CASE REPORT

Kris Sperry,[1] *M.D. and Robert Pfalzgraf,*[2] *M.D.*

Inadvertent Clavicular Fractures Caused by "Chiropractic" Manipulations in an Infant: An Unusual Form of Pseudoabuse

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ABSTRACT: A nine-month-old child was found unresponsive in his crib, five hours after his last feeding. At autopsy, there were no external or internal signs of abuse or neglect, and a few visceral pleural and epicardial petechiae were consistent with the sudden infant death syndrome (SIDS). However, postmortem total body radiographs revealed healing, symmetrical clavicular fractures and a healing left medial humeral epicondyle fracture. The parents had no explanation for these injuries and denied causing any harm to the child. The location and nature of the fractures strongly suggested abusive origin, and the case was reported to the police and the district attorney's office as child abuse. During the investigation, information from the parents indicated that the child had undergone "chiropractic" manipulations by an unlicensed therapist, between three and four weeks prior to death, to correct supposed "shoulder dislocations." This time interval correlated with the histologic age of the injuries, and the history explained their unusual bilateral location and appearance. The parents were exonerated of abuse charges, and the death was ascribed to SIDS.

KEYWORDS: pathology and biology, child abuse, autopsy, chiropractic manipulation, clavicular fracture, folk remedy, forensic pathologist, inadvertent trauma, postmortem, radiograph, trauma

A cornerstone of child abuse interpretation is the physician's ability to differentiate intentionally inflicted injury patterns from trauma that is truly accidental, or due to other, nonabusive causes. Since Caffey's early descriptions which associated long bone fractures and subdural hematomas with abusive injuries [*1*], medical professionals and their paramedical counterparts have gradually realized the scope of child abuse trauma, to the point where today most physicians are reasonably aware of injury patterns that represent true abuse.

Although the classical findings associated with severe, repetitive abuse (the "battered-baby syndrome") are usually quite characteristic, there are many clinical situations in

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[1]Associate medical examiner, Fulton County Medical Examiner's Office, Atlanta, GA.
[2]Pathologist, Hamilton County Coroner's Office, Cincinnati, OH.

which isolated injuries may suggest abuse but are not, in and of themselves, unequivocally diagnostic for intentionally inflicted trauma. Many injuries, such as single, nondisplaced lower-extremity long-bone fractures, probably represent actual accidental occurrences. In these cases, comparison of the injury features with the history of how the injury occurred will usually provide sufficient explanation, if the story is plausible. Accurate recognition of abuse is important; however, it is equally vital to avoid overinterpreting injuries and consequently falsely accusing parents or care-givers of inflicting abusive trauma. The social and legal sequelae of unwarranted child abuse allegations may cause irreparable psychological and financial damage to both parents and their offspring.

In recent years, a number of conditions have been identified which either mimic child abuse or may be misinterpreted as abuse [2–5]. Many of these are hematologic, metabolic, infectious, or congenital disorders which cause cutaneous or skeletal alterations that the overzealous or inexperienced physician may interpret as intentional trauma. Some folk remedies indigenous to particular cultures produce unusual appearances that suggest abuse to the uninformed observer [6]. Aggressive cardiopulmonary resuscitation can produce iatrogenic injuries which may be improperly diagnosed as abuse by pathologists unfamiliar with the spectrum of cardiopulmonary resuscitation (CPR) associated trauma. A variety of intrinsic skeletal conditions have radiographic presentations which may be wrongly classified as abusive trauma [7].

The following case illustrates an apparently heretofore unreported injury pattern which was initially interpreted as child abuse by experienced forensic pathologists, but was later recognized as accidental injuries inadvertently inflicted by a well-meaning, but unqualified, "chiropractic" therapist.

Case Description

A 9-month-old male child was found dead in his crib by his parents, five hours after his last feeding. Paramedics were summoned, but no resuscitative efforts were attempted. His only recent medical history had been a slight upper respiratory infection for a few days prior to his death. He had been hospitalized at the age of 6½ months for a severe viral stomatitis, but recovered uneventfully.

