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Child Abuse: Overview and Evaluation



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PEDIATRIC COLLECTIONS

Child Abuse: Overview and Evaluation

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Child Abuse: Overview and Evaluation iii

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Martin A. Finkel, DO, FACOP, FAAP Angelo P. Giardino, MD, PhD, MPH

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Foreword | Protect the Child

Over 40 years ago, I watched a rudimentary axial image of an infant's head slowly appear on the screen. The technology was state of the art, my medical school hospital proud to have installed a newly minted, first-generation computed tomography (CT) scanner. As the infant lay in the scanner tunnel, the pediatric neurosurgeon and the 3 of us shadowing second-year medical students discussed the history of the infant, how he was under the care of a babysitter when he slipped out of the babysitter's arms, falling headfirst onto the hardwood floor and immediately becoming limp and unresponsive. As the image of a pixelated, vague gray circular area encapsulated by white "crescent moons" emerged on the CT monitor screen, the neurosurgeon shook his head stating that the infant had bilateral subdural bleeds due to the fall, and the poor babysitter will probably feel guilty for what was obviously an accident. When asked how these bleeds occur, the neurosurgeon answered, "A simple fall over a short distance onto a hard surface can cause significant intracranial bleeding in an infant. Why it happens to some but not others is unknown." Later, the infant was found to have a broken right arm, also attributed to the fall. That was in 1978. Yet, while in 1946 Dr. John Caffey described infants with subdural bleeds and long bone fractures probably due to accidents, in 1972 Dr. Caffey, reconsidering what he had been observing over the years, introduced the concept of the shaken baby syndrome. Violent shaking of an infant could lead to subdural hemorrhages, retinal hemorrhages, and long bone fractures. The pattern of injuries in the infant I had encountered was not the result of a simple accidental fall.

During residency 3 years later, I was involved in the care of an infant who had bilateral subdural hemorrhages, bilateral retinal hemorrhages, metaphyseal fractures, and bruises on the face and trunk. The district attorney asked me to testify in court as to the cause of the infant's condition but also asked if I could have the attending physician testify. Now the attending physician, a national expert in his field of pediatrics, had a reputation for being gruff with residents, not wishing to be disturbed from his own academic pursuits. To ask him to testify begged retribution. I very timidly approached the attending physician and asked if he would testify. The attending gave me a very piercing stare, and I prepared myself for the expected rebuke. After a very long pause, the attending said, "Dr. Zenel, there is a point in one's career as a pediatrician you need to take a stand and protect the child." Needless to say, he testified. He also became a treasured mentor.

Since 1962, when Dr. Henry Kempe published his observations on the "Battered Child Syndrome," the definition of "child abuse and neglect" has expanded to include many forms of non-accidental trauma and neglect to the infant, child, and adolescent. There are physical abuse, sexual abuse, psychological abuse, and medical child abuse and neglect (formerly known as Munchausen by proxy). The 2 lessons I learned as a medical student and as a resident hold true today. While medicine advances in technology and knowledge, we need to stay up to date. More importantly, we need to protect the child.

Joseph A. Zenel, MD, FAAP

Editor-in-Chief, Pediatrics in Review

Introduction | When Child Abuse Enters the Medical Home

When child abuse or neglect concerns present to the provider and "enters the medical home," the initial responses might very well be a complex combination of fear, denial, and decision paralysis. Even the most experienced pediatrician might feel, "Never. Not this parent"; or maybe judge, "Of course, this family..."; or question, "What do I do now?" This small and important collection of American Academy of Pediatrics (AAP) publications and reports provides guidance and support to the medical home providers.

Be Aware. The scope of the problem of child maltreatment has essentially remained unchanged for the past decade. The National Child Abuse and Neglect Data System, a voluntary data collection system that gathers information from all 50 states, the District of Columbia, and Puerto Rico about reports of child abuse and neglect, examines trends in child abuse and neglect across the country. While sexual abuse reports have declined, reports for other forms of maltreatment have not consistently declined across our country. Our attention to child maltreatment is now framed in a broader view with a solid evidence base on identification and growing knowledge as pediatricians on the effects of child abuse on health and development. Adverse childhood experiences, toxic stress in all forms, but especially interpersonal violence, can alter brain structure, physiology, and over-functioning of the child or teen victim. Awareness that the problem exists and how to address the concern is now more than ever a call to action for the pediatrician. Keeping the diagnosis of child maltreatment on the differential for both physical examination findings and for behavioral changes is the starting point for correct identification and action.

