Health Effects and Medical Treatment of Lead Poisoning

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Objectives

• Discuss difficulties in making the diagnosis of lead toxicity in outpatient.
• Discuss interpretation of blood lead levels in setting of subsequent management.
• Discuss medical management and follow-up of children diagnosed with lead toxicity.

Case 1

• 14 month-old child is brought in for 1 year-old well child check
• Mother has no concerns
• Child looks good on exam
• Developing normally
• Eating an age-appropriate diet

• Has lead level checked

• One week later
  – Lead level = 37 µg/dL (capillary)
  – Follow-up venous lead level = 38 µg/dL

Lead Levels and Symptoms

Hand-to-Mouth Behavior
Developmental Monitoring

Lessons from Case 1

• Lead toxicity often presents with an apparently asymptomatic patient

• Rationale for lead screening as a secondary prevention strategy

• Most diagnoses will be made with no suggestive clinical symptoms

Case 2

• 2 year-old child is brought in to be seen for a well-child visit
• No concerns during visit
• As part of his exam, he has a blood lead level done by capillary stick

Case 2

• One week passes
• Friday, 12:00 PM
• Primary physician receives lab results which indicates a lead level of:

\[101 \, \mu g/dL\]

Child should be rechecked by his physician

Draw a venous sample IMMEDIATELY
Schedule for Venous Lead Testing

<table>
<thead>
<tr>
<th>Capillary BLL (µg/dL)</th>
<th>Interval for Venous Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9</td>
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</tr>
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Recheck until 2 consecutive levels are < 5 µg/dL

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Recheck until 2 consecutive levels are < 5 µg/dL

Case 2

- Child seen back immediately by his pediatrician in their office.
- Normal neurological exam
- Not fussy
- Good appetite

What else can be done?

CBC to Check for Anemia

Abdominal X-ray
So What Happened……

• Follow-up venous blood lead level was

1 µg/dL

The Likely Cause

Lessons From Case 2

• Need for confirmation venous blood sample for suspected lead toxicity
• Benefit of having child come in is also a chance to re-examine child
• Can also consider other tests
  – CBC
  – Abdominal x-ray

Case 3

• 12 month-old child is brought in for 1 year-old well child check
• No concerns during visit
• Has capillary lead level
• One week later….
  – Lead level = 42 µg/dL (capillary)

Interventions at this point?

Primary task → Find the source

Case 3

• Returns for venous lead level recheck
  – Should occur within one week by current recommendations
  – Confirmed venous lead level = 43 µg/dL
• Child still asymptomatic per mother
**Environmental Investigation/Education**

- Age and condition of housing (all sources)?
  - Housing built before 1978
  - Evidence of chewing on painted wood?
  - Renovations?
  - Peeling paint?
  - Where else does child spend their day?
- Recent immigrant?
- Other relatives or friends with high lead levels?
- Soil exposure?
- Hand-to-mouth activity or pica?
- Discuss dirt and dust exposure

**Dietary Investigation/Education**

- Adequate overall nutrition?
  - Adequate iron intake?
  - Adequate calcium intake?
  - Adequate Vitamin C intake?
- Supplementation above daily recommended amounts not shown to be beneficial
- No role for low-fat diet in lead poisoning
- Adequate resources (like WIC)

**Important Follow-up**

- Refer to the Health Department for required environmental investigation
- Refer children for developmental monitoring:
  - Age birth-36 months → CDSA
  - Age 3-5 years to the → CSC
- Social Services may need to be involved for housing and further assistance
- Test other children in family < 6 years-old

**Schedule for Follow-up Lead Testing**

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- Recheck until 2 consecutive levels are < 5 µg/dL
- May take months to go down to an acceptable level

**Other Testing**

- CBC
  - Looking for characteristic anemia
- Iron studies (if diet is suspect)
- Abdominal X-ray
  - IF indicated by history
    - PICA
    - Foreign Body Ingestion
    - Paint chips
  - Unexpected rise on follow-up lead levels
Would you chelate this child? 

No

Developmental Monitoring

Role of Chelation

Why not?

• What is the goal of treatment?

• Goal of any treatment of lead poisoning is to prevent or improve neurodevelopmental problems or deficits

• Does chelation do this???