The autopsy examination was remarkable solely for a few petechiae on the visceral pleural and epicardial surfaces. No recent or remote injuries were found on the external surfaces or within any internal organs, and his weight, length, and appearance were those of a normal, otherwise healthy child. However, postmortem full-body X-rays taken prior to opening the body disclosed bilateral, generally symmetrical healing clavicular fractures, involving the distal third of each clavicle (Fig. 1). The left fracture had incompletely united, forming a pseudoarthrosis. A small, healing fracture was also located in the medial distal left humerus, at the epiphyseal plate. No other recent or remote skeletal injuries were discovered, and comparison of the postmortem radiographs with chest X-rays taken during his hospitalization 2½ months earlier revealed no evidence of injury in the earlier studies. Microscopically, the clavicular injuries exhibited healing changes consistent with 3 to 4 weeks' duration.

Despite a thorough and complete autopsy, no cause of death could be established. Bacterial cultures of the blood, cerebrospinal fluid, and lungs were negative, and the vitreous fluid electrolytes were unremarkable. Toxicologic studies were similarly unrevealing. The opinion of the examining forensic pathologist was that the skeletal trauma represented abusive injuries which were intentionally inflicted by another individual. Two other forensic pathologists within the medical examiner's office, who both had extensive experience in child abuse evaluation, concurred with this opinion. Both the cause and the manner of death were certified as "undetermined," until the etiology of the injuries

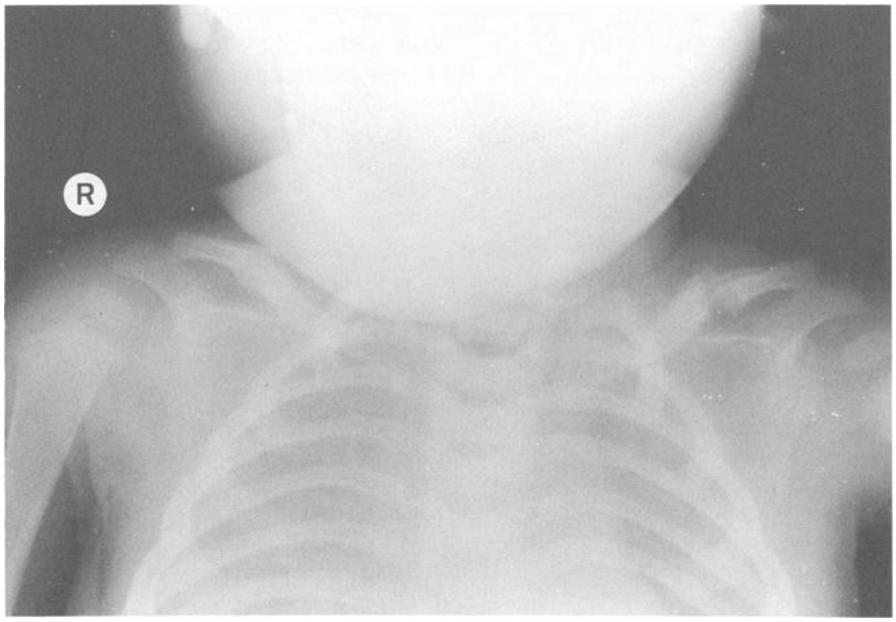

FIG. 1—Bilateral, symmetrical healing clavicle fractures detected in a postmortem X-ray.

could be established. The police and the district attorney's office were contacted and apprised of the injuries, and an investigation was initiated.

After 3 months of intermittent investigation, the pathologist who performed the autopsy interviewed the parents, prompted by information obtained from them by the minister of the church they attended. During a counseling session with the minister, the mother had recounted a trip that she, her husband, and the child had taken 3½ weeks before the death, when they visited her family in a neighboring state. They had recently been concerned over their child's inability to crawl and, shortly before their trip, had consulted their pediatrician, who told them that there was nothing wrong. While they were staying with their relatives, they sought the aid of an aunt, who was a "chiropractor," although she had never received formal training or certification in this field. She had manipulated the child's arms and shoulders, after diagnosing "dislocated shoulders." Neither parent of the child ever associated this therapeutic manipulation with the subsequently identified injuries, and only brought up the incident as part of relating the story of their visit home.