Be Prepared. Our role in identification, evaluation, and treatment for children with a diagnosis of suspected or confirmed child maltreatment can be guided—as with any diagnosis or condition—by evidenced-based guidelines. Listed here are important AAP references that are practical and essential guides when evaluating and treating sentinel injuries, physical abuse, and sexual abuse. The more complex the clinical scenario or patient, the greater the risk for the child is balanced with the need to be thorough in approach, hence the additional resources listed under high-risk populations. Practical things take an impractical amount of time and effort when child maltreatment is a concern. Consultation with other subspecialties, including child abuse pediatricians who can be found by region via the AAP Council on Child Abuse & Neglect website, should be considered depending on the physical or behavior presentations.

Stay Connected. Once a report is made to child protective services, the inherent reaction or next step may be to let the system do its job and to disconnect from the process. A key part of the ongoing evaluation of and then help for the child and family is the connected partnership of the pediatrician and child welfare system. Beyond the mandated report, we play a role in educating caseworkers about everything pediatric so they are best informed about injury, behavior, disease or condition, and of course, child development. Advocating for the parent to establish a safer and more effective parenting style is in our medical home toolbox. Establishing trusted relationships with community partners in child welfare, behavioral health, and home visitation programs is crucial in the ongoing care of these children and families.

Finally, just as we are champions for safety in injury prevention (car seats, helmets, and socket plugs), infection control (immunizations and handwashing), and child development (preschool for all kids, in-office screenings, child find services), we are all inherent child maltreatment prevention champions. As we promote positive parenting in all our early childhood interactions, we have safe and healthy children as our north star. With that in mind and heart, we can be prepared to respond when child abuse enters the medical home and a child needs our advocacy and help.

Andrew Sirotnak MD, FAAP

Editorial Board, *Pediatrics in Review* Cochair, AAP Council on Child Abuse & Neglect Director, Child Protection Team & Children's Hospital Colorado & The Kempe Center

Physical Abuse of Children

Jill C. Glick, MD,* Michele A. Lorand, MD,[†] Kristen R. Bilka, MMS, PA-C[‡]

*Department of Pediatrics, University of Chicago; Medical Director, Child Advocacy and Protective Services, University of Chicago Comer Children's Hospital, Chicago, IL.

[†]Division of Child Protective Services, Department of Pediatrics; Medical Director, Chicago Children's Advocacy Center, John H. Stroger, Jr. Hospital of Cook County, Chicago, IL.

*Department of Pediatrics, University of Chicago; Physician Assistant, Child Advocacy and Protective Services, University of Chicago Comer Children's Hospital, Chicago, IL.

EDITOR'S NOTE

This article stresses the importance of the "sentinel injury," a physical injury that is unusual for the age of the child and may herald more serious injuries, thereby necessitating further evaluation.

> Joseph A. Zenel, MD Editor-in-Chief

Practice Gap

Before receiving a diagnosis of child abuse, 25% to 30% of abused infants have "sentinel" injuries, such as facial bruising, noted by clinicians or caregivers. (1)(2)(3)(4)(5)(6) Although easily overlooked and often considered minor, such injuries are harbingers warning clinicians that pediatric patients require further assessment. Appropriate intervention is critical, and the clinician plays a major role in identifying children who present with signs or symptoms concerning for child physical abuse by ensuring appropriate and expeditious medical evaluations and reports to child protective services.

Objectives After completing this article, the reader should be able to:

- 1. Identify which injured children require a child abuse evaluation.
- Recognize subtle signs and nonspecific symptoms of major trauma in infants.
- 3. Understand sentinel injuries and their significance.
- Know which laboratory and imaging studies to obtain when child physical abuse is suspected.
- Understand the legal obligation to report children with injuries that are suspicious for physical abuse and develop a thoughtful approach to informing parents of this legal obligation.

