Abusive Head Trauma

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Outline

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

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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

Types of injuries	No. of Patients	
Subdural Haemorrhage	23 (41%)	13 (56%) bilateral 10 (44%) unilateral
Subdural Effusion	10 (17%)	7 (70%) bilateral 3 (30%) unilateral
Skull fracture	29 (51%)	18 (62%) isolated skull fracture 11 (38%) associated with another intracranial injury
Subgaleal haemorrhage	9 (16%)	All associated with other injuries
Extradural haemorrhage	4 (7%)	All associated with other injuries 3 (75%) unilateral ,1 (25%) bilateral

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%

Ghahreman A, Bhasin V, Chaseling R, Andrews B, Lang E. Non accidental head injuries in children:a Sydney experience. Journal of Neurosurgery. 2005;103(September):213-8.

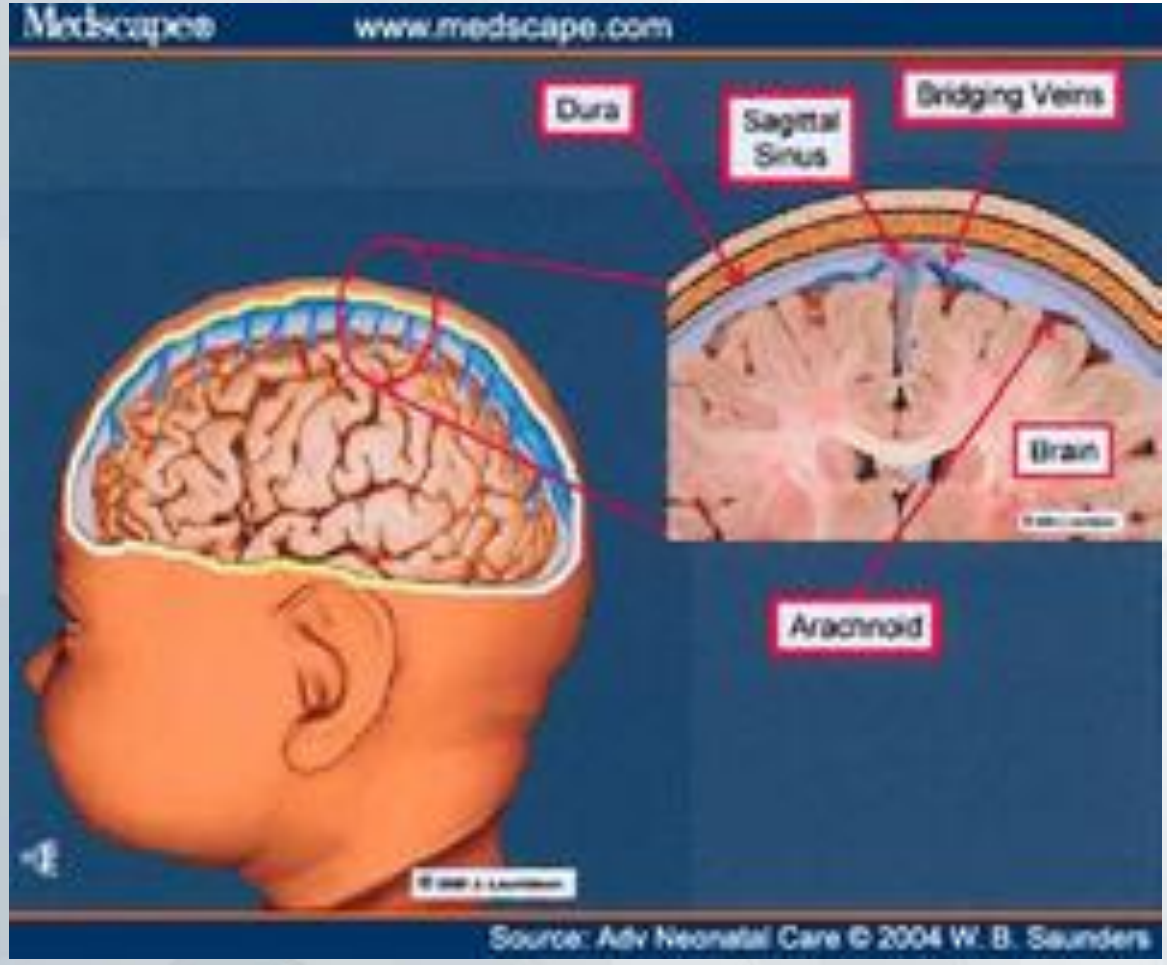
Nomenclature

- “Shaken Baby Syndrome”
- “Battered Child Syndrome”
- “Abusive Head Trauma”
- “Non Accidental Head Injury”

