

Chapter 8: Evaluating Head and Other Internal Injuries

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It is not anticipated that the CHAMP physician will be consulting much on patients with head and other internal injuries. Though these cases are life threatening, and often controversial, they are infrequent. Many times these children are ill enough to be shipped far from their home, and far from the CHAMP provider. It will take significant time for the CHAMP physician to gain enough experience to be the primary consultant on such a case. Still, there is an important role for the CHAMP physician when one of these children is admitted to the regional trauma center. Investigating agencies will be co-located with the CHAMP physician, sometimes far from the child. Communication with the treating facility can be significantly improved if the CHAMP physician is available to interpret reports, make phone calls, and coordinate consultation with other child abuse specialists. With that in mind, this chapter will depart from the organizational scheme of the other chapters. Let's discuss some issues that impact the assessment of cases with injury to the brain and other internal organs.

1. Imaging Studies:

We have already discussed imaging of the skeletal system. Virtually all children with head and visceral injuries will require a skeletal X-ray survey. The average age of these children is quite young, the nature of their injuries indicates severe trauma, and they often suffer from pain, shock or neurological compromise that make them a poor reporter of their own injuries. Additional study by repeat skeletal X-ray survey, may be overlooked, particularly if a child is discharged prior to two weeks following injury. The CHAMP physician will need to explain the reason for repeat imaging, and encourage parents, the PMD as well as CPS and perhaps law enforcement to obtain the follow up studies

Head injured children virtually always receive an initial CT scan of the head. This is the quickest way to detect injury and bleeding, and it allows ready access to unstable patients in the crucial early hours of care. CT scan is quite sensitive for acute subdural bleeding, the commonest finding in inflicted head trauma. It may not be able to distinguish between very small acute epidural, subdural and subarachnoid hemorrhages. Similarly, chronic subdural hemorrhages and expansion of the subarachnoid space may not be well distinguished. A recently realized shortcoming is that distinguishing new collections, from old collections, and collections of mixed age, is fraught with more difficulty than once imagined. A radiologist's report that interprets bright collections as acute subdural hemorrhage, isodense collections as ten to fourteen days old, and dark collections as 21 or more days old, does not adequately reflect current data on the appearance of SDH over time. Mixed density collections may be of a single generation in both the acute and chronic phases.

MRI scanning has been recommended for ALL children with suspected inflicted head trauma by the Society of Pediatric Radiology and by the American Academy of Pediatrics. Despite this, it is sometimes difficult to get an MRI because physicians caring for the child do not find it clinically necessary, or, because the patient is unstable. MRI will better distinguish subdural and subarachnoid collections, is more sensitive to brain parenchymal injury, helps to evaluate vascular anatomy and anomalies, and provides additional data to consider when evaluating the age of blood collections. Just as CT

scanning is going through a reappraisal as an instrument to date intracranial blood collections, MRI is going through the same process. The concordance of MRI and CT data, interpreted by an up-to-date pediatric radiologist or neuroradiologist is valuable.

Screening for abusive head injury has been recommended, when children present with other forms of child abuse. Two articles have looked at the return on CT scanning of asymptomatic patients. The return has been reasonable when studies are confined to children under six months with other convincing signs of inflicted injury, and children between six and twelve months with head or facial bruising, rib fracture, or classic metaphyseal lesions. .

Visceral injury is almost always assessed by CT scanning. Ultrasound, plain radiography, and contrast radiography may have their place, which should be determined by a radiologist. Imaging is usually guided by clinical appearance. The chance of a positive scan is higher when there are externally apparent abdominal injuries, or the history includes focused compressing trauma to the abdomen. Unfortunately, the majority of children with visceral injury have no externally apparent injuries, and abuse cases often present without an accurate history. When child abuse is suspected, the index of suspicion must be high for internal injuries. There is, however, no current recommendation for screening CT scan of the body. Screening for liver injury with transaminases is supported by one clinical study, and there is some support for screening with a serum amylase and a urinalysis for pancreatic and kidney injury.

