Pediatric Evaluation and Diagnostic Services (PEDS) Computer Assisted Training - Module 1

Slide 1 - Welcome

Welcome

Pediatric Evaluation and Diagnostic Services (PEDS)
Part 1 - Physical Injuries in Infants

Is it Child Abuse? What are we missing?

presented by
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Indiana University Child Protection Program
Case 1 - P.A.

- 5 week old infant:
  - Fell off dad’s chest to floor, hit coffee table.
  - No loss of consciousness, cried immediately.
  - Mild scalp swelling.
  - Past Medical History - NSVD
    - Birth Weight 8 lbs. 6 oz.
  - Family History/Psychosocial History
    - Negative, parents only caregivers.

- Physical Exam:
  - Active, irritable but consolable.
  - Swollen scalp.
  - Small bruise, R hip/buttocks, left foot, right arm.
Case 1 - P.A.

What do you think?

What do you do?
Case 1 - P.A.

- Skull film:
  - Linear fracture.

- Head CT:
  - Right parietal linear fracture.
  - No internal injury or bleeding in brain.

- Observed Overnight: stable
  - Discharged next morning in good condition.
Case 1 - P.A.

- Can a simple fall cause a simple unilateral linear skull fracture?
- The simple answer is yes.
- The real questions:
  - Does the pattern of injury fit the history?
  - What are the injuries?
Case 1 - P.A.

- 2 days later:
  - Vomiting, irritable.
  - ER: consolable, kept down bottle.
  - Discharged home.
- 3 days later:
  - Persistent vomiting, irritability.
  - Phone MD // formula change.
- 5 days later:
  - Respiratory arrest at home.
- Let's look at the films:
  - Head CT.
  - Chest X-ray.
Case 1 - P.A. Head CT

- Skull Fracture
- Subdural Hemorrhage (bleeding over brain)
Case 1 - P.A. Leg X-ray

Healing leg fracture on tibia
Case 1 - P.A. Summary

- Bilateral parietal skull fractures.

- Bilateral acute Subdural Hematomas (bleeding over surface of the brain).

- Cerebral Edema (swelling of the brain).

- Multiple healed rib fractures.

- Left knee fracture, healed.
Goals

- Describe typical patterns of injury resulting from common household accidents.

- List common presentations for nonaccidental injuries in infants.

- Describe medical evaluation necessary for evaluation of an infant with possible nonaccidental injury.

- With this background we will then look in more depth at Abusive Head Trauma.
How Many Children are Affected?

- Nationally:
  - ~2.9 million reports per year to CPS.
  - ~1 million substantiated cases per year.
  - 60% of substantiated cases involve neglect.
  - 1500 deaths per year.
  - 0-3 year olds have highest rate of victimization.
  - ~15% of children reported to CPS are placed in foster care.

- Indiana (2003):
  - Over 61,000 reports of suspected CA/N.
  - Over 23,000 substantiated reports of abuse.
  - Over 38,000 substantiated reports of neglect.
  - 51 fatalities (34 abuse/17 neglect).
Medical Background

- Subdural hemorrhage:
  - Bleeding over the surface of the brain (in the subdural space).
  - Most often associated with Abusive Head Trauma.
- Retinal hemorrhages:
  - Bleeding in the back of the eye on the retina.
- Fracture = break.
- Contusion, ecchymosis:
  - Bruise.
- Frenula:
  - Connecting mucous membrane tissue.
  - Lips to gum and under tongue.
- Differential diagnosis:
  - The diagnostic possibilities to be considered.
Radiology Techniques

- **Skeletal survey:**
  - X-rays of all the bones.

- **Bone scan:**
  - Nuclear medicine study.

- **Head CT:**
  - Imaging using Computerized Tomography.

- **MRI:**
  - Magnetic Resonance Imaging.

Have a seat Kermit. What I'm about to tell you might come as big shock...
Skeletal Survey

- At least 20 separate films!
- Appendicular skeleton (long bones):
  - Humeri (AP)
  - Forearms (AP)
  - Hands (oblique PA)
  - Femurs (AP)
  - Lower Legs (AP)
  - Feet (AP)
- Axial skeleton:
  - Thorax (AP and Lateral)
  - Pelvis (AP; including mid and lower lumbar spine)
  - Lumbar spine (lateral)
  - Cervical spine (lateral)
  - Skull (frontal and lateral)
Slide 16 - Skeletal Survey 2
Babygram

- Babygrams do not provide sufficient detail.

- Individual x-rays of ALL bones are needed to see subtle fractures often seen in child abuse.
Bone Scan - Nuclear Medicine

- Dye is injected and travels to the areas of bone where there is the most activity.
CT: Computed Tomography

- Images show slices of body parts.
- Quick (5 mins).
- No sedation.
- Good for identifying neurosurgical emergencies.
MRI: Magnetic Resonance Imaging

- Much greater detail / higher resolution.