CASE PRESENTATION

A private practice pediatrician receives a phone call from a community emergency department (ED) physician regarding one of her patients, a 4-month-old infant being treated for bronchiolitis. The ED physician informs her that the baby's chest

AUTHOR DISCLOSURE Drs Glick and Lorand and Ms Bilka have disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

radiograph has revealed multiple posterior rib fractures in different stages of healing, and physical examination shows a cluster of small bruises on her cheek. The mother denies a history of trauma and has no explanation for the findings. The ED physician is concerned that the baby has been abused and his plan includes admitting the patient to the hospital to obtain a head computed tomography (CT) scan, skeletal survey, complete blood cell count, coagulation studies, electrolytes, and liver function tests. He also plans to consult with the child abuse pediatrician and arrange for an evaluation of the patient's siblings. Lastly, he tells the primary pediatrician that he will explain the clinical findings to the family and file a report with the child welfare system. The primary pediatrician thanks him for contacting her and, recalling no significant medical history, pulls the patient's chart.

The baby's most recent visit was slightly more than I week ago for her routine 4-month health supervision visit. She is a term infant who has no prior medical complaints other than colic at I month of age that has resolved. On recent physical examination, the baby appeared well, with normal growth and development, and the mother did not raise any concerns during the visit. The primary pediatrician now notes that she documented a small circular bruise on the baby's chest that the mother stated occurred when a 3-year-old sibling hit the baby with a toy. Having had a longstanding relationship with this mother and family, she accepted this explanation for the bruise.

After reviewing the chart, she explores the current literature and management of suspected child physical abuse, including the American Academy of Pediatrics clinical report on evaluation of suspected child physical abuse. (7) She now understands that the bruise she noted on examination was a sentinel injury that should have prompted further evaluation. As a result of the case, her practice group plans to review and implement guidelines for the identification and evaluation of children presenting with signs or symptoms concerning for physical abuse.

INTRODUCTION

Child physical abuse is a difficult diagnosis to entertain primarily because clinicians are hesitant to accept that caretakers can injure children. The diagnosis is further complicated by the reality that caretakers rarely disclose maltreatment, preverbal or obtunded children cannot provide a history, and signs and symptoms of physical abuse may be subtle and confused with other common pediatric diagnoses. Clinicians must appreciate that with few exceptions, almost any injury can be either abusive or accidental.

Once considered a strictly social problem, child abuse is now also recognized as a medical problem. A recent survey by the Children's Hospital Association revealed that more than 90% of responding hospitals have child protection teams, and more than 50% have at least 1 of the 324 boardcertified child abuse pediatricians in the United States on staff. (8)

Recognition of the profound impact of childhood experiences on adult health and well-being, beginning with Feleitti's landmark adverse childhood experiences study, further solidifies the need for clinicians to recognize possible maltreatment and intervene. (9) Adverse childhood experiences have wide-ranging, cumulative, and direct impacts on adult health, increasing the incidence of chronic diseases and early death. (9)(10) The role of the clinician is therefore not only limited to promoting wellness but also to decreasing or eliminating long-term health consequences resulting from childhood exposure to trauma and violence.

EPIDEMIOLOGY

In 2014, over 3.5 million children were subjects of child maltreatment reports. Of those, 702,000 children (20%) were found to have evidence of maltreatment. (11) This translates to an annual victimization rate of 9.4 children per 1,000 in the United States and a prevalence rate of 1 in 8 children by age 18 years. (12) Neglect is the most common form of child maltreatment, constituting 75% of indicated reports; 17% are attributable to physical abuse. In 80% of child physical abuse cases, a biological parent is the perpetrator. Children in their first postnatal year have the highest victimization rate (24.4 per 1,000), and children younger than age 3 years have the highest fatality rate, comprising over 70% of the nationally estimated 1,580 child maltreatment deaths in 2014. Child welfare data and trends, however, are dubious because of a lack of standardized terminology and differences in report and response types across states.

RISK FACTORS FOR CHILD PHYSICAL ABUSE

Risk factors for abuse are commonly categorized into parental, child, and social characteristics. Identification of risk factors aids in the assessment of abuse but more importantly aids in the ability to counsel parents and develop preventive strategies. Risk factors are not, in and of themselves, diagnostic. Many families have risk factors and never abuse their children, while others have no apparent risk factors and do abuse their children. Child abuse does not discriminate; it affects children of all ages, socioeconomic classes, and ethnic groups.

Parental/household risk factors include substance abuse, mental illness, interpersonal violence (IPV), single and/or teen parent, and a nonrelated adult in the home. Among the social risk factors are social isolation, poverty, lower levels of education, and large family size. Childrelated risk factors include prematurity, low birthweight, intrauterine drug exposure, and developmental and physical disabilities. The most significant risk factor for abuse is the age of the child, with infants and toddlers being at greatest risk for serious and fatal child physical abuse.

