

Abusive Head Trauma and a Delay in Presentation for Care

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Objectives: Abusive head trauma (AHT) is the leading cause of death from trauma in children less than 2 years of age. A delay in presentation for care has been reported as a risk factor for abuse; however, there has been limited research on this topic. We compare children diagnosed with AHT to children diagnosed with accidental head trauma to determine if there is a delay in presentation.

Methods: We retrospectively studied children less than 6 years old who had acute head injury and were admitted to the pediatric intensive care unit at a pediatric hospital from 2013 to 2017. Cases were reviewed to determine the duration from symptom onset to presentation to care and the nature of the head injury (abusive vs accidental).

Results: A total of 59 children met inclusion criteria. Patients who had AHT were significantly more likely to present to care more than 30 minutes after symptom onset ($P = 0.0015$). Children who had AHT were more likely to be younger (median, 4 vs 31 months; $P < 0.0001$) and receive Medicaid ($P < 0.0001$) than those who had accidental head trauma. Patients who had AHT were more likely to have a longer length of stay (median, 11 vs 3 days; $P < 0.0001$) and were less likely to be discharged home than patients who had accidental head trauma (38% vs 84%; $P = 0.0005$).

Conclusions: Children who had AHT were more likely to have a delayed presentation for care as compared with children whose head trauma was accidental. A delay in care should prompt clinicians to strongly consider a workup for abusive injury.

Key Words: abusive head trauma, child abuse, delay in care

(*Pediatr Emer Care* 2022;38: e170–e172)

Abusive head trauma (AHT) is the leading cause of death from trauma in children less than 2 years old and is responsible for 53% of all serious or fatal traumatic brain injury cases.^{1–3} Infants are at the greatest risk for AHT, with a median age at diagnosis of around 3 to 5 months.^{2,4} This age overlaps with the peak ages of normal infant crying, suggesting that infant crying behavior may trigger AHT and other abuse.⁵ Victims of AHT typically present with more severe symptoms than patients with accidental head trauma.⁶ The history provided by caregivers at the time of presentation in children with AHT is often incomplete or incorrect, and perpetrators rarely admit to inflicting an injury.^{3,7} A delay in presentation to care for other abusive injuries, especially fractures, has been associated with abusive injury.^{8,9} In head trauma, a delay in care has been viewed as a risk factor for abuse; however, there has been limited research on this topic.^{6,10} In a 2010 article on confessed versus witnessed accidental head trauma, Vinchon et al⁶ found evidence of an association between delayed care and abuse, but this difference was not statistically significant. Another study by Vadivelu et al¹⁰ analyzed the frequency of delayed presentation to care in AHT, but the authors classified a delay based on the stroke literature and limited their study to assess only the abusive

cases where there was a confirmed known perpetrator. Vadivelu et al did find that those with moderate delay for care (6–12 hours) had worse outcomes than those with no delay (<6 hours) or severe delay (>12 hours).¹⁰

The purpose of this study was to evaluate if the timing of patients' presentation to care with head trauma can be correlated to abusive versus accidental injury. We compared children diagnosed with AHT to children diagnosed with accidental head trauma to determine if there are differences in the proportions with delayed presentation. In addition, we explored whether a delayed presentation for care among patients with AHT is associated with patient characteristics, length of stay (LOS) and/or discharge disposition.

METHODS

We retrospectively studied children admitted to the Children's Hospital and Medical Center (Children's) in Omaha, Nebraska, who were diagnosed with a severe acute head injury requiring admission to the pediatric intensive care unit (PICU). *International Statistical Classification of Diseases, Ninth Revision (ICD-9)* and *ICD-10* codes (depending on the year of admission) for head injury were used to pull head injury cases for children in the PICU from 2013 to 2017. Children's is a designated level 2 trauma center and a regional referral center. We chose children in the PICU because children with a more severe injury, and thus PICU admission, typically have a clear symptom onset. We are better able to define a delay in seeking care when there is a clear onset of symptoms. To get enough patients for appropriate statistical analysis, we expanded the age to those children younger than 6 years. Although this seems to be comparing 2 separate groups (older accidental injuries to younger abusive injury), we believe that the overall purpose of determining how quickly a caregiver responds to a critically ill child is still met.

Sixty-four unique medical record numbers were pulled from the electronic medical record, many of which had concurrent head injury diagnosis codes. These cases were reviewed by one of the authors (J.K.) to determine the duration from symptom onset to presentation to care. A diagnosis of abuse was made by the hospital child protection team at the time of the patient's admission. Using an abstract form, patient data were gathered. The history provided by caregivers, physical examinations, consultation notes, and other progress notes were reviewed to determine the nature of the injury and the approximate time from the reported onset of symptoms to presentation to care.

Presentation to care was defined as active efforts to obtain medical intervention, for example, calling 911 or getting into a vehicle to drive to a medical facility. The time determination was based on an approximation from the history recorded in the medical record, for example, if a caregiver noted that they scooped the child up and jumped in the car, this was documented as zero minutes. In cases where the history of symptom onset was not explicitly clear, a child abuse pediatrician (S.B.H.) also reviewed the chart and all notes to determine if the time to presentation was documented. After recording an approximate time from symptom onset to actively seeking care, there was a clear cutoff around 30 minutes. Therefore, we defined a delay in care as waiting approximately 30 minutes or more from severe symptom onset

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Disclosure: The authors declare no conflict of interest.