- Long process (up to an hour or more).

- Requires sedation and sometimes general anesthesia.
Case 2 - I.Z.

- 8 month old white male:
  - Acute Subdural Hematoma 1 week prior to admission.
  - Fall 1 day prior to admission.
  - Irritable, vomiting, listless.
  - Temp 102° at home.
  - Anterior Fontanelle (soft spot) full, sticking out.
Case 2 - I.Z.

- Past Medical History:
  - Mom fell with baby in pothole in parking lot.
  - Witnessed by many people.
  - Immediate apnea, EMS dispatched/responded.
  - Remained hospitalized for a few days partly due to RSV (winter cold), OM (ear infection).
  - Birth Weight: 9 lbs. 7 oz.
  - Still exclusively nursing.

- Psychosocial History:
  - Intact family.
  - Father employed.
  - 3 siblings.
  - No regular daycare.
Case 2 - I.Z.

- Physical Examination
  - Temp 37°C (98.6°F).
  - Normal growth parameters.
  - Very irritable, vigorous cry.
  - Anterior Fontanelle (soft spot) noticeably full.
  - Otherwise normal neurological exam.
  - No bruising or other injuries.
  - Frenulum intact, no signs of injury.
Case 2 - I.Z. Right Eye Exam
Case 2 - I.Z. Left Eye Exam
Case 2 - I.Z. Labs

- White blood cells // 37.3.
  - Elevated, suggesting possible infection.
- Red blood cells (hemoglobin) // 8.6.
  - Low, suggesting possible anemia.
- Platelets // 135.
  - Normal.
- Cerebrospinal Fluid:
  - 4,375 red blood cells, 0 white blood cells (indicating bleeding over surface of brain).
  - Protein // 27, Glucose // 69 (both normal).
  - Elevated, indicating possible bleeding disorder.
- Skeletal Survey // Normal.
Case 2 - I.Z. Summary

• Background:
  ▪ Infant with brain bleeding on two occasions, elevated coagulation studies.
  ▪ Still exclusively nursing, no vitamin supplements.

• Presentation/Medical Evaluation:
  ▪ Acute subdural hematoma.
  ▪ Small unilateral retinal hemorrhage.
  ▪ Prolonged PT, PTT, increased INR.
  ▪ No fractures.
  ▪ No central nervous system infection.

• Diagnosis:
  ▪ Iron deficiency anemia.
  ▪ Vitamin K deficiency.
Case 2 - I.Z. Summary

- **Background:**
  - Infant with brain bleeding on two occasions, elevated coagulation studies.
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  - No central nervous system infection.
- **Diagnosis:**
  - Iron deficiency anemia.
  - Vitamin K deficiency.
Identifying Patterns of Injury - Bruises

- Bite marks
- Looped cords
- Simple falls/accidents
- Torn frenula
- Other implements
Identifying Patterns of Injury - Bruises

- Multiple parallel bruises from small of back down to knee.

- Likely accidental?

- Underlying medical condition?

- Pattern of injuries indicates otherwise.
Identifying Patterns of Injury - Bruises

- Torn frenulum.

- White area indicates healing injury.

- Indicator of blunt force trauma.
Identifying Patterns of Injury - Bruises

- Fingerprint marks.

- May be intentionally or accidentally inflicted.

- HISTORY is the key.
Identifying Patterns of Injury - Bruises

- Slap mark across face.
- Multiple parallel linear rows of bruising.
- Will sometimes cause bruising inside the child’s ear.
Slide 34 - Identifying Patterns of Injury - Bruises 6
- Multiple parallel rows of stippled scarring.

- Can you identify the cause?
  - Hairbrush.
Identifying Patterns of Injury - Bruises

- Bruises of various ages all over shins.

- Very common in toddlers learning how to walk.

- Typically occur below the knees and on forehead.
Identifying Patterns of Injury - Bruises

- Woke up from nap with marks on chest.
  - Red/flat.
  - No discomfort.
- Millipede fell from shirt after nap.
Identifying Patterns of Injury - Bruises

- Folk medicine practice: Coining.
  - SE Asian practice.
  - Hot coin is rubbed along spine/ribs causing small hemorrhages.
- Not painful or tender.
- Not considered a form of abuse, but as a recognized cultural practice.
Identifying Patterns of Injury - Bruises

- Folk medicine practice: Cupping.
  - Hot cup placed on skin creating suction
  - Results in circular areas of hemorrhage.
- Not considered a form of abuse, but as a recognized cultural practice.
Identifying Patterns of Injury - Bruises

- Mongolian Spots:
  - Birthmarks with slate/gray/blue appearance.
  - Can appear anywhere.
  - More common in dark skinned individuals.
- How to tell the difference?
  - Bruises will change color over time.
Identifying Patterns of Injury - Bruises

- Presented with possible skull fracture/scalp swelling.
  - Physician noted marks on bottom.

