Objectives

After this session, the learner will be able to:

• describe the significance of sentinel injuries in pre-cruising infants
• recognize bruises and other minor injuries that suggest abuse
• list potential conditions and skin findings that can be mistaken for abuse injuries
Skin “marks” overview

- Skin is easily visible and changes can indicate trauma, disease, risk, contact with the environment or just normal variation
- Size of the “mark” may or may not matter
  - Tiny marks may indicate underlying disease or serious, potentially life-threatening abuse
  - Large marks can occur in benign situations
  - The presence or absence of marks does not screen for abuse in infants, toddlers and preschool age children!

Role of photos

- Photos cannot replace an exam
  - Swelling? Tenderness? Blanching? Injury deeper structures? Wipe off? Other findings not in the photo?
- Assessments based upon photos only are usually more tentative
- Photos can augment an evaluation
  - See the “mark” over time
  - Consider asking for family photos
Approach for investigators

• If you look for skin “marks”
  – Good light- use natural light if available; put lotion on the skin if it is dry
  – Move subject or yourself to get different angles
  – What type of “mark” is it?:
    • Injury:
      – Scratch or scrape (abrasion)?
      – Cut (laceration or incised wound)?
      – Burn?
      – Bruise (contusion, petechiae, ecchymosis)?
    • Rash (dermatitis or inflammation) or bug bite?
    • Other- artificial pigment or dye, birthmark (can look like any of the above “marks”), prominent blood vessels, skin coloring

Abrasions (scratches/scrapes)

• Usually the most benign of skin injuries
• Caused by traumatic removal of layers of the epidermis or dermis
• If caused by a narrow object, lesion will appear as a scratch (example-scratch on the face of a baby from her own long fingernails)
• If caused by a broad, often rough object, lesion will appear as a scrape (examples- skinned knee or rug ‘burn’)
• Large scrapes can need treatment similar to burns
Abrasions

• Usually caused by something being moved across the skin
• Depending on the type of object and the forces, an object moving across the skin can cause abrasions, bruises, lacerations or all 3!
• Linear injury can result from
  – an object moving over the skin;
  – impact against a linear implement/edge
  – “crimping” (shear)

“Cuts”- Lacerations and Incised Wounds

• Lacerations result from blunt trauma and tearing (splitting) of the skin;
• Incised wounds result from sharp objects cutting the skin
• Both can be associated with bruising along the margins of the wound
Burn—beyond scope of today’s lecture

- Thermal
  - Scald
  - Contact
  - Flame
- Electrical
- Microwave
- Chemical
- Friction—not truly a burn; results from mechanical trauma over a broad surface
What is a bruise?

- Visible blood outside the blood vessels in the skin or soft tissues
- Many different names:
  - Bruise = contusion
  - Petechiae - small, pin point bruises < 2 mm
  - Ecchymosis – bruising due to seepage of blood around an area of trauma. Usually blue-purple in color and round to irregular in shape. Sometimes used for hematomas > 1 cm
  - Hematoma- nonspecific word for collection of blood with or without swelling
  - Purpura – bruising between 2 mm and 1 cm

Is the ‘mark’ a bruise?

- Photos are insufficient to determine in many cases
- Requires some medical expertise/sophistication
  - Does the ‘mark’ blanch?
  - Is there pain or soft tissue swelling?
  - Are there associated injuries?
  - Does the ‘mark’ heal like a bruise?
  - Are additional tests needed such as X-rays or lab studies?
  - Is the ‘mark’ a bruise mimic?
- Minor ‘marks’ may be very subtle, easily missed or healed
- If the ‘mark’ is a bruise, what does it mean?
Bruises- what do they mean?

• Is a bruise always just a bruise? What makes a bruise serious?
• Considerations:
  – Age of the child
  – Developmental abilities of the child
  – Specific vulnerabilities of the child
  – Location of the bruise
  – Appearance of the bruise- pattern, size, color
  – Underlying injury to deeper soft tissues
• Is it a bruise or a mimic?

Is it just a bruise?

• Need to consider soft tissue, bone and organ injury
• Even fatal abuse may have no or minimal external signs of injury
• Important to know if there is pain, soft tissue swelling or limitation in movement associated with injury (even in obvious abusive injuries)
When should a bruise create suspicion for abuse?

- **Pattern** - bruise that has a recognizable shape or pattern **or**
- **Location** - bruise in unusual location (anywhere on a young infant or in protected locations such as (ear, hand, neck, buttocks, inner thighs) **or**
- **Age of the baby** - a bruise on an infant who is not yet cruising (infants under 6 mo)
- Often important or “severe” bruises can be very subtle and easily missed!

