



### H113 Posterior Rib Fractures in Non-Traumatic Pediatric Deaths

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The goal of this presentation is to present a case series of non-traumatic pediatric deaths in which posterior rib fractures were observed. The learning objective is to understand possible mechanisms causing posterior rib fractures in infants.

This presentation will impact the forensic science community by raising awareness of posterior rib fractures observed in non-traumatic pediatric deaths. Posterior rib fractures are considered suspicious for non-accidental injury, but mechanisms other than non-accidental trauma must be considered.

Rib fractures observed in infants and young children are considered suspicious for Non-Accidental Injury (NAI), especially fractures located in the posterior region of the rib. In fact, Barsness and colleagues found that in children under the age of 3 years, the positive predictive value of rib fractures for NAI was 95%.<sup>1</sup> Dolinak reports that in 11% of consecutive infant autopsies ( $n=70$ ), subtle Cardiopulmonary Resuscitation (CPR) - associated rib fractures were found in the anterolateral region of the ribs.<sup>2</sup> In several of the cases, multiple ribs were fractured bilaterally. No fractures were found in the posterior region of the ribs.

Researchers theorize that the mechanism causing CPR-related rib fractures is different from the mechanism causing posterior rib fractures. CPR rib fractures result from the anterior chest being forced posteriorly while the back is supported, causing the rib to fail in the mid-clavicular region. Posterior rib fractures are caused when the thorax is squeezed in an anterior/posterior direction while the back is unsupported forcing the posterior rib against the transverse process of the vertebra. This action creates a Type I lever at the costrotransverse articulation site.

In 2000, the American Heart Association, in collaboration with the International Liaison Committee on Resuscitation, recommended a new “two-thumb” technique to administer CPR to infants. The method involves placing both thumbs on the sternum of the patient, encircling the chest with the hands, placing the finger tips lateral to the spine, and compressing the sternum. This technique is similar to the mechanism commonly proposed for inflicting NAI rib fractures. Clouse and Lantz reported on four cases of premature infant decedents who each received “two-thumb” CPR.<sup>3</sup> Posterior rib fractures were observed in all decedents and NAI was excluded in each case.

Three infant deaths investigated by the District of Columbia (DC) Office of the Chief Medical Examiner were found to have posterior rib fractures and no other signs of trauma. Each decedent was transported from a private home to the hospital by the DC Fire and Emergency Medical Services (FEMS) with CPR in progress. FEMS standard operating procedure is to perform “two-thumb” CPR on infants. In each case, the posterior rib fractures were observed after the periosteum and intercostal muscles were removed from the pleural surface of the ribs. At each fracture site, little to no hemorrhage was observed. The fractures were both complete and incomplete and were positioned at the rib head or angle. In each case, several ribs were serially fractured, with up to six ribs fractured in one case. In all cases, the fractures were unilateral. Anterior rib fractures were also observed in two of the cases.

The autopsy findings in the presented cases suggest CPR-related posterior rib fractures. In each case, the fractures were subtle and difficult to recognize on radiographs as well as during the autopsy. These three cases should raise caution regarding the diagnostic value of posterior rib fractures for NAI.

#### Reference(s):

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2. Dolinak D. Rib fractures in infants due to cardiopulmonary resuscitation efforts. *Am J Forensic Med Pathol*. 2007;28(2):107-10.
3. Clouse J.R., Lantz P.E. Posterior rib fractures in infants associated with cardiopulmonary resuscitation. *Proceedings of the American Academy of Forensic Sciences*, 60<sup>th</sup> Annual Scientific Meeting, Washington, DC. 2008, 254-255.

#### Posterior Rib Fractures, Pediatric, Non-Accidental Injury