Abusive Head Trauma

Antoinette Laskey, MD, MPH, MBA
Professor of Pediatrics

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Objectives

- Identify common presentations of abusive head trauma
- Know the common triggers for abusive head trauma
- Describe the appropriate evaluation of suspected abusive head trauma
- Understand why a multidisciplinary approach is critical to identifying cases of abuse

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Abusive Head Trauma

- Leading cause of inflicted trauma death in children <4y of age
- Shaking infants is more common than recognized in medical settings among international populations[1]
- >80% of deaths from head trauma in children <2y of age are due to abusive head trauma
  - [1]Runyan, et al, *Pediatrics*, 2010

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Perpetrators

- Men>Women
- Often an unrelated male (step-father, boyfriend)
- Babysitter
- Fathers
- Mothers
- Remember—we can't and shouldn't diagnose or profile a case based on the caregiver

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Victims

- Children less than 2 years of age
  - Highest risk between 6 weeks and 4 months
- Older children can be shaken hard enough to cause injury

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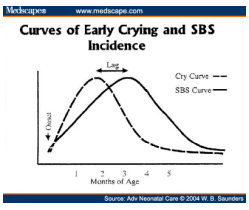
Risk Factors for Infants

- Normal infants cry for 2-3 hours per day
- Research has shown 20-30% of infants exceed this, sometimes substantially



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Triggers

- "I didn't want to choke him, but I wanted him to stop crying. I picked him up and I shook him; I threw him on the bed and he bounced…"
- "He was crying; it drove me crazy, I shook him…maybe 10 times and threw him on the sofa."

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Triggers

- "I had fits of anger. She would cry; sometimes, when she did that, I'd shake her…I got worked up and twisted her arm; I was slapping her hard for more than 2 months."
- I shook her so she'd be quiet, it lasted maybe 5 minutes; I was exasperated; I shook her up and down…I was shaking her hard; I was crying just like she was and I was worked up."

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Intracranial Injury

- Shaken Baby Syndrome (SBS)
- Abusive Head Trauma (AHT)
- Inflicted Traumatic Brain Injury (iTBI)
- Shaken Impact Syndrome (SIS)
- Whiplash Shaken Baby Syndrome
- Non-Accidental Head Trauma (NAT)
- Blunt force trauma to the head

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Physical Vulnerabilities

- Big heads relative to body size
  - Child's head is 10-15% of total body weight
  - Adult's head is 2-3% of total body weight
- Weak neck muscles
- Larger relative space between the brain and the inside of the skull
- Less developed brains than adults

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Shaking *and* Impact

- There often is an impact
  - Baby can be thrown down
  - Baby can be slammed into a stationary object
- External evidence of impact may be missing
- There is impact *within* the skull

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Brain Injuries

- Intracranial hemorrhage
  - Subdural
  - Subarachnoid
- Parenchymal contusion or laceration
- Edema
- Neuronal damage/Diffuse Axonal Injury
- Hypoxic Ischemic Injury
- Encephalomalacia

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Other Associated Findings

- Retinal hemorrhages
- Fractures
- Cutaneous findings

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Retinal Hemorrhages

- Found in 85% of AHT fatalities
- Presence or absence not necessarily linked to severity of injury
- May be unilateral or bilateral
- May be seen on high quality CT or MRI
  - NOT seeing them on imaging does not mean they aren't present—does not replace dilated eye exam

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Retinal Hemorrhages

- Single layer are non-specific unless to the periphery
- Posterior pole are non-specific and may be found after significant falls or occipital impacts
- Retinoschisis is specific for abuse
- Macular folds can be seen in crush injuries or AHT
- Multi-layer to the periphery are specific

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Retinal Hemorrhages

- Rapid exam is important to document intra-retinal hemorrhages
- Resolution may occur within 72h
- Dilated indirect ophthalmoscopy is preferred
- Non-dilated direct with limitations noted is acceptable if unable to dilate early

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Fractures

- Fractures may be present from a shaking event
- They may not be visible on initial skeletal survey
- Rib fractures and metaphyseal fractures are the most common

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Rib Fractures

- Posterior rib fractures occur due to squeezing of the chest
- Acute rib fractures may not be visible on x-ray
- Callus forms in approximately 10-14 days
- Follow up skeletal surveys in 2 weeks

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Metaphyseal Fractures

- Difficult to see on x-ray if the image is not collimated on the joint
- Almost exclusively in patients <15-18m
- Due to the forceful separation of the metaphysis from the shaft

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The Nice Family

- 6 week old healthy infant
- Mom upstairs, dad with 2y old and baby downstairs
- Sudden collapse
- Immediate medical intervention

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Outcome

- Confession by dad
- Plea
- 12d in jail, 500h community service
- Baby lives
  - Continues to have mild weakness on one side
  - Possible seizures
  - Now 2y old, unclear developmental trajectory

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Who Did What When?

