A44 Pediatric Posterior Rib Terminus Defects: An Investigation of a Potential Mimic of Traumatic Injury

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Learning Overview: After attending this presentation, attendees will be aware of rarely identified mimics of posterior rib head fractures that are inconsistent with inflicted trauma.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating that posterior rib head fracture mimics are a fairly common finding and should be interpreted cautiously.

Posterior rib fractures are considered highly suspicious for abusive injury in infants due to the mechanism by which these injuries occur.[1] Numerous studies demonstrate an association between posterior rib fractures and inflicted injury in infants. While this association is clear, recent casework at the Harris County Institute of Forensic Sciences (HCIFS) requires that at least some posterior rib defects be considered in the context of growth and development as well as the presence and/or absence of other injuries and/or risk factors. At the HCIFS, standard autopsy protocol includes an *in situ* rib exam on all pediatric cases less than five years of age. In 55% (n=41) of the 75 cases examined since January of 2019, at least one subtle linear defect was observed on the pleural surface of one or more ribs near their attachment to the vertebral column. Grossly, these defects have morphological characteristics suggestive of advanced healing, such as bone formation along the endosteal portion of the fracture surface. Similar defects have been previously described by Kemp as clefts that are "triangular-shaped defects in the primary spongiosa with the tip at the growth plate and the base at the periosteum."[2] Kemp notes that the clefts are filled with an "amorphous, granular, eosinophilic acellular material of uncertain origin," which was previously described by Dolinak and Matshes.[2,3] The exact content of the material is unknown, but Kemp hypothesizes the material is a response to inflammation and repair and contributes the clefts to microscopic fractures.[2] However, the characteristics of some of the pediatric cases at HCIFS complicate the interpretation of these defects. The defects were observed in one fetus and in several infants less than one week of age, as well as in infants with no other evidence of injury. Additionally, histological examination of these defects shows no cellular evidence of healing. As a result of these complications, a closer examination of the context in which these posterior defects are observed is warranted.

Manner and cause of death had been classified for 19 of the 41 cases with posterior defects. Cause of death was unrelated to trauma for 16 of the 19 cases. Only one of the three cases with a trauma-related cause of death was suspicious for abusive injury (Manner–Undetermined, Cause–Blunt force head trauma). Of the 41 cases with posterior defects, 16 had no other skeletal injuries, including rib fractures, and 17 had rib fractures but no other skeletal injuries. The fracture pattern in most of the cases with rib fractures was consistent with cardiopulmonary resuscitation.

A logistic regression model was used to examine the relationship between the presence of posterior defects as the dependent variable and age, sex, ethnicity, the presence of other rib fractures, and the presence of other skeletal injuries (excluding rib fractures) as the independent variables. The presence of posterior rib defects was significantly related to sex (p<.001). The odds that females had posterior defects was 7.04 greater than males (OR=7.04, 95% CI [2.27, 21.83]). Age may also have a significant effect on the presence of posterior rib defects (p=.058). The odds of observing posterior defects in older children were lower than in younger infants (OR=0.96, 95% CI [0.92, 1.00]). Age is statistically significant when entered as the only independent variable in the model (p=.047). Neither ethnicity, the presence of other rib fractures, nor the presence of skeletal injuries had a significant relationship with the presence of posterior defects (p>.05). These relationships are inconsistent with the general trends observed among the infants autopsied at HCIFS that die of abusive trauma or traumatic injury. The odds of traumatic death (OR=1.08, 95% CI [1.06, 1.10]) and abusive injury (OR=1.06, 95% CI [1.03, 1.08]) increases as age increases. Sex had no significant relationship with causes of death related to trauma or abusive injury (p>.05).

Reference(s):

1. Kleinman, Paul K. Bony Thoracic Trauma. In *Diagnostic Imaging of Child Abuse*, edited by Paul K. Kleinman, 110-48. St. Louis: Mosby, 1998.
2. Kemp, Walter Loren. *Microscopic Examination of Rib Heads: A Useful Adjunct in the Investigation of Infant Deaths.* PhD diss., University of Montana, 2014.
3. Dolinak, David, and Evan Matshes. Child Abuse. In *Forensic Pathology: Principles and Practice*, edited by David Dolinak, Evan Matshes, and Emma Lew, 369-411. Amsterdam: Elsevier Academic Press, 2005.

Child Abuse, Posterior Rib Fractures, Trauma Mimics

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