.7%)	
Allegheny County resident	32 (36.0%)	125 (43.4%)	.262
Payer type ($n = 368$)			<.001
Commercial	23 (26.7%)	143 (50.7%)	
Medicaid or self-pay	63 (73.3%)	139 (49.3%)	

Statistical analysis

The abused and non-abused groups were compared with respect to demographic factors, injuries sustained, stated cause of injury, discharge disposition, LOS, intensive care unit (ICU) admission (presence or absence), and hospital charges. Categorical data were compared using the χ^2 and Fisher's exact tests, and crude (unadjusted) odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated in order to estimate the magnitude of the relationship between head trauma category (i.e., abuse vs. non-abuse) and these variables. Total, mean, and median charges were determined for each group. Total charges and LOS data were not normally distributed. Thus, nonparametric methods (the Wilcoxon rank-sum test and the Kruskal–Wallis test) were used to compare the distributions of total charges and LOS. In order to evaluate and describe the effects of abuse among the categories of head trauma (i.e., abused vs. non-abused) within strata of potentially confounding variables, non-parametric tests were also performed within strata, defined as: age (<1 year of age vs. =1 year of age), payer type (Medicaid or self-pay vs. commercial insurance), residency (Allegheny County vs. not Allegheny County), discharge status (alive vs. dead), LOS (1 day vs. >1 day), and ICU stay (yes vs. no). Additionally, charge and LOS data were examined using negative binomial regression in order to control simultaneously for multiple potentially confounding variables. Negative binomial regression is similar to Poisson regression but allows for the variance in the data to be greater than that allowed for in Poisson models. p -values were two-sided. A p -value less than or equal to .05 was considered significant.

Results

Data was available for 377 of the 378 eligible patients. The majority of patients were male (58.9%), Caucasian (82.6%), and less than 1 year of age (52.8%). Of the 377 patients, 61 patients were classified as “presumptive abuse,” 28 “suspicious for abuse,” and 288 “not abuse.” Comparison of patient characteristics, hospital charges and LOS showed that patients in the “presumptive abuse” and “suspicious for abuse” groups were similar. Therefore, these two categories were collapsed into an “abuse” group.

Table 1 shows a comparison of the characteristics of the head trauma patients by abuse category. Subjects classified as abused were significantly younger than those classified as non-abused; 86.7% of

Table 2

Reported mechanism of injury by classification of head trauma ($n = 377$)

Mechanism of injury ^a	Abused subjects ($n = 89$), no. (%)	Non-abused subjects ($n = 288$), no. (%)
No trauma history or minor trauma history		
Fall < 4 feet	27 (30.3%)	102 (35.4%)
Stair fall	7 (7.9%)	46 (16.0%)
Struck by object	5 (5.6%)	14 (4.9%)
Shaking	5 (5.6%)	0 (0%)
No history of trauma	33 (37.1%)	1 (0.3%)
Other	9 (10.1%)	0 (0%)
Total	86 (96.6%)	154 (53.5%)*
Major trauma history		
Fall \geq 4 feet	0 (0%)	72 (25.0%)
Transport-related	0 (0%)	50 (17.4%)
Struck by object	0 (0%)	9 (3.1%)
Other	3 (3.4%)	3 (1.0%)
Total	3 (3.4%)	134 (46.5%)*

^a p -value for mechanism of injury was computed comparing abuse group with non-abuse group with respect to initial stated cause of injury classified as “minor trauma history” vs. “major trauma history.”

* $p < .001$.

the abuse group compared to 42.0% of the non-abuse group was less than 1 year of age ($p < .001$). Additionally, subjects classified as abused were significantly more likely to have Medicaid as their payer or to have no insurance ($p < .001$) than the non-abused subjects. No gender, race, or residency differences were observed.

Mechanism of injury

Table 2 lists the mechanism of injury reported initially by the caretakers at presentation to the hospital. The most common reasons for injury provided by the caretaker among abuse cases were no history of trauma (37.1%) or a fall of less than 4 feet (30.3%). Five parents (5.6%) reported “shaking” their child to resuscitate him or her. Falls less than 4 feet (35.4%), falls 4 feet and greater (25%), and transport-related injuries (17.4%) accounted for the largest proportions of non-abused subjects. Ninety-seven percent of the caretakers of abused children gave an initial history of either no trauma or minor trauma compared to 54% of the caretakers of non-abused children ($p < .001$).