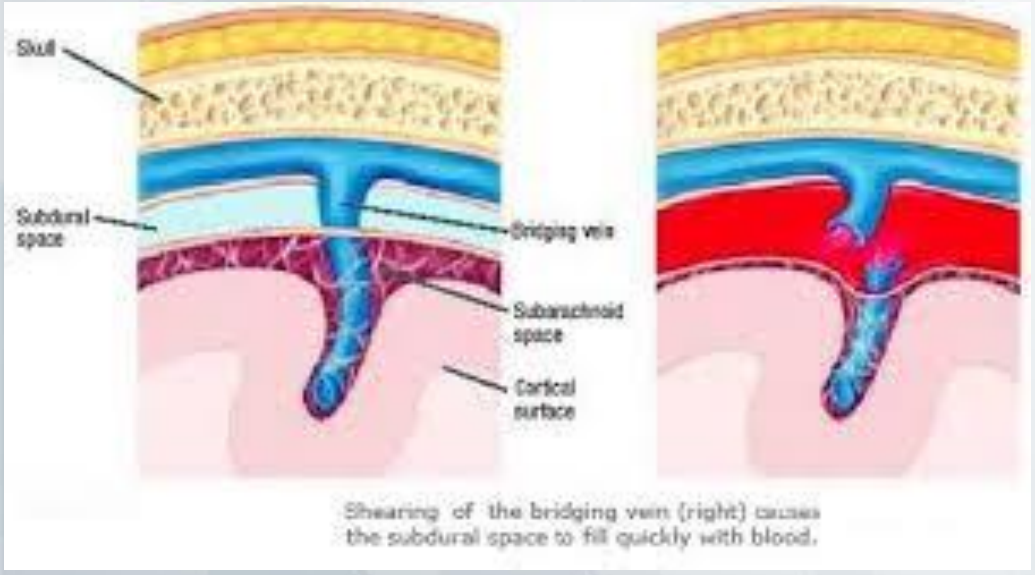
Key aspects on history

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

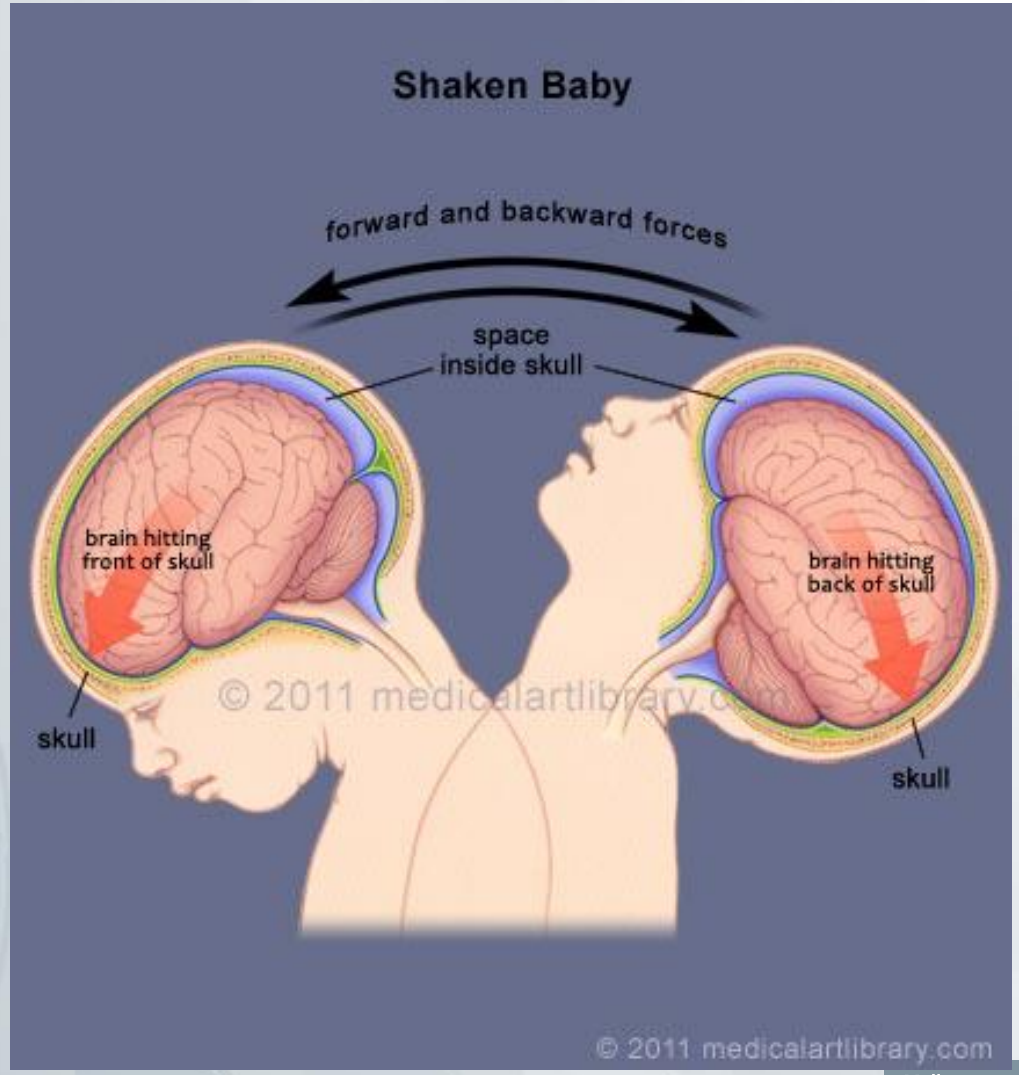
Subdural Haematomas: Anatomy



