Tales from the Cribs:
Updates in the identification and management of pediatric non-accidental trauma

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Objectives

1. Identify salient points that characterize the current state of child protection healthcare in the United States.

2. Describe the physical findings and types of injuries that should warrant suspicion for non-accidental trauma (NAT) in a child.

3. Name differential diagnoses to consider during an investigation for non-accidental trauma.

4. Define the basic components involved in initiating a work up for NAT in both the outpatient and inpatient clinical settings.

5. Discuss strategies to minimize incidence and improve detection of child abuse.
Disclosures

+ I have no financial interests or disclosures to share.
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2012 National Data

as provided by the Children’s Hospitals Association (CHA) and the Centers for Disease Control and Prevention (CDC)

- 678,810 reported victims of child abuse and neglect in the USA = 9.2 in 1000 children
- 1,640 children died of abuse and neglect in 2013
- 91,973 total cases reported by 109 children’s hospitals in 2011
- $124 billion dollar financial burden
- 600 - 1400 cases of AHT per year
- more exists than what is reported
605
Suspected Child Abuse Victims
Assessed this past year by the
audrey hepburn CARES Center
at Children's Hospital Los Angeles
1 blue pinwheel represents each child evaluated
1 pink pinwheel in memory of each child that died from child abuse
A 12 year old male who was stabbed in the chest with a knife whom we later found out was attempting to shield his younger sibling from the rage of a caregiver’s psychotic break. The knife pierced his heart and nicked his aorta.

A skinny 9 year old male with multiple scars over his body, embedded BBs in his skin, massive cerebral edema, and a subdural intracranial hemorrhage. Multiple CPS reports had been filed, yet the system failed to save this child’s life.

A 6 month old female who was picked up by EMS in cardiac arrest and was later found to have fluid collections of unknown etiology in her brain and bilateral retinal hemorrhages. Child was declared brain dead weeks later.
True or False?

1. Physical Abuse is the most common type of abuse in the pediatric population.
1. Physical Abuse is the most common type of abuse in the pediatric population?

- FALSE

- 71% neglect, 16.3% physical abuse, 9.1% sexual abuse, 7% emotional
Child Maltreatment: defined

- **NEGLECT**: parent or caregiver fails to provide basic needs for a child

- **PHYSICAL ABUSE**: attempting or actually causing physical pain or injury to a child

- **SEXUAL ABUSE**: inappropriate sexual behaviors between an older person and a child (sexual exploitation, genital exposure)

- **EMOTIONAL ABUSE**: actions or words that may incur damage to a child’s mental health or social development (may include psychological abuse and/or emotional neglect)
2. Most child abuse is reported by medical personnel.
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- FALSE
  Per 2012 Survey by the Children’s Hospitals Association
  
  - 58% of reports of alleged child abuse came from Professionals: legal and law enforcement (16.7%), teachers (16.6%), social services staff (11.1%), medical personnel, mental health personnel, day care providers, foster parents
  
  - 23% Anonymous report
  
  - 18% Non-Professionals: friends, neighbors, relatives, alleged victims, alleged perpetrators
3. Most hospitals pay for at least 50% of funding needed to run a Child Protection Team.
Most hospitals pay for at least 50% of funding needed to run a Child Protection Team?

- FALSE

- on average, most institutions cover roughly 47%

- this leaves teams responsible to find funding by other means: grants, private donations

- government reimbursement??
What is the current state of our Child Abuse Healthcare network?

- lack of funding
- gaps in education specific to child maltreatment and neglect
- disproportionate amount of patients in relation to available staff
- lack of resources/variability in quality of Child Protection Team
- inpatient and outpatient fragmentation of care
- decreased time for education/anticipatory guidance/counseling at prenatal and/or well child primary care visits
3 mo male referred to the ED for further evaluation of abnormal findings on an outpatient intracranial US earlier than morning

“extra-axial fluid collections with a possible subdural hemorrhage to the left of the falx”

currently asymptomatic aside from frequent spit ups from feeds/diagnosed with reflux
Birth Hx: FT-NSVD, no hx birth trauma, BW 7lbs, uncomplicated neonatal course.