Types of injuries

The distribution of injuries by category of head trauma is shown in Table 3. Skull fractures were present in the majority of abused and non-abused cases. Subdural hemorrhage (SDH) and subarachnoid hemorrhage (SAH) were significantly more common among abused versus non-abused subjects (65.2% vs. 19.1%, $p < .001$). This difference was largely accounted for by the high proportion of SDH/SAH without skull fracture among abused subjects compared to non-abused subjects [47.2% vs. 6.4%, respectively ($p < .001$)]. The proportion of cases with both a skull fracture and SDH or SAH was similar for both the

Table 3
Distribution of injuries by classification of head trauma ($n = 372$)

Injuries	Abused subjects ($n = 89$), no. (%)	Non-abused subjects ($n = 283$), no. (%)	p -value
Subdural hemorrhage (SDH) or subarachnoid hemorrhage (SAH)	58 (65.2%)	54 (19.1%)	<.001
Without skull fracture	42 (47.2%)	18 (6.4%)	<.001
With skull fracture	16 (18.0%)	36 (12.8%)	.289
Skull fracture ^a	46 (51.7%)	174 (61.1%)	.149
Closed head injury not otherwise specified	1 (1.1%)	87 (30.2%)	<.001
Rib fracture (s)	13 (14.6%)	1 (0.4%)	<.001
Long-bone fracture (s)	15 (16.9%)	13 (4.9%)	.001
Two or more fractures in any location (including skull)	19 (21.3%)	26 (9.2%)	.004

Note. Subjects could have more than 1 injury type.

^a Includes skull fractures with or without intracranial hemorrhage.

abused and non-abused subjects [18.0% and 12.8%, respectively ($p = .289$)]. Rib fractures ($p < .001$) and long bone fractures ($p = .001$) were significantly more common among abused versus non-abused subjects. Retinal hemorrhages were observed in 48.3% of the AHT subjects. It was not possible to compare the proportion of abused and non-abused subjects with retinal hemorrhages since most non-abused subjects did not have a dilated eye examination performed.

Discharge status

Information about discharge status (alive vs. dead) was available for 371 of the 377 patients. Fifteen children died during their hospital stay; nine of these were in the abused group (10.1% vs. 2.1%, $p = .003$). Among the survivors, proportionally more abused subjects were discharged to a rehabilitation institute (9% vs. 3.7%), but this difference did not reach statistical significance ($p = .073$). Just over half (55.1%) of the surviving abused subjects were discharged to foster care and about one-third (35.9%) were discharged to home.

Hospital charges and health care utilization

Hospital charge data and LOS data were available for 374 of the patients (Table 4). Hospital charges associated with inpatient admissions for the 374 admissions amounted to \$8,033,484 (median: \$6,016 per admission), and admissions for AHT accounted for 44.4% (\$3,567,267) of these charges. On average, hospital charges were significantly higher for the abused (mean \pm SD: \$40,082 \pm \$58,004; median: \$18,494) than the non-abused subjects (mean \pm SD: \$15,671 \pm \$41,777; median \$4,249) (Wilcoxon rank-sum test, $p < .001$).

LOS ranged from 1 to 80 days, and was significantly greater ($p < .001$) for abused versus non-abused subjects. While two-thirds of the non-abused subjects had a LOS of 1 day, only one-fourth of the abused subjects were discharged within 1 day. Abused subjects were more likely to have an ICU stay than were non-abused subjects (OR: 3.5; 95% CI: 2.1, 5.8; $p < .001$) and had longer stays in the ICU once there.

Hospital charges and LOS were examined within several subgroups that were potential confounders of both charges and LOS. These subgroups included age (<1 year vs. ≥ 1 year), payer type (Medicaid vs.

