Sentinel Injuries: When You Have to Sweat the Small Stuff

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Disclosures

• I have no financial relationships with any commercial interests.

Objectives

• Understand the definition of the term “sentinel injury”
• Distinguish between sentinel injuries and normal injury patterns in children
• Become familiar with which sentinel injuries are most often found in abused children
• Appreciate the impact of failing to recognize and address seemingly minor injuries
The Scope of the Problem
- >120,000 children are “proven” victims of physical abuse annually in the US
  - Infants have the highest rate of child abuse
- 600 deaths due to this annually in the US
  - Nearly half of all child abuse fatalities occur in infants

Prevention
- Primary
  - Prevention of child maltreatment
- Secondary
  - Detecting early signs/symptoms of child maltreatment to prevent it from continuing
- Tertiary
  - Treatment to reduce additional complications

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Preventing Missed Cases of Abuse

- But which signs and symptoms should prompt further investigation?
  - Those that are most commonly associated with abuse
  - We should be particularly attentive to the signs of child abuse (i.e., types of injuries) that are most commonly missed

Missed Cases of Abuse

- Approximately 30% of cases of abusive head trauma (AHT) are missed initially.
  - Mean time to diagnosis is 7 days.
  - Mean number of visits until correct diagnosis is ~3.
- Approximately 20% of abusive fractures are missed initially.
- Many of these children subsequently present more severely injured or dead.
  
  Jenny, et al., 1999; Ravichandiran, et al., 2010

Sentinel Injuries

- Relatively minor injuries that are suspicious for child abuse
Sentinel Injuries: Minor, But Suspicious

- Sentinel injuries are *medically minor*. They heal on their own without medical treatment.
- Sentinel injuries are *suspicious and therefore forensically significant*. They typically occur in younger infants who cannot self inflict injuries other than superficial abrasions.

Clinical Vignette

- A three-month-old infant was admitted to the hospital after presenting to the ED with a history of being limp and unresponsive at home.
- Further evaluation revealed subdural hemorrhage, retinal hemorrhage and several acute rib fractures.

Clinical Vignette

- Review of Systems
  - Mom had noticed a small bruise on the infant’s cheek 1 week prior to admission.
Medical Definitions
• Subdural hemorrhage
  – Bleeding on the surface of the brain below the skull
• Retinal hemorrhage
  – Bleeding into the retina, which is a membrane at the back of the eye that contains light sensitive cells
• Rib fracture

Medical Definitions (cont.)
• Bruise/contusion
  – Bleeding beneath intact skin at site of blunt force trauma

Medical Definitions (cont.)
• Ecchymosis
  – Blood that has moved through tissue planes to become visible externally
  – May be visible in an area that was not subjected to trauma
Medical Definitions (cont.)

- Petechiae
  - Small flat red or purple spots caused by a disruption/rupture of capillary blood vessels

Cutaneous Injuries: What’s Normal and What’s Not Normal

- Depends on a variety of factors
  - Age/developmental abilities
  - Location of injuries
  - Explanation (or lack thereof)

Normal Motor Development

- 2 months old: lift head 45° while prone
- 4-6 months old: roll over
- 6 months old: sit without support
- 9 months old: pull to stand, stand holding on and cruise
- 12 months old: take steps/walk on own
Epidemiology of Bruising

- Prospective study of 973 children 0-36 months old who presented to their primary care office
- Bruises were noted in 11/511 (2.2%) children who were not cruising.
- **Those who don't cruise rarely bruise.**

Sugar, et al., 1999

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Back to the Clinical Vignette

- Which injury is the sentinel one for this infant?

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Sentinel Injuries Are Minor, But Suspicious

- Unresponsive/limp
- Subdural hemorrhage
- Retinal hemorrhage
- Rib fractures
- Cheek bruise
The Sentinel Injury Is …..

- The bruise on the baby’s cheek
  – It is **medically minor** because it will heal on its own, but is **suspicious for abuse** based on the baby’s developmental/chronological age.

If….. and….  

- If this mom had sought medical attention for the bruise and the bruise had been recognized for its forensic significance, the subsequent abusive head trauma may have been prevented.

But…

- She didn’t report it.
- And we often don’t recognize it.
So…
Let’s work on recognition!

Types of Sentinel Injuries

- **Bruising** 80%
- Intra-oral injury 11%
- Fracture 7%

Sheets, et al., 2013

To Review

- Bruises are the most common sentinel injury by far.
- **But** not all bruises are due to abuse.
  – How can we distinguish between abusive and accidental bruises?
A Decision Rule for Predicting Abuse

- Case-control study of 95 children 0-4 years of age admitted to a PICU due to trauma
  - 42 were victims of physical abuse
  - 53 were victims of accidental trauma
- Bruising characteristics (total number and body region) and patient age were compared
  
  Pierce, et al., 2010

TEN-4

- Characteristics of bruising that are predictive of abuse
  - Bruising on the Torso, Ear or Neck of a child < 4 years old
  - Bruising anywhere on an infant < 4 months old
- Sensitivity of 97% and specificity of 84% for predicting abuse
  
  Pierce, et al., 2010

One Step Further

TEN-4 FACES

- Torso
- Ear
- Neck
  - In < 4 years old
- Any bruise < 4 months

  Frenulum
  - Auricular area
  - Cheek
  - Eyelid
  - Sclera

Pierce, et al., unpublished
Kinds of Injuries

- Frenulum
- Auricular
- Scleral

Clinical Vignette

- 5-month-old presented to the ED for emesis
- On physical exam, the physician noted a healing frenulum tear.

