Predictors of Screening and Injury in Contacts of Physically Abused Children

Daniel M. Lindberg, MD[1,2], Emily A. Blood, PhD[3], Kristine A. Campbell, MD, MS[4], Antoinette L. Laskey, MD, MPH[5], and Rachel P. Berger, MD, MPH[6], on behalf of the Examining Siblings to Recognize Abuse (ExSTRA) Study Group*

Objective To determine rates of screening in contacts of children evaluated for physical abuse, and the relationship of clinical characteristics to screening recommendation and completion and injury identification.

Study design This is a planned secondary analysis of a prospective study of 1918 contacts of 1196 children referred for subspecialty abuse consultation in 20 US centers. We used multivariable logistic models to determine the relationship of index child characteristics, contact child characteristics, and shared characteristics to screening and injury identification.

Results We identified injuries or disclosures of abuse in 180 (9.4%) contacts. Recommended screening was omitted in >20% of subjects for each screening modality. At least 1 screening test was more likely to be completed in contacts of index children of non-White race or Hispanic ethnicity (OR 1.45, 95% CI 1.13-1.87), with abuse-specific injuries (OR 2.15, 95% CI 1.63-2.83), with a confession (OR 2.18, 95% CI 1.17-4.07), when the history changed (OR 1.65, 95% CI 1.05-2.61), when an occult injury was found by imaging in the index child (OR 1.84, 95% CI 1.39-2.43), and when families lacked private insurance (OR 1.63, 95% CI 1.15-2.31).

Conclusion Completion of screening recommended for contacts of potentially abused children is relatively poor, despite high risk of injury. Several clinical and demographic factors were associated with increased contact screening. *(J Pediatr 2013;163:730-5)*.

Physical abuse is an important source of morbidity and mortality in children[1,2] that is, nevertheless, commonly missed in its early stages, when injuries are most likely to benefit from protective interventions.[3-5] Radiographic and laboratory testing in high-risk populations can identify abusive injuries and guide protective interventions.[6-10] Siblings and other household contacts of abused children have long been thought to be at increased risk of abuse, but no guidelines exist for contact screening and recommendations are highly variable among child abuse physicians (CAPs).[11,12] Physicians often depend on public Child Protective Services (CPS) agencies to bring contact children for medical care and to help facilitate medical screening, but in the absence of data, it can be difficult for CPS agencies to ensure screening if faced with resistance from caregivers.[11,13]

We previously identified occult abusive fractures in an important fraction of household contacts at high risk using a screening protocol that had been accepted as the standard of care for screening by 20 US child abuse teams.[14] However, no data are currently available for the broader population of contacts who did not meet high risk criteria for protocol inclusion, and who are most likely to have variable screening.

In index children, screening decisions can be affected by clinical characteristics that have a real or perceived relationship to abuse likelihood, such as age, sex, race, social factors, or the presence of concerning findings on the physical examination.[2,15-18] For this planned, secondary analysis, our objective was to determine the effect of these and other clinical factors on contact screening in the population of contacts as a whole, and to determine the factors that predicted injury identification among screened subjects.

Methods

This was a prospectively planned, secondary analysis of data from the Examining Siblings to Recognize Abuse (ExSTRA) research network,[14] which consisted of 20 US child abuse teams that endorsed a common protocol of recommendations for screening in contact children as their local standard of care. Enrollment occurred between January 15, 2010 and April 30, 2011. Details of the common screening protocol have been published previously.[14] The ExSTRA research network was observational and no efforts were made to encourage or ensure compliance

CAP	Child abuse physician
CPS	Child Protective Services
ExSTRA	Examining Siblings to Recognize Abuse

From the [1]Department of Emergency Medicine, Brigham and Women's Hospital, [2]Division of Emergency Medicine, and [3]Clinical Research Program, Boston Children's Hospital, Boston, MA; [4]Department of Pediatrics, University of Utah; [5]Center for Safe and Healthy Families, Primary Children's Hospital, Salt Lake City, UT; and [6]Department of Pediatrics, Children's Hospital of Pittsburgh, University of Pittsburgh Medical Center, Pittsburgh, PA

*A list of ExSTRA Study Group investigators is available at www.jpeds.com (Appendix).

Supported by the Health Resources and Services Administration/Maternal and Child Health Bureau, Emergency Medical Services for Children Program (H34MC19346-01-02). D.L. is supported in part by an Eleanor and Miles Shore Fellowship for Scholars in Medicine from Harvard Medical School. D.L. and A.L. have provided paid expert testimony for prosecution and defense in cases of alleged child physical abuse. The other authors declare no conflicts of interest.

