H5 The Aftermath of Abusive Head Trauma: A Unique Pediatric Disease

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Learning Overview: The goals of this presentation are to: (1) list the anatomic manifestations of abusive head trauma; (2) describe the long-term clinical and pathological complications of abusive head trauma; and (3) discuss the significance of long-term consequences with respect to pathophysiology.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by presenting this study that elucidates a disease complex unique to all other diseases of children.

Background: Abusive head trauma is associated with a high mortality rate. In those who survive, neurological complications are numerous and severe. In one study of 837 cases, 59% of the survivors of abusive head trauma had moderate to severe disability and 5% were in a persistent vegetative state.[1] The pathophysiology of the extensive brain damage in abusive head trauma is unclear.

Methods: A total of 13 long-term survivors of clinically suspected or confirmed abusive head trauma were identified who presented for forensic autopsy between 2017 and 2020. Cases were selected for examination on the basis of the medical information provided. Cases were not selected based on the anatomical findings or the assessment of cause and manner of death. One case did not have fixed brain available for detailed neuropathological examination and was excluded. One case of suspected post-traumatic epilepsy was due to abuse as an adult and was excluded. Brain (all cases) and dura mater (all but one case) were fixed in formalin for approximately two weeks. Post-fixed tissue was photographed, sectioned, and sampled for histopathology. Samples were dehydrated in graded ethanol and xylene solutions, embedded in paraffin, and stained with hematoxylin and eosin.

Results: The decedents ranged in age from 5 years to 44 years. Survival time ranged from 4 to 43 years. All decedents were severely neurologically impaired during life, requiring 24-hour care. Nine decedents were said to have "cerebral palsy." Dura mater showed subdural fibrosis and/or a thin neomembrane in 11 of 13 cases. Focal areas of osseous metaplasia of the dura were present in three cases. Brain examination showed widespread ischemic brain injury in 12 of 13 decedents, typically involving vascular territories of the anterior circulation. The territory of the posterior cerebral artery was inconsistently involved. The changes were patchy in all cases when present and asymmetric in five cases. There were more severe changes over the superior convexities and parasagittally, although generally in a vascular territory distribution rather than an arterial border zone distribution. There was frequent sclerosis of the basal ganglia, thalamus, and cerebellum, and hippocampal sclerosis in a minority of cases. One decedent had callosal agenesis and migration disturbance, suggesting that the severe impairment was developmental rather than secondary to abusive head trauma.

Conclusions: Abusive head trauma sets up a pathophysiological cascade that appears to be unique among pediatric diseases. Although the common manifestations of subdural hematoma and retinal hemorrhage are well known, extensive damage to the substance of the brain is less understood and appears to be responsible for long-term morbidity and mortality. Such damage is not explainable on the basis of an expanding intracranial hemorrhage or global ischemic ("hypoxic-ischemic") brain injury from systemic cardiovascular collapse. The pattern of brain injury after abusive head trauma instead suggests severe vascular territory ischemia induced by blunt force trauma, which, in the absence of large vessel thrombosis, suggests that vasospasm may play a critical role in the morbidity and mortality in this setting.

Reference(s):

1. Robert A. Minns, Patrica Jones, Karen Maria Barlow. Outcomes and prognosis of non-accidental head injury in infants. In: *Shaking and Other Non-Accidental Head Injuries in Children*, eds. Robert A. Minns, J. Keith Brown. 2005, McKeith Press. p. 364-414

Abusive Head Trauma, Shaken Baby Syndrome, Chronic Ischemic Brain Injury

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