A clear association exists between particular developmental stages and physically abusive injuries, such as excessive crying and abusive head trauma or toilet training and inflicted scald burns. Awareness of these developmental triggers should guide anticipatory guidance, with the potential for preventing an abusive injury.

IPV is a substantial risk factor for child abuse, and each health supervision visit should include IPV screening. Exposure to violence itself, even if the child is not physically harmed, has significant and long-lasting effects.

WHEN TO CONSIDER THE DIAGNOSIS OF CHILD PHYSICAL ABUSE

Injuries are common in childhood. Although most childhood injuries are accidental, the clinician must appreciate that almost any injury can be abusive. With the exception of patterned marks, very few injuries are pathognomonic for abuse. In the nonverbal child, injuries may be apparent or covert; many children present with nonspecific symptoms and a lack of history. Child physical abuse should be entertained in any infant displaying signs or symptoms potentially explained by trauma, such as irritability, lethargy, vomiting, apnea, seizures, or coma.

Several studies of abused children have demonstrated that antecedent sentinel injuries, such as bruises, intraoral lesions, and skeletal trauma, were noted by medical professionals or caregivers before a subsequent abusive act, while children presenting with accidental injuries were not found to have sentinel injuries. (I)(2)(3)(4)(5)(6) Because infants are essentially nonmobile and nonweight-bearing, they should never have bruising. Therefore, any injury in an infant must be viewed as significant and descriptive language such as "minor" should not be used. Identifying a sentinel injury with appropriate evaluation of the child may be lifesaving.

As children become mobile, the incidence of expected accidental trauma increases, and common childhood injuries such as bruises over bony prominences and toddler's, clavicular, and skull fractures are seen. In contrast to children with abusive injury, witnesses often corroborate accidental injuries in ambulatory children, caregivers seek timely care, they provide a consistent history, and the mechanism described explains the injury observed. Because the incidence of child physical abuse is highest in children younger than age 4 years, the clinician must have a high index of suspicion and add abusive trauma to the differential diagnosis of the ill-appearing young child.

Determining which injured children require an evaluation for child physical abuse should account for the age and developmental ability of the child, the injury sustained, the adequacy of the historical explanation provided, and

TABLE 1. Criteria for Consideration to Initiate a Child Physical Abuse Assessment

Age and Development

 Nonme 	obile infant with <i>any</i> injury
• Injury i	in nonverbal child
• Injury i	inconsistent with child's ability
• Statem	nent of harm from a verbal child
Injury	
• Any in	jury in a nonmobile infant
• Uncom	nmon in age group
• Occult	finding
• Mecha	nism not plausible
• Multip	le injuries, including involvement of multiple organs
 Injuries 	s of differing ages
• Patterr	n of increasing frequency or severity of injury over time
 Patterr 	ned cutaneous lesions
 Bruises 	to torso, ear, or neck in child younger than age 4 years
• Burns to	o genitalia, stocking or glove distribution, branding, or pattern
History	
• Chief co <i>and</i> pl	omplaint does not contain caregiver concern for an injury lausible history
• Careta	ker response not commensurate to injury
• Unexp	lained delay in seeking care
• Lack o	f, inconsistent, or changing history

Inconsistencies or discrepancies in histories provided by involved caretakers

clinical findings (Table 1). Fundamentally, when injuries are not explained or historical data provided contain inconsistencies or insufficiencies, a child abuse evaluation is warranted. Any child younger than age 2 years who presents with a suspicious injury should have a skeletal survey. Other studies should be obtained based upon clinical concern and findings. Negative studies do not rule out child abuse.

HISTORY OF THE PRESENT ILLNESS AND CHILD PHYSICAL ABUSE

A thorough history of present illness is the single most useful piece of information to aid the clinician in making a correct diagnosis. The detailed history should be obtained in separate interviews with each caregiver, the child (if possible), verbal siblings, and any other persons in the household. Interviews should be conducted such that each parent or caregiver can give a history in his or her own words. He or she should be allowed to provide the entire history without interruption, decreasing the chance that the interviewer unintentionally redirects or suggests a mechanism. Details about the mechanism of injury, the events leading up to the injury, and whether the injury was witnessed or unwitnessed should be elicited. For example, in injuries related to falls, having parents recreate the scene, describing the height of furniture, flooring, and the position of the child before and after the fall, is essential.