PMH: formula fed, frequent spit ups with every feed-underwent a work up for reflux, zantac initiated

Why did this child undergo a US in the first place??
5 to 6 weeks prior to current ED visit, child was assessed in the same ED due to a 7 minute episode of seizure-like activity

“eyes rolling back into the back of his head”, flexed arms, limp lower extremities, loss of consciousness, and cool skin.

no respiratory compromise, returned to baseline upon arrival to the ED

Initial ED course: urine, blood, and abdominal US were all negative. VS normal. ED recommended admission, family refused. Neurology follow up was recommended: EEG normal, US next part of work up...
• 3 additional PCP and ED visits after the initial visit for parental concerns of crying with feedings and emesis with feedings

• Child ultimately brought back to initial ED by family due to radiology call back for abnormal intracranial US....
ED course: VS, imaging, labs, admission

1. VS
   T 36.9 axillary
   HR 145
   RR 30
   BP 99/48

2. Growth Parameters
   Weight 6.84kg (56%) Height 62cm (33%) Head circumference 43cm(94%), was documented at 40.64cm approx 1 month prior
3. Imaging

CT brain w/o contrast: “bilateral subdural attenuation fluid collections, right greater than left, concerning for old evolving subdural hematomas. Mild enlargement of the lateral ventricles, suggesting mild generalized volume loss”

Skeletal Survey: negative for fx or other abnormalities
4. Labs

- WBC 13.85, HGB 11.1, HCT 31.9, PLT 379, AST 27, ALT 19, PT 11.8, PTT 21, urine negative, chem panel unremarkable

5. Admission

- to Hospitalist team: NAT vs organic vs congenital vs metabolic/mitochondrial vs infectious
“In favor of organic causes are that there are no obvious red flags in history or exam”

versus

“Given that there was an apparent abrupt increase in head circumference and new symptomatology NAT must be considered and ruled out.”
Case Study: confusing considerations...

- Misses on all fronts: frequent visits to PCP/UC/ED settings for non-specific spit up/fussiness/crying
- Previous refused admission- should this warrant concern for abuse?
- Conflicting Provider documentation regarding organic vs inflicted etiology
You are the advocate!

What should trigger suspicion for NAT in a child?
Outpatient vs Inpatient?
Red Flags

- child is repeatedly seen in dirty or old clothing
- stealing/hoarding food
- abrupt behavioral or academic changes
- habitual school tardiness
Red Flags

- unexplained injuries, bruises, scars, welts, or burns
- frequent physical injuries - often rationalized as “clumsy” accidents
- delays in seeking medical treatment
- caregiver explanations are concerning
Red Flags

- injury is not consistent with mechanism or consistent with development
- highly sexualized language or behaviors
- child disclosure
Why children don’t disclose...

- I am bad and deserve it
- FEAR that Abuser will: be mad at me, will hurt me, or hurt someone I care about
- I don’t want to tell on my parents
- I’m scared that no one will believe me
- SHAME
- GUILT
- I want to stay in my home
The many faces of NAT

- increased fussiness/crying
- spitting up/feeding issues
- apnea
- ALTE/altered mental status
- new onset convulsions/twitching/tremors
- unexplained shock
- full arrest
- sudden refusal to walk/bear weight/use an extremity
Physical findings concerning for NAT

- Blunt head trauma: AHT- SDH, EDH, skull fractures
- Retinal Hemorrhages
- Infant specific concerns: torn labial frenulum, nursing bottle caries
- Orthopedic injuries: femur, ribs, skull
- Skin manifestations: scalds, bruising, human bites
- Blunt abdominal trauma: solid organ injury/bowel perforation

- FTT
Tale from a crib...

- 5 month old male with 2 days of increased fussiness and decreased appetite. Solely formula fed on carnation gentle ease- mom states that child has been “spitting up” more frequently than usual. Mom also concerned that baby had an episode of “shaking” today- included arms and legs, lasted for “a few seconds”, no respiratory distress or facial pallor.

