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Review

Multiple unexplained fractures in infants and child physical abuse

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ABSTRACT

When an infant presents with X-rays showing multiple unexplained fractures in various stages of healing (MUFVSH), the child is usually diagnosed with child abuse based on criteria of the Academy of Pediatrics' Committee on Child Abuse and Neglect (AAPCCAAN). Almost always, the infant is subsequently removed from the home and civil or criminal proceeding commence. It may be that healing infantile rickets or other poorly understood metabolic bone disorders of infancy are responsible for these x-rays. Activated vitamin D is a seco-steroid hormone, whose mechanism of action is genetic regulation. Lack of it can result in musculoskeletal defects known as rickets. Low calcium can also cause rickets. However, it is clear that experts for the state believe that the x-rays in these cases are so definitive as to be pathognomonic for child abuse. Therefore, if the caregivers deny abusing their infants, experts following American Academy of Pediatric's Committee on Child Abuse and Neglect. guidelines are essentially claiming that x-rays showing multiple unexplained fractures in various stages of healing are lie detector tests. However, it is not widely appreciated that the gold standard for the diagnosis of rickets is a bone biopsy, not x-rays, as radiologists miss biopsy proven rickets 80% of the time; that is, 4 out of 5 infants with rickets will have normal x-rays. In this article we provide reports of two cases and their outcomes. We discuss information about healing infantile rickets and an example of common sense medical conclusions in these cases. This information could lead to a significant reduction in the number of innocent parents having their infant removed or sent to prison.

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1. Introduction

There are few subjects as contentious as child abuse. On the one hand, no one wants child abusers to have custody of an infant. On the other hand, no one wants innocent parents wrongly separated from their infant or sent to prison. Every year in the United States, infants are shot, stabbed, drowned or suffocated; we do not mean to deny the occurrence of child abuse. We limit our contentions to

Abbreviations: 25(OH)D, 25-hydroxyvitamin D; AAPCCAAN, American Academy of Pediatrics' Committee on Child Abuse and Neglect; CPS, child protective services; CML, classical metaphyseal lesion; MUFVSH, multiple unexplained fractures in various stages of healing; TPN, total parental nutrition.

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multiple fractures in infants under the age of 6 months in which there are no other clear signs of abuse. The American Academy of Pediatrics' Committee on Child Abuse and Neglect (AAPCCAN) has issued guidelines for the evaluation of children with multiple unexplained fractures, concluding they are almost always due to abuse [1].

However, common sense questions still need answering: Why would abusive parents repeatedly seek medical care for the infant they abused? How can trauma severe enough to fracture bones not leave a bruise? Why would chest trauma severe enough to fracture ribs not also result in lung damage? Why wouldn't blunt chest trauma cause some inwardly angulated rib fractures instead of all perfectly aligned fracture ends? Wouldn't parents who beat their infant severely enough to cause multiple fractures show evidence of psychopathology? Do infants who are beaten severely enough to cause multiple fractures show fear in the presence of the abuser? How often do the eyewitnesses to parental/infant interactions report the parents were concerned and loving parents?

2. Case presentations

2.1. Infant number one

African American parents repeatedly brought their four-month-old winter-born breast-feeding infant to medical professionals due to an unexplained swelling over the left clavicle and failure to thrive. His pediatrician had never prescribed or recommended the supplemental 400 IU/day of vitamin D that the American Academy of Pediatrics recommends for all infants, especially breast feeding infants.

An x-ray of the left clavicle found a fracture as well as multiple nondisplaced rib fractures. A skeletal survey was done and the radiologist reported it revealed additional non-displaced multiple rib fractures, including multiple nondisplaced posterior rib fractures in various stages of healing as well as a questionable classic metaphyseal lesion (CML) of the distal right femur. X-rays of his long bones showed questionable mild demineralization but no other fractures. The hospital radiologist reported there were no frayed epiphyses or metaphyseal widenings. Nursing notes indicated that either parent could successfully console the infant and he showed no fear being around either parent. History and physical examination revealed a history of excessive head sweating but no bruising anywhere on his body or evidence of internal injuries. The infant's initial 25-hydroxy-vitamin D [25(OH)D] level was 13 ng/ml and his alkaline phosphatase (AP) was elevated at 886 IU/L. After repeated requests by the parent's experts, Child Protective Services (CPS) obtained serum calcium, phosphorous and PTH (all normal) but they were not done until the then bottle-feeding infant had been in child protective services for 6 months.

