LEAD POISONING IN PEDIATRICS

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INTRODUCTION

- LEAD POISONING IS USUALLY THE RESULT O F CHRONIC INGESTION BY CHILDREN OR OF OCCUPATIONAL EXPOSURE IN ADULTS
- PATIENTS WITH LEAD POISONING MAY COME TO THE ED WITH VARIED COMPLAINTS OF RECENT ONSET THAT OFTEN MIMIC DIVERSE ACUTE ILLNESSES.
- SEVERE LEAD ENCEPHALOPATHY IS NOW RARE
- THE RISK OF LEAD INTOXICATION STILL EXISTS, AND EMERGENCY PHYSICIANS AND PEDIATRICIANS IN EVERY COMMUNITY MUST MAINTAIN AN INDEX OF SUSPICION.

SOURCES OF LEAD

- LEAD BASED PAINT.
- BURNING OF BATTERY CASINGS FOR HEAT OR RECYCLING OF BATTERIES,
- WATER CARRIED BY OUTDATED LEAD PIPES
- HOME-GLAZED CERAMICS, LEAD CONTAMINATION OF IMPORTED SPICES OR COSMETICS, AND DUST OR DIRT CONTAMINATED BY VEHICLES WHICH ONCE USED LEADED GASOLINE

PATHOPHYSIOLOGY

- ABSORPTION OF LEAD OCCURS THROUGH **GI** AND **PULMONARY** ROUTES.
- LEAD IS THEN COMPARTMENTALIZED INTO THREE MAIN AREAS:
  - BONE
  - SOFT TISSUES
  - BLOOD
- CONCOMITANT NUTRITIONAL DEFICIENCY, ESPECIALLY LOW DIETARY IRON AND CALCIUM, MAY ENHANCE INTESTINAL LEAD ABSORPTION.
- LEAD EXERTS ITS TOXIC EFFECT BY INTERFERENCE WITH CALCIUM FUNCTION AT THE CELLULAR LEVEL/ ENZYME INHIBITION, PARTICULARLY ON ENZYMES RICH IN SULFHYDRYL GROUPS.
- IN HUMANS, THE MOST OBVIOUS EFFECTS ARE ON **NEUROLOGIC** FUNCTION AND ON THE **HEME SYNTHESIS** PATHWAY

