

CHILDHOOD LEAD POISONING TREATMENT GUIDELINES GUIDELINE #4: INPATIENT CHELATION WITH CaNa²EDTA AND BAL

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CRITERIA FOR TREATMENT:

This protocol is appropriate for children with confirmed venous blood lead levels (VPb) > 70 ug/dL or > 45 ug/dL and acutely encephalopathic. Hospitalization should occur immediately and chelation should be initiated promptly, even in the absence of symptoms if VPB is > 70 ug/dL.

Check for symptoms: Careful history should be taken for any possible, signs or symptoms of acute lead toxicity. Symptoms of lead toxicity include the following:

GI: anorexia, constipation, abdominal pain, vomiting

CNS: irritability (may be subtle), lethargy, change in sleep or behavior patterns, headache, decreased play, ataxia, incoordination, vomiting

Severe involvement: Seizures, coma, hypertension, papilledema, cranial nerve paralysis

Children with signs/symptoms suggesting possible lead encephalopathy (usually seen with a VPb \geq 70 ug/dL) should be evaluated for **admission to the Pediatric Intensive Care Unit**. A lumbar puncture should NOT be performed in any child with possible lead encephalopathy.

Phone lab and pharmacy to assure adequate access to lab testing requirements and medications.

TOXICITY OF BAL (DIMERCAPROL):

BAL should not be used in children who are known to be allergic to peanuts or peanut products. BAL should not be used in children with G6PD deficiency, because of the potential to induce hemolysis. Between 30-50% of patients who receive BAL will experience side effects. Mild febrile reactions and transient elevations of hepatic transaminases may be observed. Other adverse affects include, in order of frequency: nausea and occasional vomiting, headache, mild conjunctivitis, lacrimation, rhinorrhea, and salivation.

ADVERSE EFFECTS OF CaNa²EDTA:

- 1) Renal: The major site of potential toxicity is the kidney. Tubular necrosis is dose related, generally reversible and manifested as hematuria and proteinuria. Assure adequate hydration (either PO, NG, or IV) keeping the urine specific gravity < 1.020 at all times.
- 2) Cardiovascular: Adverse effects that have been noted are hypotension and cardiac rhythm irregularities (bradycardia, AV block, ventricular dysrhythmias). ECG monitoring for arrhythmias during CaNa²EDTA infusion is necessary. **Consider cardiology consultation if a worrisome rhythm develops. Strongly consider PICU admission and/or telemetry during CaNa²EDTA infusion.**
- 3) Skin: Observe IV site carefully to avoid infiltration which may cause skin sloughing.

PRIOR TO TREATMENT: Children with a venous **lead level \geq 100 ug/dL**, even in the absence of encephalopathy, should be made NPO (usually for first 24 hours) and be fluid restricted to between 2/3 and full maintenance total IV fluids (including medications.)

Algorithms are not intended to replace providers' clinical judgement or to establish a single protocol. Some clinical Problems may not be adequately addressed in this guideline. As always, clinicians are urged to document management strategies.

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The Barbara Bush
Children's Hospital

At Maine Medical Center



PRIOR TO TREATMENT, Continued:

- 1) Before initiating chelation, obtain a **G6PD assay**, if the G6PD status is not known. There are documented reports of hemolysis being induced in patients who are G6PD deficient after 2-3 days of treatment with BAL. **Do not administer BAL to children with G6PD deficiency or allergy to peanuts.**
- 2) **Exposure history**, including occupational history of parents should be obtained and documented.
- 3) Obtain **BP, weight and height**. Calculate Body Surface Area.
- 4) **Withhold medicinal iron** during chelation treatment; there are potential toxic interactions.
- 5) **Laboratory**: see table below
- 6) **Radiologic Studies**:
Obtain an abdominal X-ray on any child with newly diagnosed lead poisoning or any child with known lead poisoning with a dramatic increase in lead level not consistent with a post-chelation rebound. X-ray evidence of lead in the intestinal tract, particularly the stomach and small intestine, indicates the need for gut decontamination. Lead has no appreciable absorption in the colon or rectum. In children with a venous lead level $> 70 \text{ ug/dL}$, treatment with BAL should be initiated immediately, *prior to the completion of gut decontamination*.
- 7) Refer all families for a **social work assessment** (for housing assistance)

TREATMENT:

- 1) If there is XRAY evidence of lead in the gastrointestinal tract, GI decontamination should be carried out. Polyethylene glycol solution (GoLytely) can be used for lead densities in the stomach and/or small intestine. Lead has no appreciable absorption in the colon or rectum. The dose of GoLytely is 20-40 ml/kg/hr up to a maximum of 1000 ml per hour via nasogastric tube for a minimum of 4 hours or until the patient has a bowel movement.
- 2) **Chelation is begun with BAL** at a dose of $75 \text{ mg/m}^2/\text{dose}$ every 6 hours by deep IM injection.
 - **For VPb $\geq 70 \text{ ug/dL}$ but $< 100 \text{ ug/dL}$** , BAL should be given for 24 hours (total 4 doses). Two hours after the fourth dose a VPb should be checked. If the VPb is $> 50 \text{ ug/dL}$, continue BAL for an additional 48 hours (total 12 doses).
 - **For acute encephalopathy and/or VPb $\geq 100 \text{ ug/dL}$** , BAL and CaNa^2EDTA should be co-administered for 5 days.
 - BAL crosses the blood-brain barrier, while CaNa^2EDTA only chelates from extracellular spaces without crossing the blood-brain barrier. The use of CaNa^2EDTA alone in children with lead levels $\geq 70 \text{ ug/dL}$ may precipitate encephalopathy.
- 3) **Four hours after the first dose of BAL begin CaNa^2EDTA .**
 - For children with encephalopathy, CaNa^2EDTA should be given intramuscularly at a dose of $1000 \text{ mg/m}^2/\text{day}$ divided every 6 hours for 5 days to minimize fluid intake. It should be mixed with procaine to decrease the injection site pain.
 - If urine output is adequate CaNa^2EDTA is given at a dose of $1000 \text{ mg/m}^2/\text{day}$ by continuous intravenous infusion to continue for 5 days.

