

Epidemiologic evidence for the role of coagulopathy in the diagnosis of abusive head trauma

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The interaction between the findings raising a high index of suspicion of pediatric abusive head trauma/shaken baby syndrome (*i.e.*, intracranial and retinal hemorrhage), and conditions that may increase the propensity of intracranial bleeding in the absence of physical abuse (*i.e.*, coagulopathy), is poorly defined. The lack of information on this issue is particularly problematic in the investigation of the cause and manner of a pediatric head injury-related death in which there are no collateral findings indicating likely abuse, such as extracranial new and healing fractures or other injuries, or a prior history of abuse in the household. As illustration, we present the case of a 4-month old male infant with no personal or family history of abuse, who was discovered pale, unresponsive and not breathing by his father, around 3 days after he had been found to have a bump on the back of his head. A CT scan revealed an acute on chronic subdural hematoma and cerebral edema, with no skull fracture. By the time he had died 5 days later the child had developed retinal hemorrhage. During the 5-day hospitalization it was found that the child had Factor VII deficiency, and months-later testing of his father revealed the same condition.

An autopsy conducted 2 days later noted a chronic subdural and subarachnoid hemorrhage, cerebral edema, optic nerve sheath hematoma, and retina hemorrhage. The cause of death was given by the ME as “*blunt force injuries of the head,*” despite an absence of any external sign of trauma. Based on the fact that he was the caregiver at the time that the child was discovered in a non-responsive state, the father was charged with homicide. When confronted with the evidence of Factor VII deficiency, the child abuse pediatrician opined that the condition was secondary to, rather than a result of the intracranial hemorrhage, citing to extensive personal experience with such injuries as the basis for the conclusion. The pediatrician asserted that intracranial hemorrhage and retinal hemorrhage are only possible due to physical abuse (*i.e.*, shaking with or without impact), or a high-speed traffic crash or fall from at least a 2 story height.

A forensic epidemiologic analysis of national hospital data was undertaken to assess the reliability of the claims made by both pediatrician and pathologist. Data were abstracted from the Kids’ Inpatient Database (KID) and the National Inpatient Sample (NIS). The analysis included all children aged 1 and under who were admitted to the hospital with intracranial and retinal hemorrhage from 2000 to 2014, inclusive. There were an estimated 9,493 children who met these criteria, approximately 633 infants per year. Coagulopathy was present in 406 (4.2%) of the hospitalized infants, or around 27 per year.

Of the 9,493 hospitalized infants there were 5,014 (52.8%) who had no other diagnosed injuries that would be consistent with abuse (fractures, burns, internal injuries, *etc.*), or around 334 per year. Abuse was diagnosed or designated as a cause in 70.9% of the cases where there was no other diagnosed injury. Among the children who did not have a diagnosis of abuse, in the majority for which there was a cause specified, the injury resulted from a low energy event, such as a ground level fall, or a fall from furniture or a bed. The analysis revealed the fact that among pre-mobile children who are hospitalized for intracranial and retinal hemorrhage, both with and without coagulopathy, the injury did not result from abuse in at least 1 out of every 5 cases. The ME and pediatrician claims that the injuries could only be explained by intentional

abuse were demonstrably false. After being presented with the above evidence, in combination with the familial evidence of a coagulopathy, the state dismissed the homicide charge against the father.