Objectives

• Identify “sentinel injuries” in context of possible child abuse
• Understand the medical evaluation required when a sentinel injury is identified
• Understand possible outcomes associated with sentinel injuries
Disclosures

• I have no actual or potential conflict of interest in relation to this presentation/program.
CPS agencies received 3.6 million reports involving the alleged maltreatment of 6.6 million children

2.2 million screened-in reports (3.9 million children) received dispositions by CPS agencies

National estimate of child abuse in 2014 was ~702,000 children
• ~1,546 children died due to child abuse or neglect as reported by 50 states
  - 70.7% of all fatalities were <3 years old
  - 72.3% of child fatalities suffered neglect
  - 41.3% of child fatalities suffered physical abuse either exclusively or in combination with other forms of abuse
• 2014: DCS received 171,907 referrals
  – Screened in and investigated 104,513
  – Screened out 67,394
• 49 kids died from abuse or neglect in 2014
  - 14 from abuse
  - 35 from neglect
  - 57% of these kids were \( \leq 1 \text{y} \)
Multiple choice

• Children in their ____ year of life had the highest rate of victimization.

• A. 3rd
• B. 2nd
• C. 1st
Answer

• C: First year of life

• The estimated rate is 24.4 per 1000 children in first year of life
What do you think? If a man owns a hundred sheep and one of them wanders away, will he not leave the ninety-nine on the hills and go to look for the one that wandered off? In the same way your Father in heaven is not willing that any of these little ones should be lost. Matthew 18:12, 14 NIV
What is a Sentinel Injury?

• Warning sign
• Visible minor injury in pre-cruising infant
• Poorly explained, and thus suspicious for physical abuse
• May be missed or downplayed by medical providers
Sentinel Injuries

Definition of Sentinel Injuries

- Minor injuries
- Pre-cruising infant
- Visible or detectable to a care giver
- Poorly explained and unexpected
- Can be identified in hindsight by history or noted in past p.e.

Examples of Sentinel Injuries

- Bruises (most common)
- Subconjunctival hemorrhages
- Nursemaid’s elbow (radial subluxation)
- Minor Burns
NOT sentinel injuries

- Nonspecific reddening or superficial abrasions as these are expected injuries in infants

- Rib fractures and corner fractures because these are occult and not visible
What we know about bruising

- **Bruises/contusions**: bleeding under intact skin at site of blunt impact trauma
- **Petechiae**: leakage of blood from tiny blood vessels, from injury or pressure changes
- **Ecchymosis**: blood that dissected through the tissue planes and is seen externally
Bruising

- Skin injuries are the most common presentation of child abuse
- Soft tissue injuries are rare in infants who are not abused
- Bruising does not typically occur during routine handling and/or normal activity before an infant is mobile
Bruises in Infants and Toddlers: Those Who Don’t Cruise Rarely Bruise  
Sugar et al, 1999

- Prospective cross sectional study looking at frequency and location of bruises in infants and toddlers <36 months at well child care visits
- Excluded any child with known medical condition related to bruising and infants with bruising from birth
Categories of kids

- Pre-cruisers: no upright walking
- Cruisers: walking while holding onto an object
- Walkers: taking 2 or more steps independently
Bruises in Infants and Toddlers: Those Who Don’t Cruise Rarely Bruise
Sugar et al, 1999

- 973 children <3y
- 366 <6 mos: 2 had bruises (0.6%)
- 473 <9 mos: 8 had bruises (1.7%)
- 203/973 (20.9%) had bruises
- 511/973 were non-cruisers, 11 (2.2%) of which had bruises
- 17.8% of cruisers had bruises
- 51.9% of walkers had bruises
Bruises in Infants and Toddlers: Those Who Don’t Cruise Rarely Bruise  

Sugar et al, 1999

Most common sites
- Shins/Knee
- Forehead
- Scalp
- Upper leg (anterior thigh)

Large majority of bruises were located over bony prominences (93.1%)

Less common sites
- Back
- Chest
- Forearm
- Face (cheek or nose)

Noted in <2% of walkers and extremely rare in pre-cruisers and cruisers
• Bruising in infants <9 months and not walking rarely have bruises

• Infants <6 months had NO bruises on face, trunk or extremities; scalp bruises were extremely rare

• Highlights that medical providers should seriously consider medical condition or inflicted injury when evaluating an infant who presents with bruises
 Bruising

• Accidental
  – Located over bony prominences
  – Not patterned
  – Matches developmental stage of child
  – Matches history provided
Bruising

• Intentional
  – Located centrally on soft tissues
  – Patterned
  – Petechiae
  – Multiple
  – Clustered
  – Doesn’t match explanation given
Accidental or Inflicted?

