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

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.

1) **Check for symptoms: A careful history should be taken for any possible signs or symptoms of acute toxicity. Symptoms of lead poisoning 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**

2) **Children with signs/symptoms suggesting possible lead encephalopathy (usually seen with a VPb ≥ 70 *u*g/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.**

3) **Phone inpatient 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 for hemolysis. Between 30-50% of patients who receive BAL will experience side effects. Mild febrile reactions and transient elevations of serum transaminases (ALT, AST) are most common. Other adverse effects include, in order of frequency: nausea and occasional vomiting, headache, mild conjunctivitis, lacrimation, rhinorrhea, and salivation.

ADVERSE EFFECTS OF CaNa²EDTA:

1) **Renal: The most common toxicity is kidney dysfunction. Tubular necrosis is dose related, generally reversible, and manifested as hematuria and proteinuria. Assure adequate hydration (either PO, NG, or IV) to keep the urine specific gravity < 1.020 at all times.**

2) **Cardiovascular: Adverse effects include 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 monitor for infiltration, which may cause skin sloughing.**

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.

Last revised March 2020, by Dr. Jennifer A. Jewell

The Barbara Bush Children's Hospital
At Maine Medical Center

PRIOR TO TREATMENT:

1) **Children with a venous lead level ≥ 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.)**

2) **Before initiating chelation, obtain a G6PD assay, if the G6PD status is not known. There are documented reports of hemolysis in patients who are G6PD deficient after 2-3 days of treatment with BAL. Do not administer BAL to children with G6PD deficiency or with an allergy to peanuts.**

3) **Exposure history, including occupational history of parents, should be obtained and documented.**

4) **Obtain BP, urine dip and specific gravity. Confirm height and weight. Calculate Body Surface Area (for dosing).**

5) **Iron must be stopped during this time of chelation therapy.**

6) **Laboratory: see table below**

7) **Radiologic Studies:**
Obtain an abdominal x-ray on any child with newly diagnosed lead poisoning or any child with known lead poisoning with an increase in lead level not consistent with a post-chelation rebound. X-ray evidence of lead in the gastrointestinal tract, particularly in 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 *ug*/dL, treatment with BAL should be initiated immediately, *prior to the completion of gut decontamination*.

7) **All families should be referred for a social work assessment (for housing assistance)**

TREATMENT:

1) **If there is x-ray 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 and/or until the patient has a bowel movement.**

2) **Chelation is begun with BAL at a dose of 75 mg/m²/dose every 6 hours by deep IM injection.**
   - **For VPb ≥70 ug/dL but <100 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 *u*g/dL, continue BAL for an additional 48 hours (total 12 doses).**
   - **For acute encephalopathy and/or VPb ≥ 100 ug/dL, BAL and CaNa²EDTA should be co-administered for 5 days, beginning the CaNa²EDTA four hours after the first BAL injection.**
   - **BAL crosses the blood-brain barrier, while CaNa²EDTA only chelates from extracellular spaces without crossing the blood-brain barrier. The use of CaNa²EDTA alone in children with lead levels ≥ 70 *u*g/dL may precipitate encephalopathy.**

3) **Four hours after the first dose of BAL begin intramuscular or intravenous CaNa²EDTA.**
   - **For children with encephalopathy, CaNa²EDTA should be given intramuscularly at a dose of 1000 mg/m²/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, CaNa²EDTA is given at a dose of 1000 mg/m²/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; it must be diluted in 250-500 ml of either 5% dextrose and water or in 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. <u>It is incompatible with any 10% dextrose solution, lactate Ringers, and other Ringers solutions.</u> Each 5 ml 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.**
- **<u>FOR CaNa²EDTA DILUTED IN 250 ML OF VOLUME</u>, the rate should be set at 13 cc/hr for 20 hours. Any residual volume can be delivered over the remaining 4 hours.**
- **<u>FOR CaNa²EDTA DILUTED IN 500 ML OF VOLUME</u>, 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 <u>≥</u> 100 *u*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 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
CBC with differential ZPP (Zinc Protoporphyrin) Iron, Ferritin, TIBC	ZPP CBC	ZPP	Urinalysis, if urine dip is positive for blood, protein, or LE
CMP	CMP	CMP	If VPb ≥ 100 *u*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 studies - 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 reinstitution 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 $CaNa^2EDTA$ will be necessary. If the VPb is ≥ 70 ug/dL, therapy should begin again per protocol, including BAL and $CaNa^2EDTA$.**

2) **The child must be discharged to a lead safe environment. The lead status of the home will be determined for Maine patients by the Maine Childhood Lead Poisoning Prevention Program (MCLPPP), (207) 287-4311 or for New Hampshire patients by the Healthy Homes and Lead Poisonong Prevention Program (HHLPPP), (603) 271-4507 and (800) 897-5323.**

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 after chelation has been completed. 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 2 weeks, 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 initial 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) 662-2151
Maine Medical Center Lab: (207) 662-2711

New Hampshire Healthy Homes and Lead Poisoning Prevention Program: (603) 271-4507 and (800) 897-2523