A history of the onset and progression of symptoms since the child last appeared well should be obtained. Determining who was caring for the child and asking each of the caretakers how the child appeared by focusing on descriptions of activity and movement (particularly during feeding, bathing, and diaper changing) can aid in determining when a child may have been injured. For infants with intracranial injury, it may be difficult to develop a timeline of when the child was last well because the infant may be thought of as "well-appearing" while asleep when the child actually may be seriously injured. Important features of the history that should raise concern for an abusive injury include: no history of trauma; a history of trauma inconsistent with the severity, pattern, or timing of the injury; injury inconsistent with the developmental capabilities of the child; multiple or evolving histories; discrepant histories from the same caregiver or between caregivers; injury attributed to a sibling or pet; and a delay in seeking medical care.

In addition to a detailed history of the incident, the patient's birth, past medical, developmental, and dietary

histories should be obtained. A complete social history identifies risk factors for maltreatment, and a family medical history focusing on illnesses such as bone disease or bleeding tendencies allows for screening and identification of possible underlying medical problems in the patient.

PHYSICAL EXAMINATION AND DIAGNOSTIC EVALUATION

A thorough and well-documented physical examination of any child with concerns for possible child abuse is imperative. The clinician should be aware that children may suffer more than one type of abuse; the physically abused child may also be neglected or sexually abused. The child's mental status, affect, and level of activity should be noted. The child must be undressed and all skin surfaces examined with good lighting. The entire body must be evaluated, including areas that may be overlooked, such as the pinnae, behind the ears, the oral cavity including the teeth and frenula, the soles and palms, the genitals, and the anus. Every cutaneous injury should be described according to color, shape, size, and location. Photographic documentation or drawings should be completed and placed in the medical record. The presence or absence of swelling and the ability to move limbs should be noted. Paradoxical comfort (a baby who is more comfortable when not being held but cries when picked up) may be observed in infants with occult injuries such as rib fractures. An assessment of the child's nutritional status, including completion of a growth chart, is crucial because neglect, malnutrition, and failure to thrive may be comorbidities with physical abuse.

The diagnostic evaluation of suspected physical abuse should always be driven by the history, physical examination, and differential diagnosis. Clinicians must consider the possibility that multiple types of trauma may coexist and recognize that injuries may be occult. Any nonverbal and nonambulatory child with an injury should have a standard child abuse evaluation (Table 2) no matter how "minor" the injury. The most prudent approach is to rule out skeletal trauma in all children younger than 2 years of age with a standard skeletal survey and assess for occult central and/or internal injuries by choosing appropriate imaging and laboratory studies (Table 3).

ABUSIVE HEAD TRAUMA

Abusive head trauma (AHT) has the highest mortality of all forms of child physical abuse, with an estimated fatality rate greater than 20%. Survivors have irreversible sequelae of brain injury, ranging from minor behavioral

TABLE 2. Protocol for the Evaluation of Suspected Child Physical Abuse

History of Present Illness

- Interview primary caretakers separately; note historian's ability to provide history
- Ask caretakers about age-appropriate developmental abilities of child. Observe child if possible
- Develop a timeline from when the child was last agreed upon to be in his or her usual state of good health and note the following:
 - o Onset of symptoms and progression
 - The patient's observed mental status and activity level. Ask specifically about how the child appeared at time of hand off between caretakers
- Note if there were any witnesses, photos taken of child, or other corroborating information

Social History

- List all adults having access to the child, including age, relationship, and contact information
- List all children, including age and relationship; identify in which home they reside
- Note history of drug or alcohol abuse, intimate partner violence, mental illness, prior history of involvement with child protective services

Relevant Past Medical History

- Skeletal trauma: child or family history of bone disease, diet history
- Abusive head trauma (AHT) and cutaneous injuries: child or family history of bleeding diathesis, eg, prolonged bleeding after circumcision, umbilical cord removal, or surgery or as a result of past injuries

Physical Examination

- Examine closely for possible intraoral injuries such as frenulum tears; explore all unexposed surfaces: behind ears, genital region, and bottoms of feet
- Growth chart: obtain prior growth data, and with regard to AHT, note trajectory of head circumferences

