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Case report

Uncommon Sources and Some Unsual Manifestations of Lead Poisoning in a Tropical Developing Country

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Abstract: Lead-containing cooking utensils, sometimes used in South Indian homes, and indigenous medications, widely used in India and increasingly in developed countries, may be responsible for lead intoxication in adults. We report chronic lead poisoning in five adult patients. Not all patients had abdominal colic, while dramatic weight loss, depression and encephalopathy were seen. Once recognized, lead poisoning is treatable and sometimes preventable. Response to chelation therapy with agents such as calcium ethylenediaminetetraacetate (CaEDTA) is impressive, although several courses of therapy may be necessary.
Key words: Lead poisoning, adults, chelation therapy

INTRODUCTION

Lead poisoning has been known since ancient times [1] and is recognized worldwide in adults and in children [2–4]. Stringent regulations regarding the use of lead-based compounds has decreased the incidence of lead poisoning in developed nations. This is not the case in the developing world. Additionally, folk medicine, Ayurvedic and Homeopathic remedies, largely unregulated, are widely used in developing countries. Also unregulated is the manufacturing process of these medications which may be contaminated by heavy metals. This report serves to remind one that lead poisoning remains a problem in certain tropical and developing countries. Once recognized, however, it is a condition that can be effectively treated and sometimes prevented from recurring.

The symptoms and signs of lead poisoning are not pathognomonic and are commonly encountered in other diseases. Chronic lead poisoning can manifest clinically in one of three forms: (1) the alimentary form characterized by anorexia, vomiting, a metallic taste, constipation or diarrhoea, colicky abdominal pain (lead colic) or abdominal wall rigidity. (2) The neuromuscular form, which is more commonly seen in adults, presents with muscle weakness, myalgias, arthralgias, wrist drop, peripheral neuritis, muscle atrophy, weakness and tremor of forearm extensors. (3) The cerebral or the neuropsychiatric form, more commonly seen in children, is characterized by irritability, sleeplessness, encephalopathy, headache, dizziness, memory problems, confusion, loss of vision and convulsions [5–11]. Less commonly, chronic renal disease and toxic hepatitis can be seen in lead poisoning, possibly a result of contaminants rather than lead.

Acute lead poisoning is uncommon and is usually due to a suicide attempt [12], or self-ingestion [13], by mentally impaired patients in nursing homes and psychiatric facilities [14]. If ingestion is recognized early and treatment instituted promptly, the patient may remain asymptomatic. Acute toxicity may affect several organ systems including the kidneys, gastrointestinal tract, the central nervous system, liver, and the hematopoietic system, resulting in abdominal pain, diarrhoea, vomiting, haemolytic anaemia, hepatitis, and minor neurologic dysfunction [14, 15]. Less commonly delirium and hallucinations [16], acute renal failure or death may occur [17].

RESULTS

We report five adult patients to illustrate some uncommon clinical features of lead poisoning and highlight some unusual sources of lead. The latter are peculiar to some tropical developing countries. However, with the increasing popularity of complementary and alternative medicine therapy in the West, one must be aware of the possibility of lead poisoning due to lead contaminated medications.

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Case 1:

A 33-year-old previously healthy housewife presented with a history of abdominal pain, anorexia, undocumented weight-loss, constipation, insomnia unrelated to abdominal pain, and generalized myalgias of one year's duration. The abdominal pain usually occurred following a large meal but at times no obvious precipitating factor was identified. The pain was boring in nature, persisting for several hours. Colicky pain was not present at any time. Examination revealed that she was pale, emaciated and depressed. A gingival lead line was present but no other abnormality was detected.

Investigations revealed a haemoglobin of 11.8 gm%, haematocrit of 36% and reticulocyte count 7%. The anaemia was microcytic, hypochromic with basophilic stippling observed in the peripheral blood smear. The total and differential white blood cell count and platelet count were normal. The sedimentation rate was 55 mm in the first hour. Heinz bodies were absent and RBC osmotic fragility, and Coombs test were negative. Serum liver enzymes and bilirubin were normal. Qualitative urinary coproporphyrin and uroporphyrin were strongly positive. The blood lead level was 150 μg/dl and 24-hour urinary lead was 240 μg.

A diagnosis of lead poisoning was made and the patient was treated with CaEDTA 1 gm in 200 ml 5% dextrose, twice daily intravenously for five days. The blood lead level decreased to 75 μg/dl, urinary porphyrins became negative, the reticulocyte count fell to 1% and the patient became asymptomatic. The source of lead poisoning could not be determined.

A year later she presented with severe generalized colicky abdominal pain, vomiting and weakness. On examination, she was found to be rolling in bed secondary to colicky abdominal pain. No other abnormality on physical examination was noted. Results of investigations were as follows: haemoglobin of 8.5 gm%, a haematocrit of 28%, reticulocyte count 7% and a normal total and differential white blood cell count. Plain films of the abdomen were normal. Qualitative urinary coproporphyrin was strongly positive and blood lead levels elevated. CaEDTA was given as before following which the symptoms subsided completely. The haemoglobin rose to 11.1 gm%, the haematocrit to 31% and urinary coproporphyrins became undetectable two weeks following therapy. She was asymptomatic at follow-up seven months later although she had a reticulocyte count of 5%.

Despite a detailed history the source of lead could not be identified. She was not using any lead-glazed earthenware vessels at home for storing foods or water, nor was she taking any indigenous medications. The lead content of the drinking water was not elevated. Lead containing fuel or gasoline is no longer available.

Case 2:

A 30-year-old male healthy office worker, complained of constant noncolicky lower abdominal pain and backache of one month's duration. He had unintentionally lost 13.5 kg during this time. He gave no history of abdominal colic, constipation or vomiting. He was pale and a gingival lead line was present. The rest of his examination was otherwise unremarkable.

