



## Practice Implications

## Prior opportunities to identify abuse in children with abusive head trauma



Megan M. Letson (MD, MEd)<sup>a,b,\*</sup>, Jennifer N. Cooper (PhD)<sup>a</sup>, Katherine J. Deans (MD)<sup>a,b</sup>, Philip V. Scribano (DO, MSCE)<sup>c,d</sup>, Kathi L. Makoroff (MD, MEd)<sup>e,f</sup>, Kenneth W. Feldman (MD)<sup>g,h</sup>, Rachel P. Berger (MD, MPH)<sup>i,j</sup>

<sup>a</sup> Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205, USA

<sup>b</sup> The Ohio State University College of Medicine, 370 W. 9th Ave., Columbus, OH 43210, USA

<sup>c</sup> The Children's Hospital of Philadelphia, 3401 Civic Center Blvd, Philadelphia, PA 19104, USA

<sup>d</sup> Perelman School of Medicine at the University of Pennsylvania, 3400 Civic Center Blvd, Building 421, Philadelphia, PA 19104, USA

<sup>e</sup> Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave., Cincinnati, OH 45229, USA

<sup>f</sup> University of Cincinnati College of Medicine, 3230 Eden Ave., Cincinnati, OH 45267, USA

<sup>g</sup> Seattle Children's Hospital, 4800 Sand Point Way NE, Seattle, WA 98105, USA

<sup>h</sup> University of Washington School of Medicine, 4333 Brooklyn Ave. NE, Seattle, WA 98105, USA

<sup>i</sup> Children's Hospital of Pittsburgh of UPMC, 4401 Penn Ave., Pittsburgh, PA 15224, USA

<sup>j</sup> Safar Center for Resuscitation Research, 3434 Fifth Ave., University of Pittsburgh 15260, USA

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## ABSTRACT

Infants with minor abusive injuries are at risk for more serious abusive injury, including abusive head trauma (AHT). Our study objective was to determine if children with AHT had prior opportunities to detect abuse and to describe the opportunities. All AHT cases from 7/1/2009 to 12/31/2011 at four tertiary care children's hospitals were included. A prior opportunity was defined as prior evaluation by either a medical or child protective services (CPS) professional when the symptoms and/or referral could be consistent with abuse but the diagnosis was not made and/or an alternate explanation was given and accepted. Two-hundred-thirty-two children with AHT were identified; median age (IQR) was 5.40 (3.30, 14.60) months. Ten percent (22/232) died. Of the 232 patients diagnosed with AHT, 31% (n = 73) had a total of 120 prior opportunities. Fifty-nine children (25%) had at least one prior opportunity to identify abuse in a medical setting, representing 98 prior opportunities. An additional 14 (6%) children had 22 prior opportunities through previous CPS involvement. There were no differences between those with and without a prior opportunity based on age, gender, race, insurance, mortality, or institution. Children with prior opportunities in a medical setting were more likely to have chronic subdural hemorrhage (48 vs. 17%,  $p < 0.01$ ) and healing fractures (31 vs. 19%,  $p = 0.05$ ). The most common prior opportunities included vomiting 31.6% (38/120), prior CPS contact 20% (24/120), and bruising 11.7% (14/120). Improvements in earlier recognition of AHT and subsequent intervention might prevent additional injuries and reduce mortality.

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\* Correspondence to: Center for Family Safety and Healing, 655 E. Livingston Ave. Columbus, OH 43205, USA.  
E-mail address: [megan.letson@nationwidechildrens.org](mailto:megan.letson@nationwidechildrens.org) (M.M. Letson).

## 1. Introduction

Abusive head trauma (AHT) is the leading cause of death due to child physical abuse in young children (Klebens & Leeb, 2010). Children who survive often suffer lifelong consequences, including developmental delays and neurological problems (Keenan, Hooper, Wetherington, Nocera, & Runyan, 2007; Keenan, Runyan, & Nocera, 2006; Miller et al., 2014; Rhine, Wade, Makoroff, Cassidy, & Michaud, 2012). However, AHT can be difficult to identify on initial presentation because of the non-specific nature of many of the symptoms of brain injury. Vomiting, lethargy, fussiness, and decreased oral intake, for example, can be symptoms of brain injury but also of many other childhood diseases. In addition, in cases of AHT, caregivers frequently do not provide a trauma history, or if they do provide one, the history is often inaccurate and/or incomplete (Flaherty, 2006). Therefore, child abuse, including AHT, may not be considered as part of the differential diagnosis when a child initially presents for medical care. As a result, the child may be mistakenly diagnosed with a less serious medical condition or accidental injury, resulting in delayed or missed diagnosis (Barlow, Thompson, Johnson, & Minns, 2004; Jayawant & Parr, 2007; Jenny, Hymel, Ritzen, Reinert, & Hay, 1999; Karandikar, Coles, Jayawant, & Kemp, 2004; King, MacKay, Sirnick, & Group, 2003; Ricci, Giantris, Merriam, Hodge, & Doyle, 2003; Sheets et al., 2013; Shein et al., 2012).

