Lead in Blood

Introduction

Lead is used in storage batteries, ammunition and type metal, cable sheaths, solder, previously used in anti-knock compounds in petrol and the plastics industry. It is also present in many metals such as brass (1-3.5%). Lead can also be a problem in the home, particularly from sanding old lead based paints and making diving and fishing weights, and in artists’ studios and potteries. Indoor small bore rifle shooters are also at risk from lead poisoning.

Acute lead poisoning in adults is commonly characterized by abdominal pain, tiredness, aching limbs and joints, and irritability. Nerve palsy and wrist drop have also been mentioned but are very rare. In children and animals lead poisoning is accompanied by CNS signs such as convulsions, irritability, vomiting and anaemia. High lead intake can also be asymptomatic as in a lot of occupational exposure where increased lead intake is seen only by blood lead level measurement. Chronic cases present in neurological wards with polyneuritis and renal impairment.

Sample requirements

Note: Blood lead levels reported in µmol/L of whole blood (rather than red cell lead levels) are now used for assessment of blood lead status.

A 6 mL blood sample is collected in a K2 EDTA trace metal blood tube. Collection tubes and needles can be supplied by the laboratory.
**Interpretation**

Population reference range (last updated 24 August 1995)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Red cell lead (µmol/L)</th>
<th>Whole blood lead (µmol/L)</th>
<th>PCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>adult</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.0-1.10</td>
<td>0.0-0.50</td>
<td>0.40-0.55</td>
</tr>
<tr>
<td>female</td>
<td>0.0-0.90</td>
<td>0.0-0.35</td>
<td>0.38-0.45</td>
</tr>
<tr>
<td>child</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-16 yrs</td>
<td>0.0-1.40</td>
<td>0.0-0.55</td>
<td>0.35-0.40</td>
</tr>
<tr>
<td>9 mths - 4 yrs</td>
<td>0.0-1.50</td>
<td>0.0-0.55</td>
<td>0.33-0.37</td>
</tr>
<tr>
<td>&lt; 9 mths</td>
<td>0.0-1.30</td>
<td>0.0-0.50</td>
<td>0.30-0.35</td>
</tr>
<tr>
<td>dog</td>
<td>0.0-0.90</td>
<td>0.0-0.45</td>
<td>0.40-0.56</td>
</tr>
<tr>
<td>cat</td>
<td>0.0-1.10</td>
<td>0.0-0.45</td>
<td>0.32-0.44</td>
</tr>
</tbody>
</table>

**Non occupational exposure**

A whole blood lead of > 0.48 µmol/L (10 µg/ml) is a notifiable disease to the Medical Officer of Health.

Results greater than 0.48 µmol/L are abnormal; they are indicative of increased lead absorption and should initiate environmental measures to minimise the level of exposure. Between 1.0 and 1.9 µmol/L some children will require chelation therapy and a paediatric consultation is recommended. Above 1.9 µmol/L most children will require chelation and referral to a paediatrician is highly desirable. Levels above 3.0 µmol/L generally require URGENT medical treatment to reduce the risk of lead encephalopathy.

**Occupational exposure**

It is desirable for all lead workers to minimize their exposure to lead and maintain a whole blood lead level less than 1.5 µmol/L. It is the responsibility of the employer to ensure regular monitoring of blood lead levels and to report all blood lead levels above 2.6 µmol/L to the Occupational Safety And Health (OSH) Service of the Department of Labour. At this ‘action’ level the work environment and work practises should be investigated. After a
single blood lead result of 3.2 µmol/L or greater (‘suspension’ level) or three consecutive blood lead levels above 2.6 µmol/L the worker should be removed from further exposure.

*Note: For further information please see next section.*
1. Biological Monitoring of Lead Workers

The aim of blood lead monitoring of workers exposed to lead is to maintain a blood lead level below 1.5 µmol/L of whole blood. A pre employment screen is recommended to exclude sources of lead other than occupational exposure; these may include home renovations, small bore rifle shooting, casting lead sinkers, home mechanics etc.

New employees in 'at risk' occupations should be monitored monthly until the blood lead level is stabilised. After that monitoring at regular intervals is recommended;

- < 1.5 µmol/L whole blood lead: repeat 12 monthly
- 1.5 - 2.0 µmol/L whole blood lead: repeat 6 monthly
- 2.1 - 2.5 µmol/L whole blood lead: repeat 3 monthly
- ≥ 2.5 µmol/L whole blood lead: repeat monthly

Blood lead results of 2.6 µmol/L whole blood or above should be notified to the OSH Service.

