

## Overview of Health Effects of Lead Stevan Cordas DO MPH

### *Introduction*

Lead poisoning is still a factor to be dealt with as we approach the millenium. Children are especially susceptible to the effects of lead due to their developing nervous system.

It is estimated that over 3 million children may be at risk and the new blood limit has been lowered in recent years to 10 micrograms/dl. If a child with lead problems is not found and treated within 15 months, the result is felt to be irreversible. 50% of black children entering the first grade exceed the federal blood allowance. One source of lead is Pica. Pica or abnormal ingestion of dirt is not uncommon in children. Children can consume 100 milligrams of dust/day.

### *Pathology*

Lead's effects, like mercury, are due to binding of lead with sulfhydryl groups on proteins. Especially if these involve zinc dependent enzyme systems. Primarily the brain, peripheral nervous system, bone marrow, liver and kidney are involved. Anemia results from several enzymes in heme synthesis being interfered with. (aminolevulinic acid) Also pyrimidine 5-nucleotidase involved with the breakdown of RNA, is interfered with. This results in stippling in the red cell. 1,25-dihydroxyvitamin D production is blocked. Tubular renal function is altered and neurons and Schwann cells are affected. Inhibition of Ferrochelatase results in an increase in uroporphyrin in the urine and increase in protoporphyrin in the blood. RBC protoporphyrin levels in the adult will rise when the blood level is around 25-30 micrograms/dl. Neurotransmitters are affected directly by lead.

### *Pharmacodynamics*

Lead is absorbed only 10%-20% in the adult but up to 50 % in the child. Calcium and zinc appear to block absorption. Iron enhances it. Some lead salts ,however are completely absorbed. These include the oxides (red lead), the naphtholate, and acetate. Metallic lead in tissue is poorly absorbed. If near a joint however, the contact with joint fluid may allow lead toxicity. Organic lead but not the inorganic form can be absorbed through the intact skin. After absorption in the bloodstream almost all of the lead is found in the RBC. With prolonged exposure almost all of it ends up in the bone. Lead appears to be substituted for calcium in the bone matrix. Lead crosses the blood-brain barrier and concentrates in the grey matter. It also crosses the placental barrier and may concentrate in the fetus. Lead has a terminal half life of thirty years. In workers with elevated blood levels, 50% reached 40 micrograms/dl in 180 days and 75% in 460 days,. Sources are paint, putty folk remedies, contaminated clothing. dirt and air contamination. Lead pipe or solder, glazed pots, bullets, Indoor firing ranges and industrial sources with lead smelters, battery reclamation lead paint with welding or using an acetylene torch.

### *Clinical Poisoning*

Inorganic acute poisoning: Rare, as we usually see chronic poisoning with acute manifestations. Suicidal attempts with lead salts are the exception. In the toddler first they loose their appetite. Then they refuse to play and get irritable. They loose their recently gained skills. Ataxia, vomiting and periods of lethargy or even stupor occur. This can lead to coma and death. In adults lead lines are rarely seen. Severe anemia is rare and basophilic stippling is rarely seen. In the preschooler and older child or adult the picture is different with abdominal cramps, constipation, fatigue, irritability, anemia with basophilic stippling resembling iron

deficiency with mild hemolysis can occur later. Hypertension. Peripheral axonal motor neuropathy with wrist drop may or may not occur. Nerve conduction time is a useful measurement. Gout, joint pain and a metallic taste and vomiting may occur. Fanconi's syndrome can develop with proximal tubular cell accumulation. With very high respiratory exposure, such as using oxyacetylene to cut lead coated steel or with exposure to tetraethyl lead fumes in workers acute encephalopathy with cerebral edema and a blood level in the range of 150 micrograms/dl. followed by kidney failure can occur. This is rare and most cases occur more gradually. Usually a subacute encephalopathy occurs. Headaches and lassitude are common early symptoms. Sleep disturbance with early morning awakening, irritability, and loss of libido then occur. Workers that were apparently asymptomatic with blood levels of 40-60 micrograms/dl had abnormal neurobehavioral tests. Needleman and his colleagues have shown an even more serious effect on the small child with a developing nervous system. Children with a high lead absorption had a marked deficit in school performance. About one out of 10 "hyperactive kids" is lead poisoned. Abstract learning Even in utero lead accumulation can impair cognitive performance. A direct effect on spermatogenesis is found and higher spontaneous abortion rate can be seen with higher lead levels.

***Management:***

in children look for pica and houses with lead paint. Look for basophilic stippling, and epiphyseal lead-line on long bone x-rays. Confirm with a blood lead and erythrocyte protoporphyrin. With blood levels over 70 hospitalize and start on BAL 4-5 mg/kg IM every 4 hours. Hydrate then give EDTA 1500 mg/m<sup>2</sup>/24 hours. This is continued for 5 days. assuming encephalopathy. A second course may be needed if rebound occurs 2 days after the combined therapy.

BAL not needed at lower blood levels and EDTA is given 1000 mg/m<sup>2</sup>/24 IM or IV for 5 days. BAL is excreted in bile and can be used with renal compromise. D Penicillamine removes lead Adults take it for 10 days at 250 mg 4 times a day. DMSA or Chemet is now available at 100 mg size. Above 45 micrograms it is approved in children. 10 mg/kg every 8 hours for 5 days then every 12 hours for 14 more days. Then rest for 2 weeks and reevaluate. DMSA will probably be the drug of choice and is a water based analog of BAL. DMSA is more effective than EDTA. Remove child or adult from environment

With encephalopathy start with BAL 5 mg/kg every 4 hours Hydrate the EDTA 2 GMS/day for 5 days. DMSA will probably be the drug of choice in adults at a later time.

**Exposure limits**

Air EPA limits 1.5 micrograms/m<sup>3</sup> as an mean averaged over a calendar quarter. OSHA PEL is 50 micro/m<sup>3</sup> TWA 8 hours. EPA wants a 5 microgram/dl limit in drinking water.

In adults over 40 Micrograms/dl and in kids 10-15 micrograms requires evaluation and possible therapy.

Compiled by Stevan Cordas DO MPH revised 10/99