The infant was the product of an uncomplicated 39-week gestation weighing 6 pounds four ounces. The mother used a phosphate binder and antacid, calcium carbonate, on a daily basis the last two months of her pregnancy. The infant was discharged the day after his birth to the care of his parents. He never required total parental nutrition (TPN) and had no gastrointestinal procedures. However, his growth and development showed he was not gaining enough weight with breast-feeding and he failed to follow faces with his eyes. The mother had a 25(OH)D of 14 ng/ml five months after her infant had been taken out of the home.

The states' experts interpreted his x-rays as showing no evidence of rickets or other metabolic bone diseases. Osteogenesis Imperfecta was ruled out. Radiology, endocrinology and pediatric child abuse experts at an academic medical center tested for other rare causes of multiple fractures, such as Ehlers-Danlos syndrome, scurvy, copper deficiency, genetic rickets, Menkes' syndrome, biliary atresia, proprionic acidemia, myofibromatosis, congenital syphilis, and congenital cytomegalovirus infection, which were all negative. They diagnosed child physical abuse, stating they saw no evidence of frayed epiphyses, metaphyseal widening or significant demineralization; they opined there was a CML on the right distal femur. CPS removed the infant from his home. Repeat x-rays done 6 weeks after the infant was removed from the home and on formula showed multiple healing fractures and no new fractures.

The parents moved to have their son returned home but CPS refused. The state hired the three academic experts described above while the parents hired radiology and endocrinology experts, and a forensic psychiatrist (JJC).

The defense's forensic psychiatrist testified he found no evidence of psychopathology or any mental illness in the parents. All eyewitnesses to the parent's interactions with the infant in and around the time of the alleged abuse testified the parents were excellent parents and never abusive. The parents' radiological expert diagnosed multiple fractures due to healing infantile rickets. He testified the right distal humorous epiphysis was frayed. The states' expert stated the CML proved child abuse per AAPCCAN diagnostic guidelines. The court accepted the six expert reports into evidence, heard testimony, and subsequently returned the infant to the parents, commenting that the lack of bruising, lack of internal trauma, lack of angulated fractures, lack of psychopathology in the parents and the parent's character witnesses as the basis of his judgement. The infant was then started on 2000 IU/day of vitamin D and 250 mg of calcium for three months and began thriving. X-rays done at age 10 months showed no fractures or evidence of rickets.

2.2. Infant number two

The infant was the product of a normal 40-week pregnancy and delivery with the exception of the mother using large amounts of calcium carbonate as an antacid for the last three months of her pregnancy. He weighed 5 pounds 6 ounces at birth and was discharged the next day. He never required TPN and had no known medical problems. His pediatrician did not prescribe or recommend vitamin D supplements.

Over the course of the two months after the birth of their winter-born infant, the parents, who were European-American, repeatedly brought their breast-feeding infant to the attention of medical personnel for fussiness, not eating well and failure to thrive. He completed a course of ampicillin for a suspected ear infection but that did not help his fussiness. At ten weeks of age the parents brought the infant to the emergency room for unexplained swelling over the left upper leg.

X-rays revealed a spiral fracture of the left femur and a skeletal x-ray survey revealed multiple fractures, including non-displaced posterior rib fractures, in various stages of healing. The radiologists stated there was no evidence of rickets. Two areas of bluish brown discolorations of the skin were noted on the infant's left hand, which was charted as a bruise by one of the nurses. However, no bruises were present over any of the fracture sites. Physical exam showed no evidence of internal injury, lungs or otherwise. Other than excessive sweating of the head, the rest of the infant's history and exam were normal.

The infant's 25(OH)D level was 12 ng/ml and his AP was elevated at 446 U/L. Serum CA and phosphorous were within normal limits. Two hospital radiologists ruled out metabolic bone disease and diagnosed child abuse based solely on the x-rays. They opined there was a CML on the distal right tibia. Child protective services had the infant removed from the home. The parents claim no physician interviewed or examined them, other than to accuse them of abuse.

After the infant was removed from the home, the child was referred to a tertiary academic medical center where serum

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