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ISSN: 0749-5161

(when the caregiver identified that the child was clearly ill). LOS and discharge disposition were evaluated as measures of the severity of the child's outcome.

Descriptive statistics included counts and percentages for categorical data and means, SDs, medians, minimums, and maximums for continuous data. The Fisher χ^2 test for categorical variable and Wilcoxon-Mann-Whitney test for continuous variables were performed to describe the association of AHT with other risk factors. Analysis of variance test was applied to evaluate the influence of elected risk factors on major outcome variables LOS and home discharge. LOS was log transformed in the multivariable regression model due to the skewed distribution of the outcome values. All analyses were done using SAS, Version 9.4. $P < 0.05$ was considered statistically significant.

RESULTS

Sixty-four cases were identified and reviewed. Five were excluded: one was a case of brain injury due to sodium overdose rather than trauma; one was confounded by a bleeding disorder; one was an admission for a repeat surgery related to a previous head trauma; one case was eventually determined to be unexplained and had no signs of trauma; and one was excluded because of a very poor documented history where the nature of the head injury was unable to be determined. Of the remaining 59 children, 25 were diagnosed with an accidental head injury and 34 with an abusive head injury.

Patients who had AHT were significantly more likely to have a delayed presentation to care than those who had accidental head trauma (61.8% vs 20.0%; $P = 0.0017$). This finding holds true at other age ranges, although the youngest range is not statistically significant, likely secondary to fewer cases of accidental injuries in infants. P values for other age ranges are listed in Table 1. Children who had AHT were younger (median, 4.0 vs 31.0 months; $P < 0.0001$) and more likely to receive Medicaid (85.3% vs 24.0%; $P < 0.0001$) than those who had accidental head trauma. Patients who had AHT had a longer LOS (median, 11.0 vs 3.0 days; $P < 0.0001$) and were less likely to be discharged to a home environment than patients who had accidental head trauma (38.2% vs 84.0%; $P = 0.0005$). In a secondary analysis of the AHT group ($n = 34$), a delay in presentation to care was not significantly associated with age, sex, race, Medicaid insurance status, LOS, or discharge disposition (Table 2).

DISCUSSION

Although a delay in presentation has been reported as a concern for child abuse, there has been little in the literature to support that statement.^{8,10} This seems to be the first study to attempt to compare the time from injury to presentation in accidental and AHT cases. The data show a clear association between a delay in care and AHT, but it is not, however, solely diagnostic of abuse, as there were cases of accidental head trauma where there was a perceived delay in care. In conclusion, historical data, such as a

TABLE 2. Findings in Accidental and Abusive Cases

Variable	Accidental (n = 25)	Abusive (n = 34)	P
Age in months, median [range]	31 [2, 65]	4.0 [1, 54]	<0.0001
Sex ratio, male/female	13/12	19/15	0.797
Delay, n (%)	5 (20)	21 (62)	0.0015
White race, n (%)	19 (76)	18 (56)	0.168
Hispanic, n (%)	3 (12)	7 (21)	0.490
Medicaid, n (%)	6 (24)	29 (85)	<0.0001
LOS in days, median [range]	3 [2–20]	11 [2–126]	<0.0001
Discharged home, n (%)	21 (84)	13 (38)	0.0005
Child advocacy team consult, n (%)	4 (16)	34 (100)	<0.0001
Type of injury			
Epidural hemorrhage, n (%)	8 (32)	1 (3)	0.0031
Subdural hemorrhage, n (%)	15 (60)	32 (94)	0.0023
Retinal hemorrhage, n (%)	0 (0)	22 (64)	<0.0001
Skull fracture, n (%)	15 (60)	7 (21)	0.0022
LOS, length of stay.			

delay in presentation for care, can assist providers, but the final diagnosis needs to be made with an incorporation of all of the history, physical examination, and testing.

As noted above, our study incorporated children up to the age of 6 years to gather enough data to compare 2 groups. There were clear age differences in the accidental and abusive cases, which is consistent with reported literature.² In addition, there were greater numbers of abuse cases, which we believe is the result of increased severity of injury that is seen in cases when AHT is compared with accidental head trauma.²

Our study has limitations. The patient sample is relatively small and represents only a single center. The retrospective nature of the study limited the data to those that were recorded by the admitting physicians at the time the child was receiving care and may have been incomplete. The determination of a delay was based on the report of the caregiver and, especially in the AHT group, may have underestimated the time that the child was actually injured. Finally, there is some concern for circular reasoning, as a delay in care is commonly known as a risk for abuse and may have had an impact on the admitting provider's evaluation of injury origin. However, the clear differences in age and severity of injury between the abusive and accidental cases support what is reported in the literature.^{6,11}

We anticipate that this single-center study can set the stage for a larger multicenter study to more definitively measure the relationship between a delayed presentation for care and the likelihood of abuse.

In conclusion, children who were diagnosed with AHT were more likely to have a delayed presentation for care than those children admitted with accidental head trauma. Children who are diagnosed with AHT also have significantly longer LOS and a reduced probability of discharge to a home environment. A delay in care should prompt clinicians to strongly consider a workup for abusive injury.

TABLE 1. P Values Based on Age Range for a Delay in Care

Age Range	P
0–1	0.0883
0–2	0.0129
0–3	0.0050
0–4	0.0035
0–5	0.0017

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