Non Accidental Head Trauma: Best Evidence Update

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DISCLOSURE

I do not have any relevant financial relationship with commercial interest to disclose.
Learning Objectives

Discuss the current evidence on the etiology, physiology, recognition and the child protection management of non accidental head trauma
Abusive Head Trauma

Definition

Abusive head trauma (AHT), according to the U.S. Centers for Disease Control and Prevention, is an injury to the skull or intracranial contents of an infant or child younger than 5 years caused by inflicted blunt impact, violent shaking, or both.

History

- Inflicted trauma injuries in infants recognized from the 19th century
- Documented by French Pathologist – Auguste Ambroise Tardieu
- Battered Child Syndrome – 1962 by Kempe et al
- Whip Lash Shaken Infant Syndrome – 1974 by Caffey
- Abusive Head Trauma – 2009 American Academy of Pediatrics
Abusive Head Trauma

• Encompasses a broader array of traumatic mechanisms compared to just shaking (rotational injury)
• These mechanisms involve slamming, striking with an object, throwing and crush forces.
• The change in nomenclature removes the focus from shaking as a mechanism and places it on the commonality that the head is involved and that the actions causing the trauma are abusive in nature.
The case of the missing parent

3 day old baby admitted to the postnatal ward because of jaundice

Mother revealed that her partner had disappeared and was missing for the past 2 days. She said that he had got up in the middle of the night very angry and started holding the baby very tight and telling the baby to stop crying and almost shaking. He immediately stopped kept the baby gently back and walked away. He subsequently went missing for 2 days.
Parents

• Single male parent
• Young age
• Single parent
• Low level of maternal education
• Low socioeconomic status
• Mental health problems
• Victims of previous/ongoing abuse
• Drugs or alcohol misuse
Child

- Male
- Less than 1 year old
- Excessive crying
- Born prematurely
- Low birth weight
- Disability
- Behavioral problems
Symptoms that may suggest abusive head trauma

• Impaired level of consciousness or unresponsiveness not explained by another medical condition

• Lethargy or drowsiness

• Large or increasing head circumference over a short period of time
Vague symptoms on presentation

- Decreased oral intake
- Vomiting
- Irritability
- Respiratory distress and apneas in an otherwise well child
- Unexplained collapse
- Seizures
- Unexplained developmental delay
- Behavioral changes
- Faltering growth
Other injuries associated with non accidental injuries

• Fractures (rib, humerus, femur, skull)
• Bruises
• Bulging fontanel
• Lingual or labial frenulum injuries
• Burns
• Other signs of neglect
Pathophysiology

AHT – Primary injury

• Primary injury occurs as a result of the force that causes the brain to hit the skull, resulting in contusions (NICE 2014)
• Tearing of cerebral bridging vessels causing subdural hemorrhage
• Tearing of vessels associated with skull fractures
• Rotational forces resulting in shearing injury resulting in concussion or diffuse axonal injury
Pathophysiology

AHT – Secondary injury

• Secondary injuries can cause a change in clinical condition from the time of initial presentation where symptoms may have been vague or not suggestive of head injury.
• This can occur because of a change in cerebral blood flow and cerebral edema following the primary injury.
• This can in turn cause neuronal cell death which is related to poor long term outcome.
Clinical Presentation

Presentation

- Triad of subdural haematoma, brain oedema and retinal hemorrhage is well known to be associated with AHT
- Developmental milestones should be considered alongside the history given to establish if the mechanism of injury reported is feasible to sustain for the child’s developmental age.
- Once AHT is suspected, appropriate investigations, interventions and referrals to neurosurgeons should be carried out
Clinical Presentation

History

• Studies showed that 75% of parents reported trauma as a cause in accidental injuries. Compared to 2.5% in AHT cases.

• Another study in New Zealand found 90% presented with no history of trauma in AHT
Recognition

Bruising

• Significant in non mobile children
• Not always reliable
• Among AHT Fatalities – 21% had no bruising
• Another study showed only 16% of infants who died had one or two bruises.
Recognition

Fractures

• Absence of bruising in children with fractures is well described

• 72% of children with fractures did not have bruises associated with fractures within one week of injury
Retinal Hemorrhages

• Accidental causes of RH are distinct from those associated with AHT

• Hemorrhages extending to the outer margins of the retina and involve multiple layers are associated with AHT

• Retinoschisis is also strongly associated with AHT
Subdural Hemorrhages

- Commonest cause is birth – 25% potentially has a small SDH which usually resolve in 4-6 weeks
- Next common cause is trauma
- Inadequate history has a high association with AHT
- Neuroimaging features include subdural hemorrhages, post fossa hemorrhages as well as hypoxic injury with cerebral edema
Biomechanics

• Rotational component of head motion – primarily responsible for injuries described in AHT
• Previous experiments involved primates as well as rigid body computational models to assess whether infant kinematics during shaking exceed the proposed injury thresholds.
• Current study was validated using rigid body computational modelling approach using in vivo shaking
Subdural Hemorrhage

- In traumatic impact injuries the tearing of the Bridging veins can cause substantial SDH
- The impact injuries have potential of causing small SDH even from short distance falls.
- So a fall from a small height in the right circumstance can still cause SDH and Retinal hemorrhages.
- Intra dural hemorrhages are more common in shaken babies who are healthy with small bleeds.
- Massive Subdurals are more common in impact injuries
Evidence

Challenging the Pathophysiologic Connection between Subdural Hematoma, Retinal Hemorrhage and Shaken Baby Syndrome

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Supervising Section Editor: Paul Walsh, MD, MSc

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Biomechanics

Figure 1. Ommaya’s whiplash study apparatus. Foot note: Reproduced with permission Ommaya et al, JAMA 1968;204(4)4 Copyright Auspices of the Board of Trustees, 1968.

A sagittal plane opensim model of a 4.5 month-old human infant used to simulate head flexion and extension kinematics during AHT.
Evidence

Shaking and SDH

• The results of this study provide no biomechanical evidence to demonstrate how shaking by a human alone can cause the injuries observed in AHT, suggesting either that additional factors, such as impact, are required, or that the current estimates of injury thresholds are incorrect.

Article

Probabilistic description of infant head kinematics in abusive head trauma


To link to this article: https://doi.org/10.1080/10255842.2017.1403593
Retinal Hemorrhages

Retinal hemorrhage is a non-specific finding that occurs with many causes of increased intracranial pressure, including infection and hypoxic brain injury.

The evidence challenging these connections should prompt emergency physicians and others who care for children to consider a broad differential diagnosis before settling on occult shaking as the de-facto cause.

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Case

Coming back to the missing father.

• He did come back after 3 days. He felt guilty of being angry at his baby for inconsolable crying and had to go away. He eventually got some help to talk about other issues he was having.

• The baby - after discussions with the safeguarding team and social services did go home to both parents.
Management

• Blood tests
• Imaging – Skeletal Surveys, CT Scan/MRI Scan
• Ophthalmology Review
• Follow local safeguarding policy
• Other conditions to think about
• Timely Neurosurgical referral
• Prevention strategies
Conclusion

• Relatively common cause of head injury in less than 2 years
• Diagnosis made by reflecting on current and past history
• Along with specific physical, ophthalmological and radiological findings
• Vague symptoms at initial presentation
• Recognition early is important as long term effects are devastating
• Time critical neurosurgical transfer
Thank You
Reference


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