- **TEN-4** body region and age based bruising clinical decision rule in kids <4y
  - **Torso**: chest, abdomen, back, buttocks, genital area
  - **Ear**
  - **Neck**
- **ANY** bruising anywhere on an infant 4 months or younger
- **FACES**
  - Frenulae (#3)
  - Angle of jaw
  - Cheek
  - Eyelid
  - Sclerae
- **Facial “T” location**
  - Forehead
  - Nose
  - Mouth
  - Chin
Petechiae

- **Nayak et al. 2006** – in 21.9% of kids <17y, presence of petechiae increased likelihood that injuries were from PA

- **Kemp et al. 2014** – kids <6y referred to CPT, petechiae found in 15.4% of PA kids children vs. 1.9% of non-PA kids
Subconjunctival Hemorrhages in Infants

• Can be present immediately after birth, usually resolves in a few weeks
• Rare to see in infants from anything other than trauma
• Often associated with smothering, suffocation, strangulation, and/or direct injury to eye
• DO NOT sustain these injuries from constipation, vomiting, crying, or coughing (unless pertussis)
Intraoral Injuries

- Should raise serious concern unless plausible history provided
- Found in significant number of abused infants
Intraoral Injuries

- **Maguire et al. 2007** systemic review - 9 studies documenting abusive torn frena in 27 kids
  - 24/27 died from abuse
  - 22/27 were <5y
  - Only substantiated mechanism: blow to the face
  - 2 studies showing accidental labial tear from intubation
Nursemaid’s elbow

• “Pulled Elbow” or radial head subluxation
• Typically occurs in kids 1-4y
• Frequently accidental injury in walking children
• Caregiver jerks child up by arm to prevent a fall
Nursemaid’s elbow

- Rarely occurs from a fall
- Holds arm at side, refuses to bend elbow or move arm
True or False?

• Children <3 years of age are at highest risk for severe child abuse.
Answer

• True

• Fatal abuse and serious abusive injuries are more common among children and infants < 2 years of age

• Rate of serious abuse in hospitalized children <1y found to be 58.2 in 100,000 vs 6.2 in 100,000 in kids in general
Why are infants at such high risk for abuse?

- Needy
- Completely dependent on caregivers
- Physically vulnerable
- Crying agitates caregivers
  - Identified as trigger by perpetrators
  - Peaks in 2nd month of life
  - Caregivers response to and perception of why infant is crying is bigger risk factor than crying itself
Multiple choice

The following are all difficult developmental phases and thus potential triggers for child physical abuse:

A. Intractable crying, toilet training, and giggling

B. Toilet training, toddler diet (normal poor appetite), and getting into everything

C. Intractable crying, saying NO, and sleeping through the night

D. Separation anxiety, saying YES, and toddler diet
Answer

• B. Triggers or the seven difficult developmental phases are:
  – colic
  – night time waking/crying
  – separation anxiety
  – normal exploratory behavior
  – normal negativism
  – normal poor appetite
  – toilet training
Other Risk Factors for Child Abuse

- H/O prematurity or low infant birth weight
- Product of unwanted pregnancy
- Child with chronic health needs and/or disability
- Child viewed as “difficult” by caretakers
Other Risk Factors for Child Abuse

- Young/single parent
- Parent with substance abuse or mental health diagnosis
- Parent with past h/o abuse
- Social isolation
- Violence in the home
- Poverty
Multiple Choice

- Children living in households with unrelated adults are _____ times more likely to die of inflicted injuries.
  - A. 2
  - B. 10
  - C. 30
  - D. 50
Answer

• 50 times more likely versus children living in a home with two biological parents.
Why do we care about sentinel injuries?

• Multiple studies show an association between minor abusive injuries in a pre-cruising infant and later more severe physical abuse, and in some cases death.

• SI can be from an initial isolated incident and/or may precede escalation of violence.

