

Guide to the Medical Evaluation in Suspected Physical Abuse

Introduction

Every year more than 3 million referrals are made to child protective services for concerns of child abuse and neglect with almost 700,000 children found to be victims of child maltreatment. While the majority of reports are due to neglect, almost 20% are due to physical abuse affecting almost 10 out of every 1,000 children.¹ Infants are disproportionately affected with rates of serious physical abuse² and abusive head trauma³ more than twice the rate of children between 1 and 3 years of age⁴. The diagnosis of physical abuse is still frequently missed resulting in additional injuries⁵ and/or death^{6, 7}. Diagnostic testing for additional occult injuries in children with concerns for abuse may be based on clinician gestalt or on the presence of social risk factors such as a history of domestic violence, caregiver substance abuse, or previous involvement with social services. While the presence of risk factors is associated with child maltreatment, this approach may result in disproportionate child abuse evaluations according to race and/or socioeconomic status.^{6, 8-12} Despite published recommendations by the American Academy of Pediatrics on screening for occult fractures in children under 2 years of age, fewer than 50% of physically abused children under 2 years of age received a skeletal survey for occult fractures with substantial variation between US hospitals.¹³ An approach to child physical abuse that includes routine medical evaluations for additional serious injury may minimize this disparity while reducing the risk for additional serious injury.

“Red Flags”

While many children with abusive head trauma and inflicted skeletal trauma may not have visible cutaneous trauma^{14, 15}, bruising is still one of the most common manifestations of physical abuse and perhaps the easiest to recognize. Physicians have long recognized that bruises are rare in healthy infants who have not become mobile (e.g. crawling or cruising).^{16, 17} Bruising, in an infant younger than 6 months of age, is therefore considered a “red flag” for abuse.¹⁸⁻²⁰ Red Flags also include patterned skin injuries and unusual locations of injury. These unusual locations are referred to as the TEN-FACES distribution; where TEN refers to bruising to the torso, ear or neck and FACES refers to frenulum, auricular (ear), cheek, eyelid or sclera. An easy mnemonic to remember is *TEN-4 FACES* where the number 4 refers to children under 4 years of age with bruising in the TEN distribution or any bruising in infants less than 4-6 months of age.¹⁹ The importance of the bruise in an infant cannot be understated. One recent publication identified a history of prior bruising or oral injury in more than 25% of infants evaluated for serious physical abuse and abusive head trauma.²¹ In a recent analysis of infants presenting with apparently isolated bruising, 50% had at least one additional serious injury identified on routine medical evaluation including physical examination, skeletal survey, neuroimaging and abdominal injury screening.²²

Other “red flags” may be found as part of the comprehensive medical evaluation. The comprehensive medical evaluation includes history of injury, developmental history, nutrition, past medical history (including pregnancy and birth), family medical history, social history, review of systems, physical examination and screening for additional serious injury through skeletal

survey, neuroimaging, and abdominal injury screening, or screening for medical conditions (e.g., bleeding disorders^{23, 24}, metabolic bone disease²⁵).

The history of injury should include determining when the infant or child was “last well” as onset of symptoms such as crying, irritability, vomiting, and change in appetite or activity may represent symptoms of injury. Chief complaints such as unresponsiveness, seizure activity, colic or fussiness, or ALTE should be considered high risk necessitating a detailed skin examination. When the injury is “known” such as a long bone fracture, the history should assess injury plausibility. The child’s developmental capabilities, timeline, and mechanism provided should be consistent with the fracture type (e.g., transverse, oblique, compression, buckle etc.).²⁶

Psychosocial assessments should review the child’s caregivers and who lives in the home. Other children and respective ages should be identified as these contacts in the home are also at risk for additional injury and may require medical evaluation.²⁷ Psychosocial “red flags” to identify include: *social service involvement, domestic/intimate partner violence, law enforcement involvement, substance abuse (drugs and/or alcohol), mental health issues, and negative attributions ascribed to the child by the caregiver*. Current research utilizing these 6 psychosocial risk factors after a positive TEN-4-FACES skin screening examination has helped differentiate accidental from abusive head trauma.²⁸ However, additional research is still in progress at multiple institutions to determine whether clinical decision rules are needed²⁹ to predict abusive head trauma or to determine which children need additional serious injury screening³⁰.