Subdural Anatomy



Shearing of the bridging vein (right) causes the subdural space to fill quickly with blood.



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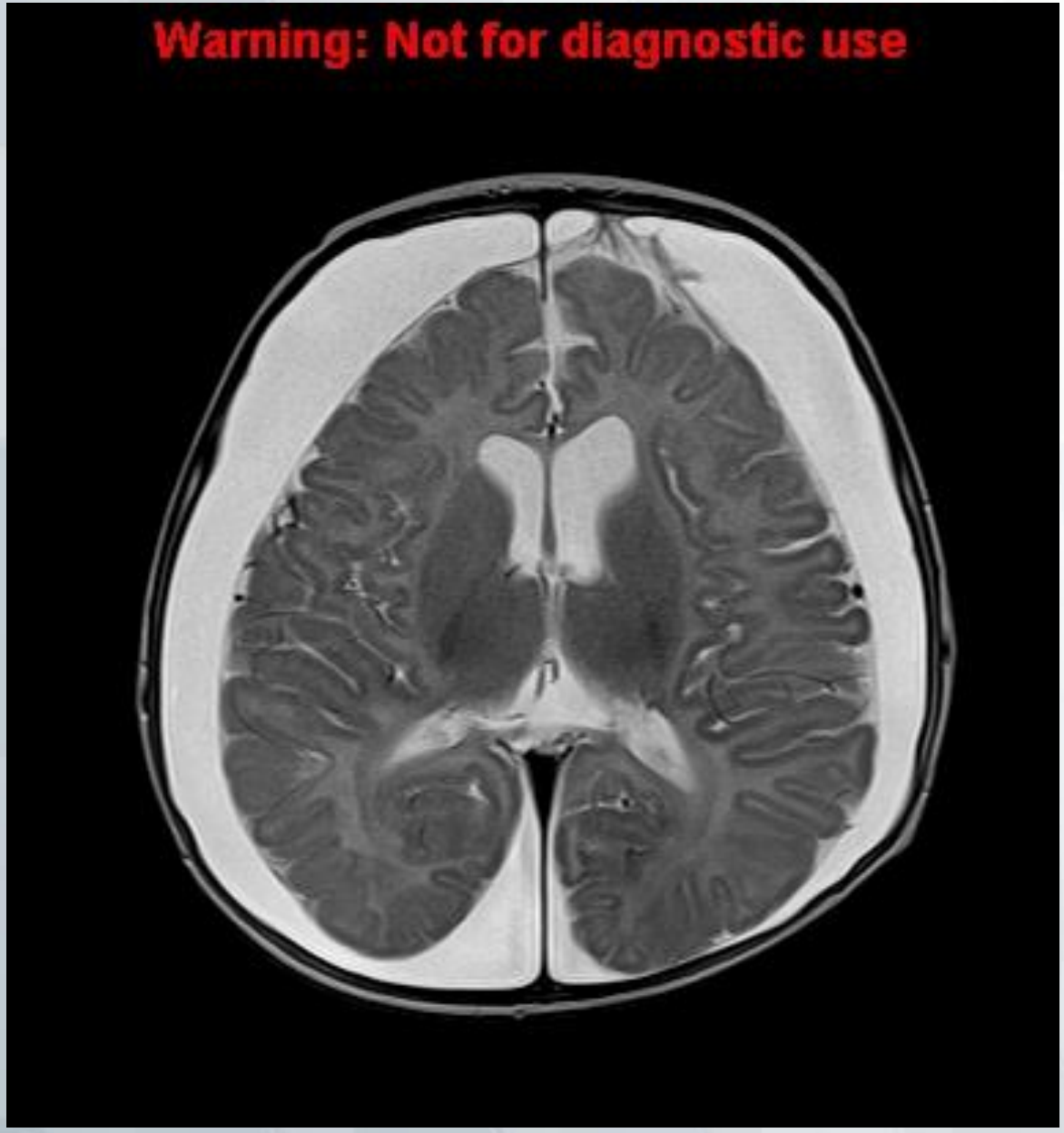