• Time between SI and subsequent more severe abuse can be as short as 1 day to months.
Medical Providers Miss Abuse

- Injuries are subtle or seem mild
- Symptoms are nonspecific
- Bruises not seen in “hidden” locations
- Injuries heal quickly
- Failure to consider abuse as possibility
Analysis of Missed Cases of Abusive Head Trauma, Jenny et al, 1999

• Retrospective chart review -- looked at frequency of missed AHT by physicians in a group of children and the factors associated with missed cases

• 173 children included:
  - <3y (10d to 2.9y, mean 274d)
  - AHT was diagnosed by CAP/team
Analysis of Missed Cases of Abusive Head Trauma, Jenny et al, 1999

54/173 (31.2%) missed

22 (40.7%) had medical complications

15 (27.8%) were reinjured after dx missed

• MISSED: Child had been seen by a doctor after an abusive event and was diagnosed as something else or not recognized
Analysis of Missed Cases of Abusive Head Trauma, Jenny et al, 1999

- 20 (16.8%) children died when AHT dx was not missed
- 5 (9.3%) children died when AHT dx was missed (4 felt to be preventable)
Children with unrecognized AHT were more likely to be associated with certain psychosocial factors:

- very young (180d missed vs 278d not missed)
- white (37.4% missed white vs 19% missed minority)
- intact families (40.2% missed vs 18.7% missed NIF)
Analysis of Missed Cases of Abusive Head Trauma, Jenny et al, 1999

- Children who were missed were more likely to present with less severe symptoms
  - Awake and alert (29.4% recognized vs 64.8% missed)
  - Normal respiratory status (37.8% recognized vs 81.5% missed)
  - Seizures or respiratory compromise more likely to be recognized
• Many other studies have looked at missed cases all essentially showing children are often subject to recurrent abusive injuries

• Perpetrator admissions include repeated abuse
• Be alert to bruises on faces and heads (20/54 – 37% of missed cases all had facial or scalp injuries attributed to an accident)

• Include head trauma in the differential diagnosis of infants and toddlers presenting with nonspecific symptoms
Missing abuse ➝ higher risk of death

- **Oral et al 2008**: retrospectively reviewed charts to see how many kids died from missed diagnosis of AHT
- 38 cases of AHT
  - 33/38 survived: 3 (7.9%) normal vs. 30 (78.9%) with neurological impairments
- 5/38 had past h/o abuse that was missed
- 3/5 (7.9%) died
Medical Evaluation

• THOROUGH HISTORY
  – Detailed explanation for the injury
  – Review birth, medical history, developmental, family, and social histories

• RED FLAG SHOULD WAVE
  – No history
  – Changing history
  – History doesn’t fit developmental stage
  – History is inconsistent with severity of injury
  – Inappropriate delay in seeking care
Medical Evaluation

• CAREFUL AND COMPLETE HEAD TO TOE PHYSICAL EXAM
  - All 3 frenulae
  - Ears
  - Scalp
  - Anogenital area
  - Hands and Feet
  - Head circumference
  - Photodocumentation
  - Written documentation of pattern, location, and size of any injuries
Medical Evaluation

- Head CT in children <6 months or those with abnormal neurological findings
- Skeletal survey if less than 2y
- Repeat skeletal survey ~2 weeks later
  - Harper et al 2010 found that follow up skeletal survey added new information in 21.9% of cases
Medical Evaluation

- Laboratory studies to screen for abdominal injuries
- Consider occult drug screen
  - Oral et al, 2011 found positive illicit drug screen in 15% of children evaluated for child abuse
- Consider testing for predisposing medical conditions (bleeding disorders)
True or False?

This is an appropriate skeletal survey for an infant <6 months of age in order to cut down on radiation exposure.

http://aappolicy.aappublications.org/cgi/content/full/pediatrics; 105/6/1345
Skeletal Surveys for Suspected Child Abuse
Guidance for following ACR-SPR Practice

21 radiographs - the minimum required

**Skeletal survey (number of X-rays)**
- Skull (2)
- Frontal and lateral cervical spine (1)
- Lateral thorax (4) AP, lateral, right and left obliques
- Lumbosacral spine (1) Lateral
- Pelvis (1) AP
- Humeri (2) AP
- Forearms (2) AP
- Hands (2) PA
- Femurs (2) AP
- Lower legs (2) AP
- Feet (2) AP

**Points to Remember**
1. Proper technique - High resolution while optimizing dose
2. Positioning
3. Collimation
4. Image identification
5. Restraining methods
6. Patient shielding

Department of Radiology and Imaging Science, IU

For any questions, please speak with one of our staff radiologists at Riley Tel: 317-948-6315

FALSE

Minimum of 21 plain x-rays in the AP/PS/lateral positions to evaluate entire skeleton
Case controlled retrospective study to determine how often abused infants had a history of a SI in comparison to non-abused infants