- Denies fever, URI symptoms, forceful emesis, constipation, diarrhea, rash, or any other concerns.

- FT-NSVD, BW 6lbs, no complications. Previous pyloric US negative, diagnosed with reflux, no medications. No previous hx of any seizure-like behavior.

- PE: WDWN, 5 month old male NAD. Anterior fontanelle slightly full- Otherwise nothing remarkable upon physical exam VSS.
Upon presentation with discharge papers, child started to seize...

Interventions:

- Oxygen
- PIV
- Ativan: seizure stopped after 2 minutes
- Blood work: glucose, lytes, ABG, BUN, creatinine, calcium, magnesium, phosphorus, CBC wi diff, LFTs
- Urine: toxicology
- Imaging: CT brain non-con
CT brain demonstrated bilateral SDH

Further investigation revealed bilat retinal hemorrhages and multiple rib fractures at various stages of healing

A confession was made that included pressing down firmly on the baby’s chest and shaking him to “shut him up.”
Shaken baby syndrome vs Abusive head trauma?

- Shaken Baby Impact/Syndrome: legal term = SDH, retinal hemorrhages, cerebral edema
- 1946 Caffey
  1962 Battered Child Syndrome
  1971 Guthkelch

- Abusive head trauma: medical term via CDC “injury to the skull or intracranial contents of an infant or young child (<5 yrs) due to inflicted blunt impact and/or violent shaking”
Pathophysiology of AHT

- Rupture of bridging veins
- Coup, contre-coup mechanism
- Neuron rupture triggers enzyme release that contributes to vicious cycle: hypoxia, cerebral edema, increased intracranial pressure
- Traumatic DAI
Blunt head trauma/AHT

- AHT = third leading cause of death for pediatric head injuries after falls and MVC
- 20-30 cases AHT per 100,000 < 1 year old
- 20% fatality rate
- 2/3 survivors with significant neurologic, cognitive, behavioral impairments
- SDH in children less than 2 years can lead to: developmental delay, focal neurologic deficits, seizure disorders, death
Signs and symptoms concerning for increased ICP

A. Pre-verbal children

- Irritability, poor feeding
- High-pitched cry, difficult to soothe
- Fontanels: tense, bulging
- Cranial sutures: separated
- Eyes: setting-sun sign
- Scalp veins: distended
B. Older Children

1. EARLY
   HA
   Nausea/vomiting
   ALOC/behavior changes

2. LATE
   Cushings triad
   Seizures
   Unresponsive to painful stimuli
   Posturing
   Dilated, non-reactive pupils
Ddx for the afebrile fussy infant

- idiopathic
- colic/GERD
- corneal abrasion/FB in eye
- fracture
- hair tourniquet
- insect bite
Ddx for the afebrile fussy infant

- constipation
- SBO/intussusception
- SVT
- drug exposure/overdose
- ICH/increased ICP
Retinal hemorrhages: True or False?

1. Only ophthalmologists can see retinal hemorrhages.
1. Only ophthalmologists can see retinal hemorrhages.

✦ FALSE

✦ The posterior pole can be visualized with a basic ophthalmoscope—take a look!
Documentation for retinal hemorrhages = Ophthalmology consult

- detailed description of retinal findings
- retinal photography
- literature currently inconclusive regarding successful dating
- follow up
2. All retinal hemorrhages are associated with child abuse.
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- 85% AHT cases feature retinal hemorrhages

FALSE
Retinal hemorrhages associated with abuse

- too numerous to count, extends into periphery
- multi-layer involvement (pre-retinal, sub-retinal, within the retinal tissue)
- no papilledema (swelling of optic disc associated with ICP)
- mention of retinoschesis and/or retinal folds is always consistent with abuse
- Retinoschesis = splitting of retinal layers with blood accumulating within the resultant space
Differential Diagnosis: retinal hemorrhages