Photodocumentation

- If photos are obtained, document in the medical record details of the photos taken, including location of injuries, number of photos taken, date, and photographer
- If photodocumentation is unavailable, use a body diagram noting all cutaneous lesions by size, location, and color

Evaluation

- Indicated laboratory and imaging studies for current illness or injury
- Studies to assess occult injuries, such as skeletal survey
- Communication with appropriate subspecialists regarding findings and treatment, including child abuse pediatricians when appropriate for referral and consultation

Mandated Reporting and Safety

- Develop dialogue to inform parents about mandated reporting, safety, and reason for report
- Ensure that forms and phone numbers for reporting are accessible
- Establish office process for specific scenarios with regard to obtaining imaging and laboratory studies and process for transfer to appropriate facility for evaluation and treatment, including protocol for accessing expertise of child abuse pediatrician
- Facilitate thorough sibling assessment, including appropriate imaging, laboratory studies, and interpretation; establish protocol to ensure results of sibling assessments are communicated to others in the investigation, including primary care clinician
- Ensure medical record and photodocumentation accessibility for investigators (consent not required after report to child welfare)
- Discuss disposition of, medical follow-up, and supportive services for patient with child welfare case worker

issues and neurodevelopmental delays to significant neurodevelopmental delays, seizures, blindness, and paralysis. (13) The incidence of AHT is 15 to 30 cases per 100,000 infants annually in the United States. AHT

occurs most often in children younger than age 2 years and crying is the most commonly identified trigger. Recognizing that the phrase "shaken baby syndrome" implies a specific mechanism, in 2009 the American Academy of Pediatrics (AAP) recommended that AHT replace this terminology to acknowledge that multiple mechanisms, either separately or together, can cause calvarial, brain, and cervical injuries. (14)

Infants and young children who have AHT can present with signs and symptoms ranging from mild to lifethreatening, with a clinical spectrum that includes irritability, vomiting, lethargy, seizures, apnea, coma, and death. Often there are no external findings suggestive of trauma and the history is lacking or misleading. Thus, depending on the extent and severity of the injuries, traumatic brain injury is often misdiagnosed as colic, viral syndrome, otitis media, gastroenteritis, gastroesophageal reflux, or pyloric stenosis. Clinicians must keep AHT in their differential diagnoses and have a high index of suspicion to obtain a thorough history and perform the appropriate diagnostic tests.

Brain injuries seen in 80% of AHT cases include subdural hemorrhage that is interhemispheric, posterior, often layering over the tentorium, and/or a thin subdural layer over either or both of the convexities. Mass effect results not from the subdural trauma itself but rather from significant cerebral edema. The parenchymal damage evolves into a clinical picture consistent with hypoxicischemic encephalopathy. Although additional injuries need not be present to diagnose AHT, these neurologic injuries are frequently associated with other traumatic findings, such as retinal hemorrhages, posterior rib fractures, and classic metaphyseal lesions (CMLs). Bruising to the scalp or other parts of the body may or may not be present. The clinician must be mindful to ensure a thorough evaluation for other occult injuries, including neck, internal, and other skeletal trauma.

A short fall leading to fatal head trauma is exceptionally rare, with a calculated risk of less than I per I,000,000 children annually. (I5) A unique situation is the development of an epidural hematoma after minor blunt trauma in which a temporal linear skull fracture may sever the middle meningeal vessels and lead to an accumulation of blood that results in mass effect. This is one circumstance in which a child may be neurologically intact after minor or trivial trauma but experience deteriorating mental status and acute symptoms as a result of mass effect.

Head and neck imaging must be obtained for any child for whom there are concerns for AHT. A CT scan is the initial imaging modality of choice because it can be performed quickly in the critically ill child. However, CT scan does not reveal parenchymal injuries, cannot reliably differentiate between subdural and subarachnoid collections, and involves substantial radiation exposure. Magnetic resonance imaging (MRI) should be performed once the patient is stable, ideally a few days after admission, to optimize visualization of the parenchyma and evaluate for edema, stroke, and thromboses. MRI can also elucidate the location of extra-axial fluid collections and aid in the aging of intracranial hemorrhages. MRI imaging of the spine is also indicated because studies have now demonstrated injury to the cervical spine, such as ligamentous injury and spinal subdural hemorrhage, in children with AHT. (16)(17) MRI is also preferred over CT scan when clinical findings such as rapidly increasing head circumference or focal neurologic issues suggest remote injury. MRI does not entail radiation exposure, but it is a longer study that most often requires sedation.