0022-3476/$ - see front matter. http://dx.doi.org/10.1016/j.jpeds.2013.02.051

with the common screening protocol for research purposes. CAPs omitted testing or recommended screening beyond the protocol at their own discretion. All participating centers and the data coordinating center obtained approval from their local institutional review board with a waiver of informed consent.

Index children were defined as children less than 120 months (10 years) old who were evaluated by a CAP for concerns of physical abuse. Contact children were defined as children less than 120 months (10 years) old who, in the previous month, shared the same household or other care environment where abuse was suspected to have occurred in an index child. Contacts were most commonly biological siblings of the index child, but could also include half-siblings, step-siblings, other relatives, or daycare contacts.

Each participating center maintained an independent census of patients eligible for inclusion; numbers of enrolled patients were compared monthly with numbers of eligible patients and missed subjects were entered retrospectively. All participating centers enrolled >90% of eligible subjects based on monthly audits.

This analysis includes all contacts, regardless of whether they met protocol criteria for screening. When multiple children from the same household were brought simultaneously with concerns for abuse, all such children were considered index children and any other children not initially brought for care were considered contacts. We excluded 9 such contacts with multiple index children because we wished to isolate the clinical characteristics of the index child that were associated with contact child screening.

Data were entered for index and contact children by the CAP and included any screening studies that were recommended or completed in contact children and results of any completed studies. For index children, we prospectively defined "abuse-specific injuries" to include: patterned bruises, retinal hemorrhages characteristic of abuse (as determined by the CAP), classic metaphyseal fracture(s), posterior rib fracture(s), or presence of both acute and healing fractures.[19-25] Information about the insurance status, race, and ethnicity were abstracted by investigators from hospital registration records. Age and sex data were missing for 31 and 68 contacts, respectively. The relationship between index and contact was missing in 47 cases and race and ethnicity data were missing for 22 index children.

All screening was undertaken according to the standard of care for the participating center. All centers performed skeletal survey according to the standards endorsed by the American Academy of Pediatrics[26] and/or the American College of Radiology.[27] Neuroimaging included computed tomography or magnetic resonance imaging, but not cranial ultrasound alone. Interviews of contact children were conducted according to the clinical practice of the participating center, and included interviews conducted by clinicians, social workers, law enforcement, or CPS. For children older than 2 years, the physical examination could be performed by a physician or CPS. Although most CPS agents are not trained to perform a medical physical examination, they often determine if children have cutaneous injuries and/or clear signs of malnutrition.

For this study, screening studies were recommended if the CAP undertook the screening themselves, or recommended the study verbally or in writing to the clinical team caring for the index or contact child or to a CPS agency with responsibility for the case. Studies were completed if results were available to the CAP. Skeletal survey, neuroimaging, and physical examination were positive if they identified an injury that had not been identified previously. Interviews of contact children were considered positive if the contact child disclosed abuse of the index child and/or of themselves. The determination of whether there was a changing history was made by the responsible CAP.

Data Analyses

Descriptive statistics were used to characterize the population of contact children. Generalized estimating equations with a logit link were used to model screening recommendation, screening completion, and injury identification among contacts. Generalized estimating equation models were used to account for the correlation of data from multiple contacts related to the same index child. The participating center was not included as an adjusting covariate as some centers enrolled few subjects and, therefore, the model was not estimable. Multivariate models were run separately for each outcome as well as for each screening type (physical examination, skeletal survey, neuroimaging, and interview). In addition, an overall model of screening recommendation, screening completion, and injury identification by any of the tests was also fit. Clinical characteristics were chosen for inclusion into models a priori based on factors thought by the authors most likely to influence the likelihood of abuse and by factors suggested by prior literature.[2,12]

Analyses based on race and ethnicity dichotomized children with both White race and non-Hispanic ethnicity and all others. Analyses of insurance status compared children with private insurance to those with public insurance or no insurance. Analyses of the relationships between index and contact children dichotomized siblings from all other contacts (half-siblings, step-siblings, other relatives, daycare, or other). Statistical significance is considered at the 0.05 level. No adjustment was made for multiple comparisons. All analyses were run using SAS v. 9.2 (SAS Institute, Cary, North Carolina).

Results

After excluding 9 contacts with multiple index children, 1918 contacts and their 1196 index children formed the main study cohort. Clinical characteristics of index and contact children are shown in **Table I**. Proportions of index children with abuse-specific injuries were similar to proportions of contacts associated with index children with each injury (**Table II**; available at www.jpeds.com).