G127 Using ß-Amyloid Precursor Protein Staining to Study Patterns of Axonal Injury in Young Children With Hypoxic Ischemic Encephalopathy

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After attending this presentation, attendees will be able to appreciate whether the pattern of axonal injury in abusive head trauma in young children is caused by hypoxia or trauma.

This presentation will impact the forensic science community by presenting the findings in a group of infants and young children with hypoxic ischemic encephalopathy from causes other than abusive head trauma (AHT) using beta amyloid precursor protein (BAPP) immunohistochemistry reactivity. The study will detail the pattern/patterns of axonal injury caused by pure hypoxic/ischemic insults in young children. The hypothesis is that infants and young children with AHT have overlapping patterns of traumatic (tDAI) and hypoxic/ischemic axonal injury (VAI) and that these two patterns need to be able to be distinguished to determine whether traumatic axonal injury exists in the AHT group. In known fatal human cases of tDAI, the gross brains demonstrate numerous streak and punctuate hemorrhages in association with the axonal damage. These small hemorrhages are not seen in young children with tDAI. It has been questioned whether the vessels of young children do not tear because they are very elastic. Another possibility is that there is vascular injury without disruption of the vessels and that vascular damage causes failure to perfuse leading to hypoxia.

BAPP immunohistochemical reactivity is a very sensitive method of detecting axonal injury. Young children with AHT have been studied in several series to determine whether tDAI or VAI occurs in these children. Many of these children obviously have VAI as they have suffered respiratory arrest or distress early on in their course. Some of these children have evidence of both types of axonal injury present. Typically, tDAI produces a pattern of scattered small groups of axons reactive for BAPP in hemispheric white matter, corpus callosum, internal capsule, and brainstem. VAI appears to produce a pattern of reactive axons described as broad geographic areas often related to vessels. One possibility is that although young children with AHT frequently show the VAI pattern of damage, the more subtle pattern of tDAI is being obscured under the more pervasive damage caused by the VAI. Another possibility is that the pattern of VAI in young children with AHT is changed by the damage to small blood vessels and differs from VAI seen in non-AHT cases.

The first cases of intrauterine causes of hypoxic ischemic encephalopathy studied have demonstrated no or very minimal VAI BAPP reactivity. These cases have survived several days with severe hypoxia which may have also existed for some period intrauterine. All cases demonstrate typical ischemic changes on H & E staining.

Because the axonal injury in cases of AHT may be present in a mixed pattern, it is important to study a non head injured group to discern true VAI patterns. An issue of great interest in AHT in children is the timing of the injury. If tDAI is the basis of AHT in young children, certain predictions can be made about the timing of the injury. Because tDAI is a type of immediate impact injury, the injury or disruption of the axonal processes occurs at the moment of injury and not subsequently as a result of hypoxia or increasing intracranial pressure. Damage of axonal processes at the level of the thalamus and deep gray matter has been demonstrated in experimental primate models of DAI as well as in the CT examination of brains of known human cases of tDAI to be lesions which produce immediate onset of unconsciousness.

Abusive Head Trauma, Axonal Injury, Hypoxic Encephalopathy

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