Patterns of Bruising/Injury*

- Common patterns of bruising or scarring
- Bites deserve special attention

Patterns of Bruising by Mechanism of Injury

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Abuse example</th>
<th>Example of Not Abuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crush - bruise at site of contact</td>
<td>Bite, pinch, grab ‘marks’</td>
<td>Bump into furniture or fall onto knee</td>
</tr>
<tr>
<td>High velocity impact - outline of implement</td>
<td>Hand slap, looped cord, hanger</td>
<td>Rare accidents such as a motor belt snapping and striking someone</td>
</tr>
<tr>
<td>Pressure changes - petechiae</td>
<td>Hockey, strangulation</td>
<td>‘Hickey’, cough, vomiting, crying, rare strangulation accidents</td>
</tr>
<tr>
<td>Incised wounds (cut) - bruise along edges of wound</td>
<td>Knife wound, fingernail gouge injury</td>
<td>Accidental razor blade cut</td>
</tr>
<tr>
<td>Lacerations (torn skin with tissue bridges) - bruise at edges of laceration</td>
<td>Punch to face resulting in a laceration</td>
<td>Fall resulting in laceration</td>
</tr>
<tr>
<td>Indirect forces (shearing) - bruise distant to contact</td>
<td>Vertical bruises from bare bottom spanking</td>
<td>Genital bruising from vehicle run over event</td>
</tr>
<tr>
<td>Dependent - bruise results in blood settling under the effects of gravity</td>
<td>‘Black eye’ from bruise on forehead</td>
<td>‘Black eye’ from bruise on forehead</td>
</tr>
</tbody>
</table>

Petechiae- Pin point Bruises

- **Causes**
  - Mechanical trauma: Blunt impact, or “rubbing,” or crush against a patterned surface
  - Pressure changes
    - Suction
    - Increased venous pressure
  - Removal of epidermis- burns and abrasions
- **Significance?**
  - Clue to mechanism of injury
  - Tend to resolve more quickly than larger, deeper bruises, but no science to accurately date petechiae

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Shear bruising - distant to site of impact

- Unique pattern indicates severe forces
- Represents crimping or shearing injury


Location of Bruises

- Normal bruising of childhood usually occurs over bony prominence.
- Ear, genital, buttock, abdominal bruises are suspicious.
- Assess in terms of the overall distribution of bruises!
Age of the child: Sentinel Injuries

• Small, apparently insignificant injuries such as bruises and mouth injuries in young infants are often from abuse
• These “Sentinel Injuries” often precede more serious abuse
• When recognized and responded to, escalation of abuse to fractures, head trauma and infant homicide might be prevented

Bruising in Pre-Cruising Infants

• What do we know?
  – Bruising in pre-cruising infants is unexpected
    • Published studies are based on physical exams of well infants presumed to be non-abused
    • Cannot completely screen out abused infants
    • Well cohorts contain abused infants
  – Unintentional bruising can occur but is unexpected

✓ Mortimer PE. Are facial bruises in babies ever accidental? (Arch Dis Child. 1983;58:75-76)
Isolated Bruising – Is It Abuse?

• Isolated bruising in pre-cruising infants evaluated for abuse
  – < 6 months old evaluated for abuse
  – 50% have other serious injury identified on skeletal survey, neuroimaging or abdominal injury screening
  – 70% were screened for bleeding disorders and none identified
  – Always consider alternative hypotheses to abuse!
  – Bruising can be the first injury from abuse!


Injury From Abuse Can Escalate

• Injury from abuse can escalate
• Prevention critical
• Background for the sentinel injury research studies

Sentinel Injury Research

• Clinical observations:
  – AHT observations
  – Doctors and family accept implausible explanations. Why?
    • Abuse of an infant is unthinkable
    • Injuries are “minor” or apparently trivial
    • Lack of awareness of bruising significance
    • Biases – families perceived to be low risk
  – How often do abused infants have prior visible injuries and could early detection make a difference?

