



Pathology/Biology Section - 2016

H32 Unusual Blunt Force Trauma to the Cranial Vault: Investigation of an Atypical Infant Abuse/Homicide

*Jered B. Cornelison, PhD**, Western Michigan University School of Medicine, Dept of Pathology, 1000 Oakland Drive, Kalamazoo, MI 49008; *Carolyn V. Isaac, PhD*, 1000 Oakland Drive, Kalamazoo, MI 49008-8074; *Brandy Shattuck, MD*, Western Michigan Homer Stryker MD, School of Med, 1000 Oakland Drive, Kalamazoo, MI 49008; and *Joyce L. deJong, DO*, WMU Homer Stryker MD, School of Medicine, Dept of Pathology, 1000 Oakland Drive, Kalamazoo, MI 49008

After attending this presentation, attendees will better understand multiple unusual blunt force cranial injury patterns and manual asphyxiation, ultimately resulting in homicide. Attendees will also learn how a combination of microscopic and macroscopic examination contributed to interpreting an injury pattern that was sustained on multiple occurrences over an extended period of time.

This presentation will impact the forensic science community by highlighting a continued need for case studies to understand how unusual blunt force injuries can produce atypical fracture patterns. Interpretation is complicated within a context of repeated traumatic events.

A three-month-old infant was found unresponsive in a pack and play at home. The parents transported the infant to the hospital for evaluation. After extensive life-saving procedures, the infant failed to thrive and died. At postmortem examination, most body measurements fell well below expected growth rates (less than 5th percentile). The conjunctivae were pale with multiple petechiae and there were multiple petechiae on the skin of the face adjacent to the right eye. Areas of injury evident at autopsy included two areas of hemorrhage of the scalp, corresponding areas of hemorrhage of the soft tissues adherent to the skull, multiple skull fractures associated with the areas of hemorrhage, and attendant subarachnoid hemorrhage underlying the skull fractures. Multiple skull fractures and Classic Metaphyseal Lesions (CMLs) were also observed radiographically.

The vault portions of the parietals, frontal, occipital, and the left arm were removed at autopsy for gross, microscopic, and histological anthropological trauma analysis. The skeletal analysis revealed multiple healing fractures including seven fractures on the left parietal, six fractures on the right parietal, and one fracture on the occipital. Notably, six of the cranial fractures were linear fractures oriented perpendicular to the sagittal plane and extending to the sagittal suture. The pattern of these fractures are consistent with multiple compressive blunt force injuries to the head.

Healing CMLs were observed grossly and radiographically on the left proximal humerus, left distal radius, and left distal ulna metaphyses. The distal ends of the ulna and radius display rotational deviation and distortion with reactive bone along the shafts, suggesting previously healed fractures. The injuries indicate a rotational force applied to the infant's arm.

Microscopic and histological examination revealed that the fractures of the skull and left arm were in varying stages of healing. These different stages of healing are distinguished by: (1) an early stage in which the fracture margin is open with rounded fracture margins and subperiosteal bone along the fracture margins; (2) a middle stage in which the fracture margins exhibit intermittent bone bridging and subperiosteal reactive bone along the fracture margins; and, (3) a late stage in which the fracture margin is completely obliterated with persistent subperiosteal reactive bone. These results indicate the infant experienced multiple traumatic events during life but none of these directly contributed to death.

The diffuse petechiae of the face and conjunctivae indicate the infant died of asphyxia due to obstruction of airways. Law enforcement investigation produced reports of repeated manual compression of the head, neck, and chin of this infant by another individual. Such a mechanism of injury would account for the multiple cranial fractures and various stages of healing.

In summary, this individual demonstrates multiple fractures of the head and left arm in varying stages of healing, suggesting multiple traumatic events. More importantly, if the information from law enforcement is accurate regarding the mechanism of injury, forensic pathologists and anthropologists gain insight into the effects of low velocity and slow-loading compressive blunt force trauma on fracture patterning of an infant skull. Histological methods provide an opportunity for forensic anthropologists to understand the bone healing response to repeated injury of the cranial vault. Finally, this case study highlights the need for anthropologists and skeletal biologists to investigate cranial histological and gross healing responses and stages in infants and children.

Child Abuse, Blunt Force Trauma, Fracture Healing