TREATMENT, continued:**4) Dosing of CaNa²EDTA**

- For IV infusion, the total daily dose of 1000 mg/m²/day is diluted in 250-500 ml of either 5% dextrose or 0.9% saline solution.
- The infusion must be diluted to a concentration of < 0.5% (5 mg/ml) in either 5% dextrose and water or in 0.9% saline solution. It is incompatible with any 10% dextrose solution, lactate Ringers, and Ringers solutions. Each 5ml ampule contains 1000 mg CaNa²EDTA in water (equivalent to 200 mg/ml). One ampule diluted in 250 ml of either 5% dextrose or 0.9% saline solution will give a concentration of < 0.4%.
- The rate of infusion should be calculated to deliver the total dose over 24 hours. Because 250 ml and 500 ml IV fluid bags have a range of 20-50 ml overflow, the rate of volume administration must be adjusted such that 250 ml or 500 ml be administered over 20 hours; the residual should be administered over the remaining 4 hours.
- FOR CaNa²EDTA DILUTED IN 250 ML OF VOLUME, the rate should be set at 13 cc/hr for 20 hours. Any residual volume can be delivered over the remaining 4 hours.
- FOR CaNa²EDTA DILUTED IN 500 ML OF VOLUME, the rate should be set at 25 cc/hr for 20 hours. Any residual volume can be delivered over the remaining 4 hours.

5) Monitoring:

- If VPb \geq 100 μ g/dL or child is symptomatic, perform neuro checks and monitor for seizure activity for at least 24 hours.
- ECG monitoring for arrhythmias during CaNa²EDTA infusion is necessary. It can be interrupted for brief periods of play when the daily infusion has completed.
- Check BP with vital signs every 4 hours.
- Check urine dip stick on all specimens during chelation therapy for specific gravity, leukocyte esterase, hemoglobin, and protein

6) Laboratory Testing – see table for recommended schedule

- The occurrence of symptoms or lab abnormalities during, or prior to, chelation indicates the need for more frequent lab surveillance.

| DAY 1 BASELINE | DAY 3 | DAY 5 | DAILY |
|--|---|---|---|
| VPb (Venous Lead Level) G6PD Level | VPb (unless already repeated on DAY 2); obtain at least 2 hrs after infusion | VPb (obtain at least 2 hrs after infusion is completed) | Urine dip and specific gravity each shift |
| CMP | CMP | CMP | Urinalysis if urine dip is positive for blood, protein, or LE |
| CBC with differential ZPP (Zinc Protoporphyrin) Iron, Ferritin, TIBC | ZPP CBC | ZPP | If VPb \geq 100 μ g/dL or child is symptomatic obtain CMP |

VPb: 1 ml in lavender micro

G6PD Level: 2 ml in ACD, solution B - yellow

ZPP: 0.2 ml in lavender micro

CMP: 0.6 ml in mint green micro

CBC: 0.5 ml in lavender micro

Iron, Ferritin, TIBC: 3 ml in gold

CRITERIA FOR DISCHARGE

- 1) The blood lead level at the time of discharge will be evaluated to determine the need for reinstatement of chelation therapy. If further chelation is necessary, a minimum of 2 days must elapse before restarting therapy. If the VPb is 50-69 ug/dL, a second course of CaNa²EDTA will be necessary. If the VPb is \geq 70 ug/dL, therapy should begin again per protocol.
- 2) The patient must be able to reside in a lead safe home. The lead status of the home will be determined by a state contracted Lead Inspector at no cost to the family; contact MaryAnn Amrich, Program Manager Maine Childhood Lead Poisoning Prevention Program at (207) 287-4311.
- 3) The parent or caregiver must be able to attend follow-up appointments and laboratory testing.

FOLLOW UP:

- 1) The first follow-up visit should be one-week after chelation has been completed and then again at two weeks. Follow up should continue at monthly intervals until the VPb is < 15 ug/dL, then every two to three months.
- 2) The following labs should be obtained at each follow up visit
VPb: 1 ml in lavender micro
ZPP: 0.2 ml in lavender micro

Rechelation is indicated if at any time after the 2 week follow up visit the VPb is > 45 ug/dL, or > 40 ug/dL in the face of a large lead burden (Elevated ZPP). Many children will require more than one round of chelation therapy.
- 3) Continue monitoring until VPb is < 15 ug/dl on two occasions three months apart.
- 4) All children with significant lead exposure, and especially those who have undergone chelation, require a neurodevelopmental assessment. This should be obtained within 2 months of completion of the original course of chelation, and then yearly until the age of 6.

Important Contact Numbers

State Lab (for lead testing results): (207) 287-2727
Maine Childhood Lead Poisoning Prevention Program: (207) 287-4311
Maine Medical Center Inpatient Pharmacy: (207) 662-2131
Maine Medical Center Lab: (207) 662-2711