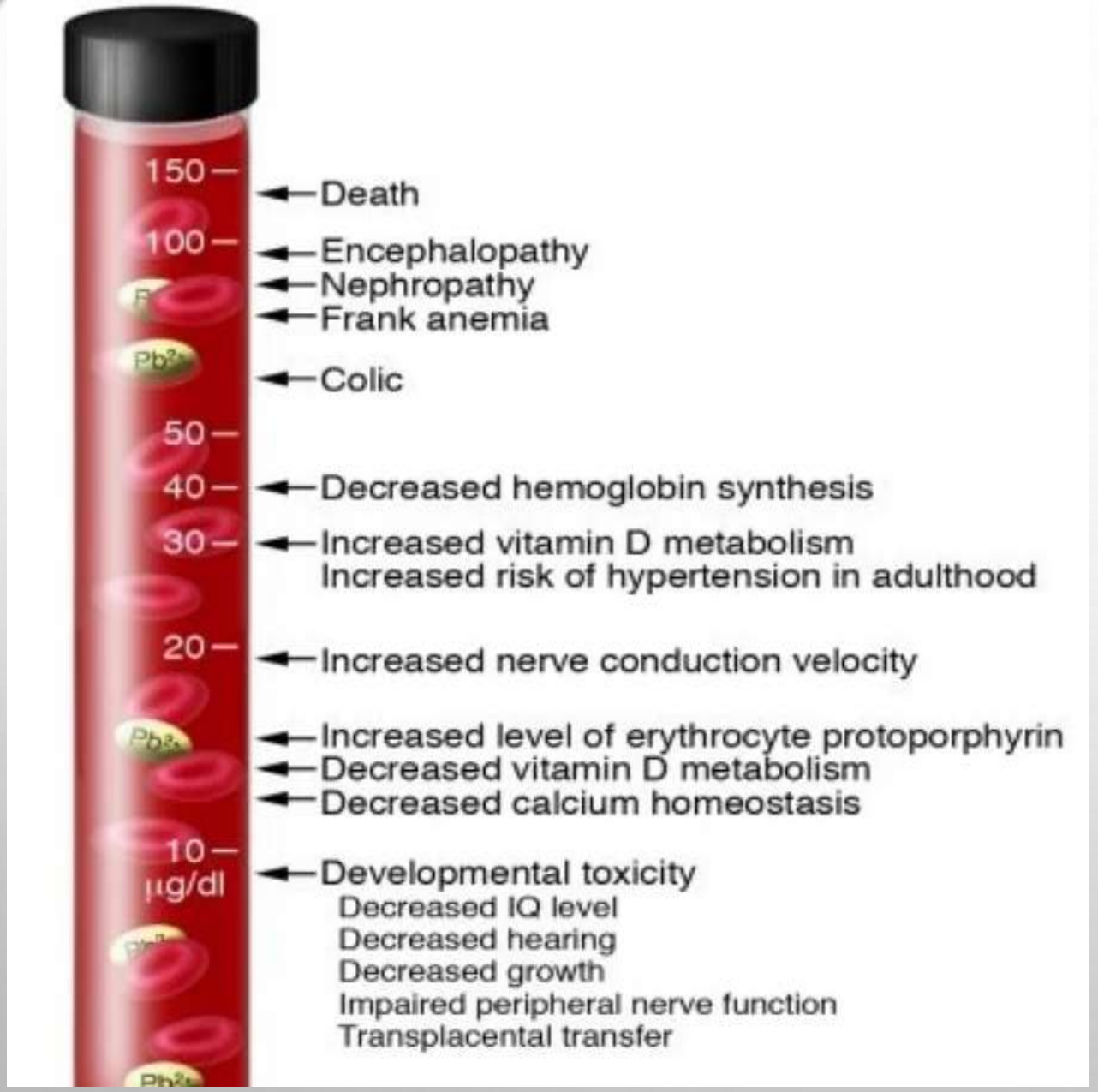
CLINICAL FINDINGS

Early signs and symptoms
BPb 25–60 g/dL

1. loss of appetite
2. vomiting
3. weight loss
4. constipation
5. anemia
6. Irritability
7. learning disabilities
8. behavior problems.

Acute or Late signs and symptoms
BPb > 80–120 ug/dL

1. Cranial nerve paralysis
2. Encephalopathy
3. seizures
4. coma


150
Death
100
Encephalopathy
Nephropathy
Frank anemia
Colic
50
40
Decreased hemoglobin synthesis
30
Increased vitamin D metabolism
Increased risk of hypertension in adulthood
20
Increased nerve conduction velocity
Increased level of erythrocyte protoporphyrin
Decreased vitamin D metabolism
Decreased calcium homeostasis
10
µg/dl
Developmental toxicity
Decreased IQ level
Decreased hearing
Decreased growth
Impaired peripheral nerve function
Transplacental transfer

MANAGEMENT

- REMOVE EXPOSURE
- THE ASYMPTOMATIC CHILD DISCOVERED TO HAVE A BLL (5-44), WARRANTS ENVIRONMENTAL INVESTIGATION /FOLLOW-UP.
- ALL SYMPTOMATIC CHILDREN AND THOSE WITH BLL >44 WARRANT URGENT TREATMENT

TREATMENT

Condition, BLL	Regimen
Encephalopathy	Dimercaprol 450 mg/m2/day + CaNa2EDTA 1 ,500 mg/m2/day
Symptomatic, and/or BLL > 70	Dimercaprol 300-450 mg/m2/day CaNa2EDTA 1 ,000-1 ,500 mg/m2/day
Asymptomatic, BLL 45-69	Succimer 700-1 ,050 mg/m2/day or CaNa2EDTA, 1 ,000 mg/m2/day

LITHIUM TOXICITY

INTRODUCTION

- FIRST-LINE MAINTENANCE TREATMENT FOR BIPOLAR DISORDER /REFRACTORY DEPRESSION.
- NARROW THERAPEUTIC WINDOW
- TOXICITY CAN BE A RESULT OF
  - INTENTIONAL INGESTION
  - DOSAGE ERROR
  - ALTERED METABOLISM SECONDARY TO COINGESTION OF OTHER MEDICATIONS
  - IMPAIRED KIDNEY FUNCTION AND/OR DEHYDRATION

