Intracranial haemorrhage and non-accidental injury

Introduction

Intracranial haemorrhage due to non-accidental injury must be differentiated from birth trauma, accidental injury, and spontaneous bleeding. The history needs to be viewed in the context of the family circumstances. The site, age, and nature of the haemorrhage will aid diagnosis as will the character of any attendant skull fracture.

Subarachnoid haemorrhage

Spontaneous subarachnoid haemorrhage in childhood is very rare and unlikely to be confused with traumatic haemorrhage. In children with spontaneous subarachnoid haemorrhage one third will be shown to have a ruptured aneurysm, one third will have an arteriovenous malformation, and the remainder will have no demonstrable lesion. Three large series reporting on over 10,000 patients with subarachnoid haemorrhage included none who was aged 12 months or less. Perret and Nishioka found only 89 of 6368 cases of ruptured arteriovenous malformation to be aged 1–19 years with 41 cases of ruptured aneurysm in the same series. Matson found no infants in his 12 year experience and only three children aged between 1 and 5 in a review of over 2000 patients. Sedzimir and Robinson found only 124 (6.7%) of 1847 patients to be aged less than 20 years. Rare cases of aneurysmal rupture in infancy have been reported in a four week and three month old respectively but clearly these instances are exceptionally rare.

Subdural haemorrhage

Concern over non-accidental injury will usually arise when subdural haemorrhage is present. These are invariably traumatic in origin. Symptoms can be insidious in onset and within the first three or four weeks of life birth trauma remains a likely culprit. It must be remembered that subdural haemorrhage may occur after apparently atraumatic deliveries including caesarean section. Regardless of the birth route taken shearing forces are applied to the head. Even at caesarean section the head often needs disengaging and further pressure changes occur as it moves through a uterine incision that may be tight into atmospheric pressure at the moment when venous pressure is also rising. Haemorrhagic disease of the newborn may present with subdural haemorrhage emphasising the importance of a platelet count and clotting screen at any age.

The history, physical examination, and expert neuroradiology aid assessment. An acute onset of neurological symptoms attributable to the haemorrhage is most likely to indicate a recent onset. It must be remembered that a rebleed may cause confusion in this respect. Although this is most likely to occur within a week or two of the initial haemorrhage, rebleeding may be delayed for some weeks. A gradual onset of symptoms with accelerating head growth and a filling fontanelle would indicate the time of onset to be more remote. This emphasises the value of the routine recording of the head circumference at birth. Factors related to the mode of delivery may raise the index of suspicion that birth injury has occurred. In all cases of child abuse the clinical and radiological findings must be viewed in the psychosocial context of the family involved.

Retinal haemorrhage is an important and common sign of child abuse. Sezen found retinal haemorrhages in 14% of 1238 newborns, but this incidence had fallen to 2.6% by the third to fifth day. This is in contrast to the observation by Aron et al that the retinal haemorrhage in abused children could last for several years and is seen in up to 90% of abused children (see below).

Computed tomography of infants can also add useful information on the timing of a bleed. As the haematoma resolves the appearance of the blood on the scan changes from initially being hyperdense to brain tissue to an ultimate hypodense appearance. The rate of this change depends on the haemoglobin concentration, the higher the concentration the slower the resolution. Other features on the scan may also help. In the acute phase it is not uncommon to see diffuse hemisphere oedema, the result of either ischaemia due to vasospasm or to trauma or both. The appearance of the computed tomogram will help differentiate between a new acute bleed and a rebleed into a chronic resolving haemorrhage. In chronic subdural haemorrhage layering is often seen with an anterior hypodense antedependent portion well demarcated from a posterior hyperdense portion. The mesial edge, rich in capillaries, will enhance with contrast and this is usually the site of the fresh haemorrhage.

Caffey has emphasised how the infant’s anatomy increases susceptibility to subdural bleeding: the infantile head is relatively heavier and postural...
control poorer than at any other age.9 The pliable sutures and fontanelle are relatively larger and more stretchable and the unmyelinated brain softer than later on in development. Shaking, particularly repeated shaking, may lead to subdural haemorrhage in the absence of external signs of injury on the head or elsewhere by the application of lacerating, whiplash stresses to the cerebral bridging veins at the fixed sites of their attachment to the sagittal sinuses.