Table 4

Length of stay and hospital charges by classification of head trauma ($n = 374$)

	Abused subjects ($n = 89$)	Non-abused subjects ($n = 285$)
Total hospital charges (1999 dollars)**		
Median	\$18,494	\$4,249
Mean \pm SD	\$40,082 \pm \$58,004	\$15,671 \pm \$41,777
Minimum–maximum	\$1,131–\$315,618	\$1,072–\$379,614
Total LOS (days)**		
Median	5.0	1.0
Mean \pm SD	9.25 \pm 13.84	3.03 \pm 6.59
Minimum–maximum	1–80	1–58
Number (%) with an ICU stay***	46 (51.7%)	66 (23.2%)
ICU LOS (days), ($n = 112$)*		
Median	3.0	1.0
Mean \pm SD	8.52 \pm 13.28	4.53 \pm 7.27
Minimum–maximum	1–80	1–31

* $p = .001$, Wilcoxon rank-sum test.** $p < .001$, Wilcoxon rank-sum test.*** $p < .001$, χ^2 -test.

commercial), residency (Allegheny County or not), discharge status (alive vs. dead), ICU stay (yes or no), and LOS (data not shown) using the Wilcoxon rank-sum test. Admissions for abused subjects had longer LOS and were more costly than admissions for non-abused subjects among the following subgroups of patients: under 1 year of age, discharged alive, resident of Allegheny County, not a resident of Allegheny County, ICU stay, no ICU stay; primary payer Medicaid, and primary payer commercial insurance. Among patients with a LOS greater than 1 day, hospital charges were significantly higher for abused compared to non-abused subjects ($p = .016$). Among patients with a 1-day LOS, mean (abuse: \$7,782 \pm \$10,036; non-abuse: \$4,284 \pm \$4,064) and median (abuse: \$3,615; non-abuse: \$2,981) charges were greater for abused than for non-abused subjects, although the difference was not significant ($p = .164$).

Negative binomial regression analysis was used to evaluate the association between AHT and charges controlling for age (<1 year of age vs. =1 year of age), payer type (commercial insurance vs. Medicaid or self-pay), residency (Allegheny County vs. not Allegheny County), year of admission, ICU stay, and LOS (1 day vs. >1 day). Charges remained significantly greater for abused compared to non-abused subjects in this analysis ($p < .001$). In multivariate analysis, LOS for abused subjects was significantly ($p = .008$) longer than in non-abused subjects after controlling for age, payer type, discharge status (dead vs. alive), and ICU stay (yes or no).

Discussion

This study provides important data on health care charges associated with AHT in a large population of children hospitalized with head trauma. Our results highlight the significant economic impact of head trauma injuries related to child abuse. In this large regional pediatric trauma center, AHT admissions accounted for a disproportionate share of hospital charges among children less than 3 years of age; although

abuse-related admissions accounted for about one-fourth of all head trauma cases, they accounted for 44.4% of the total hospital charges in this population. Average charges were almost three times higher for abused subjects versus non-abused subjects, reflecting a greater use of resources among the abuse victims. These higher charges were most likely due to more severe injury in abuse cases, requiring ICU (rather than non-ICU) admissions and longer hospitalizations, a finding supported by the higher proportion of fatalities in the abused subjects. Our findings corroborate the findings of Libby and colleagues who noted that patients with AHT had a mean total bill 89% higher than patients with non-abusive head trauma. However, Libby's study was significantly limited by the use of ICD-9 and E-codes rather than medical record review to classify patients. Comparison of classification of our subjects based on ICD-9-CM codes versus classification by individual record review by an expert in child abuse showed that ICD codes were 80.9% sensitive and 96.2% specific for identification of AHT where the gold standard was individual medical record review. This finding suggests that ICD-9 codes falsely classified about 20% of subjects as abused when they are likely not. The actual costs associated with AHT in our study are also consistent with the study by Irazuzta et al. (1997) in which the mean charge per admissions for 13 AHT cases was \$36,453 (reported charges adjusted to 1999 dollars) compared to our estimate of the \$40,082. Our estimate for abused subjects admitted to the ICU is significantly higher: \$68,074.

Our study also provides information about the mechanism of injury provided in cases of abuse versus non-abuse. In this study, the initial stated cause of injury by caretakers for all but three of the abuse-related admissions was either a lack of any trauma or a history of a minor traumatic event. This is particularly important since the injuries in these subjects were more severe as measured by ICU admissions and fatality rate. The lack of an accurate history of trauma in cases of AHT is well established (Jenny et al., 1999; O'Neill, Meacham, & Griffin, 1973).