SI defined as a previous injury reported in the medical history that was suspicious for abuse because the infant did not cruise or the explanation was implausible
• 4 cohorts of infants <12 months of age evaluated for abuse by a hospital based CPT
  – 100 definitely abuse AHT
  – 100 definitely abused non-AHT
  – 100 indeterminate
  – 101 not abused
Sentinel Injuries in Infants Evaluated for Child Physical Abuse, Sheets et al., 2013

200 definitely abused: 27.5% with SI

100 indeterminate: 8% with SI

101 not abused: 0 with SI
Sentinel Injuries in Infants Evaluated for Child Physical Abuse, Sheets et al., 2013

63/401 infants total with SI

55 (27.5%) DA with SI

8 (8%) IA with SI

30 (30%) AHT with SI

25 (25%) non-AHT with SI

Types of SI in DA group
• 80% bruises
• 11% intraoral injuries
• 7% other

Types of SI in IA group
• 87.5% bruises
• 12.5% NM elbow
• NO children who were not abused had SI
  – 83% had accidental injuries
  – 11% had medical mimic of abuse
  – 6% had a normal variant mistaken

• History of an SI should elevate concern for possible child abuse and prompt evaluation
• SI can be the first and only abusive injury OR the precursor of recurrent more severe injuries
• Early recognition and intervention can prevent further abusive injury and death
Recurrent abuse higher risk of death

- **Deans et al 2013** compared mortality rates of kids <16y with recurrent NAT vs single episode NAT with associated risk factors
  - 53/1572 kids had rNAT
  - Mortality rate in kids with rNAT was much higher (24.5%) vs those with sNAT (9.9%)
  - Risk factors associated with higher mortality rate and rNAT related to race and place of treatment
Recurrent abuse → higher risk of death

Putnam-Hornstein et al 2011: kids 5y and younger with prior allegation of NAT reported to DCS found to be >5.5x more likely to die from abusive injuries
Recurrent abuse ➔ higher risk of death

Schmidt et al 1990: 35-50% increased risk of rNAT in abused kids going home w/o intervention

– 5-10% higher risk of death from rNAT episode
Now What?
Drawing Conclusions

• Even if all surveillance studies are normal with no other injury identified, child abuse should still be the primary diagnostic consideration in an infant with an unexplained SI

• SI may be the only injury from abuse and should be explained and understood as such
Drawing Conclusions

• Mandated reporters -- suspicion of abuse must be reported to DCS, diagnostic certainty is not required

• Infants returned to environments where abuse is occurring without intervention are at extreme risk for escalating injury and death
Reporting Child Abuse in Indiana

Indiana Child Abuse and Neglect Hotline

1-800-800-5556

The Indiana Dept. of Child Services Hotline above is available 24 hours day, 7 days week including holidays. Reports may be made anonymously.
Protecting Children

- Completing medical evaluation and reporting may be only opportunity in prevention
- Even if unable to substantiate abuse, interventions (evaluation and reporting) may be helpful to families
Protecting Children

- Understand triggers and risk factors that played role in SI
- Provide well child care and directed anticipatory guidance, education, and resources
Summary - Avoiding Pitfalls

- Properly identify sentinel injuries
  - Bruising: TEN-4, FACES, Facial “T”, patterned
  - Petechiae
  - Intraoral injuries
  - Subconjunctival hemorrhages
  - Nursemaid’s elbow

- Get detailed history and question it

- Never assume lack of risk factors mean lack of risk
Summary – Avoiding Pitfalls

- Complete medical evaluation in every case of unexplained SI (HCT, SS, repeat SS, screening labs)
- Remember negative surveillance studies DO NOT mean you have ruled out abuse
- Get help from child abuse specialist if needed
- Report suspicions to DCS
- Remember to ALWAYS ask about any siblings and have them evaluated as appropriate
Summary – Avoiding Pitfalls

• SI can be difficult to recognize because they seem minor

• Remember they are not minor, research has very clearly shown that they are warning signs of the potential for further abuse and possible death
Resources

• Block, S. Petechiae and Purpura: The Ominous and the Not-So-Obvious? Pediatric Annals, August 2014-Vol43:8 297-303
• Google Images
• Laskey A. Sentinel Injuries: Recognizing the symptoms of the canary in the coal mine before it’s too late. Powerpoint Presentation
• Maguire, S. Which Injuries may indicate child abuse? Arch Dis Child Educ Pract Ed 95:170-177, 2010
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- Ricci, L. Sentinel Injuries. Powerpoint Presentation