MEDICATIONS THAT INCREASE PLASMA LITHIUM	
MECHANISM	MEDICATION
↓ GFR	NSAIDs, ACE inhibitors (Enalapril, Lisinopril)
↑ Renal Tubular Absorption	Thiazide diuretics (Chlorothiazide), Spironolactone
Unknown	Calcium channel blockers (Diltiazem, Nifedipine)

CLINICAL MANIFESTATIONS

- ACUTE / CHRONIC / ACUTE ON CHRONIC
- **MORTALITY FROM TOXICITY IS LOW AND MOST PATIENTS FULLY RECOVER AFTER MANAGEMENT.**
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CLINICAL MANIFESTATIONS	
Cardiac	Common: Flattened or inverted T waves in the precordial leads (not associated with ↓ LV function, ↑ cardiac markers)
	Other: Sick sinus syndrome, sinus bradycardia, Wandering atrial pacemaker, Brugada syndrome, heart block, ST-segment elevation, ↑ QT
	Rare: Serious arrhythmias, clinical effects
Central Nervous System	Mental Status: Lethargy, ataxia, confusion, agitation
	Neuromuscular Excitability: Irregular coarse tremors, fasciculations, myoclonic jerks, hyperreflexia, choreoathetoid movements, clonus
	Other: Seizures (rare, severe toxicity), dysarthria, nystagmus
	SILENT: Syndrome of Irreversible Lithium Extenuated Neurotoxicity: Permanent: 2 mo after stopping Lithium without another neurologic cause
GI	Nausea, vomiting, diarrhea, ileus
Renal	Tubulo-interstitial nephritis, nephrogenic diabetes insipidus
Acute: Primarily GI, minor EKG changes Chronic: Primarily Neurologic Acute on Chronic: Symptoms of both Acute and Chronic (GI and Neurologic)	

DIAGNOSTIC TESTING

- MONITOR SERUM ELECTROLYTES AND RENAL FUNCTION. CONSIDER COINGESTANTS.
- THE SERUM LITHIUM LEVEL DOES NOT CORRELATE WITH ACUTE TOXICITY DUE TO DELAYED CNS DISTRIBUTION. THE LITHIUM LEVEL IS BETTER CORRELATED WITH TOXICITY IN CHRONIC INGESTIONS.
- FOLLOW LITHIUM LEVELS SERIALLY UNTIL PEAK AND BEGINNING OF DESCENT.

SUMMARY: MANAGEMENT OF LITHIUM TOXICITY
Airway, Breathing, Circulation
Intravenous access, cardiac monitoring, EKG
Assess bedside glucose if altered mental status
Send Labs, Lithium level
Discontinue Lithium administration
GI Decontamination: Large, acute ingestion only (no role in chronic ingestion) 1. Lithium is a small molecule that does not readily bind to activated charcoal 2. Consider whole bowel irrigation or gastric lavage if acute ingestion Polyethylene glycol 500-2000 ml/hour PO or NG until rectal effluent is clear
Intravenous Hydration: To facilitate Lithium excretion (↑ GFR, ↓ resorption) Normal saline: 2x maintenance, Adult: 2-3 liters depending on cardiac function May require free water if hypernatremic: Nephrogenic DI + Normal Saline → ↑ Na
If nephrogenic diabetes insipidus, monitor serum Na every 4-6 hours
Seizures: Benzodiazepines are 1st line
Consider renal consult early for significant ingestion, potential need for hemodialysis

HEMODIALYSIS INDICATIONS
Lithium Level: > 5 mEq/L
Lithium Level: > 4 mEq/L with renal impairment (Creatinine > 2 mg/dl)
Lithium Level: > 2.5 mEq/L with: 1. Significant toxicity: Seizures, depressed mental status OR 2. Renal insufficiency or condition that decreases Lithium excretion OR 3. Factors precluding intravenous volume resuscitation (e.g. heart failure)

DISPOSITION

- PATIENTS WITH LITHIUM TOXICITY REQUIRE ADMISSION. THOSE WITH SIGNIFICANT TOXICITY TO AN ICU SETTING. PATIENT ARE GENERALLY DISCHARGED WHEN THEY ARE ASYMPTOMATIC WITH A LITHIUM LEVEL < 1.5 MEQ/L AND CLEARED BY PSYCHIATRY IF INDICATED .


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