Journal of Radiology Nursing 36 (2017) 70–78

Contents lists available at ScienceDirect

Journal of Radiology Nursing

journal homepage: www.radiologynursing.org

Understanding the Importance of Radiology Screening When Suspecting Child Abuse

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Keywords:
Physical abuse
Fractures
Radiographic images

A B S T R A C T

Child abuse is a global problem causing serious consequences to victims, their families, and society. To protect children, nurses and other health care providers need to be aware of the signs of child abuse and understand the role of radiologic studies in the evaluation of physical child abuse. The aim of this article is to present the different types of fractures caused by abuse, and the necessity of using different radiographic images to determine the locations and the severity of fractures.

Introduction

Child abuse is an international epidemic. Despite the growing interest in preventing child maltreatment, hundreds of millions of children around the world are victims of abuse (Merrick & Latzman, 2014). Child abuse is one of the leading causes of childhood morbidity and mortality and carries huge costs to the family and society. In 2008, the costs of health care, special education, and loss of worker productivity in the United States were estimated at 124 billion dollars (Fang, Brown, Florence, & Mercy, 2012). Between four and seven children in America die every day because of abuse and neglect (US Department of Health & Human Services, 2016). In 2014, more than 1,500 children died because of abuse, which is a 1.3% increase from the 2010 national estimate (US Department of Health & Human Services, 2016). Children younger than 1 year old have the highest rate of victimization. Boys have higher fatality rates than girls; 2.48 per 100,000 boys in the population die from abuse, whereas girls die at a rate of 1.82 per 100,000 girls (US Department of Health & Human Services, 2016).

Second to soft tissue abuse, fractures are the most common injury occurring in 55% of physically abused children (King, Diefendorf, Apthorp, Negrete, & Carlson, 1987). The fractures are often occult and found in infants and toddlers who cannot give a casual explanation. More than 20% of children who present with abusive fractures had at least one previous visit with a health care provider, and the possibility of abuse was not raised (Servaes et al., 2016). Violence is a pattern and often escalates; if abuse is not recognized in its less severe forms, a child is at high risk for being reabused and/or dying from abuse.

Nurses and other health care providers are in a unique position to recognize abuse in its milder forms and to report suspicions to the appropriate authorities. It is equally important that health care providers understand the importance of careful consideration when evaluating fractures so as not to confuse a fracture resulting from abuse with fractures that result from metabolic bone diseases such as rickets and osteogenesis imperfecta (Servaes et al., 2016). Therefore, it is vital for nurses and other health care providers to learn how to identify and properly evaluate children who might have been physically abused. Each presentation of abuse is unique, but there are guidelines as to proper evaluation of a child when there are concerns regarding physical abuse. A precise radiology study can depend on the scenario, which includes the age of the child, chief complaints, mechanism of injury offered, and findings from the physical examination.

Radiologic studies used in the evaluation of child abuse include plain radiographs, skeletal surveys (SS), radionuclide bone scan, computed tomography (CT) scan, and magnetic resonance imaging (MRI). Radiographic evaluations can help the health care provider identify the injuries for medical and child protective purposes. In other words, it is important to identify all injuries that might require medical intervention, and it is equally important to establish the amount, type, and severity of injuries to diagnose

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http://dx.doi.org/10.1016/j.jradnu.2017.03.006
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physical abuse. Making the diagnosis of physical child abuse can help protect children. Each type of radiographic evaluation has its own unique advantages and disadvantages. This article is intended to help nurses and other health care providers understand the different types of fractures that present in physical abuse cases and the necessity of radiographic examination to help protect child victims of abuse.

The American Academy of Pediatrics (AAP, 2009) presents clear guidelines for how a medical evaluation should proceed. Beginning with a detailed history of the present illness (injury), the physician details the medical history, age of the child, the developmental status, the location and type of fracture, the reported mechanism of injury causing the type of fracture, and the presence of other injuries (Flaherty et al., 2014).

Overview of child abuse

The awareness of child abuse as a social problem has improved in recent years and is now viewed as a medical diagnosis. Nurses working with pediatric patients play a large role in recognizing and preventing child abuse because the nurse is often the first to assess the patient, gather a story, and triage the patient.

Although the clear majority of fractures in childhood are because of accidental mechanisms, abuse must be on the differential when evaluating very small children. Approximately, 1 to 4 per 1,000 children younger than 2 years are treated annually for fractures from all causes. According to Flaherty et al. (2014), fractures account for 8% to 10% of all pediatric injuries; physical abuse is the cause of 12% to 20% of fractures in infants and toddlers. About 10% of these children on average are evaluated for possible physical abuse (Servaes et al., 2016). Fractures constitute a clear majority of physical abuse; it is therefore necessary to discuss the different characteristics of fractures related to abuse.

