Abusive Head Trauma

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Outline

- Challenges
- Subdural haematomas
- Controversies in AHT
- Eye findings
- Skull fractures
- Outcomes and prevention
Abusive Head Trauma

Infant violently shaken, babysitter hearing told
The challenges facing clinicians

- Are the injuries as a result of trauma or a medical condition?
- If trauma, abuse, neglect or accidental
- Majority of cases are young and non verbal
- Family unwilling to consider abuse
- Differing opinions from clinicians
Case 3 Baby I

• 2/12 ex 30/40, presented with bruising
• Seizure activity in ED, multiple bruises noted over body
• CT: “bilateral parietal fractures, acute left parafalcine and tentorium cerebelli subdural haematoma”
• T/F to MMC ICU for further investigation and Neurosurgery involvement
Baby I contd

• Sk survey “metaphyseal fractures distal left femur, proximal left tibia, lateral left 5th, 6th & 7th ribs.
• Ophthalmology: L eye, multiple retinal haemorrhages
• Several different carers
• No history provided
• In OOHC (maternal grandmother)
• No criminal charges laid
Case 1 Baby L

- 6/12 male, BIBA ED ? Seizure
- Vaccinations 3/7 ago, fever + URTI x2/7
- Lethargic and pale x1/7, “blank/funny episode”
- O/E, pale and floppy, seizure x 1 and unresponsive
- Several episodes
- CT scan
Baby L?

• CT brain “skull fracture with acute right sided subdural haematoma, suggestion of thin l sided subdural collections”
## VFPMS experience

<table>
<thead>
<tr>
<th>Types of injuries</th>
<th>No. of Patients</th>
<th>Details</th>
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<tbody>
<tr>
<td>Subdural Haemorrhage</td>
<td>23 (41%)</td>
<td>13 (56%) bilateral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 (44%) unilateral</td>
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<tr>
<td>Subdural Effusion</td>
<td>10 (17%)</td>
<td>7 (70%) bilateral</td>
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<tr>
<td></td>
<td></td>
<td>3 (30%) unilateral</td>
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<tr>
<td>Skull fracture</td>
<td>29 (51%)</td>
<td>18 (62%) isolated skull fracture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 (38%) associated with another intracranial injury</td>
</tr>
<tr>
<td>Subgaleal haemorrhage</td>
<td>9 (16%)</td>
<td>All associated with other injuries</td>
</tr>
<tr>
<td>Extradural haemorrhage</td>
<td>4 (7%)</td>
<td>All associated with other injuries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 (75%) unilateral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (25%) bilateral</td>
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</table>
Australia/NZ experience

- Sydney: 65 cases over 7 years (Ghahreman et al 2005)
- Subdural haemorrhage most common injury (81.5%)
- 55% evidence of extracranial skeletal findings (20%) clinical evidence
- MRI revealed additional findings in 49%

Nomenclature

- “Shaken Baby Syndrome”
- “Battered Child Syndrome”
- “Abusive Head Trauma”
- “Non Accidental Head Injury”
Key aspects on history

- History from caregiver
- When were they last well?
- How the caregiver responded
- Developmental history
- Recent trauma and responses
Subdural Haematomas: Anatomy
Subdural Anatomy

Shearing of the bridging vein (right) causes the subdural space to fill quickly with blood.
Warning: Not for diagnostic use
Subdural Haematomas

- Annual incidence 12.54/100,000 < 2 years
- 186 children in total, 106 NAHI, rest varied causes
- Birth: Can occur post delivery but usually resolve by 4 weeks and are asymptomatic
- Location: birth subdurals located more often in posterior cranium

Other causes

• Bleeding diathesis/coagulopathy
• Accidental trauma
• Glutaric Aciduria Type 1 (cerebral atrophy, widening of Sylvanian fissures and basal ganglia changes)
• Congenital malformations
• Infectious: meningitis
The controversies

- The triad: retinal haemorrhages + subdural haemorrhages + encephalopathy
- Geddes: “unified hypothesis” pathogenesis of SDH + RH was hypoxia ischaemia not trauma
- Dr Squier: raised arterial and venous pressure, quoted mechanical studies

  - Squier W. Shaken baby syndrome; the quest for evidence Dev Med Child Neurol Jan 2008; 50:10-14
The controversies contd.

- UK Court of Appeal – R v Harris, Rock, Cherry and Faulder [2005] EWCA Crim 1980
- 2 convictions quashed

Squier W, Adams L.B. The triad of retinal haemorrhage, subdural haemorrhage and encephalopathy in an infant associated with evidence of physical injury is not the result of shaking, but is most likely to have been caused by a natural disease. *J. Prim Health Care* 2011:3(2)159-163
Alternative Theories

• “SDH occurs as rebleeds of birth subdurals”
• “Short Falls can cause signs and sx of AHT”
• “Unexplained SDH are the result of venous sinus thrombosis”

• Jenny C Alternative theories of causation in abusive head trauma: What the science tells us Pediatr Radiol (2014) 44 (Suppl 4) S 543-S547
Other Subdural collections

• Subdural hygroma vs chronic subdural haemorrhage
• Radiological appearance may be similar to CSF
• What is the pathogenesis?
• What about BESS? (Benign enlargement of the subarachnoid spaces)