- Followup identified areas as bruises.
  - Emphasizes need for a FULL examination, and proper followup.
Identifying Patterns of Injury - Bruises

- You Don’t Bruise Until You Cruise!
  - Sometimes bruises caused by older siblings.

- MOST infants have older siblings, yet
  MOST infants don’t have bruises.
Identifying Patterns of Injury - Burns

- Does the pattern of injury make sense in relation to the injury you're seeing?
Identifying Patterns of Injury - Burns

- Pattered burn injury:
  - Multiple burns in concentric circles.
  - Caused by automobile cigarette lighter.
  - Unable to self-inflict due to the location of injuries.
Identifying Patterns of Injury - Burns

- Flow burn:
  - Hot liquid flows from top of head down chest, and spreads out as it flows.
  - As it flows downward, more streams appear, and it cools, causing less severe burns.

- Accident or inflicted?
  - Unable to tell just by looking.
  - History is the key.
Identifying Patterns of Injury - Burns

- Immersion burn:
  - Hands immersed in hot liquid.
  - Glove distribution.
  - No splash marks.
Identifying Patterns of Injury - Burns

- Immersion burn:
  - Stocking distribution.
  - Sock-like pattern.
  - Can be difficult to distinguish accidents vs. abuse or neglect.
Identifying Patterns of Injury - Burns

- Immersion burns.
Identifying Patterns of Injury - Burns

- Iron burn.
• Curling iron burn.
Identifying Patterns of Injury - Burns

- Folk medicine practice: Moxibustion.
  - Recognized cultural practice.
Rib fractures are some of the most common associated with inflicted injury in infants.
- Result from anterior/posterior (front to back) compression of the child’s chest.
Identifying Patterns of Injury - Fractures
Identifying Patterns of Injury - Fractures

Sudden jerk on extremity tears metaphyseal tips.
Identifying Patterns of Injury - Fractures

- Spiral fractures.

Twisting of extremity.
Other Causes of Fractures

- Accidents.
- Bone disease:
  - Osteogenesis Imperfecta.
  - Copper deficiency.
  - Genetic causes.
  - Severe nutritional deficiency, rickets, etc.
  - Chronic immobility.
- TBBD (Temporary Brittle Bone Disease):
  - No scientific data that this condition exists.
Prevalence of Abuse and OI

- Osteogenesis Imperfecta:
  - 1 in 50,000 live births have OI type IV.

- Child abuse:
  - 1 in 1,000 children have fractures from abuse.
### Fractures in Young Children

#### Concensus Ratings for Each Age Group

<table>
<thead>
<tr>
<th>Age, mo</th>
<th>n</th>
<th>Abuse</th>
<th>Unknown</th>
<th>Unintentional</th>
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</thead>
<tbody>
<tr>
<td>0-11</td>
<td>103</td>
<td>40 (39)</td>
<td>12 (12)</td>
<td>51 (50)</td>
</tr>
<tr>
<td>12-23</td>
<td>51</td>
<td>7 (14)</td>
<td>1 (2)</td>
<td>43 (84)</td>
</tr>
<tr>
<td>24-35</td>
<td>61</td>
<td>5 (8)</td>
<td>5 (8)</td>
<td>51 (84)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>215</strong></td>
<td><strong>52 (24)</strong></td>
<td><strong>18 (8)</strong></td>
<td><strong>145 (67)</strong></td>
</tr>
</tbody>
</table>

*Percentages are the total number in each age group

Slide 59 - Humeral Fractures in Children

Humeral Fractures in 124 Children < 3 Years

Number of patients with humeral fractures distributed by age and etiologic category.

Case 3 - K.A.

- 3 month old female.
- Fell off couch and injured arm.
- Physical Examination:
  - Well developed and nourished.
  - Alert, crying, consolable.
  - Not moving arm.
  - No bruises.
  - Frenulum intact.
Case 3 - K.A.

- Does the story make sense?
- What are the details of the fall?
- Is there any other injury?
Case 3 - K.A.

- Details of fall:
  - Started to roll off couch.
  - Babysitter grabbed her arm to stop her from falling.
  - Rolled over but never actually hit the floor.
  - No other injuries.

Makes Complete Sense!
Case 4 - S.H.

- 3 month old male.

- Brought to ER by mother:
  - Cough.
  - Upper Respiratory Infection (URI).

- Bumped head 1 week earlier:
  - Small bruise above eye.

- Full term, spontaneous vaginal delivery.
Case 4 - S.H.
Case 4 - S.H.

