Abusive Head Trauma

AHT Case

- 2 month old baby boy
- Left with Mom's boyfriend while mom went to work
- Boyfriend calls mom at work says baby "threw his arms up and stopped breathing"
- Baby is transported to a local hospital and airlifted to a tertiary care center

AHT Case

- On arrival to the PICU baby had:
  - Diffuse Cerebral Edema
  - Bilateral thin SDH's
  - 4 acute posterior rib fractures
  - CML's of both distal tibias
  - Extensive bilateral RH to the periphery

Definition

- Signs and symptoms, clinical and radiographic findings that result from violent shaking, with or without impact
- Abusive Head Trauma/Injury
- Inflicted traumatic brain injury
- 'Shaken Baby Syndrome'
AAP Statement May 2009

- The use of broad medical terminology that is inclusive of all mechanisms of injury, including shaking, is required. The American Academy of Pediatrics recommends that pediatricians develop skills in the recognition of signs and symptoms of abusive head injury, including those caused by both shaking and blunt impact, consult with pediatric subspecialists when necessary, and embrace a less mechanistic term, abusive head trauma, when describing an inflicted injury to the head and its contents.

Basic Anatomy & Physiology

file://localhost/shaken_baby_mac/menu

Incidence

- Prospective population-based studies (Scotland and North Carolina) suggest an annual incidence of about 30 babies per 100,000 under 1 year.

Incidence

- Abusive head injury is a leading cause of serious head injury in small children
  - 95% of serious head injury in <1 year
  - 1/3 of head injury hospitalizations in <3 yr

Incidence

- Homicide is leading cause of infant death due to injury
  - 2/3 are due to AHT
  - 6 deaths each year due to AHT for each 100,000 children <1 year
  - 2000 deaths/yr is an underestimate

Demographics

- High risk populations– maltreatment
  - Premature Infants
  - Twins
  - Mom’s <18
- High risk populations–iTBI
  - Males (54-64%)
  - Children <1 year old (mean age 2.2-8.7 mo.)
  - Children in military families (RR 3.45)
Risk Factors

Perpetrators

2/3 are male
Fathers most common, followed by boyfriends, female babysitters, and mothers

Outcomes

1/3 die, 1/3 disabled, 1/3 “normal”
Severe neurologic sequelae
cognitive, motor, visual
may be delayed
AHT has higher morbidity/mortality than accidental head injury

Pathologic and Diagnostic Features:

- Injury to the brain substance
- Intracranial hemorrhage
- Retinal hemorrhage
- Associated Skeletal and Soft Tissue Injuries

Injury to the brain substance

- Clinically:
  - Evidence of concussive injury

- Radiologic:
  - Shearing injury,
  - Cytotoxic edema
  - Infarction

- Pathologically:
  - TAI
Forces Required

No good experimental model exists... high degree of force

Biomechanics Research
Biofidelic Dolls
Dulcie
Jenny
Piglets
Intracranial injury

- Diffuse
- Contact

Causes of Infant and Toddler SDH

- Feldman et al
- Pediatrics 2001;108:66

- 66 kids ≤ 36 months with SDH
- 59% Abusive
- 23% Accidental (unintentional)
- 18% Undetermined

Contact Injury

Causes of Infant and Toddler SDH

- Demographics
- Gender
- Ethnicity
- Insurance Status
- Primary Caregiver Marital Status
Causes of Infant and Toddler SDH

- Diagnostic Determinates
  - > 2 hours in seeking care
  - 85% history of short falls or none at all
  - Presence of chronic bleed
  - Fractures (except skull)**

Retinal Hemorrhages

Normal Retina

Retinal Hemorrhages

Pathophysiology
- No perfect model
- Mechanical forces on the orbit and traction of the vitreous on retina

Ophthalmic Manifestations of iTBI

- Epidemiology
  - 80% of iTBI
  - Most on post
  - Least in intact survivors
  - Sidedness insignificant
  - Probably 45% of vaginal births
  - Mostly superficial flame or splinter
  - Generally gone in 3 days
  - Some deeper rh may rarely persist 6 wks
Characterizing Retinal Hemorrhages
- No longer just positive
- Location and distribution are becoming increasingly important
- Description of lesions critical