Clinical Vignette

- Clinician asked about the mechanism of injury. Caregiver replied “some times he stuffs his pacifier in his mouth really hard.”
- Clinician did not ask any additional questions about this injury.
- Patient was diagnosed with gastro-enteritis and discharged home.
Clinical Vignette

• Seven days later this patient returned to the ED dead on arrival.
• Autopsy findings were consistent with severe traumatic brain injury.

The Frenulum Tear Was His Sentinel Injury

• Unfortunately, escalating and repeated violence occurs in nearly 1/3 of physically abused infants
  – vs a single event of loss of control by and frustrated caregiver

Sheets, et al., 2013

How Common Are Sentinel Injuries?

In other words, will I ever see one?
Prevalence of Sentinel Injuries

- Case-control, retrospective study of 401 infants who were evaluated by a hospital based Child Protection Team (CPT)
- Authors extrapolated CPT's level of concern
  - Definite abuse
  - Intermediate concern for abuse
  - No concern for abuse

Sheets, et al., 2013

Their Definition of a Sentinel Injury

- A previous injury reported in the medical history that was suspicious for abuse because
  - The infant could not cruise.
  - The explanation was implausible.

Sheets, et al., 2013

Prevalence of Sentinel Injuries

- Definitely abused infants
  - 55/200 (27.5%)
- Infants with intermediate concern
  - 8/100 (8%)
- Non-abused infants
  - 0/101 (0%)
Definitely Abused Infants

- 55 of the 200 (27.5%) definitely abused infants had a sentinel injury.
  - Of the 55 abused infants with a sentinel injury
    - 44 (80%) had a bruise
      - Head >> extremity > trunk
    - 6 (11%) had an intraoral injury
    - 4 (7%) had a fracture

Sheets, et al., 2013

It Gets Worse....

- 23 of the 55 (42%) caregivers of infants who were definitely abused and had a sentinel injury stated that a medical provider knew about this injury prior to the current hospitalization.

Sheets, et al., 2013

Review of Outside Medical Records

- 10 of the 23 (43.5%) infants who were ultimately abused were suspected to have been abused at the time of the sentinel injury.
  - Some clinicians made reports to CPS, but the children were not protected for various reasons.
  - Others suspected abuse, but concluded that the infant wasn’t abused because the rest of the forensic evaluation was negative.

Sheets, et al., 2013
A Word About Child Abuse Evaluations

- One of the purposes of this evaluation is to identify potential occult injuries.
  - It cannot “rule out” abuse.
- The implications of an evaluation that does not identify additional injuries is very different from other types of medical evaluations (e.g. sepsis).

Review of Outside Medical Records

- 13 of the 23 (56.5%) infants who were ultimately abused and had a sentinel injury had no documentation suggesting that the clinician suspected abuse.
  - Some clinicians simply noted the exam finding.
  - Some clinicians diagnosed the injury as accidental, self-inflicted or a condition unrelated to the injury.

Sheets, et al., 2013

Clinician Challenges

- Lack of recognition
  - Lack of education
  - Information not retained
- Denial/Avoidance
- Bias
Missed Abusive Head Trauma

- 54/173 (31%) children with AHT were classified as having been “missed.”
  - Mean number of physician visits before the diagnosis was made was 2.9.
  - Mean length of time to diagnosis from the day of the first visit was 7 days.

    Jenny, et al., 1999

Back to Bias

- Factors that were found to be significant in missed vs identified cases of AHT
  - Race
    - 37.4% of cases in white children were missed
    - 19% of cases in non-white children were missed
  - Family composition
    - 40.2% of missed cases were children from “intact” families
    - 18.7% of missed cases were children whose parents were not living together

Bias

“Prejudice in favor of or against one thing, person, or group compared with another, usually in a way considered to be unfair”
How Can We Address Bias?
At least in terms of decreasing the number of victims of child physical abuse that are missed by medical providers?

**Protocols**

Primary Care Decision Making
- Prospective observational study of clinicians who evaluated children with injuries
- Clinicians did not report
  - 27% of injuries thought to be likely/very likely to be due to abuse
  - 76% of injuries thought to be possibly caused by abuse
  Flaherty, et al., 2008

Reasons Clinicians Don't Report
- Familiarity with the family
- Anticipated negative consequences to child, family, medical practice
- Discomfort with the process
  Jones, et al., 2008
Prevention

- Appropriate investigation/intervention at the first concern of abuse might prevent further abusive injuries.

Early Detection of Sentinel Injuries

- Requires education about the significance of sentinel injuries
  - Caregivers of young infants
  - CPS workers
  - Medical professionals

More Specifically

- Adults who interact with children should be taught
  - To recognize that bruises and intraoral injuries as well as fractures in pre-cruising infants are not typical
  - That these types of injuries are potentially serious and warrant a comprehensive medical evaluation
Who Should Hear This Message?
Adults who interact with children
Pretty Much EVERYONE

Evaluation After Identification of a Sentinel Injury
• Routine/protocolized evaluation
  – Comprehensive physical exam
  – Neuroimaging
  – Skeletal survey
  – Ophthalmologic evaluation
  – Blood/urine/stool samples
  – Report to CPS

Conclusions
• Sentinel injuries are medically minor, but are suspicious for abuse and therefore forensically significant.
• The most common sentinel injuries are bruises followed by intraoral injuries and fractures.
• The TEN-4 FACES Decision Rule can help to predict the likelihood of abuse.
Conclusions

• In terms of prevention, we need to
  – Educate (and re-educate) those who care for children about the significance of sentinel injuries
  – Address bias (in part with protocols) and denial/avoidance
  – Help mandated reporters to become more comfortable with the process

Don’t Sweat the Small Stuff

Unless it is a sentinel injury

References

References