Further questioning about the specific manipulative technic revealed that the "therapist" had placed a great amount of pressure on the child's shoulder regions, while attempting to reduce the "dislocations." This was also accompanied by vigorous twisting of the child's arms, to "put the arm back into place." The child cried quite loudly during these procedures; however, the mother did not consider this unusual, as her aunt had performed manipulations on her in the past which were also quite painful. The child had cried intermittently for several hours following the therapeutic sessions (which were repeated twice, two days apart).

In the days after his shoulder manipulations, the child's motor behavior changed perceptibly. He refused to get to his hands and knees, or to support himself by pushing up on his arms. He had previously locomoted by rolling, but this ceased, and he was content to lay on his back. Prior to the shoulder therapy, he enjoyed holding onto his parents'

hands and pulling himself to a sitting position; this now caused him pain, and he refused to pull up with his arms. Despite noticing these changes, the parents did not think to associate his apparent discomfort and behavior changes with the manipulative therapy. Even after apprising them of the probable relationship between his "chiropractic" therapy and the injuries detected during the autopsy, they asserted that the woman who performed the therapeutic exercises "would never hurt a child."

Based upon this information, the most probable explanation for the child's injuries was inadvertent trauma during the "chiropractic" manipulations for a nonexistent shoulder problem. The death certificate was amended to list the sudden infant death syndrome (SIDS) as the cause of death, and the police and district attorney were notified. The investigation was subsequently closed.

Discussion

One of the most important facets in proving child abuse is the inconsistency that is frequently evident between the injuries and the story of how the injuries supposedly occurred. Severe trauma in the face of a history which documents only innocuous or minor events, or an injury pattern which necessitates the involvement of another individual, is frequently sufficient to substantiate child abuse allegations. In many instances, the severity of the injuries and their anatomical distribution essentially stand alone, and an intentional etiology is the only logical and reasonable explanation.

Equivocal, unusual, or isolated injuries which are not necessarily pathognomonic for child abuse origin require further investigation to ascertain their source. In these instances, evaluation of the history provided by the parents of other care-givers attending the child is crucial. A reasonable explanation for the injuries must be given consideration, just as illogical or patently impossible explanations can indicate that the real mechanism for the trauma is being intentionally dissembled. Obviously, the physician who renders opinions regarding an injury origin must take great care to avoid both overdiagnosis and underdiagnosis.

Clavicular fractures are rather unusual in child abuse, and were detected in only 7% of 563 abused infants and children in one series [*8*]. In newborns, however, the clavicle is the most common bony site injured during birth; Cumming recorded 10 fractured clavicles in 23 children with delivery-related skeletal fractures, all localized in the midshaft region [*9*]. A clavicular fracture encountered in an infant more than 11 days after birth and one which does not exhibit radiologic evidence of healing is most probably related to abuse.

In older children, the clavicle is one of the most frequently accidentally fractured bones, and isolated clavicular breaks are generally a nonspecific finding in suspected abuse. The midshaft region of the bone is the most usual fracture localization in both accidental and abusive etiologies; either a fall on an outstretched arm or a direct blow to the clavicle will cause a similar-appearing injury. Medially and laterally placed fractures, especially immediately involving or adjacent to the acromioclavicular or sternoclavicular joints, are much more suggestive of abuse [*10*]. It is postulated that forcible twisting and traction of the upper arm on the shoulder axis will disrupt the acromioclavicular region. The amount of force necessary to cause these injuries is not necessarily severe, especially in small infants.

In the case presented here, the presence of bilateral clavicular fractures was rather unusual. The bones were nearly identically broken, each just slightly distal to the midshaft region, and both exhibited extensive healing alterations radiographically. Without additional information, the most probable mechanism for the fractures was a direct blow to the front of the shoulder, on each side. A healing fracture involving the left medial

humeral epicondyle indicated that this extremity had been forcibly twisted at some point. With these findings in a nine-month-old child, the most logical and probable explanation for the injuries was intentionally inflicted abuse.

During the course of the investigation, the parents gave information that their child had been subjected to "chiropractic" manipulations by a well-meaning relative, who apparently had some rudimentary knowledge but no formal training or licensure to perform this therapy. After misdiagnosing bilateral "shoulder dislocation," the "chiropractor" put the child's upper extremities and shoulders through a series of forcible maneuvers that clearly exceeded the strength of the clavicles, causing bilateral, symmetrical fractures which were undetected until the child's sudden death 3½ weeks later. The fracture of the left humerus was also consistent with a forcible twisting of this extremity beyond the delicate limits of an infant's appendicular skeletal tolerances.