Early detection of child physical abuse is vital. Multiple studies have demonstrated that physical abuse is rarely an isolated event and often children who are diagnosed with physical abuse have sustained prior abusive episodes (Alexander, Crabbe, Sato, Smith, & Bennett, 1990; Sheets et al., 2013; Sieswerda-Hoogendoorn et al., 2013; Thackeray, 2007). However, these prior episodes of physical abuse frequently go undiagnosed (Jenny et al., 1999; Oral, Yagmur, Nashelsky, Turkmen, & Kirby, 2008; Petska, Sheets, & Knox, 2012; Sheets et al., 2013; Thackeray, 2007). In a landmark retrospective study, Jenny et al. (1999) showed that 31% (54) of 173 children diagnosed with AHT had been seen by physicians after an injury occurred but the diagnosis had been missed. The most common incorrect diagnoses included gastroenteritis, accidental head injury, and 'rule out sepsis'. King et al. reviewed child homicide deaths and showed that of 37 children less than 4 years who died of abuse, seven (19%) were evaluated by a physician within the month prior to sustaining fatal injury (King, Kiesel, & Simon, 2006). Three of these seven children had an emergency department visit for chief complaints that, in retrospect, were concerning for abusive injury. Sheets et al. (2013) performed a case-control retrospective study which evaluated sentinel injuries (defined as prior injuries that were visible to at least one parent before presentation for hospitalization and were suspicious for abuse i.e. bruising and intraoral injuries) in 401 infants less than 12 months old who were evaluated by a hospital-based child protection team (CPT) for physical abuse concerns. They observed 27.5% (55) of 200 infants diagnosed with 'definite abuse' had prior sentinel injuries compared with 8% (8/100) in the 'intermediate concern for abuse group' and 0% (0/101) in the 'no concern for abuse' group. These studies suggest that the medical community often fails to diagnose abuse on initial presentation, which can have devastating consequences for children.

Although the published studies clearly demonstrate that the diagnosis of abuse, including AHT, is often missed, these studies provide little information about the setting where the missed opportunities occur. The objectives of our study were to evaluate demographic and clinical characteristics of a consecutive multi-center sample of children diagnosed with AHT to determine whether they had a prior opportunity to identify abuse, to describe that opportunity, and to evaluate potential predictive factors that may be associated with prior opportunities.

## 2. Methods

This is a secondary analysis of data as part of an AHT consortium, methods of which have been published previously (Berger et al., 2011). Four pediatric hospitals constituted the AHT Consortium (Children's Hospital of Pittsburgh of UPMC [Pittsburgh, Pennsylvania], Cincinnati Children's Hospital Medical Center [Cincinnati, Ohio], Nationwide Children's Hospital [Columbus, Ohio], and Seattle Children's Hospital/Harborview Medical Center [Seattle, Washington]). All participating hospitals received institutional review board approval with a waiver of consent.

The study population for the current study included all children younger than 5 years with AHT diagnosed at a participating hospital between 7/1/2009 and 12/31/11. The diagnosis of AHT was determined by consensus of the study hospitals' respective child protection teams (CPT) and by study child abuse pediatricians' review of the study subject's entire evaluation, including history, injuries, and child protective services (CPS) and/or law enforcement investigations, when available. All information regarding CPS and law enforcement investigations was limited to information found in the medical records and/or obtained as part of the CPT consultation process. Primary records for the prior opportunities were not consistently available. Obtaining such information from family members and/or investigative agencies is a standard part of the CPT consultation. Study authors did not routinely have access to CPS or law enforcement records for the purposes of this study. Defining an injury as abusive based on a CPT's conclusion is frequently used in studies of AHT (Berger et al., 2011; Jenny et al., 1999; Keenan et al., 2003; Scribano, Makoroff, Feldman, & Berger, 2013; Sheets et al., 2013; Shein et al., 2012).

Demographic data included age, gender, race, ethnicity (Hispanic or Latino), and insurance status. Race and ethnicity were defined as per the National Institute of Health's recommendation (Office of Management and Budget, 1997). Clinical information included reason for presentation, if a trauma history was provided at the time of presentation, initial Glasgow Coma Scale (GCS) score, presence or absence of PICU admission, tracheal intubation/mechanical ventilation status, and mortality at hospital discharge. Information about intracranial and extra-cranial injuries was collected as dichotomous data (e.g. present or absent). The presence of subdural hemorrhage (SDH) and subarachnoid hemorrhage (SAH) were further categorized as 'acute only', 'chronic only', or 'acute and chronic' based on the attending radiologist's CT and/or MRI initial

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