The percent of head injuries our study due to abuse (24%) is consistent with other previous studies of young children hospitalized with head trauma that have shown rates between 11% to 36% (Billmire & Myers, 1985; DiScala, Sege, Li, & Reece, 2000; Duhaime et al., 1992; Goldstein et al., 1993; Reece & Sege, 2000). The distribution of the types of injuries observed in our study was also similar to what has been seen in prior studies. SDH and SAH occurred more frequently in abused subjects versus non-abused subjects, particularly among children without skull fractures. Retinal hemorrhages were diagnosed in half of our abused subjects compared to .4% of our non-abused subjects, a proportion consistent with earlier research. However, it is difficult to interpret this data since the majority of subjects with non-abusive trauma did not have a dilated eye examination to assess for retinal hemorrhages (Billmire & Myers, 1985; Duhaime et al., 1992; Ewing-Cobbs et al., 1998; Kivlin et al., 2000; Reece & Sege, 2000).

Limitations

While we hypothesized that the children with abusive injury had more severe injury, we were unable to classify injury severity with a standardized measure such as the Glasgow Coma Scale (GCS) in this report because a GCS score was not consistently available in charts prior to 1997. This is unfortunately a limitation of retrospective research, particularly when it involves review of older records.

In order to capture all hospitalizations for head trauma in this population, cases were identified using the ICD-9-CM codes for skull fracture as well as for intracranial injury. Similar codes have been used elsewhere for the identification of traumatic brain injury (Thurman & Guerrero, 1999). As a result of this identification method, 88 patients with a code for intracranial injury, but with both negative CT scans and normal neurologic exams, were included; 87 of these patients were classified as non-abused. Because

these subjects are overwhelmingly in the non-abuse group and presumably have milder injuries with lower hospital charges and LOS, we reanalyzed the data excluding these 88 patients. There were no significant changes in the results; hospital charges and LOS remained significantly greater among abused compared to non-abused subjects. The presence of this subgroup highlights one of the limitations of using databases that rely on ICD-9-CM codes for identification of subjects.

It is also possible that factors unrelated to the injury contributed to the differences observed in LOS. For example, it is plausible that in order to investigate suspected child abuse, children in the abuse group might have been admitted to the hospital more frequently and hospitalized longer than non-abused children with similar injuries. While this may have contributed to the increase in costs, it is unlikely that it accounts entirely for the fact that the average LOS for abused subjects was three times that of non-abused subjects. Furthermore, though such factors might affect the decision to admit a child to the hospital, they are unlikely to affect a decision to admit to an ICU. Finally, significantly more abused subjects died as a result of their injuries. Based on these observations, the abused subjects experienced injuries of greater severity than the non-abused subjects, and this was likely the most important cause of greater use of health care resources among the abused subjects.

Finally, studies of child abuse in general are often limited by the circularity in the definition and diagnosis of child abuse and by the retrospective nature of the majority of these studies. In order to use Duhaime's criteria to classify head injury cases as "suspicious abuse" or "presumptive for abuse," there needed to be sufficient information in the medical record. In some cases, particularly those that occurred in 1995 and 1996, there was insufficient historical information and/or a lack of a skeletal survey that made classification difficult. As a result, cases of abuse may have been misclassified as "not abuse" simply because the physicians at the time of injury did not suspect abuse and therefore did not perform the necessary evaluation to make the correct diagnosis. Since misclassification would almost always place an abused child in the non-abused category, this limitation would bolster rather than refute our findings that AHT results in a greater financial burden than non-abusive head trauma.

Conclusions

AHT represents a serious form of child physical abuse and is associated with high morbidity and mortality (Alexander et al., 2001; Duhaime, Christian, Moss, & Seidl, 1996; Jayawant et al., 1998). This study provides some of the first data to show that AHT is associated with higher health care charges than non-abusive head trauma. While efforts should be made to reduce any type of pediatric head injury, our findings highlight the importance of focusing greater resources on decreasing the incidence of AHT. While this report only examined the initial economic burden that results from AHT, the long-term costs of caring for victims of AHT are likely to be far higher, particularly since victims are often very young and have a poor outcome. Further studies are needed to describe long-term costs associated with AHT.

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Résumé

Objectif: Décrire (1) les caractéristiques observées chez des enfants admis pour cause de traumatismes à la tête dans un centre hospitalier régional de traumatismes pédiatriques (2) le déroulement de l'hospitalisation et (3) les frais hospitaliers par rapport à ces admissions, puis d'examiner si ces facteurs varient selon que ces traumatismes furent le résultat de mauvais traitements ou non.

