



G12 Posterior Rib Fractures in Infants Associated With Cardiopulmonary Resuscitation

Jolene R. Clouse, MD, and Patrick E. Lantz, MD, Wake Forest University, School of Medicine, Department of Pathology, Medical Center Boulevard, Winston-Salem, NC 27157-1072*

The goals of this presentation are to: (1) describe the recommended method of chest compressions for infants by the American Heart Association, (2) describe the proposed mechanism causing posterior rib fractures due to child abuse, and (3) describe how chest compressions during cardiopulmonary resuscitation in an infant could cause posterior rib fractures.

This presentation is intended to educate the attendees that posterior rib fractures in infants can occur in circumstances other than child abuse; specifically they can be associated with chest compressions performed during cardiopulmonary resuscitation (CPR). This study will impact the forensic community and humanity by demonstrating that posterior rib fractures can be related to CPR chest compressions and should not automatically assumed to be a result of abuse without supporting evidence and investigation.

A commonly held belief by forensic pathologists, pediatricians and pediatric radiologists is that posterior rib fractures in infants are highly specific for child abuse and rarely if ever result from chest compressions during cardiopulmonary resuscitation. Those who concede that rib fractures may very rarely occur due to CPR contend that the injuries involve the anterior or anterior/lateral aspects of the rib. This issue is of particular importance as rib fractures in small children are most commonly the result of non-accidental injury and therefore may be strong evidence in support of child abuse. A complete autopsy and a thorough investigation of circumstances are critical in determining the manner of death in infants. Misclassification due to over-interpretation of a single finding could have devastating effects on caregivers who may be falsely accused of abuse and therefore face litigation.

The normal immature infant skeleton has increased plasticity compared to the adult skeleton making it relatively resistant to fracture unless there are congenital or acquired disorders of the collagen matrix or mineralization. However, with enough force applied to the costovertebral angle, minute fractures of the rib head and neck can occur. Current American Heart Association guidelines suggest that CPR for infants given by health care providers be performed using the two-handed method with thumbs on the sternum and fingers encircling the chest and back. In this manner, direct pressure not only depresses the sternum but also can lever the posterior ribs at their articulation with the vertebral column at the transverse processes of the thoracic vertebrae. In instances where untrained individuals provide CPR, improper technique may also contribute to fractures. As acute fractures in many cases are quite subtle and nondisplaced, they may be missed on antemortem and postmortem radiographs even when critically examined. These fractures may also be missed at autopsy particularly if the parietal pleura is not removed. In fact, the true incidence of infant rib fractures may be underestimated due to the difficulty in their detection.

Presented here are the gross, radiographic, and microscopic findings from four hospitalized neonates and infants, aged 1 day to 3 months, who died of natural causes but were noted to have posterior rib fractures at autopsy. Three cases showed evidence of acute fractures after terminal CPR attempts. In one case, remote fractures with callous formation were identified in an infant with multiple previous CPR episodes due to complications resulting from his premature birth. These infants and neonates spent the majority of their lives within the hospital. In all cases the infants had no history of abuse, no outward evidence of inflicted injury, and no additional internal injuries consistent with child abuse. It is imperative that the presence of posterior rib fractures in an infant not be ascribed impulsively to child abuse until a thorough investigation is conducted including assessment of resuscitative techniques.

Posterior Rib Fractures, Cardiopulmonary Resuscitation, Child Abuse