What is your differential diagnosis?

What do you want to do?
Case 4 - S.H. Head CT

Depressed Skull Fracture
Case 4 - S.H. Chest X-ray
Case 4 - S.H. Arm and Leg X-rays

- Previous fracture on femur.
- Arm fracture near wrist.
Case 4 - S.H. Bone Scan
Case 4 - S.H. Summary

- Bruise over eye.
- Multiple small scars.
- Torn frenulum.
- 17 fractures.
- No underlying medical condition.
Consider the Possibilities

You must consider the possibility of nonaccidental injury in order to identify it
History

- History leading up to hospitalization:
  - Last well, what happened?
- Past history:
  - Hospitalizations, surgeries, ER visits.
  - Old injuries, fractures, significant bruising.
- Family history:
  - Fractures, bone disease, bleeding, bruising.
  - Sibling injuries, deaths.
- Developmental history:
  - See, hear, roll, stand, walk, talk, etc.
- Psychosocial history:
  - Care providers.
  - Prior CPS involvement with family.
Differential Diagnosis

- Trauma:
  - Inflicted or accidental?

- Coagulopathy (bleeding disorder):
  - Primary or secondary?
  - Reaction to medication?

- Infection?

- Metabolic error?

- Bony dysplasia (bone disorder)?

- Birth trauma?

- Folk medicine practices?
Increased Likelihood of Abuse

- Consider factors that have been shown to increase the likelihood of abuse, such as:
  - Young age.
  - Lower socioeconomic status.
  - Developmental handicaps.
  - Prematurity.
  - Other associated injuries.
  - Implausible history or injuries inconsistent with story.
Medical Examination

- Anything but a clearly documented accident:
  - Complete unclothed physical examination.
  - Skeletal survey if child is less than 24 months old.
  - Bone scan if less than 12 months.
  - Head CT.
  - Ophthalmologic exam.
  - Coagulation studies.
  - Urine Genetic Screen.
Assessment/Impression

- Is the story reliable?
- All parties tell the same story.
- Story does not change with time.
- Can the child/other children confirm?
- Independent corroboration:
  - Medical records, phone contacts, etc.
- Is the history consistent with the injury?
  - Mechanism.
  - Severity.
  - Timing.
  - Multiplicity of injuries.
Medical Role

- Identify and report:
  - The earlier the report is made, the better.
  - Once report is made, additional information gathered by CPS and/or law enforcement will help support or refute concern of possible abuse or neglect.

- Support child and family.

- Medical evaluation is complete and the treatment is appropriate.

- Follow-up treatment.

- Communication, coordination.
CPS and Law Enforcement Involvement

- Legal mandate to report if suspicious.
- CPS/LE can investigate things health care provider cannot:
  - Previous CPS involvement.
  - Domestic violence.
  - Scene investigation.
- Can be very helpful in substantiating the unusual history, and corroborating the weird story.
- Protection of siblings, if abuse is indicated.
Likely to be Involved

• Physicians:
  • ER
  • Neurosurgeon
  • Trauma Surgeon
  • Pediatrician
  • Child Abuse Specialist
  • Radiologist
  • Ophthalmologist

• Nurses:
  • ER
  • Ward

• Social Workers
• Chaplain
• EMS personnel:
  • - Paramedics
  • - 911 calls
Slide 80 - What to Ask

What to Ask

- Preliminary vs. later information?
- Injuries present?
- Timing of injuries?
- Mechanism of injuries?
- Plausible explanations?
- Medical conditions?
- Scene investigation?
Be Prepared

- Know case.

- Know scene.

- Know people involved.

- Know records.

- Know what your questions are.
Scene Investigation/Other

* Witnesses - eye // phone:
  * Details of incident.
  * When child was last well.
  * Caretaking.

* Scene condition:
  * Cribs, tables, chairs, stairs, other obstacles.
  * Safe environment for child.

* Criminal/CPS history.
Evaluate Siblings

- Don’t forget to have siblings evaluated.
- When one child in a family is abused or neglected, the others are at increased risk.
Getting to Court

- Plenty of advance notice.
- Arrange time, notification.
- Arrange parking.
- Notify of schedule changes ASAP.
- Review what needs to be covered, what attorneys are likely to ask, and what you may need to ask.
Final Comments

If common everyday events and household accidents caused severe injury, the human race would have been extinct long ago.
Thank You

IUCPP Contact Information

Emergencies: Contact the IU Operator at (317) 944-5000 and ask for the child abuse pediatrician on-call.

Non-emergencies: Contact the IUCPP office at:
(317) 630-2617
(Monday-Friday 8am-4pm)

Fax: (317)630-2587

Email: iucpp@iupui.edu

Download contact information sheet

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