• Wittschieber D et al *Subdural Hygromas in Abusive Head Trauma: Pathogenesis, Diagnosis, and Forensic Implications* *AJNR* Mar 2015
Investigations

• Skeletal survey and bone scan in children < 2 years (UK suggest rpt survey after 2 weeks)
• CT brain
• MRI brain
• Ophthalmology
Radiology

- Location of subdural in NAHI
  - Interhemispheric, along falx
  - Several areas of SDH
  - Differing densities
- CT best first line study
- Early MRI if abnormal CT
- MRI/DWI ischaemic changes and aids prognosis

Kemp a et al. *What neuroimaging should be performed in children in whom inflicted brain injury is suspected? A systematic review* *Clin Radiol* May 2009; 64(5): 473-83
What about spinal injuries?

- Recent studies have suggested that spinal injuries may be more common than previously thought.
- Injuries may include spinal subdurals, ligamentous injury or spinal fracture.
- All types of injury more common in AHT than accidental.

Recommendations

• If spinal injury/fracture on skeletal survey, MRI is recommended
• Consider cervical spinal MRI in children with suspected AHT
• Children with impaired consciousness, stabilize neck and include c spine imaging
• Posterior cervical ligamentous injury strongly predictive of brain ischaemia

Choudhary AK et al Imaging of spinal injury in abusive head trauma: a retrospective study Pediatr Radiol 2014 Sep, 44 (9):1130-1140
Ophthalmology

• Who should do it?
• When?
• What do you need to know?
Ophthalmology

- Pre-retinal or subhyaloid haemorrhages
- Intraretinal
- Subretinal
- Peripapillary (around optic nerve head)
- RH in macula or peripapillary “posterior pole”
Retinal haemorrhages

- Can occur after birth but usually resolve by 6 weeks
- Significant RH are not seen in coughing, vomiting or seizures
- Thought to be secondary to rapid acceleration/deceleration
- RH in NAHI are more often bilateral and involve the pre-retinal layer

Other causes of RH

- Hypertension
- Bleeding disorder
- Meningitis/sepsis/endocarditis
- Vasculitis
- Cerebral aneurysm
- Retinal disease
- CO poisoning
- Anaemia
- Hypoxia/hypotension
- Raised ICP
- Glutaric aciduria
- OI
- ECMO
- Hypo/hypernatremia
RH contd.

- Current interest in retinal haemorrhages and raised ICP
- Seen with elevated OP, intraretinal, near a swollen optic disc “peripapillary”
- Not the widespread picture seen in AHT

Bienenbaum G et al. Patterns of retinal haemorrhage associated with increased intracranial pressure in children. *Pediatrics* 2013; 132 e430-e434
Skull fractures

• Can result from short vertical falls
• Accidental usually linear and non displaced
• Bone scan insensitive to detect them
• Unable to age
• ? Need for further imaging

Wood J, Christian C, Adams C. *Skeletal Surveys in Infants With Isolated Skull Fractures* Pediatrics 2009;123 (Feb)e247-e52

• Ruddick C et al. *Head trauma outcomes of verifiable falls in newborn babies* Arch Dis Child Fetal Neonatal Ed 2010;95:F144-145
Distinguishing AHT from accidental head trauma

- History: 1) Low height fall 2) No history of trauma
- May present with a variety of symptoms
- Several factors eg young age more commonly associated with AHT
- In children with an intracranial injury apnoea and retinal haemorrhages most predictive feature of iBi
- Maguire S et al *Which clinical features distinguish inflicted from non-inflicted brain injury? A systematic review* *Arch Dis Child* online June 15 2009
What are the long term outcomes?

- Mortality 20-25%
- Varied morbidity, epilepsy, motor deficit, cognitive delay
- Factors associated with poorer prognosis, SE background, initial presentation, extent of RH etc

- Chevignard M. *Long term outcomes in abusive head trauma* Pediatr Radiol (2014) 44 (Suppl 4) S548-S558
Prevention

• Crying as a trigger
• Prevention aimed at reducing crying or changing pattern
• Changing caregiver response to crying
**PURPLE crying**

The acronym PURPLE is used to describe specific characteristics of an infant’s crying during this developmental phase and lets parents and caregivers know that what they are experiencing is normal:

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<tbody>
<tr>
<td>Peak of crying</td>
<td>Unexpected</td>
<td>Resists soothing</td>
<td>Pain-like face</td>
<td>Long lasting</td>
<td>Evening</td>
</tr>
<tr>
<td>Your baby may cry more each week. The most at 2 months, then less at 3-5 months.</td>
<td>Crying can come and go and you don’t know why.</td>
<td>Your baby may not stop crying no matter what you try.</td>
<td>A crying baby may look like it is in pain, even when it is not.</td>
<td>Crying can last as much as 5 hours a day, or more.</td>
<td>Your baby may cry more in the late afternoon and evening.</td>
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Source: www.purplecrying.info
Summary

• AHT poses many challenges to the clinician
• Careful consideration of other possible aetiologies is required
• High quality evidence exists but the area is also plagued by “non believers!”
• Strategies to aid prevention are essential