Screening for Additional Head Injury

Abusive head trauma is the leading cause of serious intracranial injury in infants and death in children less than 4 years of age.³¹ Intracranial injuries in young infants can be difficult to diagnosis as symptoms are non-specific (vomiting, irritability, fussiness, poor feeding) and can be attributed to benign illness (e.g. gastritis, colic, reflux). Although the presence of occult intracranial injury in approximately 30% of neurologically asymptomatic infants is supported by published studies^{32, 33}, recommendations on neuroimaging have not been as clearly defined as those for skeletal survey. In a recent multicenter study of infants under 6 months of age presenting with apparently isolated bruising, 90% of infants had neuroimaging obtained with new injury identified in 25%. Neuroimaging (CT or MRI, or both.^{34, 35}) should be performed even in neurologically asymptomatic infants with suspected child abuse. While the Center for Safe & Healthy Children’s guidelines for physical abuse state that neuroimaging is mandatory for infants under 6 months (categorized as high-risk), occult injury still occurs in infants 6-12 months of age.^{32, 33} Further study is needed to determine an appropriate age cut-off for mandatory neuroimaging.

Screening for Additional Skeletal Trauma

The skeletal survey (SS) is a series of radiographic images of the entire skeleton for the purpose of assessing a child for trauma as well as skeletal dysplasias and neoplasias. In a recent large population-based study, child abuse accounted for 12% of fractures in children less than 36 months of age.³⁶ The goal of the SS is to accurately identify fractures in children with suspected abuse as fractures may not be appreciated on examination (healing) and as associated bruising is uncommon.^{14, 15}

SSs are recommended by the American Academy of Pediatrics in all children younger than 2 years of age with concerns for child physical abuse, and in selected children between 2-5 years of age (e.g. developmental delay, non verbal, burns^{37, 38}, extensive trauma).^{34, 35} SSs identify additional injury in as many as 25% of infants and children when obtained.^{22, 39-42} There is published literature to support obtaining SSs in older children as the yield of the SS in children 2-3 years of age is comparable to children 1-2 years of age (10% versus 12%).⁴³ It is also recommended to repeat the initial SS in 2 weeks, as acute fractures (e.g., rib fractures and classic metaphyseal lesions) may be occult. Large multisite studies have identified additional healing fractures on the follow-up skeletal survey or FUSS in 10-15%^{41, 44} with overall additional clinical information (new fractures or reassuring findings) in more than 20% of children.⁴¹ SSs should also be performed in children presenting with burns as the prevalence of fractures detected has been between 14-18%.^{37, 38}

Screening for Additional Abdominal Injury

Abdominal injury is the second leading cause of death in children from physical abuse (second only to head injury). Overall, the estimate of the rate of missed diagnosis in child physical abuse is 30% or higher.^{6, 45} The prevalence of inflicted abdominal injury is not sufficient to recommend universal screening with computed tomography of the abdomen. However, clinical examination remains insufficient to diagnose occult abdominal injury from child abuse. The prevalence of occult abdominal injury ranges from 3-6% depending upon the population studied.⁴⁶⁻⁴⁹ In the highest risk age group (12-23 months), occult injury can be detected in 1 of every 20 toddlers with the use of liver transaminases.⁴⁸

The ULTRA study⁴⁷ (Utility of Liver Transaminases to Recognize Abuse in Children) prospectively studied 1676 children under the age of 5 years receiving child abuse consultation. Of these children, 1272 had liver transaminase screening with 54 (3.2%) having an identified abdominal injury (17 of those injuries were clinically occult). The rate of injury on CT of the abdomen was 16% (1 in 6 children). Sensitivity and specificity of an AST or ALT greater than 80 for the identification of abdominal injury was 77% and 82% respectively with a negative predictive value of 98%. If the physical examination is notable for abdominal bruising or tenderness or a GCS score < 15, the sensitivity and specificity of the CT for the identification of abdominal injury was 83% and 80%.

NOTE: If transaminase screening were to be performed on 100 children with suspected child abuse – 100 blood tests would be ordered, 18 CT scans of the abdomen (when AST or ALT is greater than 80) would be performed, and 3 additional injuries would be detected.