Méthode: Une étude comparative d'une série de cas, par le biais d'une revue rétrospective des dossiers médicaux d'enfants de moins de trois ans admis à l'hôpital pédiatrique de Pittsburgh entre le 1^{er} janvier 1995 et le 31 décembre 1999. En se servant de la nomenclature ICD-9-CM pour traumatismes crâniens, on a retenu 377 dossiers qu'on a classés "maltraités" ou "non-maltraités" selon qu'ils répondaient à des critères normalisés par rapport au type de blessure, à l'anamnèse de la personne chargée de la garde de l'enfant et aux observations physiques et radiologiques.

Résultats: Quatre-vingt neuf enfants (23.6%) ont été classés "maltraités" et 288 enfants (76.4%) "non-maltraités." Les enfants maltraités étaient plus aptes que le deuxième groupe à être âgés de moins d'un an (vs un an et plus), être assurés via le programme Medicaid (vs une assurance privée) et avoir été admis aux soins intensifs. Les personnes chargées de la garde des enfants maltraités étaient plus aptes à rapporter aucun incident de traumatisme ou bien un incident mineur, comparés aux gardiens d'enfants non-maltraités (97% vs 54%, $p < .001$). La durée de l'hospitalisation était beaucoup plus longue pour les enfants maltraités que pour le deuxième groupe (moyenne de 9.25 jours vs 3.03 jours, $p < .001$). Les frais hospitaliers en dollars américains étaient beaucoup plus élevés pour les enfants maltraités (déviations moyennes ± 40.082 , $\$ \pm 58.004$.) vs les non-maltraités (moyenne ± 15.671 , ± 41.777).

Conclusions: Ces résultats soulignent les différences démographiques, les caractéristiques à l'admission et les retombées économiques des traumatismes crâniens causés par les mauvais traitements, comparés aux blessures qui ne résultent pas de mauvais traitements.

Resumen

Objetivo: Describir las características de presentación, la evolución hospitalaria y los costes hospitalarios asociados con admisiones por traumatismo craneal en niños en la Unidad de Traumatología de un hospital provincial pediátrico, y examinar si estos factores difieren entre sujetos maltratados y no maltratados.

Método: Se llevó a cabo un estudio comparativo de series de casos que implicaba la realización de una revisión retrospectiva de archivos de niños menores de tres años admitidos en el Hospital Infantil de Pittsburgh entre el 1 de Enero de 1995 y el 31 de Diciembre de 1999. Un total de 377 sujetos fueron identificados como daño craneal en base a los códigos de la ICD-9-CM. Los sujetos fueron clasificados como maltratados o no maltratados en base a criterios normalizados utilizando información acerca del tipo de lesiones, la historia relatada por el cuidador y los hallazgos físicos y radiológicos.

Resultados: Un total de 89 sujetos (23.6%) fueron clasificados como maltratados y 288 como no maltratados (76.4%). Los sujetos maltratados tuvieron más probabilidades que los no maltratados de ser menores de 1 año de edad (OR: 9.8; 95% CI: 5.0, 19.2), ser beneficiarios del Medicaid (OR: 2.8; 95% CI: 1.7, 4.8), y ser admitidos en la UCI (OR: 3.5; 95% CI: 2.1, 5.8). Los cuidadores de los sujetos maltratados tenían más tendencia a proporcionar una historia de ausencia de trauma o de trauma menor comparados con los cuidadores de los sujetos no maltratados (97% vs. 54%, $p < .001$). La duración de la estancia fue significativamente mayor para los sujetos maltratados que para los no maltratados (media de 9.25 días vs. 3.03 días, $p < .001$). Los costos hospitalarios (en dólares del año

1999) fueron significativamente más altos en el caso de los sujetos maltratados (media \pm DT: \$40.082 \pm \$58.004) que los no maltratados (media \pm DT: \$15.671 \pm \$41.777).

Conclusiones: Estos resultados resaltan las diferencias en aspectos demográficos, características de presentación e impacto económico de las lesiones craneales provocadas por maltrato comparadas con las lesiones craneales no provocadas por maltrato.