The "chiropractor's" statement provided independent corroboration for the incident, and the histologic age of both clavicular injuries was between three and four weeks, further substantiating the probable sequence of events. These facts, coupled with an explanation for the injuries that was both plausible and possible, allowed the pathologist to consider the injuries as incidental only and not contributive to the child's death. The death certificate was amended to indicate SIDS as the cause of death, and the investigation was terminated. This saved the parents from further emotional turmoil and alleviated the suspicions that had been raised by friends and family.

Despite occasional beneficial claims, it is highly doubtful that there is any meaningful or necessary therapeutic purpose in performing manipulations on the extremities of otherwise normal and healthy infants. The growing and developing joints are not able to withstand excessive stresses associated with anything but the most passively administered range of motion exercises. More forcible stresses, especially incorporating twisting motions, are delivered across the metaphyseal-epiphyseal juncture, causing cartilage plate disruptions and the characteristic fractures associated with child abuse. These injuries have occasionally been observed in infants undergoing supposedly "passive" motion exercises which, most probably, were delivered much more aggressively than necessary [*11*]. Direct pressure to long bones or the shoulder region may fracture the thin underlying bones. When the physician encounters unusual or symmetrical extremity or shoulder girdle injuries, a careful history should be obtained to detect inadvertent skeletal injury sustained during well-meant but overly aggressive therapeutic manipulations.

References

[*1*] Caffey, J., "Multiple Fractures in Long Bones of Infants Suffering from Chronic Subdural Hematoma," *American Journal of Roengtenology*, Vol. 56, No. 8, Aug. 1946, pp. 163–173.

[*2*] Kaplan, J. M., "Pseudoabuse—The Misdiagnosis of Child Abuse," *Journal of Forensic Sciences*, Vol. 31, No. 4, Oct. 1986, pp. 1420–1428.

[*3*] Kaplan, J. M., "The Misdiagnosis of Child Abuse," *American Family Physician*, Vol. 30, No. 9, Sept. 1984, pp. 197–200.

[*4*] Wheeler, D. M. and Hobbs, C. J., "Mistakes in Diagnosing Non-Accidental Injury: 10 Year's Experience," *British Medical Journal*, Vol. 296, 30 April 1986, pp. 1233–1236.

[*5*] Kirschner, R. H. and Stein, R. J., "The Mistaken Diagnosis of Child Abuse," *American Journal of Diseases of Children*, Vol. 139, No. 9, Sept. 1985, pp. 873–875.

[*6*] Rosenblat, H. and Hong, P., "Coin Rolling Misdiagnosed as Child Abuse," *Canadian Medical Association Journal*, Vol. 140, 15 Feb. 1989, p. 417.

[*7*] Radkowski, M. A., "The Battered Child Syndrome: Pitfalls in Radiologic Diagnosis," *Pediatric Annals*, Vol. 12, No. 12, Dec. 1983, pp. 894–903.

[*8*] Merten, D. F., Radkowski, M. A., and Leonidas, J. C., "The Abused Child: A Radiological Reappraisal," *Radiology*, Vol. 146, No. 2, Feb. 1983, pp. 377–381.

[*9*] Cumming, W. A., "Neonatal Skeletal Fractures: Birth Trauma or Child Abuse," *Journal of the Canadian Association of Radiologists*, Vol. 30, No. 3, March 1979, pp. 30–33.

[*10*] Kleinman, P. K., *Diagnostic Imaging of Child Abuse*, Williams and Wilkins, Baltimore, MD, 1987.

[*11*] Helfer, R. E., Scheurer, S. L., Alexander, R., Reed, J., and Slovis, T. L., "Trauma to the Bones of Small Infants from Passive Exercise: A Factor in the Etiology of Child Abuse," *Journal of Pediatrics*, Vol. 104, No. 1, Jan. 1984, pp. 47–50.

Address requests for reprints or additional information to
Dr. Kris Sperry
Fulton County Medical Examiner's Office
50 Coca Cola Place, S.E.
Atlanta, GA 30303