Abusive Head Trauma.... what every provider should know

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Learning Objectives

- Describe the prevalence of NAT and distinguish the signs and symptoms of non-accidental vs accidental trauma in children.
- Justify the use of non-biased screening for NAT using an objective and systematic algorithm.
- Review radiologic findings in skeletal injuries and abusive head trauma and discuss multiple case scenarios.
- Illustrate the importance of identifying abuse in its early stages, before fatal or near fatal abuse occurs.
- Argue the importance of a high index of suspicion for abusive head trauma (AHT) with non-specific presenting symptoms.

Disclosure statement

Faculty/Presenters/Authors/Content Reviewers/Planners disclose no conflict of interest relative to this educational activity.

Epidemiology

- 702,000 substantiated cases of child abuse in 2014
  - 1546 deaths
- Estimated <5% of physical abuse reported to CPS
- 50-80% of fatal/near fatal cases – evidence of prior abuse
- Past history of abuse – 50% chance repeat abuse; 10% chance of death

Clinical manifestations

Soft tissue injury – most common type of injury

- Bruising, bites, burns, pattern injuries
- Face, neck, ears, torso, buttocks
- Intraoral trauma
- Petechiae
Incidence of Fractures Attributable to Abuse in Young Hospitalized Children: Results From Analysis of a United States Database

Clinical Manifestations

- 55% of abused children
- Multiple fractures more common with abuse
- Ribs, radius/ulna, tib/fib, humerus, femur, clavicle, skull
- Transverse, spiral, oblique
- Metaphyseal fractures

Corner fracture

Fractures — 2nd most common type of injury

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<th>Fracture</th>
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<th>12–23 mo</th>
<th>24–35 mo</th>
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Case #1

- 3 mo male, 30 wk preemie
- Admitted to PICU in resp distress
- Viral illness, high flow NC oxygen, nebs
- Exam shows multiple small/mild bruises, abrasions – forehead, trunk, penis/scrotum
- Linear pattern bruise to abdomen
- Hematologic and metabolic workups started

Case #2

- 2 mo male presents to ED with parents
- 2nd degree burns noted to right heel and buttocks/genitalia.
- Parents report bathing pt in sink in “flower bath” when water filled up through drain from opposite side.
Case #3

- 5 wk old male brought in for URI symptoms-Flu A+
- RN noted bruising to abdomen
- NAT work-up completed
- Skeletal survey:
  - 2 right parietal skull fx
  - Bilateral distal tibial metaphyseal fx
  - L proximal tibia metaphyseal fx
  - CT head: neg
  - CT abd/pelvis: bilat posterior 6th/7th rib fx

RED FLAGS

- Injury inconsistent with mechanism
- Vague/varying history, delay in care
- Developmentally incompatible history
A. Evaluation of children < 12 months or non-ambulatory with a skeletal fracture or other injury suspicious for abuse:

- Thorough history
- Head to toe physical assessment
- Social services consultation
- Skeletal survey
- ALT/AST
- UA with micro
- Head CT
- All children less than 6 mos.
- Children with neurologic abnormality (see section 7.2) and/or external evidence of head injury

B. Blood and urine (additional evaluation) as indicated:

- Urine & serum toxicology
  - Concern for neglect
  - Evidence of nonaccidental injury (head CT is obtained)
  - Report or suspicion of substance abuse to complete the history or presentation

- CBC, PTT, PT, FPA Panel, Factor VII & VIII levels

- Bone, abnormality evaluation:
  - Skeletal fracture
  - Concern for abuse
  - Radiographic concern for osteogenesis imperfecta or metabolic bone disease

C. Consultation as indicated:

- Neurosurgical Consultation
  - All patients with skull fractures (excluding concuss, base and orbit)
  - Must have neurosurgical consultation prior to discharge from the hospital

- Orthopedic Consultation
  - Children < 12 mos. or non-ambulatory
  - Children with a long bone fracture must have orthopedic consultation prior to disposition from the hospital

- Ophthalmology Consultation
  - Patients with TSC also consider genetics to the head/neck jonc:
  - Eye findings concerning for genetic disorders
  - Ophthalmology consulted after admission

D. Diagnostic imaging (additional) as indicated:

- CT AbP/Abs/Pelvis with N contrast
  - Abnormal chest or abdominal x-ray
  - Consider with >2 lRBC per Hct on urinalysis
  - ALT/AST >45 mg/dL
  - Or admit to Trauma Service for abdominal and spinal abdominal exams

- MRI brain/spine
  - May be indicated with CT to further delineate injury per neurosurgery or CMF team
Case #4