Female workers

It is considered unwise for females who could become pregnant to work with lead due to the harmful effects of lead on a foetus. However, if a female works in a job where excessive exposure is possible, a whole blood lead less than 1.5 µmol/L should be maintained. A lead level equal to or less than 0.5 µmol/L of whole blood is considered 'safe' for a developing foetus.

Occupations at risk of lead exposure

High risk:
Majority of workers with whole blood lead > 1.5 µmol/L

- Radiator repair
- Muffler repair
- Foundry (general)
- Engine reconditioning shooting
- Smelting
- Scrap metal
- Container repair
- Small bore rifle
Paint removal (with lead based paints)  Lead battery manufacture

**Medium risk:**

Majority of workers with whole blood lead $> 0.9 < 1.5 \, \mu\text{mol/L}$

- Panel beating
- Metal machining
- Printing
- Gas cutting/welding
- Spray painting
- Metal polishing
- Metal extrusion
- Garage mechanic
- Pottery/ceramics
- Lead casting
- Plastic production

**Low risk:**

Majority of workers with whole blood lead $< 0.9 \, \mu\text{mol/L}$

- Plumbing
- Cable jointing
- Car assembly
- Electroplating
- Boat building
- Bright soldering
- Petrol pump attendant
- Exhaust fume exposure

**Sources of lead for different occupational groups**

**Radiator repair:**

Solder (60% lead, 40% tin) is used. After repair the excess solder is buffed off using a grinder type wheel, creating dust. In addition radiators were formerly painted with lead based paint but this practice has been discontinued.

**Smelting:**

High heat generated in the furnace leads to fumes. Lead (2-3%) is added to brass (copper/zinc alloy) and some bronzes (copper/tin alloy) e.g. gunmetal, as it gives the metal a lubrication quality and prevents machinery seizure. Phosphor bronze and aluminium bronze have minimal lead content.

**Muffler repair:**

Exhaust systems may have deposits of lead oxide from lead petrol. This creates fine dust and lead fumes during welding.
Scrap metal:
This includes burning off the covering of old cables, cutting lead enamelled baths, handling old lead batteries and smelting down lead using crude furnaces.

Metal moulding:
The high temperatures used produce fumes from lead and lead containing alloys.

Container repair:
Welding, brushing and sandblasting of lead paint in the confined spaces of containers produces dusts and fumes.

Engine reconditioning:
This involves engines and oils that may be contaminated with lead deposits from leaded petrol.

Panel beating:
Workers are exposed to lead dust and fumes from sanding and welding car bodies containing lead. Lead is still used by some panel beaters to repair surface defects.

Metal machining:
Dust is created by the cutting and spinning of metal alloys containing lead.

Metal polishing:
Fine dust is created when buffing lead based alloys.

Printing:
Old printing equipment used lead based letters for printing.

Welding/gas cutting:
This involves cutting metals coated with lead based paints or bath enamel.

Spray painting:
Exposure occurs during the preparation of surfaces previously coated with lead based paints.

Lead battery manufacture:
Used lead batteries are recycled by smelting down and making lead ingots. Manufacture of new lead batteries involves making the
lead plates, pasting them with a lead oxide paste and assembling the battery.

**Plastic production:**
PVC contains tri basic lead sulphate as a scavenger of acids produced in the degradation of PVC and improves thermal stability. Workers are exposed in the debagging room, where the dampened powder is opened and mixed with high speed mixers and a free flowing powder is formed which contains approximately 2% lead. A fine dust can escape from the mixers.

**Leadlighting:**
Soldering temperatures are generally not high enough for the fumes to be hazardous. However, lead dust is created when sanding and buffing the lead solder seams.

**Metal extruding:**
See metal moulding.

**Garage mechanic:**
See engine reconditioning.

**Pottery/ceramics:**
Lead based glazes are used.

**Plumbing:**
Plumbers sometimes use red lead putty as a sealant, as well as soldered joints and lead flashings.

**Cable jointing:**
Lead is used to mould around joins in cables, which is generally carried out in confined spaces. This practice is gradually being phased out in favour of plastics.

**Electroplating:**
Lead soldered seams are buffed up and polished prior to chrome plating.

**Bright solder/electronics:**
These use lead solder. Jewellers mostly use silver solder (bright solder).

**Paint removal/painting and decorating:**
Exposure occurs during removal of lead based paints, eg by sanding.
Exhaust exposure/petrol pump operation:
Leaded petrol exhaust fumes affect car park attendants and WOF workers.

Smallbore rifle shooting:
Lead fumes arise from both the bullet and the primer. There is additional lead in the dust when cleaning the shooting range.