Lead Toxicity and Flint, Michigan

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Lead Toxicity and Flint, Michigan

Adam Bishop, Marvel Davis, Patricia Flatt

Abstract

In light of the recent events in Flint, Michigan this poster will review lead toxicity and its long term effects. We will be covering the multitude of sources of lead poisoning, the mechanisms by which lead does its damage, detection methods, treatment options, and limitations thereon. The issues in Flint have highlighted the flaws in current acceptable detection procedures as well as brought to light the dangers of lead. Public concerns about clean drinking water have brought these issues to the forefront.

Methods and Mechanisms

Lead has the capability of passing the blood-brain barrier, causing damage. Intracellularly, lead replaces calcium as a second messenger, binding more readily than calcium, altering the protein's conformation. Intracellular concentrations of Ca^{2+} increase in two ways: opening the calcium channels in the cell membrane or release of stored calcium. Lead has a high binding affinity even at low levels, often higher than calcium itself.

Sources of Lead Exposure

• Folk remedies and supplemental treatments
• Ceramics
• Lead pipes/water
• Antiques
• Lead paint
• Soil
• Occupation
• Chew toys
• Some Mexican candies
• Lead crystal
• Koch: A Traditional Cosmetic Source

Testing and Acceptable Limits

Acceptable Limits
• Water: 15 ppm of water must exceed 15 ppm.[3]
• Blood: 5 µg/dL for Adults
• Soil: 400 ppm in play areas

Testing
• Venous blood lead (VLL) testing is the recommended diagnostic tool to identify potentially lead-exposed individuals.
• Hand-held X-ray Fluorimeters can be used to detect lead in paint on walls.
• X-ray Fluorimeters can be used to detect lead in soil.

Cities Affected

Sebring, Ohio (2016)
Travis County, Texas (2016)
New Jersey (2016)
Atlantic City, New Jersey
Somerset County
East Orange
Elizabeth
Inphin
Jersey City
New Brunswick
Newark
Passaic
Paterson
Plainfield
Salt Lake County
Trenton
Flint, Michigan (2016)
Jackson, Mississippi (2016)
North Carolina (2016)
Ottumwa
Greenville

Testing

Symptoms and Toxicity

Symptoms
• Children:
  • Developmental delay
  • Learning difficulties
  • Irritability
  • Loss of appetite
  • Weight loss
  • Staggering and fatigue
  • Abdominal pain
  • Vomiting
  • Constipation
  • Hearing loss

• Newborns:
Exposure before birth:
  • Learning difficulties
  • Slowed growth

Adults
• High blood pressure
• Abdominal pain
• Constipation
• Joint pains
• Muscle pain
• Decline in mental functioning
• Pain, numbness or tingling of the extremities
• Headache
• Memory loss
• Mood disorder
• Red blood cells count, abnormal sperm
• Miscarriage or premature birth in pregnant women

Toxicity

By the time signs and symptoms appear people are typically already at toxic levels.

Children:
• 1.86 µg/dL – greater peripheral resistance response to stress
• 300 – 499 µg/dL – Anemia
• 500 – 599 µg/dL – Lethargy
• > 600 µg/dL – Decreased Vitamin D levels

Adults:
• > 10 µg increased risk of high blood pressure

Flint, Michigan

The Flint water crisis began in April of 2014 when local officials in the area switched the city’s water source temporarily as a cost-cutting move. The water source was switched from Lake Huron to the Flint River until the city could implement a new pipeline to Lake Huron. According to city officials the water piped from the river was to be treated at the local city water treatment plant, although the water did not receive the necessary treatment to make it safe for consumption. For almost two years raw toxic was unknowingly exposed to high levels of lead in their drinking water. In a recent study done by the local pediatrician, the percentage of children tested and found to have elevated lead blood levels above 5 µg/dl in Flint had doubled from 2.4 to 4.9%. Recently the crisis in Flint, Michigan has come into the national spotlight with the federal government declaring a state of emergency and the issue being a part of presidential debates.[1]

Treatment Options

Oral chelation therapies are used to lower blood lead levels, however they are not effective in removing lead from the bones, where lead can be stored. The effectiveness of chelation therapies to help those exposed to lead over long periods of time have been debated, and at the moment the only real effective treatment is to avoid exposure to lead altogether.

Conclusions

In conclusion, we found that there are many hidden sources of lead in and around the house which can contribute to lead toxicity. We also found that there is limited testing available for lead toxicity and the acceptable limits in water are at a rate that which signs and symptoms of lead toxicity are already beginning to appear. Surprisingly toxically high levels of lead found in the blood of children are all over the United States dating back into the 1960s, with 20 more cities with higher rates than Flint in the US showing up this year.

Lead passes through the blood brain barrier via the calcium channel causing a multitude of symptoms to occur due to its higher affinity of binding to the substrate than calcium. Since studies have shown that even low levels of lead cause a degree of toxicity, often before symptoms occur, these signs and symptoms are often the last sign that toxicity has occurred.

The crisis in Flint, Michigan should be a teaching moment for all of us. City officials had knowingly modified the procedures for testing lead levels in water so as to artificially lower the levels they reported to the EPA. This is a shocking trend that is being seen across the country in cities that are strapped for cash. If lead testing procedures are continually allowed to be modified, we will continue to see high lead levels across our country. The best course of action would be for legislation to be passed creating a standardized procedure for lead testing that cannot be modified by individual cities.

References

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