Editorial

Pediatric Neurosurgery

Pediatr Neurosurg 2003;39:57–59
DOI: 10.1159/000071315

Significance of a Subdural Hematoma in a Child with External Hydrocephalus

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Most physicians take the presence of a subdural hematoma in a child without a history of trauma as presumptive evidence of abuse. This assumption rests on our understanding of the pathophysiology of subdural hemorrhage; subdural hematomas are caused by tearing intracranial bridging veins and it requires substantial force to rupture the veins and cause bleeding. The force required is thought to be more than can be generated in a short fall or by typical household accidents. Moreover, subdural hematomas most frequently occur in conjunction with other injuries, such as retinal hemorrhages and long bone fractures, which are indicative of severe trauma. There are some conditions, however, that are recognized to predispose a child to develop a subdural hematoma after even minor injury: among them are coagulopathies, glutaric aciduria, large arachnoid cysts and osteogenesis imperfecta [1–5]. There have been suggestions that the presence of external hydrocephalus (i.e. familial macrocephaly, benign subdural effusions of infancy) also puts a child at risk [6–8]. Both theoretical and clinical evidence supports this position.

Theoretical evidence comes from Papasian and Frim [9], who have created a mathematical model specifically to examine the forces required to cause a subdural hematoma in a child with external hydrocephalus. They used two concentric hollow spheres to represent the brain and skull. Bridging veins were modeled to run orthogonally between the two spheres. Using currently accepted information about venous length and tensile strength, the authors calculated the strain on the veins caused by various forces and then defined the likelihood that the veins would fail in a given situation. They found that the same force caused veins to stretch proportionately more in children with extra axial collections than in those without. They calculated that the forces associated with low impact injuries were sufficient to cause venous rupture in children with external hydrocephalus. This finding held true for simulations with a variety of vessel lengths and diameters. Other groups have come to similar conclusions [10].

As a practical issue, it does appear that a disproportionate number of children with external hydrocephalus develop subdural hemorrhages. Several groups have commented on the relationship. Laubscher et al. [11] described 22 children with megalencephaly and enlarged subarachnoid spaces. Three of the 22 had subdural hematomas: all apparently did well and none had recognized trauma. Similar results were reported by Mori et al. [12], Azais and Echenne [13] and, later, by Piatt [14]. The clinical association between external hydrocephalus and subdural hemorrhage has also been noted in the neuroradiology literature. In 1982, Kapila et al. [15] presented 16 children with subdural hematomas and enlarged CSF spaces. The authors reviewed several studies, both before and after the advent of CT scanning, and concluded that 'enlargement of the ventricles and subarachnoid spaces in this group of patients predisposes them to the develop-

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1016–2291/03/0392–0057$19.50/0

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ment of subdural hematoma with minimal or no trauma.'

The Japanese recognize a diagnosis of infantile acute subdural hematoma. It is defined as the occurrence of a subdural hematoma in an infant due to apparently minor head injury [16, 17]. Craniocerebral disproportion is thought to be one of the etiologic factors. The existence of this entity has been questioned by several investigators, notably many in the United States, because they suspect that essentially all of the children described have been unrecognized victims of abuse [18, 19]. Three aspects of the Japanese experience suggest that this might not be the case: (1) Many of the children in the Japanese series have had relatively benign clinical courses and have made excellent recoveries. This is clearly distinct from the situation reported in the United States. (It may be, however, that, in this instance, the American literature does not fully reflect clinical practice. I suspect that every practicing pediatric neurosurgeon has seen a child with external hydrocephalus, a history of minor trauma, a small subdural hematoma and a normal neurologic exam. Few, if any, of these children have been included in published reports.) (2) Almost every reported series includes some cases in which the causative trauma was witnessed by more than one person and was thought to be minor. In a handful of these, the injury occurred while the child was in a medical facility. Many of the children involved demonstrated no other evidence of abuse. Although it is possible that all those present misrepresented the event or, alternatively, that the substantive injury occurred at a different time, this seems unlikely. (3) Children with subdural hematomas that are the result of inflicted injury are also seen and recognized in Japan, but this group of children is thought to be distinct from those diagnosed with infantile acute subdural hematoma.

The distinction between subdural hematomas caused by minor trauma and those caused by abuse has been more readily accepted outside of the United States than it has within. As a consequence, injuries that in the United States are thought to be pathognomonic of abuse are not so thought of in other parts of the world. Indeed, there is a perception that in the United States the diagnosis of nonaccidental injury is made too frequently. A recent editorial in *The Archives of Diseases of Childhood* reviewed the issue [20]. The article highlighted the difficulty in defining the forces that are generated by trauma and the variable effects of those forces based on the unique circumstances of the event. Several conditions that could alter the effect of a fall were discussed: the rotational component of the applied force, initial head position and the surface struck as well as conditions unique to the child involved. The author concluded by counseling against categorical statements about the effects of a given fall. His caution seems well advised. Certainly, my experience has been that similar falls can have vastly different results.