- birth or other trauma
- CMV retinitis
- altitude sickness
- carbon monoxide poisoning
- ROP, ECMO
- blood dyscrasias: VwD, Vit K deficiency, ITP, hemophilia, anemia
Differential diagnosis: retinal hemorrhages

- ALL/AML
- meningitis
- cerebral aneurysm
- vasculitis
- papilledema
- HTN, glutaric aciduria type I
- hyper or hyponatremia
3. Retinal hemorrhages are associated with poor prognosis and cause permanent damage.
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- Retinal hemorrhages rarely cause complete vision loss.
- Vision loss with AHT is linked to retinal avulsion, retinal detachment, vitreous hemorrhage, macular damage/retinoschisis.
- Presence of vitreous hemorrhage is linked to poor ocular and neurologic outcomes.
Tale from the crib...

- 2 month old female brought to the ED by mother due to increased crying with diaper changes and decreased movement to her RLE. Mom denies hx of trauma.

- Child is SEVERELY underweight- she looks like a 6 week old- and you appreciate swelling to the R femur.

- Additional history reveals that child has been fed solely almond milk since birth and that mom suffered from post partum depression during her first pregnancy. This is her second child.
A 6 month old male was transferred from an OSH due to concern for injury to his RLE. Child was reported to have been intact in his rear facing car seat during a MVC 5 days prior to OSH ED visit. Mother and Father were both reported to have been in the car at the time—neither sustained major injuries. Mom noticed that child was more fussy than usual and not moving his leg.
After transfer, it was determined that he had compartment syndrome to the RLE.

He underwent an emergency fasciotomy and external fixation placement.

Further imaging studies revealed: healing rib fractures, a small SDH, an old L tib/fib fx, and an old R distal forearm fracture.
Orthopedic injuries concerning for NAT

- fractures at variant stages of healing
- fractures that are not consistent with development (ie spiral femur fracture in a non-ambulatory child)
- fracture is not consistent with proposed mechanism of injury (ie “I just pulled on it a little”)
Differential Diagnoses: multiple fractures

- osteopenia of prematurity
- FTT/malabsorption syndromes
- Rickets
- vitamin D deficiency
- Caffeys disease
- Job syndrome (hyper IgG) - eczema, bone, tooth defects
- skeletal dysplasias
Metabolic work up

- **BLOOD**: calcium, phosphorus, magnesium, alk phos, bone specific alk phos, PTH, vitamin D\textsubscript{1:25} hydroxy, Vit \text{D} \textsubscript{25} hydroxy,
- **URINE**: urine calcium, urine creatinine, lactate, pyruvate, urine organic acids, urine amino acids
Accidental vs Non-accidental?
- Laceration of labial/sublingual frenula
- Forceful introduction of bottle nipple or other feeding utensil (implies unsafe home environment)
- Trauma
Dental manifestations of child abuse

- **Dental Neglect:** “willful failure of parent/guardian to seek and follow through with tx necessary to ensure a level of oral health essential for preservation of function and freedom from pain/infection” American Academy of Pediatrics. Rampant dental caries...

- Nursing bottle caries: thin primary tooth enamel is decalcified = pulpal necrosis.

- more common to incisors rather than molars

- sleeping with a bottle
Ecchymosis

- Birthmark?
- Pattern?
- Color of ecchymosis is not a reliable measure for age...
- Must take depth, size, location and previous health of child into context
Differential Diagnoses: Skin manifestations

- impetigo
- birth marks/vascular malformations
- HSP
- meningococcemia
- phytophotodermatitis aka berloque dermatitis
- blood dyscrasia: ITP?
- cultural practices
- trichotillomania
Coagulopathy work up

- DIC panel
- ristocetin cofactor,
- Vw factor multimer, Vw factor antigen, Vw factor Normandy
- quantitative factor XII activity
- factor VII
- PFA 100
Human bite marks: unlikely to be accidental
Management of human bites

- copious debridement
- do not suture and never use dermabond
- if cosmetically significant: clean, cover, delayed closure (usually 4 days).
- bite injuries are dirty- needs close follow up. common pathogens- anaerobes, staph, strep = augmentin or clinda for hands and feet
- remember tetanus prophy
- joint involvement with a human bite injury may warrant surgical exploration
Burns

- scalds: 130°F 10 seconds, 135°F 4 seconds, 140°F 1 second, 150°F 1/2 second

- water heaters should never be set higher than 120°F

- accidental vs torture?
Tale from the crib...