How Much Force?
- RH rarely reported in severe household falls – even those associated with skull fracture
  - If present, they are confined to the posterior pole
- RH associated with injuries requiring a great deal of concussive force

IMPACT?
- Impact may contribute to the severity of RH but is not Mandatory

Direct evidence of A/D injuries w/o impact causing RH
- Emergency aircraft ejection
- Experimental deceleration >40g
- Bungee jumpers
- MVC’s
- Confessions of Baby Shakers

Associated Skeletal Injuries
- Skull fractures
- Rib Fractures
- CML’s

When Kids Fall
Injuries resulting when small children fall out of bed


- 161 children < 5 y/o fell at home
  - 6 fractures (3.7%)
- 85 children < 5 y/o fell in hospital
  - 1 fracture (1.2%)
- 0 intracranial injuries

Falling out of bed:
A relatively benign occurrence


- 207 children < 6 y/o
- fell 25" - 54" from hospital beds
- 1 skull fracture
- 1 clavicle fracture
- 0 intracranial injuries

Bunk Bed Injuries


- 68 falls from bunk beds (6 feet)
- 37% < 2 y/o
- 8 concussions (12%)
- 1 skull fracture w/SDH (1.5%)

Stairway Injuries in Children
(including falls in walkers)


- 363 Children
  - head and neck injuries predominated (73%)
  - only 2.7% had injury to more than one body area
  - any fracture: 25 (7%) (skull fracture 2%)
  - 40% skull fracture if carried by adult during fall
  - concussion: 1%
  - intracranial hemorrhage: 0

Injuries to children related to shopping carts

Smith. *Pediatrics*, 1996 (Columbus)

- 62 children
- head injuries (79%)
- skull fracture: 5 (8%)
- LOC: 4 - 10%
- intracranial injuries: 0 (14% had C-T)

Death from Falls – How far is Fatal

Chadwick, et al. *Journal of Trauma*, 1991 (San Diego)

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>Number of Falls</th>
<th>Death Rate (CHI)</th>
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<tbody>
<tr>
<td>10' - 45'</td>
<td>177</td>
<td>1 death (CHI)</td>
</tr>
<tr>
<td>4' - 10'</td>
<td>65</td>
<td>0 deaths</td>
</tr>
<tr>
<td>&lt; 4'</td>
<td>100</td>
<td>7 deaths (CHI)</td>
</tr>
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</table>
Evaluation Of AHT

Accidental Trauma

Analysis of Missed Cases of AHT
Carole Jenny, Kent Hymel et al
JAMA 2/17/99---v281,#7

Missed Cases of AHT
- 173 abused children over 5 year period with head injuries
- 54 (31.2%) were seen by a physician after the AHT and were not diagnosed
- 15 (27.8%) were reinjured after the missed diagnosis
- 5 deaths in the missed group; 4 preventable

Missed AHT
- Erroneous Diagnoses
  - Viral gastroenteritis
  - Influenza
  - Accidental Injury
  - Otitis media
  - URI
  - UTI
- Radiologic Errors
  - 7 cases were missed secondary to radiologic error
  - 6 cfs
  - 2 long bones
Missed AHT
- Conditions predisposing to Dx error
  - No abnormal breathing
  - No seizures
  - No facial or scalp injuries
  - Intact families
  - White

Diagnosis of AHT

Evaluation of AHT in Children
- Detailed History
- Head C.T, MRI
- Consider CT of chest and abdomen
- Skeletal survey, bone scan
- Ophthalmologic examination / consultation
- Bleeding studies
- LFT's
- Pediatric Child Abuse Consult
- Search for Alternation Etiologies
- Community Liaisons

Detailed History
- Document description of injury
- Use quotes when possible
- Identify "players"
- Control information exchange
- Don’t suggest a mechanism of injury
- Avoid confrontation or accusation
- Use dolls