Discussion of the pathophysiology of subdural hematomas in children with external hydrocephalus is complicated by the social and legal issues that are inextricably tied to the diagnosis of abuse. Physicians are understandably reluctant to fail to identify an abused child and, consequently, are wary of validating plausible excuses for otherwise unexplainable injuries. To state that in children with external hydrocephalus a subdural hematoma can result from minor trauma is potentially to allow inflicted injury to be seen as accidental. Unfortunately, to fail to recognize that minor trauma can cause a subdural hematoma in children with external hydrocephalus is potentially to allow accidental injury to be seen as inflicted. While neither outcome is palatable, the presumption of innocence requires that we choose the latter. It is my opinion that, in the absence of other evidence of inflicted injury, the presence of a subdural hematoma in a child with external hydrocephalus is, by itself, insufficient to prove abuse.

References

1 Duhaime A, Christian CW, Rorke LB, Zimmerman RA: The 'shaken baby syndrome'. N Engl J Med 1998;338:1822–1829.
2 Yoffe G, Buchanan GR: Intracranial hemorrhage in new born and young infants with hemophilia. J Pediatr 1988;113:333–336.
3 Ryan CA, Gayle M: Vitamin K deficiency, intracranial hemorrhage and a subgaleal hematoma: A fatal combination. Pediatr Emerg Care 1992;8:143–145.
4 Tokoro K, Nakajiima F, Yamataki A: Infantile chronic subdural hematoma with local protrusion of the skull in the case of osteogenesis imperfecta. Neurosurgery 1988;22:595–598.
5 Haworth JC, Booth FA, Chudley AE, et al: Phenotypic variability in glutaric aciduria type 1: Report of fourteen cases in five Canadian Indian kindreds. J Pediatr 1991;118:52–58.
6 Barkovitch AJ, Edwards MSB: Applications of neurosurgery in hydrocephalus. Pediatr Neurosurg 1992;18:65–83.
7 Aoki N, Masuzawa H: Infantile acute subdural hematoma: Clinical analysis of 26 cases. J Neurosurg 1984;61:273–280.
8 Ikeda A, Sato O, Tsugane R, Shibuya N,Yamamoto I, Shimada M: Infantile acute subdural hematoma. Childs Nerv System 1987;3:19–22.

9 Papasian NC, Frim DM: A theoretical model of benign external hydrocephalus that predicts a predisposition towards extra-axial hemorrhage after minor head trauma. Pediatr Neurosurg 2000;33:188–193.
10 Yamashima T, Friede RL: Why do bridging veins rupture into the virtual subdural space? J Neurol Neurosurg Psychiatry 1984;47:121–127.
11 Laubscher B, Deonna T, Uske A, van Melle G: Primitive megalencephaly in children: Natural history, medium term prognosis with special reference to external hydrocephalus. Eur J Pediatr 1990;149:502–507.
12 Mori K, Sakamoto T, Nishimura K, Fujiwara K: Subarachnoid fluid collection in infants complicated by subdural hematoma. Childs Nerv Syst 1993;9:282–284.
13 Azais M, Echenne B: Idiopathic pericerebral swelling (external hydrocephalus) of infants (in French). Ann Pédiatr (Paris) 1992;39:550–558.
14 Platt JH: A pitfall in the diagnosis of child abuse: External hydrocephalus, subdural hematoma and retinal hemorrhages. Neurosurg Focus 1999;7(4).
15 Kapila A, Trice J, Spies WG, Siegel BA, Gado MH: Enlarged cerebrospinal fluid spaces in infants with subdural hematomas. Neuroradiology 1982;142:669–672.
16 Morris MW, Smith S, Cressman J, Ancheta J: Evaluation of infants with subdural hematoma who lack external evidence of abuse. Pediatrics 2000;105:549–553.
17 Kleinman PK: Head trauma: Extra-skeletal trauma and miscellaneous conditions in diagnostic imaging of child abuse, ed 2. St. Louis, Mosby 1998:312–313.
18 Aoki N, Masuzuwa H: Subdural hematomas in abused children: Report of six cases from Japan. Neurosurgery 1986;18:475–477.
19 Howard MA, Bell BA, Uttley D: The pathophysiology of infant subdural hematomas. Br J Neurosurg 1993;76:393–397.
20 Wilkens B: Head injury – abuse or accident? Arch Dis Child 1997;76:393–397.