- 16 year old female presents to the ED with progressively worsening abdominal pain after she was “assaulted” by an ex-boyfriend. Patient states that she was punched in the face, pushed to the ground, and repeatedly kicked in the abdomen.

- Now with R periorbital ecchymosis and swelling, R sided facial cheek bruising with a swollen upper lip, and abdominal pain.

- Pain is generalized to the R, constant. + decreased appetite and nausea, no emesis.
Blunt abdominal trauma

- Mechanism: kicking/punching to the abdomen
- S and sx: abdominal pain, nausea, vomiting, ecchymosis/abrasion
- Solid organ injuries: liver, spleen, pancreas, bowel
- Duodenal hematomas occur 2-3 times more frequently than laceration or disruption of the duodenum
- Refer to the nearest ED for stabilization: labs, CT with and without contrast
When to report

- “reasonable suspicion”
- disclosure
- observed abuse
- must report ASAP: approx 36 hour time frame to file report
Who to call

- Law Enforcement: Abuser is a third party not in direct home environment or concern for immediate threat to safety
- DCFS/CPS: Abuser is in the home, concern that home is not safe
- When in doubt, call both!
Evaluation for NAT

- refer to the appropriate higher level of care: NEVER by car if you truly are concerned for NAT
- depends upon symptoms and physical exam
- Basic: forensic interview, imaging, labs

  LABS: cbc with diff, PT, PTT, AST, ALT, urine dip, urine tox, urine GC/chlamydia, urine HCG, cultures from lesions

- IMAGING: skeletal survey, CT brain WO contrast, MRI wi DTI and spectroscopy
Imaging: Skeletal Survey


- high contrast/high resolution

- 12 views of the appendicular skeleton: Humeri(AP), forearms(AP), hands( PA), femurs(AP), lower legs(AP), feet(AP), lateral cervical spine, thorax (AP, lateral, R/L obliques to include thoracic and lumbar spine, laberal lumbar spine

- special components: lateral view of spine, separate views of hands and feet, anteroposterior and lateral views of the skull because skull fx in axial plane can be missed on CT

- Repeat in 10-14 days
The Child Protection Team
We are the team...

- The Medical Team: Residents, fellows, **Advanced Practitioners**, Attendings
- Nursing
- Social work
- Medical Subspecialists: trauma surgery, ophthalmology, orthopedics, neurosurgery
- Law Enforcement
- DCFS
- The family
- Psychology/Psychiatry
The best treatment is prevention

- injury prevention anticipatory guidance thorough well child checks
- family centered care: screening for stress, coping mechanisms
- domestic partner and animal abuse are affiliated with child abuse
- non-verbal children and children with special needs are at higher risk
- support education efforts geared towards law enforcement, social workers, and educators- most child abuse is identified here
Anticipatory guidance: all infants cry

- Unrealistic parental expectations about crying can result in injuries...
- Crying is how babies communicate
- Infant crying is not indicative of a parental failure
- Infants cannot learn social behaviors: they are not little adults
Pearls for Parents: crying infants

- expect an increase in crying from birth until approx 6 weeks
- crying is more common in the late afternoon and evening
- never discipline a crying infant via forcefully shaking or tossing
- stage an intervention: some parents enlist a phone-a-friend type model to have support for frustrating child care moments
In conclusion

- There is hope...
- Greater awareness = more anticipatory guidance, better resources/support, quicker identification and treatment
- Together, we can work together to create a better future for our children!
Questions?
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