Retinal injuries such as hemorrhages, schisis or tearing, and folds are associated with AHT and may be seen in up to 80% of cases. Hemorrhagic retinopathy from AHT is classically described as multilayered, with hemorrhages that are too numerous to count and extend to the ora serrata. This very specific finding is unique to AHT and is not due to increased intracranial pressure, blunt head trauma, or cardiopulmonary resuscitation. Retinoschisis and macular folds are reported almost exclusively in children who have sustained violent craniorotational injury and are specific to this mechanism. Any infant or child who has intracranial injuries suspicious for abuse should be evaluated by an ophthalmologist who can meticulously and precisely document the ocular findings, preferably with use of photo imaging. The rate of healing varies from days to weeks and aging of retinal hemorrhages is imprecise. Of note, an ophthalmologic examination is not a screening tool for AHT but is indicated when there is evidence of intracranial injury.

CUTANEOUS INJURIES

The skin is the most frequently injured organ in child abuse, with bruises, bites, and burns accounting for many child maltreatment injuries. Although cutaneous injuries are very common in childhood, they are rare in the preambulatory child: "those who don't cruise don't bruise." (18)(19) Considerable data support that bruising is not only extremely uncommon in infants but highly correlated with child abuse. (20)(21) Thirty percent or more of seriously injured or fatally abused children have been noted to have bruises, which are sentinel signs (Figure 1), reported on physical examination before subsequent severe or fatal abuse. These data support the directive that any nonmobile infant who has a bruise must receive a full child abuse evaluation (Table 2) and a report to child welfare for investigation. (3)(4)(5)(6)

TABLE 3. Child Physical Abuse Medical Evaluation: Imaging and Laboratory Studies

STANDARD CHILD PHYSICAL ABUSE MEDICAL EVALUATIONS

Skeletal Injuries

- Skeletal survey (with views according to the collaborative practice parameter issued by the American College of Radiology and the Society for Pediatric Radiology)
- Follow-up skeletal survey is indicated in 2 weeks when abuse is suspected on clinical grounds and/or initial findings are abnormal or equivocal
- Core laboratory studies for bone health: calcium, magnesium, phosphate, and alkaline phosphatase
- If concerns for vitamin D deficiency (elevated alkaline phosphate, abnormal bone density, or dietary concerns), consider 25-hydroxyvitamin D and parathyroid hormone level

Central Imaging

- Head computed tomography (CT) scan (useful for screening, and/or monitoring an ill child)
- Magnetic resonance imaging (MRI) of head and spine (useful for elucidating extra-axial spaces, parenchymal disease, and spinal injury)

Routine Trauma Laboratory Tests

- Hematologic: complete blood cell count and platelets
- Coagulation: international normalized ratio, prothrombin time, and activated partial thromboplastin time
- Metabolic: glucose, blood urea nitrogen, creatinine, calcium, magnesium, phosphate, albumin, and protein
- Urinalysis: urine toxicology screen, order myoglobin if urinalysis positive for blood and red cells are not seen on smear
- Liver function tests: aspartate aminotransferase and alanine aminotransferase (>80 U/L [1.34 μ kat/L] is concerning for occult injury)
- Pancreatic enzymes: amylase and lipase

ADDITIONAL POTENTIAL TESTS

Ophthalmologic Examination

- Indicated if evidence of either acute or remote central nervous system trauma
- Not a screening tool for abusive head trauma

Abdominal (Thoracoabdominal) Imaging: CT Scan With Intravenous Contrast

- Elevated liver or pancreatic enzyme values
- Comatose patient
- Evidence of trauma with delay in care (liver function tests may have decreased to normal levels)

Concerns for Bleeding Diathesis (Family History or Clinical Concerns)

- von Willebrand antigen, von Willebrand activity (ristocetin co-factor), Factor VIII, Factor IX, platelet function assay
- Hematology consultation