Role of Chelation

Effect of Chelation Therapy on the Neuropsychological and Behavioral Development of Lead-Exposed Children After School Entry

Kao YN, Dutcher AM, Jarrard M, Yoon JO, Verbrugge L, Bader E,還有人的名字...


Caution with Chelation

Deaths Associated with Hypocalcemia from Chelation Therapy --- Texas, Pennsylvania, and Oregon, 2003--2005

Managing Elevated Blood Lead Levels Among Young Children: CDC March 2002 publication

Bottom Line

- Chelation of children with BLL’s between 20–44 µg/dL with succimer did not improve neurodevelopmental test scores even though blood lead levels were lowered

Case 3

- PRIMARY THERAPY → END EXPOSURE
  - Need thorough environmental investigation
  - Lead hazard reduction
- Neurodevelopmental monitoring
- Dietary and environmental education
- Monitor lead levels to assure decline

Lessons from Case 3

- Primary intervention → end exposure
- Environmental investigation vital
- Chelation has limitations as therapy
- Children require close developmental and neurologic follow-up with interventions in this regard as necessary
Case 4

- Reading through the day’s lab slips, you come across a follow-up venous blood lead level of a child you had seen in your office
- Capillary lead level had been 45 µg/dL
- Follow-up venous blood lead level is now →

52 µg/dL

Case 4

- Patient immediately brought to physician’s office for evaluation and treatment
- No complaints per mother
- Physical exam completely normal
- What else needs to be done?

Case 4

- Investigation (end the exposure)
- Same referrals and diagnostic studies
- Scheduled follow-up
- Does this child receive chelation?
  - YES

Chelation

- Recommended at levels of ≥ 45 µg/dL
- Should be done only with consultation with someone who has expertise in this area
- Should be done in a lead-safe environment (hospitalization considered)
- Example of one of most commonly used agents is succimer (oral)

Chelation

- Course will cause level to drop within 1 week of starting
- “Rebound” commonly within 7 weeks of ending course (≤ 75% of previous level)
- First follow-up level should be done within 7-21 days of completing course
Chelation

- Continued rise above “rebound” level is concerning and probably indicates continued exposure
- Must re-investigate environment

**CHELATION IS NO SUBSTITUTE FOR ENDING EXPOSURE TO LEAD**

Lessons from Case 4

- Chelation has a role in some cases
- Not substitute for education, history and thorough environmental investigation, and stopping exposure
- Only use chelation in consultation with physician or agency used to using these agents regularly

Case 5

- 12 month-old male comes in to his PCP’s office for a well-child check
- His mother is concerned because for the last 2 weeks he has been “fussy”
- He’s also had decreased appetite and his weight gain is slightly decreased from his usual growth curve
- Also has been constipated recently

Case 5

- On physical exam, child looks “tired”
- His temperature is 100.4°F and has a lot of nasal congestion (started yesterday)
- Rest of exam is normal
- Thought to have URI
- Received vaccines and fingerstick hemoglobin and lead level

Case 5

- Capillary lead level comes back a week later as 88 µg/dL
- PCP calls family and child returns
- Child has been very sleepy for past 3-4 days and has had poor oral intake
Case 5

- Physical exam
  - HR: 190; BP: 80/50; T: 98.6 °F
  - Lethargic
  - Pale
  - No other focal findings
  - Repeat venous lead level drawn

Venous blood lead level is: 90 µg/dL

Diagnosis?

LEAD ENCEPHALOPATHY

What needs to be done?

- Hospitalization
  - Venous BLL's > 70 µg/dL require inpatient observation and therapy
  - Abnormal neurologic exam at lower levels requires this be considered as well

- Chelation at this stage may be lifesaving and MUST be managed at a facility familiar with this therapy in this setting

Final Points

- Diagnosis of lead poisoning largely depends on lead blood screening
- Capillary levels done initially but all actions are based on venous confirmation
- Management and follow-up of lead poisoning initially depends on blood level obtained
- History and environmental investigation is key component of evaluation

Final Points

- Main therapy for lead intoxication is to end the exposure promptly
- The role of chelation in treating lead poisoning is limited and reserved for high lead levels (≥ 45 µg/dL)
- Abnormal neurological findings on physical exam as well as a venous blood lead level >70 µg/dL are especially concerning