**Accidental injury**

Accidental trauma enters the differential diagnosis and there are two very helpful studies on this subject.10 11 Kravitz et al studied 536 children who had accidentally fallen a distance of between 20 and 60 inches.10 Only one subdural haematoma was found. Looking at first falls in 255 non-ambulant children, 105 (41%) had a head injury reported with no haematoma, 118 (46%) had soft tissue (43%) or bony (3%) head injury, whereas only 17 (7%) had sustained non-head injury. The authors make the point that the infant’s top heavy nature probably leads to the high frequency of head involvement with signs of external injury to other parts of the body being relatively rare. Helfer et al reviewed 246 children aged 5 or less who had fallen up to 60 inches and found that none had sustained serious or life threatening injury.11 Skull radiography of the children in this study showed only three with abnormalities, but there were no bilateral or diastatic fractures recorded, and no fracture was greater than 1 mm in width.

These findings complement the observations of Hobbs who reviewed 89 children with skull fractures who were aged 2 years or less.12 The fracture due to deliberate injury was likely to be multiple or be of complex configuration, depressed, wide (>5 mm), or growing. Occipital fractures were to be viewed with particular suspicion as was any fracture that was non-parietal or involved more than one bone.

Billmire and Myers compared children with injuries known to be deliberate with those with accidental injury.13 All children were less than 12 months old. The linear parietal skull fracture was again shown to be most likely to have been accidentally sustained. When uncomplicated skull fractures were excluded 64% of all head injuries and 95% of serious or life threatening head injuries were shown to be due to child abuse. Retinal haemorrhage was seen in 89%. Zimmerman et al also found 65% of 26 abused children to have retinal haemorrhage.14 This represented 80% of those with acute interhemispheric subdural haemorrhage. Acute subdural haematoma was found in 17 (65%) of these children and in 15 (58%) it was parieto-occipital extending into the interhemispheric fissure posteriorly.

**Herpes simplex encephalitis**

Herpes simplex virus causes a fulminant, necrotising encephalitis of a focal and often haemorrhagic nature. To this extent it may well mimic the clinical presentation of traumatic intracranial haemorrhage. A prodromal illness is present in 40% of children but in the remainder, particularly in infancy, the onset may be acute with a fever, seizures, and a bulging fontanelle. Fever was noted in 57% of children with subdural haemorrhage in one large series of 319 cases; this adds to the diagnostic dilemma.15 Although a choroidoretinitis may be seen in some neonatal cases, in older children the presence of retinal haemorrhage should point to trauma. The erythrocyte sedimentation rate is more likely to be raised in infection with herpes simplex virus and the acute phase proteins to be deranged. Examination of the cerebrospinal fluid will usually show a pleocytosis but frank haemorrhage has been reported.16 17

Computed tomography can add useful information. Herpes simplex virus infection most commonly leads to diffuse areas of low attenuation in the affected brain representing local oedema; the temporal lobe is most commonly affected but in the young infant there is no such predilection and the involvement may be diffuse. Areas of haemorrhage may be seen but these are often diffuse within the substance of the cerebral mantle or following the contour of the gyri.18 20 Frank subdural collections are unreported and in the few cases where substantive intracerebral bleeding has occurred this has been a preterminal event. In the very rare cases where the diagnosis remains uncertain acyclovir treatment should be started and viral studies should give the answer. Isolation of the virus or a fourfold increase of antibody titres in blood or cerebrospinal fluid provide diagnostic certainty. Since the advent of relatively non-toxic antiviral agents brain biopsy is rarely indicated.

**Conclusion**

It can be seen that computed tomography adds useful information on the management of intracranial haemorrhage. The site, age, and nature of the bleed all help with the differential diagnosis. It is recommended that all children with intracranial haemorrhage are transferred to a centre for computed tomography and neurological assessment. Ultrasound scanning will not give the same quality of information. Subdural taps should only be
performed at the referring hospital if it is thought that the immediate relief of intracranial pressure is likely to be life saving. Once the diagnosis is secure and the condition stable the child should be returned to the district hospital as soon as possible so that local resources might be used in the further management of the psychosocial and medicolegal aspects of the case.

References


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