Metabolic Diseases

• Genetics consultation

As children start to ambulate, the incidence of bruising increases. Bruise location and morphology are important factors to consider when assessing for child physical abuse in ambulatory children. Accidental injuries tend to occur over bony prominences (shins and elbows) in contrast to bruises due to abuse, which are located on the face, head, neck, torso, flanks, buttocks, and thighs. The mnemonic "TEN 4" is useful to recall which bruise locations are concerning for abuse: Torso, Ear, Neck, and 4 signifying children younger than age 4 years and any bruising noted in infants younger than 4 months. (20) Bruising and abrasions that occur on more than one body surface, are in multiple stages of healing, and are patterned or well demarcated are more likely to be the result of abuse. Patterned injuries reflect the shape of the instrument, such as loop marks from a cord or cable, linear bruises from belts, or multiple parallel linear bruises equally distributed from a slap with a hand. Contrary to some common beliefs, children do not bruise more easily than adults and bruises cannot be aged precisely. The appearance of a bruise is related to many factors, including the state of hemoglobin degradation, the color of skin pigment, the depth of the bruise, the location on the body, the lighting in the room, and the patient's metabolism and circulation. Bruises of differing colors do not signify different times or incidents. Finally, because bruises or soft-tissue injury may be painful for days, the presence of tenderness does not necessarily mean the injury is acute.

Determining whether marks or bruising from corporal punishment constitutes abuse is a difficult task. Legally, some states condone corporal punishment as an acceptable form of behavioral modification while others define it as a form of child maltreatment and require reporting to child welfare. The AAP and the American Academy of Child and Adolescent Psychiatry do not condone corporal punishment due to its limited effectiveness and potential deleterious effects. Although known to be immediately effective, spanking and corporal punishments have significant adverse outcomes, such as increased aggression and decreased development of appropriate behavior. (22)(23) (24) Both groups advise against the use of corporal punishment and encourage alternative methods of behavioral modification - such as time out, loss of privileges, positive reinforcement, and opportunities for positive touch like hand holding and hugging - that have healthier, long-lasting effects. From a practical standpoint, each clinician must be versed in his or her state laws. More importantly, the clinician must develop a thoughtful and culturally sensitive



Figure 1. Infant displaying bruising that represents a sentinel sign for physical abuse.

dialogue with parents that promotes alternative methods of discipline.

Bite marks are another patterned skin injury noted in abused children. Clinicians can discern between animal and human bites by assessing the shape: animal bite marks are puncture wounds with a sharply angulated arch, while human bite marks are crush injuries consisting of an ovoid pattern of tooth marks that may surround an area of central bruising. In general, adult bite marks measure greater than 2 cm between the maxillary canines. Consultation with a forensic odontologist may assist in the evaluation of welldemarcated bite marks. Multiple bites on different body planes, bites on soft-tissue areas, and bites on areas generally covered by clothing should raise a suspicion of abuse. Bites to the genitalia, buttocks, and/or breasts should raise a concern of possible sexual abuse. Acute bites to the genitalia, buttocks, and/or breasts may warrant collection of forensic evidence for DNA by swabbing the area with a cotton swab moistened with distilled water.

Hot liquid, grease, steam, hot objects, chemicals, electricity, or microwave ovens may cause abusive burns. Compared to accidental burns, abusive burns are more severe, more likely to be full-thickness, and require more extensive treatment, including grafting. Children who are abusively burned are most often younger than 4 years and inflicted immersion burns to the buttocks and genitalia are commonly associated with toilet training.

Abusive burns most often take the form of immersion scald burns, characterized by well-demarcated areas of confluent depth with no splash or cascading flow pattern. Immersion burns may involve the buttocks, perineum, extremities, hands, or feet. Circumferential burns affecting the feet and/or hands are sometimes referred to as having a "stocking" or "glove" distribution. In immersion burns, the position in which the child was held may be surmised by the burn pattern and depth. If the child's buttocks come into contact with the tub surface, a "doughnut" type pattern may be noted with relative sparing of the part of the anatomy coming into contact with the tub. Sparing of the flexion creases is often observed. Persons who inflict these burns generally do not suffer burns themselves. A careful scene reconstruction and investigation, including water temperature, may help determine the length of time the child was held in the water. Generally, the hotter the water, the shorter the duration of submersion. Partial-thickness burns develop in minutes at 48.9°C (120°F) but take mere seconds at 65.6°C (150°F). (25)

Children often come into contact with hot objects, such as irons, hair tools, radiators, and stovetops. Resultant burns are related to the heat of the object and period of contact with