Prevention Through Early Detection

• Human - prevent abuse to the child and devastation of families
• Financial –
  – Potential estimated savings of $210,000 life-time cost for each case prevented (Fang)
  – >$2,600/year/high risk or maltreated child on Medicaid (Florence)

Definition of Sentinel Injury

- Sentinel injury –
  - Visible/detectable injury reported to have been to at least one parent prior to the events leading to the current admission
  - Occurred at an age when the infant could not cruise and injury was unexplained or poorly explained
  - Such as bruising or mouth injury in infant < 7 mo
- Example: 6-month old infant with abusive head trauma
  - healing rib fractures (not sentinel injuries)
  - history of an unexplained cheek bruise at 2 months of age

Examples of Sentinel Injuries

- 1 ½-month-Spiral fracture femur.
  - 3 weeks of age-cheek bruising on both sides “like someone had grabbed her while feeding her”
- 4-month-old with AHT
  - 2 weeks before, mother noticed chest bruises- attributed them to “father does not know his own strength”
- 8 ½-month old
  - inflicted burns had these bruises at 3 months of age:
SENTINEL INJURY STUDY
RESULTS

Results Summary

Sentinel Injuries in AHT/Battered Infants (N=52)
Sentinel Injuries in Non-Abuse Infants (N=101)
Non-Abuse (N=101)
AHT/Battered Infants (N=200)

Cumulative Percent

Age, months

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Ages at Risk

- Crying normally peaks at 1-2 months
- Sentinel Injuries peaked at 2-3 months
- Abusive head trauma peaks at 3-6 months

Prevention

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The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/early/2013/03/06/peds.2012-2780
High stakes- bruising in infants

- 25-30% of severely abused infants have a prior history of sentinel injuries (bruising, oral injury or fractures in a pre-cruising infant) (Sheets et al., 2013 Pediatrics)
- Most sentinel injuries are ‘minor’ abusive injuries that will heal completely and quickly such as a bruise or a frenulum tear
- Bruises in pre-cruising infants are serious until medically evaluated
- Medical evaluation of concerning injuries should be performed by the most experienced professional available

Mouth Injuries

- Common in walking children
- Result from abuse in infants not yet able to walk
- Angry, frustrated caregiver “rams” something in the mouth:
Subconjunctival Hemorrhage

• Unexpected injury in infancy
• Should raise concern for child maltreatment if not well-explained

Subconjunctival Hemorrhage

• Chart review of 14 cases with SCH evaluated by the child protection team
• Ages 1 mo to 5 yr (median 6.5 mo)
• None with history of cough, vomiting or constipation
  – 79% also had bruising
  – 43% had fractures
  – 3 (21%) had intracranial injuries or liver laceration
• SCH should raise concern about abuse in young children, especially in pre-cruising children

DeRidder, et al. SCH in infants and children; Pediatri Emerg Care. 2013
Subconjunctival Hemorrhage

- Rupture of conjunctival capillaries
- Size of hemorrhage not related to the etiology or severity of injury
- Result of direct blow or increased intrathoracic/abdominal pressure
- Differential: trauma, increased intravascular pressure, infection, hematologic and oncologic etiologies

Subconjunctival Hemorrhage

- Infants are not usually able to generate sufficient intra-thoracic or intra-abdominal pressure to cause SCH
  - Exception for pertussis which also increases vascular permeability
  - 2/100 infants with pyloric stenosis had SCH (none had RH)
- May or may not have other signs of abuse on exam.
Dating Bruises Is Inaccurate!

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Inexpensive bleeding study:

- No national consensus
- Consultation with CHW Hematology has resulted in the following consensus at CHW:
  - “Minor” bleeding such as bruises
    - CBC with auto diff, PTT, PT, TT, PFS, vWD Activity and antigen
  - Severe bleeding (such as abusive head trauma)
    - Same as above plus Fibrinogen and d-Dimer; consider obtaining a heme consult

Also see: Thomas AE. The bleeding child; is it NAI? Arch Dis Child. 2004;89:1163-1167
When does a possible bruise need medical evaluation?

- Any suspected injury in a pre-cruising infant (see decision tree on next slide)
- All patterned injuries
- Suspected excessive discipline with an implement
- Bruising on the neck, hands, feet, ears, genitals, anal area, buttocks in young children

Siblings and contacts—How much work-up?