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Subdural Haematomas

- 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

- Whitby E.H. Et al **Frequency and natural history of subdural haemorrhages in babies and relation to obstetric factors** *The Lancet* 2004;**363**:846-51
- Hobbs C et al **Subdural Haematoma and effusion in infancy: an epidemiological study** *Arch Dis Child* 2005;**90**:952-955

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

- Geddes J.F. et al**Dural haemorrhage in non-traumatic infant deaths:does it explain bleeding in “shaken baby syndrome”?** *Neuropathol Appl Neurobiol* 2003,29:14-22
- 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 < 2years (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 **What neuroimaging should be performed in children in whom inflicted brain injury is supected? A systematic review** *Clin Radiol* may 1 , 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

Kemp A et al **Spinal Injuries in abusive head trauma: patterns and recommendations** *Pediatr Radiol (*2014) 44 (Suppl 4) S 604-S612

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”

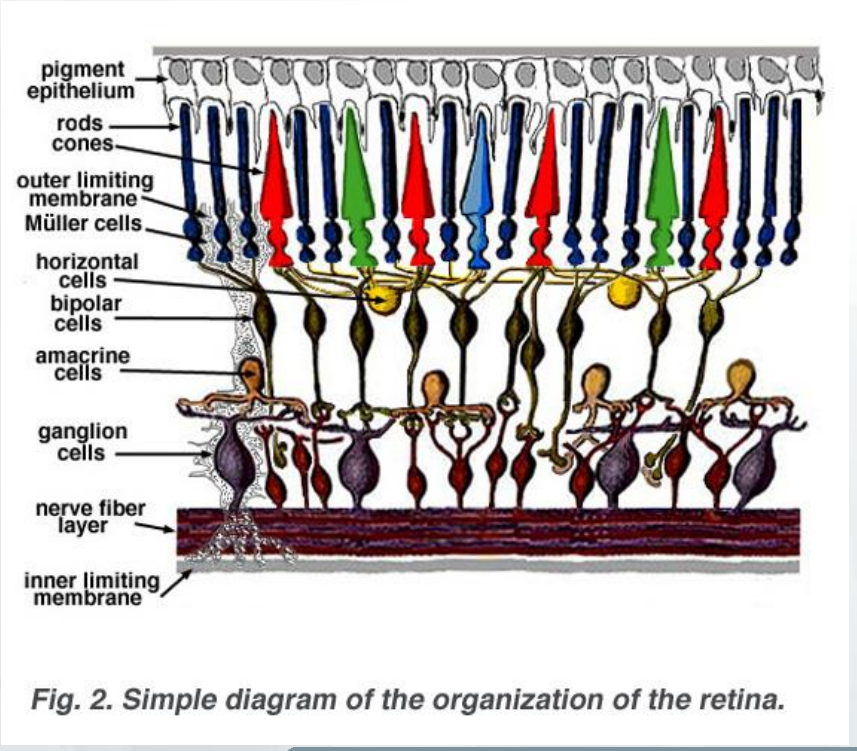


Fig. 2. Simple diagram of the organization of the retina.

