

## Sentinel Injuries: When You Have to Sweat the Small Stuff

Alicia Pekarsky, MD, FAAP

ABP Certified in General Pediatrics & Child Abuse Pediatrics  
Co-Medical Director, McMahon/Ryan Child Advocacy Center  
Assistant Professor of Pediatrics, Upstate Medical University

---

---

---

---

---


---

---

---

## 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**

Child Maltreatment, 2014



---

---

---

---

---

---

---

---

### 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



---

---

---

---

---

---

---

---

### Prevention

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



---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

### Back to the Clinical Vignette

- Which injury is the sentinel one for this infant?



---

---

---

---

---

---

---

---

### 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 it's 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 **T**orso, **E**ar or **N**eck 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



---

---

---

---

---

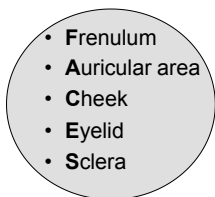
---

---

---

### One Step Further TEN-4 FACES

- **T**orso
- **E**ar
- **N**eck
  - In < 4 years old
- Any bruise < 4 months



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.AND/OR
  - 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

- American Academy of Pediatrics. "The Evaluation of Suspected Child Physical Abuse." *Pediatrics* 2015.
- Flaherty, E.G., et al. "From suspicion of physical child abuse to reporting: Primary care clinician decision-making." *Pediatrics* 2008; 122(3): 611-9.
- Harper, N., et al. "Additional Injuries in Young Infants with Concern for Abuse and Apparently Isolated Bruises." *Journal of Pediatrics* 2014; 165: 383-388.
- Jenny, C., et al. "Analysis of Missed Cases of Abusive Head Trauma." *JAMA* 1999; 281(7): 621-626.
- Joffe, M. & Ludwig, S. "Stairway Injuries in Children." *Pediatrics* 1988; 82(2): 4457-461.
- Lindberg, D., et al. "Testing for Abuse in Children With Sentinel Injuries." *Pediatrics* 2015; 136(5): 831- 838.



---

---

---

---

---

---

---

---

## References

- Jones, R., et al. "Clinicians' Description of Factors Influencing Their Reporting of Suspected Child Abuse: Report of the Child Abuse Reporting Experience Study Research Group." *Pediatrics* 2008.122; 2: 259-266.
- Maguire, S., et al. "Can you age bruises accurately in children? A systemic review." *Archives of Diseases in Children* 2005; 90:187-189.
- Marshall, M. "Radiological Imaging in Infant Non-Accidental Injury." *International Journal of Radiology* 2015. 3(1): 72-81.
- Pierce, M.C., et al. "Bruising Characteristics Discriminating Physical Child Abuse from Accidental Trauma." *Pediatrics* 2010; 125: 67-74.
- Ravichandiran, N., et al. "Delayed Identification of Pediatrics Abuse-related Fractures." *Pediatrics* 2010. 125(1): 60-66.



---

---

---

---

---

---

---

---

## References

- Sheets, L.K., et al. "Sentinel Injuries in Infants Evaluated for Child Physical Abuse." *Pediatrics* 2013; 131: 701-707.
- Sugar, N.F., et al. "Bruises in infants and toddlers: Those who don't bruise rarely bruise. Puget Sound Pediatric Research Network." *Arch Pediatr Adolesc Med* 1999; 153(4): 399-403.
- U.S. Department of Health & Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. (2016). *Child Maltreatment 2014*. Available from <https://www.acf.hhs.gov/sites/default/files/cb/cm2014.pdf>



---

---

---

---

---

---

---

---