- 3m old presents to PCP with increasing head size
  - No history of trauma
  - Birth head circumference 70%, off the chart by 3m visit

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Outcome

- Eyes normal on exam (as expected due to older collections)
- Subdural required draining
- No perpetrator identified

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Severe Brain Injury "During Sleep"

- 2m old put down for nap
- Caregiver went to check after failed to wake for next feed
- Unresponsive, barely breathing
- Transported and then Life Flighted

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Outcome

- Skull fracture
- Torn cortical bridging veins
- Cytotoxic edema with difficult to control seizures
- Severe retinal hemorrhages
- Caregiver ultimately confessed to shaking with a slam

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She Fell

- Previously healthy 4m old, presents to medical care after a "fall" from caregiver's arms
- Unresponsive at scene
- Requires aggressive resuscitation
- Deteriorates after transfer to trauma center

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Outcome

- Severe anoxic brain injury
- Surgical evacuation of SDH as life saving measure
- Severe retinal hemorrhages with schisis cavities
- Ultimately progresses to brain death despite medical intervention
- No confession but only one caregiver at the time

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Dropped in the Bathtub

- 4w old former 36 wk preemie
- Mom reports bathing him and dropping him into tub onto faucet
- Dries him off and puts him in crib
- Later returns to find him with agonal respirations
- At hospital, in status epilepticus

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Dropped in Bathtub

- Large acute subdurals
- Retinal hemorrhages in both eyes to the periphery
- Acute liver injury
- Facial and abdominal bruising

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Hospital Course

- 2m in hospital, discharged to foster care
- G-tube dependent
- Able to breathe independently but chronic aspirations

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Outcome

- Mom confesses to multiple shakes with terminal throw, missing bed and landing on floor and punching in abdomen
- Adopted by foster mom
- Cortically blind and deaf
- Dies at 2y of age from pneumonia
- Head circumference at death, same as birth, 35 cm
  - Normal 2y old body size

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Key Point

- If a child presents with
  - Vomiting
  - Lethargy
  - New onset seizure
  - Irritability
- You must conduct a complete
  - History
  - Physical exam

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Exam

- Always look at
  - All of the skin
    - Document bruises, petechiae
  - The labial and lingular frenula
    - Torn frenula are rare in non-mobile infants
  - The conjunctiva
    - Subconjunctival hemorrhages are concerning for suffocation/smothering or direct trauma

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Key Point

- You should consider
  - Imaging
    - Head CT or MRI
    - Neck imaging
    - Skeletal survey
  - Lab studies
    - Blood counts
    - Liver function
    - Coagulation studies
  - Dilated fundoscopic exam

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Imaging

- Head CT should NOT be used for timing of injury/aging of blood
  - This includes using caution when determining “more than one age of blood”
- MRI should be optimally done at least 3 days after an injury if there is concern of diffuse axonal injury or hypoxic ischemic injury
- MRI can help with timing of blood products

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Labs

- In very young infants, consider Vitamin K deficiency resulting in catastrophic intracranial hemorrhage
- If AST or ALT is >80, consider abdominal CT for occult abdominal injury
- Lumbar puncture is NOT indicated

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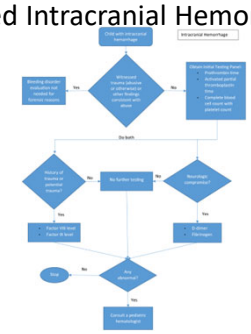
Isolated Intracranial Hemorrhage



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Key Point

- Abusive head trauma that is missed due to subtle initial presentation may result in further injury or death if returned to the caregiver who caused the injury

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Key Point

- Precise timing of injury in subtle presentations can be very difficult

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Outcomes

- An estimated 1/3 of abusive head trauma patients die from their injuries
- 1/3 have serious, lifelong morbidity
  - Mental retardation
  - Cerebral palsy
  - Paralysis
  - Seizures
  - Blindness
  - Deafness

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Outcomes

- The 1/3 that look "normal" at discharge almost always have some level of behavioral, developmental or learning impairment manifest as they get older

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Falls and Head Trauma

- Kids fall **ALL** the time—<u>rarely</u> do kids suffer injuries this severe from minor falls
- Playground falls
  - ~120,000 kids requiring ED visits/yr; death rate of 1.3 per 100,000 falls
- Falls from beds
  - In hospital falls onto hard floors, some small, linear skull fractures and soft tissue injuries, some intracranial hemorrhage, no deaths

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Medical Events

- Unexpected medical crisis
  - Choking
  - Stopped breathing
  - Turned blue
  - Found down
  - Seizure
- Often due to head injury, not the cause of head injury

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Resuscitation Efforts

- Medical event leads to resuscitation
- Inexperienced resuscitation is blamed for findings
  - Shaking
  - Slamming
  - Dousing with water
  - Slapping
  - Incorrectly done CPR

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Other "Causes"

- Younger siblings
- Dogs
- Self-inflicted trauma
- Forgotten traumas from previous days

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Communicating with CPS/LE

- When a report is made to CPS and Law Enforcement, HIPAA does **NOT** preclude the healthcare team from talking to them
- Timely communication about the status of the child is critical
- Mechanisms of injury, timing of injury, presence of more than one injury may be best coming from a single data source
  - You don't want the intern in the PICU and the resident in the ED and the attending neurosurgeon all answering the question differently

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Summary

- AHT is the leading cause of inflicted traumatic death in infants and young children
- We SHOULD NOT date blood based on a CT alone
  - This includes speculating about more than one age of blood
- Retinal hemorrhages are frequently found but are not required for the diagnosis
- There may be need for bleeding evaluation to rule out undiagnosed bleeding disorder

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D-MED - AHT

Toni Laskey

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