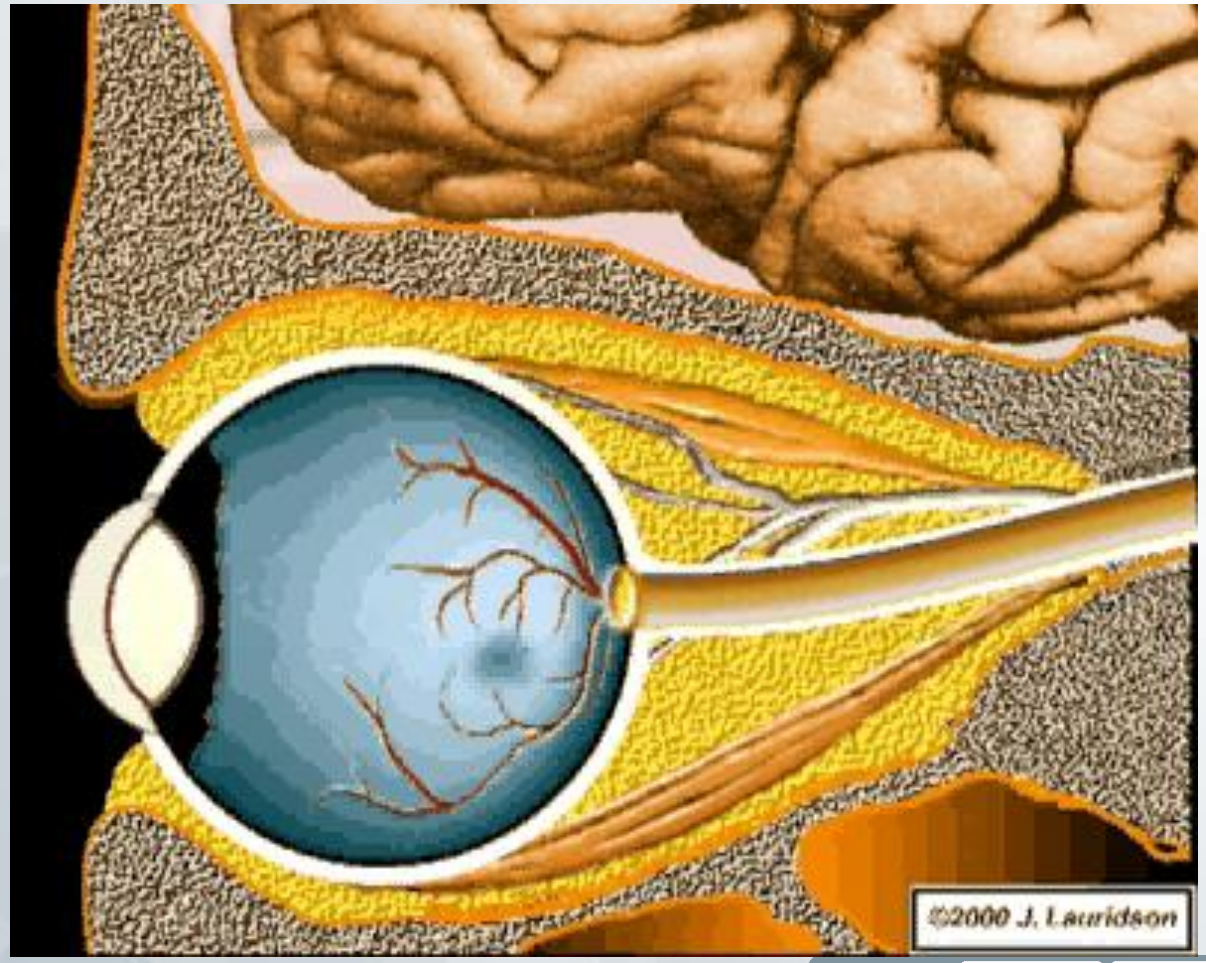
Retinal haemorrhages

- 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/deccelaration
- RH in NAHI are more often bilateral and involve the pre-retinal layer

- Bechtel K, Stoessel K, Leventhal JM, Ogle E, Teague B, Lavietes S, et al. **Characteristics that distinguish accidental from abusive injury in hospitalized young children with head trauma.** *Pediatrics*. 2004 Jul;114(1):165-8.

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 or 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

Binenbaum 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:

P	U	R	P	L	E
Peak of crying	**Unexpected**	**Resists soothing**	**Pain-like face**	**Long lasting**	**Evening**
Your baby may cry more each week. The most at 2 months, then less at 3-5 months.	Crying can come and go and you don't know why.	Your baby may not stop crying no matter what you try.	A crying baby may look like it is in pain, even when it is not.	Crying can last as much as 5 hours a day, or more.	Your baby may cry more in the late afternoon and evening.

Source: www.purplecrying.info

Standard-Examine

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