The most sensitive and specific examination for the identification of abdominal trauma remains the abdominal/pelvis CT with contrast. While ultrasound has the benefit of speed, and is without radiation, it is insensitive and non-specific. In a study of the utility of liver enzymes to screen for abdominal trauma in children, 13% of abdominal injuries were missed including a grade 3 liver laceration.⁵⁰

MINNESOTA CHILD ABUSE NETWORK – Assessment for Physical Abuse

Tools in the Medical Evaluation (see Appendix A – ASSESSMENT FOR PHYSICAL ABUSE CHART):

1. If the routine patient encounter identifies “red flags” on the history, physical examination or observation, a more comprehensive medical evaluation for suspected abuse and neglect is indicated:
 - a. Red Flags on Chief Complaint:
 - i. Vomiting
 - ii. Fussiness
 - iii. ALTE or unresponsiveness
 - iv. Unwitnessed Fall or “Fell off bed” (most common history in accidental and abusive injuries)^{51, 52}
 1. A witnessed fall would include the presence of an additional person other than the primary caregiver
 - b. Red Flags on History:
 - i. Injury not consistent with child’s age, development abilities, or injury morphology
 - ii. History is vague or changes with time, repetition or caregiver
 - iii. Delay in seeking medical care
 - c. Red Flags on Psychosocial Assessment
 - i. Negative attributions ascribed to the child by the caregiver (e.g., “my baby is mean”)
 - ii. Social service involvement
 - iii. Law enforcement involvement
 - iv. Domestic/intimate partner violence
 - v. Substance abuse
 - vi. Mental health issues
 - d. Red Flags on Examination
 - i. Full or bulging fontanelle in an infant
 - ii. Rapidly increasing head circumference
 - iii. Any bruising in an infant
 - iv. Bruising in a child in the TEN or FACES distribution
 - v. Patterned injury
 - vi. Failure to thrive or weight loss
 - e. Red Flags by Injury Type
 - i. Rib Fracture
 - ii. Metaphyseal Fracture
 - iii. Long bone Fracture (non-ambulatory infant or child)
 - iv. Oropharyngeal Injury (non-ambulatory infant or child)
 - v. Abdominal Injury (non-MVC)
 - vi. Head Injury (unwitnessed – see above, unexplained)
2. Laboratory Evaluation: The goal of laboratory evaluation includes screening for additional serious abdominal injury:
 - a. All children under age 5 years with concerns for physical abuse:
 - i. CBC, Metabolic panel with liver enzymes, Lipase
 - ii. Urine Drug Screening

- b. Additional testing to consider:
 - i. Non-patterned bruising: PT-INR/PTT
 - ii. Intracranial hemorrhage: PT-INR/PTT, Fibrinogen, D-Dimers
 - iii. Extensive skin trauma: CPK
 - iv. Suspected chest wall trauma: Troponin or CK-MB
 - c. Child Abuse Physician Consultation:
 - i. Intracranial Hemorrhage (no skeletal trauma or patterned injury): Bleeding disorder evaluation to include PT-INR/PTT, Fibrinogen, D-Dimers, Factors 8/9/13 (quantitative)²⁴
 - ii. Bruising (no skeletal trauma or patterned injury): Bleeding disorder evaluation to include PT-INR/PTT, von Willebrand's Panel and PFA-100²⁴
 - iii. Skeletal Trauma (no additional ICH or patterned injury): Metabolic bone disease evaluation to include calcium, phosphorous, alkaline phosphatase, intact PTH, 25-hydroxy Vitamin D. Additional testing such as DNA for Osteogenesis Imperfecta should occur only in consultation with Genetics.
3. Skeletal Surveys:
- a. Initial SS recommended in all children under age 2 years and in selected children 2-5 years of age⁵³
 - i. Bruising:^{19, 54}
 - 1. SS should be completed in any infant under 6 months of age with a bruise except in cases of injury as a result of MVC, birth trauma, or witnessed fall in a public place.
 - 2. SS should be completed in a child under 2-3 years of age with cutaneous injury in the TEN-FACES distribution, patterned injury (e.g. loop marks), injury occurring during domestic violence.
 - ii. Fractures:⁵⁵
 - 1. SS is necessary in all children under 2 years of age with fractures thought secondary to domestic violence or attributed to minor trauma such as a toy or object.
 - 2. SS is necessary in all children under 2 years of age with unusual or high specificity fractures such as rib fractures, metaphyseal fractures, complex or ping-pong skull fractures.
 - 3. SS is necessary in children 0-11 months of age with ANY type of fracture with the exception of the following (as long as there are no additional concerns for injury):
 - a. Linear unilateral skull fracture in a child over 6 months of age with a history of a fall or a caregiver landing on a child
 - b. Distal radius/ulna buckle fracture or toddler's fracture of the tibia/fibula in a cruising child 9 months of age or older
 - c. Clavicle fracture likely attributed to birth (e.g., acute fracture in an infant less than 2-3 weeks old or a healing fracture in an infant less than 1 month of age)
 - b. Initial SS should be completed to ACR Standards⁵⁶
 - c. The literature supports the use of the SS in children 2-3 years of age with a similar yield (10%) as children 1-2 years of age (12%).⁴³