- 4 mo infant presents with scalp swelling following a fall off the changing table onto tile.
- Alert, neuro intact and tolerating PO well.
- CT head - left parietal non-displaced linear skull fracture with no underlying hemorrhage.
- H & P – unremarkable
- Skeletal survey – otherwise negative
- UA – negative for blood
- ALT/AST – normal
- SW consult – no concerns
- Neurosurgery consult – follow up in clinic in 2 wks

Case #5

- 9 month female presents to ED with mother
- Cc: right leg swelling & pain s/p fall from bed
- Displaced femur fx identified
- NAT protocol followed
- Skeletal survey: multiple metaphyseal fxs
- Chest CT: right scapula fx & 6th rib fx
- Discharged with foster family

Abusive head trauma (AHT)

- Most common cause of traumatic death under 2 yrs
- Most common cause of neurotrauma <2 yrs
- 30 in 100,000 children in first year of life
- Underestimated, underreported, underrecognized
  - For every identified case, 152 go undiagnosed
  - 3-6% of parents self-report shaking

Abusive head trauma

- 13-35% victims die
- Survivors
  - >60% significant neuro impairment
  - Considerably worse outcomes than non-inflicted
Risk factors
- Prematurity
- Physical/mental disability
- Male
- Age 2-6 months
- Young parents, lower SE status
- Unstable family situation, military service
- Substance abuse, mental disorders
- Unreasonable developmental expectations

Epidemiological factors cannot guide decision-making.

Perpetrators
- #1 - Father
- #2 - Mother's boyfriend
- #3 - Female babysitter
- #4 – Mother

Pathophysiology
- Rotation-acceleration forces
- Tearing of bridging veins across subdural spaces
- Bleeding and subdural hematoma (SDH)
- Diffuse brain dysfunction
- Cerebral edema, hypoxic-ischemic injury
- Retinal hemorrhages

Clinical presentation
- History of minor trauma or no trauma
- No trauma – 92% PPV
- **Neurological impairment**
  - Altered LOC (77%)
  - Seizures (43-50%)
  - Vomiting (15%)

Clinical presentation
- Apnea - critical distinguishing factor
  - 93% PPV
- Respiratory insufficiency complicated by delayed care
- Repeated trauma to respiratory centers
- Out of hospital CPR
- Hypoxic-ischemic brain injury
Abusive head trauma should be considered in ALL young children presenting with neuro changes & neurotrauma.

Case #1

- 3 mo female ex 33 week twin, in care of father and reported to be “not acting right.”
- Presented to ED with eye deviation concerning for seizure activity.
- Fussy with multiple episodes of vomiting.
- Minor facial/scalp bruising noted.
- Loaded with 3% NaCl and keppra and to CT scanner
- SDH, SAH, bilat. skull fractures, cervical ligamentous injury, healing radius/ulna fxs, rib fxs, bilat. retinal hemorrhages

- 9 day hospital stay, seizures resolved
- Patient discharged with no neuro deficits
- Twin removed and both placed in foster care
**Case #2**

- 4 yo female presents to ED with Cc: vomiting. No diarrhea or fever.
- Petechiae noted around eyes.
- Dx with UTI and sent home.
- 48 hrs later, found unresponsive by caregiver.
- EMS to scene - GCS 4, posturing, blown right pupil
- Extensive abdominal bruising; facial and extremity bruising.
- 100% BVM, spine immobilized, transported to ED

**Case #2**

- CT head with diffuse edema, loss of gray-white differentiation, SDH, and extensive herniation. CT abd/pelvis with mesenteric hematoma.
- To OR for evacuation and hemicraniectomy, ventriculostomy, ICP monitor; exploratory laparotomy.
Case #5

- 2 month old reported to fall off the couch at babysitter’s.
- Caregiver stated “he’s not breathing right.”
- EMS found pt apneic and responsive only to pain
- 100% BVM with color improved
- Posturing en route, right pupil dilated, deviated gaze
- IO placed, valium given

Case #5

- Arrived in the ED; intubated and to CT scanner
- Left parietal skull fracture, SDH with herniation
- 3% NaCl, phenobarb, PRBCs
- To OR for decompressive craniectomy, ICP monitor
- ICPs 50s despite maximum medical management
- Parents decide to withdraw care on HD# 7

The TRIAD

- Bilateral thin-film SDH
- Retinal hemorrhages
- Encephalopathy

Abusive head trauma

- Vomiting
- Change in mental status
- Seizures
- Apnea, resp distress/arrest