2. Laboratory Testing

All internal bleeding should prompt a bleeding assessment. While CBC, PT, and PTT may suffice for a bruised child with a negative family history, a more extensive evaluation is called for here. Thrombin time, fibrinogen, fibrin degradation products, D-dimers, factor VIII, IX, and XIII levels, von-Willebrand's panel, and platelet function studies have all been recommended. The role of PIVKA for detecting vitamin K deficiency has been debated. Not only may coagulopathy cause intracranial bleeding, but brain injury may cause coagulopathy. Follow up assessment with a hematologist may help clarify this situations, though this may take some time. When head injury is accompanied by stroke, or venous sinus thrombosis, thrombophilia evaluation may be recommended. Protein C, protein S, antithrombin, factor V Leiden, Prothrombin mutation, anti-phospholipid antibodies, MTHFR mutation, and others are sometimes recommended. Again, a hematologist may best direct such an assessment. The CHAMP physician may need to be the person who suggests hematological evaluation of the family, or in the follow up period.

Genetic diseases impact on internal injuries as well. Glutaric aciduria type 1 is rare, but may present as subdural hemorrhages with limited retinal hemorrhage. These children typically have large heads, and excess sub-arachnoid fluid. In particular, they suffer from front-temporal atrophy, which gives a particular CT or MRI appearance. A family history of mental retardation, cerebral palsy or movement disorder should prompt the search for this or other metabolic disorders. Visceral injuries may be the consequence of

Ehlers Danlos syndrome. Type four in the old nosology, or vascular type in the new system, may suffer large blood vessel or hollow viscus compromise following minor or inapparent trauma, creating confusion with abuse. Osteogenesis imperfecta has been reported to present with limited retinal hemorrhages and with subdural hematoma, in rare instances. The additional finding of fractures would be seen as confirming the abuse diagnosis, but actually also supports the diagnosis of osteogenesis imperfecta. The CHAMP physician may need to explain these conditions to investigators, and suggest a genetics assessment in the proper setting.

3. “Shaken Baby Syndrome” versus inflicted head trauma

While the CHAMP faculty believe in the existence of the Shaken Baby Syndrome, and the injurious effects of violent shaking, a liberal and injudicious use of this concept will result in misunderstanding and courtroom controversy. The scientific underpinning of the shaken baby hypothesis have been attacked, and biomechanical arguments on both sides of the deliberation are both compelling, and incomplete. Physicians have diagnosed SBS in the face of scalp contusions and skull fractures, clear evidence of head impact. Police investigators have over focused on shaking, and taken reports of gentle shaking to revive as a firm confession. The CHAMP physician must help investigators understand that shaking does not explain all head injuries, that subdural hematoma may result from other causes besides shaking, that some, but not all retinal hemorrhages strongly suggest shaking, and that injurious shaking is obviously violent and will not be mistaken for a normal or safe act. This education should take place before a case comes up, but will need to be re-stressed when an investigation is under way. In general we recommend that you use the term inflicted head trauma, and avoid using the term “shaken baby syndrome” while not rejecting the concept.

4. Delayed Care Seeking

Delayed care seeking is in the literature as a sign of child abuse. It appears in several research articles on visceral injuries, and many reviews. This is a good example where prior thinking was simplistic and has not borne the test of time and experience. There are times when serious complications from obviously inappropriate delay create the strong impression of abuse. In general, however, delay in care seeking is not a strong indicator of abusive etiology. It is not uncommon for a parent to first think the problem is minor and likely to improve. Often it does. Other times, it may worsen (eg a burn that becomes infected) and the need for professional care is apparent. The “delay” in seeking such care is understandable and reasonable.

There are many examples where the condition may deteriorate over time. Intra-abdominal injuries, in particular, have been found to worsen after a period of time. Sub-capsular hepatic hemorrhages may burst resulting in delayed onset of shock. Contused or ischemic bowel may rupture, resulting in delayed onset of peritonitis. While most of these children are symptomatic from the time of injury, prior to their delayed deterioration, rare cases of relatively normal behavior and even food consumption, prior to decay, have been reported. Similarly, serious head injury usually results in immediate

onset of neurological symptoms. Delayed deterioration is found in a few percent of severe head injury, but a larger proportion of mild head injury. Hyponatremia, seizure, and expanding intracranial mass are the classic causes of delayed deterioration. The CHAMP physician should make sure that investigators know of and explore these possibilities. Most investigators will presume that the child was with the abuser when they suddenly deteriorated. This is usually a correct presumption, but the possibility of exceptions should be explored.

5. Conclusion

This short sampling of the complexity of abusive internal injuries hopes to serve two purposes. First, we hope that CHAMP physicians will contact faculty to support them in all cases of internal injury. Second, the CHAMP physician will have the long term relationship with the local investigating agencies. The CHAMP physician will be in the best position to educate these investigators before hand, and to support them in their investigation, when areas of difficulty, complexity and controversy arise.