In a study conducted by King et al. (1987), 50% of patients had only one fracture, 21% had two fractures, 12% had three, and 17% had more than three fractures. The researchers reported that the femur was the most common location of an abusive fracture, constituting 35% of abuse cases. The humerus was the next common site of an abusive fracture and was present in 29% of cases. In the same study, skull fractures were present in 16% of child abuse cases. In terms of types of abusive fractures, King et al. (1987) explained that 48% of long bone fractures are transverse fractures, 26% are spiral fractures, 16% are avulsion fractures, and 10% are oblique fractures. Nurses and other health care providers should have at least a basic understanding of the mechanism associated with common fractures and must be very vigilant while questioning the parent or the caregiver. Identifying abuse depends on the nature of injuries, the child's age, his and/or her developmental status, the position before the accident, and the final position and location after the injury. In addition, contradictory stories regarding the injury, the fact that the person who was present during the accident is absent, and any unusual behaviors by the parents or caretakers are red flags that can raise the possibility of abuse (Bilo, Robben, & van Rijn, 2010).

In cases where abuse is suspected, children who can talk need to be interviewed separately by a professional who is trained in forensic interviewing. When health care providers suspect that a fracture was caused by abuse, they need to examine the skin carefully to detect bruising, grab marks, and/or areas of pulling or twisting that caused the injury. The absence of marks does not exclude an abusive mechanism of the injury as most fractures are not associated with bruising at the time of presentation or within the first week of the injury (Day, Clegg, McPhillips, & Mok, 2006). The key is to localize and identify fractures to differentiate accidental from nonaccidental traumas. The SS is an important tool that helps physicians identify occult fractures and detect clinically unsuspected fractures when physical abuse is suspected (Christian et al., 2015).

The SS

The SS is a technique that uses X-rays with a digital panel detector, which provides high-quality diagnostic imaging at the lowest possible radiation dose (Berger, Panigrahy, Gottschalk, & Sheetz, 2016). An SS consists of 15 different radiographic examination including anteroposterior (AP) and lateral views of the skull and the chest, oblique views of the rib, lateral views of the spine, AP views of the pelvis, long bones of the extremities and feet, and posteroanterior oblique views of the hands (Servaes et al., 2016, p. 330). The AAP and the American College of Radiology (2016) recommend an SS for all children younger than 2 years when there is suspicion of physical abuse. In cases of suspected abuse in children older than 2 years, it is up to the physician's discretion to order an SS. Given the high risk of mortality and morbidity of physical abuse and the consequences associated with missing early signs of abuse, Berger et al. (2016) strongly recommend that health care providers perform an SS whenever there is a concern for abuse or when an infant is suspected of having a bone fracture. The risk of radiation dose outweighs the benefit of detecting and reporting an abuse case. The estimated amount of radiation dose used in the SS is comparable with background radiation or exposed radiation with airline travel (Berger et al., 2016).

If the SS shows suspicious fractures, it is recommended that children have a follow-up SS in 10 to 14 days. Early radiographic images may not show obvious changes of the bone structure, and often fractures are only seen when healing. If the second SS remains negative, then the suspicion of abuse decreases (Bilo et al., 2010). In addition to revealing previously unseen fractures, the second SS can help determine whether the original X-ray was misinterpreted and will help physicians determine the age of the injuries and identify healing fractures as well. For example, when an X-ray shows callus formation, which is a sign of bone healing in diaphyseal fractures, the physician may conclude that the injury is not acute and represents a more remote fracture. Callus formation appears between 5 and 14 days; therefore, if the parent or the caregiver says the child's injury occurred the day before presentation, but the X-ray shows callus, then the suspicions for abuse increase. Although the SS is the gold standard to detect fractures in child abuse, other imaging such as radionuclide bone scan, ultrasound, CT scan, and MRI can also be used to detect other nonaccidental injuries.

Radionuclide bone scan

The radionuclide bone scan is a method that can be used as a complement to SS. It cannot be used as the sole tool to detect fractures in children and has somewhat fallen out of favor in recent years because of the high radiation dose. The injected radiation dose in children is based on adult dosing. Although the dose of radiation is safe, the distribution of the radiation product is different in children than it is in adults with higher activity in the growth plates (Carty, 1993). Although the level of radiation is small, it is recommended that after having a bone scan, long periods of contact with a pregnant or breast-feeding woman, an infant, or young child is not recommended until at least 1 day after the scan. However, the radionuclide bone scan remains a sensitive method in detecting long bone shaft fractures and rib fractures. Limitations include a poor ability to detect classic metaphyseal lesions (CMLs) or skull fractures. Detecting skull fractures is best done with X-ray, and if the bone scan shows abnormalities, it is better to follow up with X-rays than a second bone scan. Although not as commonly