- 2012 Lindberg et al. (*Pediatrics*. 2012;130:1-9)- ExSTRA multisite research study:
  - Found ~12% of contacts under 2 y/o had abusive fractures
  - Twins at substantially increased risk of fracture when the index child was the other twin; odds ration 20x!!
Abuse Mimics

- Accidental bruising
- Self-inflicted injury
- Birthmarks- vascular and pigmented
- Cultural treatments
- Bleeding disorders
- Rashes and other skin conditions
- Pigments such as markers
- Venous Congestion, especially between the eyes and in the perianal area

Mimics- Mongolian Spots or Slate Blue/gray nevi

- Congenital dermal melanocytosis or slate blue nevus
- May be absent at birth.
- Can gradually become more prominent over the first few months of life
- Can occur in unusual locations
- Occurs in infants of any ethnicity/race
Folk Remedies

• Cao gio (Coin Rubbing)
  – Practiced in Southeast Asia and Southern China
  – Coin is rubbed against oiled skin, causing stripes of petechial bruising
  – Motive is healing
  – Quat sha (Spoonling) is similar, except uses a porcelain spoon

Henoch Schonlein Purpura (HSP)

• A form of vasculitis involving small blood vessels, usually following a viral illness
• Presents with purpura on lower extremities and buttocks
• Often presents with abdominal pain, joint pains and nephritis
• May see blood in urine and blood in stool
• Diagnosed by clinical signs/symptoms-no definitive lab test
“Rash” and other mimics

- Many other mimics and conditions that could be mistaken for abuse
- Usually requires medical input in order to consider
- Even in obvious abuse, consider a bleeding disorder

Medical Input

- Medical evaluation plus photos is best strategy
- Seek medical evaluation by most experienced provider
- If unsure, seek advice (triage) from closest center of excellence
- Don’t assume that MD = best provider
- Ask about what alternative hypotheses (differential diagnoses) were considered
Medical Input

• There are many conditions mistaken for child maltreatment and there are many maltreatment injuries missed or mistaken for other conditions
• Medical expertise (highest quality available) usually necessary when abuse is suspected, even in “obvious” cases
• Important to consider organ and bone injury in infants, toddlers and preschoolers

Sentinel Injury Education

• Wisconsin Child Abuse Network (WI CAN)
• Need to educate medical providers and
  – Law enforcement
  – CPS
  – Prosecutors
  – Day care providers
  – Home visitors
  – Others
Background

• Children and Families
  • Child maltreatment has serious consequences for the child and family
  • Child and family have a right to accurate identification of abuse

• Investigators
  • Reports to law enforcement and child welfare deserve the best response
  • Medical information can be a valuable part of a child abuse investigation or family assessment for safety

• Medical Evaluations
  • Child Abuse Pediatrics is a highly specialized field and is the newest subspecialty of Pediatrics
  • Access to child abuse medical expertise is a challenge for many states
  • Even when access to expertise is available, it is under-utilized

Slide Courtesy Barbara L. Knox, MD

Wisconsin Child Abuse Network (WI CAN)

• WI CAN is a public-private partnership including representatives from:
  – State departments (DCF, DHS, DOJ, Children’s Trust Fund)
  – Non-profit community based organizations (CAC’s)
  – Statewide professional associations (PANDA, WCASA)
  – State’s medical universities and children’s hospitals
    • University of Wisconsin School of Medicine and Public Health
    • Medical College of Wisconsin
    • Children’s Hospital of Wisconsin
    • American Family Children’s Hospital

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WI CAN

• Goal: Increase medical expertise in child abuse investigations to improve accuracy of investigations and overall safety of children and families
• Target Population:
  – Medical providers that interact with children who are suspected of being abused
  – Investigators (law enforcement personnel and child protective service workers) who have the primary role of determining if child maltreatment has occurred
• Who Benefits: Children and families

Education and Peer Review

• Medical education web-based distance learning (webinars) and peer review sessions started in 2007
• Sexual abuse peer review (links SANE providers, physicians and advanced practice providers throughout the state)
• Investigator webinars for child welfare and law enforcement began in 2011
• Offered monthly
• Sessions are web-based and by telephone so participants can be in office with a phone and a computer (or at home)
Improving Access to Resources

• Website to go live in 2015
  – Webinars on demand
  – “Just in time” resources including guides about what to do when a sentinel injury is detected
  – Module on advanced issues in mandated reporting for health care professionals
  – Prevention information
  – Links

Key Points

• Ask about sentinel injuries
• Seek a qualified examination of infants with suspected injury in good light and completely undressed
• Pay attention to minor injuries – ask questions
• When unsure, call a child abuse expert for advice
• Think about other conditions that can mimic abuse
• Look for occult (hidden injury) by performing full work-ups in children suspected of being physically abused – unless injury is clearly explained by history
• Remember – the lack of occult injuries does not rule out abuse!
• Offer resources to parents of distressed infants
Questions?

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