G51 Ganglia and Nerve Root Hemorrhage in Cases of Pediatric Blunt Head Injury

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The goals of this presentation are to introduce a novel method for extraction of the entire spinal cord with the attached dorsal root ganglia and to present the results of a pilot study comparing histological findings of pediatric decedents with and without documented trauma.

This presentation will impact the forensic science community by introducing a novel method for spinal cord extraction that is more cost- and time-efficient than the previously published *en bloc* method as well as a concise method for scoring the presence or absence of nerve root and dorsal root ganglia hemorrhage. A preliminary comparison of hemorrhage in nerve roots and/or ganglia within cervical, thoracic, and lumbar regions between traumatic and non-traumatic deaths will be presented.

Downs, Downs and Alexander, and Matshes *et al.* all have presented preliminary data supporting a relationship between cervical nerve root and ganglion hemorrhage and abusive head trauma.[1-3] Downs and Downs and Alexander were the first to describe a method for extracting and examining cervical nerve roots and ganglia and identified hemorrhage in these structures of children with a history of abusive head injury.[1,2] Using the same extraction technique, Matshes and colleagues found nerve root hemorrhages in the cervical ganglia that they attributed to tensile forces associated with the back-and-forth motion of the neck during shaking.[3] The extraction technique used in each study involved removal of the cervical vertebral column with enclosed neurological tissues *en bloc*, followed by histologic preparation of the entire specimen. The method was labor intensive, costly, time consuming, and highly invasive; additionally, histologic processing of the spine required decalcification of the specimen which may also introduce artifacts or interfere with any subsequent immunohistochemical studies.

The Harris County Institute of Forensic Sciences (HCIFS) has developed an alternative method for extracting a spinal cord with attached dorsal root ganglia that is time- and cost-efficient and much less destructive. Extraction of the spinal cord begins with a standard posterior approach. A posterior laminectomy is completed using a reciprocating saw. The lateral column is then removed by cutting through the overlaying superior and inferior articulating facets and then the pedicle using Stony Coral Cutters, a manual bone-cutting instrument. The segmented bone is retracted and the underlying ganglion is exposed. Then each nerve is cut lateral to the ganglion with a scalpel. Finally, the complete spinal cord is removed with the attached ganglia. The neurologic tissue is preserved and sectioned following standard methods.

In addition to the time and cost advantage previously mentioned, the proposed method removes only the posterior and lateral regions of the vertebrae, leaving the vertebral bodies articulated; this maintains the structural integrity of the entire vertebral column. Furthermore, the method allows examination of the cervical, thoracic, lumbar, and sacral ganglia without distortion of the body.

To evaluate the extraction method and to obtain preliminary information regarding hemorrhage in all spinal levels, HCIFS conducted a pilot study. Spinal cords using the proposed method were removed from 26 pediatric decedents. The ages of the decedents at death were 1 to 48 months of age (mean age: 9 months of age). The study population was broken into two groups: a control group with no traumatic findings during the autopsy; and, an experimental group with traumatic findings during the autopsy. The control group included 9 decedents, age range 1 to 6 months. The experimental group included 17 decedents, age range 1 to 48 months. Cranial trauma was identified in 16 decedents of the experimental group. For each decedent, histological sections of nerve roots and dorsal root ganglia were examined for the presence of hemorrhage. Each slide was scored using a binary system of presence/absence. In the control group, hemorrhage was observed in only one (11%) decedent, a documented hemophiliac. In the experimental group, hemorrhage was observed in 16 (77%) of the decedents, all with documented cranial trauma.

Although the pilot study sample population was small, the results indicate that removal of the spinal cord using the proposed method is valid and that hemorrhage in the spinal nerve roots or dorsal root ganglia is an indicator of trauma. HCIFS, in collaboration with a regional pediatric hospital, is conducting a protracted study to more thoroughly investigate the role of nerve root hemorrhage in pediatric deaths.

References:

 ** Presenting Author*

1. Downs JCU. Shaken/Impact Syndrome: Are We Looking in the Right Place? NAME Annual Meeting, October, 2005, Los Angeles, CA
2. Downs JCU, Alexander R. Untrue Defenses. In *Abusive Head Trauma in Infants and Children* (eds. Frasier, Alexander, Rauth-Farley, Parrish) 2006:421-440
3. Matshes EW, Evans RM, Pinckard JK, Joseph JT, Lew EO. Shaken infants die of neck trauma, not brain trauma. Acad For Path. 2011;1(1):82-91.

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