- d. Follow-up SS or FUSS should be completed in approximately 2-3 weeks after the initial SS⁵³
 - e. Published literature supports the use of a more limited view FUSS as long as the child has been in protective placement and does not have prior concern for vertebral or pelvic fractures⁵⁷
4. Abdominal Imaging:
- a. Abdominal/Pelvis CT with contrast is indicated:
 - i. Abnormal abdominal examination – e.g. bruising^{47, 58}, distention⁵⁸, tenderness⁴⁷
 - ii. AST or ALT greater than 80^{47, 49}
 - b. Ultrasound is insensitive and non-specific for the identification of abdominal trauma⁵⁰
5. Neuroimaging:
- a. CT head and/or MRI brain is indicated in all infants under 6 months of age with concerns for abuse regardless of symptoms or location of bruising^{22, 32, 33}
 - b. CT head and/or MRI brain is indicated in children with concerns for abuse and
 - i. Altered mental status
 - ii. Skull fracture(s)
 - iii. Bruising to the face, ear, scalp
 - c. Child Abuse Consultation:
 - i. MRI Brain is indicated in infants with abnormal mental status whose initial head CT is considered “normal” as hyperacute subdural hemorrhages may not be detected on initial CT^{59, 60}
 - ii. When early head CT is complemented by MRI Brain, additional information is identified in 25% of children including intracranial hemorrhages, shearing injury, ischemia and infarction.⁶¹
 - iii. MRI Brain & MRI C-Spine (with STIR) is indicated in children with concerns for abusive head trauma on initial CT head due to associated cervical injuries identified in infants.^{62, 63}
 - iv. NOTE: The literature also supports MR imaging of the whole spine due to associated cervical and thoracic injury.^{63, 64}
6. Ophthalmology: Dilated fundoscopic examination should be performed:
- a. In infants and children with intracranial hemorrhage and concerns for abusive head trauma.
 - b. In infants with negative neuroimaging, but who have abnormal mental status and concerns for physical abuse.
 - c. Within 24 hours of presentation due to the transient nature of retinal hemorrhages, ideally no longer than 72 hours⁶⁵
 - d. NOTE: Dilated fundoscopic examination is not necessary if neuroimaging is negative with normal mental status and without facial bruising⁶⁶; OR the intracranial hemorrhage is small and in contact with a linear non-occipital skull fracture⁶⁷ in an infant or child with normal mental status and without facial bruising.

MINNESOTA CHILD ABUSE NETWORK (MN CAN)

Consultation by a Regional Child Abuse Program should be considered for the following:

- Bruising or oral injury in non-ambulatory infants
- Unexplained head injury (e.g., intracranial hemorrhages, skull fractures), especially in children < 3 years of age
- Unexplained fractures or fractures occurring in non-ambulatory children
- Unexplained (non-MVC) abdominal injury, especially in children < 3 years of age
- Unexplained burns including immersion, “pattern” and questionable burns in non-ambulatory children
- Concerns for prolonged exposure or intentional starvation

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