Investigations revealed a haemoglobin of 10.6 gm%, haematocrit 30% and a reticulocyte count of 18%. The anaemia was hypochromic and microcytic with faint basophilic stippling in the peripheral blood smear. Urine corproporphyrins was strongly positive. Bone marrow examination showed normoblastic maturation with erythroid hyperplasia and basophilic stippling. Serum liver enzymes, bilirubin and albumin and a plain film of the abdomen were normal. Treatment with CaEDTA 500 mg in 5% dextrose intravenously for 5 days resulted in marked improvement in symptoms and sense of well being. The haematocrit rose to 37% and the urinary coproporphyrins were negative.

A month later he was readmitted because of lower abdominal colicky pain. He had gained 2 kg. Investigations revealed a haematocrit of 38% and reticulocyte count of 0.5%. The urinary coproporphyrin was again strongly positive.

Following CaEDTA re-administration the abdominal pain completely subsided and he gained 4 kg over a period of one month. The source of lead was identified to be a lead-lined utensil which had been procured 3 months earlier and was being used to cook a popular South Indian food preparation called 'rasam' (an infusion of tamarind and pepper water). No other member of his family showed clinical or biochemical evidence of lead poisoning.

Case 3:

A 45-year-old male hotel owner with no known medical problems complained of constant, mild, epigastric pain, nonradiating in nature, episodic bilious vomiting half an hour after food and constipation, all of 15 days' duration. The pain was not relieved by vomiting or over-the-counter antacids. While undergoing evaluation, he developed features of depression and a few days later he became confused. His brother had died two years earlier in another hospital with similar symptoms. On physical examination, he was pale and confused with no other significant clinical findings. In particular, there was no localizing neurologic finding including neck rigidity.

Investigations confirmed that he was anaemic with a haemoglobin of 9.5 gm%, haematocrit of 29%. The reticulocyte count was 8.5%. No basophilic stippling was detected in the peripheral blood smear. The sedimentation rate

in the first hour was 57 mm, Coombs test was negative. Serum liver enzymes and bilirubin were normal. Qualitative urinary coproporphyrin was strongly positive and porphobilinogen was negative. A 24 hour urinary lead excretion was 530 μg and blood lead levels 290 μg%.

CaEDTA 1 gm was administered intravenously in 200 ml of 5% glucose for 10 days. After the first dose of EDTA the 24-hour urine lead level increased to 1,395 μg and on the second day to 2,090 μg. At the time of discharge, the patient was no longer confused and he felt well.

Ten days later he was readmitted because of mild paresthesias in the lower limbs. An electromyogram suggested mixed motor and sensory neuropathy. The haematocrit was 37% and the reticulocyte count 5%. The 24-hour urine lead excretion was 225 μg. Therapy with CaEDTA was reinstituted following which the 24-hour urinary lead was 3,946 μg. At the time of discharge the haematocrit was 42%, the reticulocyte count 2%, and the patient was asymptomatic. No source of lead could be identified and the patient was lost to follow-up.

Case 4:

A 51-year-old male accountant presented with a history of constipation, anorexia, and unintentional, documented weight loss of 18 kg in one month. He had no abdominal pain. He was a known diabetic and was on regular treatment with insulin and oral hypoglycaemic agents. He gave a history of having recovered from viral hepatitis four months earlier, following which he had begun taking an indigenous medicinal powder touted to alleviate weakness. On physical examination, he was emaciated, pale and edentulous. No other abnormality on examination was detected. Other members in the family who were asymptomatic were also examined and found to be clinically normal.

The patient's haemoglobin was 9.8 gm%, haematocrit 28%, reticulocyte 6.8%. Basophilic stippling was present in a peripheral blood smear. The blood lead level was 90 μg%. Liver enzymes and bilirubin were normal. The sedimentation rate was 45 mm in the first hour. Qualitative urinary coproporphyrin was strongly positive. Chemical analysis of the indigenous medicinal powder revealed the presence of lead carbonate.

CaEDTA 1 gm was given intravenously daily for 5 days following which the patient's appetite improved and his bowel habits returned to normal. At follow-up 3 months later he felt well and had gained 10 kg. His haemoglobin was 13.6 gm%, haematocrit 41%, and the reticulocyte 1.5%.

Case 5:

A 24-year-old previously healthy male student presented with constant mild left lower quadrant pain of one week's duration. He had had three episodes of generalized colicky abdominal pain during the previous six months, lasting for 1–2 hours. Unlike the previous episodes, the present one did not respond to antispasmodics. There was no history of constipation, anorexia, weight loss, vomiting or gastrointestinal haemorrhage. On physical examination he was a moderately built young man. He had ill-defined tenderness over the left iliac fossa and no other abnormality.

The haemoglobin was 10.3 gm%, haematocrit 34%, and reticulocyte count 8.8%. Red cells were hypochromic, microcytic with basophilic stippling present on the peripheral blood smear. The bone marrow was hypocellular with normal erythroid hyperplasia, increased polychromasia and occasional basophilic stippling. The platelet count was 280,000 per cu/mm^3. The sedimentation rate was 10 mm in the first hour. Serum iron, folate, calcium and phosphorus levels were normal. Coombs test was negative and serum liver enzymes were normal. Urine for coproporphyrin and porphobilinogen were negative. Blood lead was 110 μg% and 24-hour urine lead 463 μg. Following therapy with parenteral CaEDTA 500 mg twice a day intravenously in 500 ml of 5% glucose and penicillamine 250 mg four times a day for four weeks, the haemoglobin rose to 13.2 gm%. The peripheral smear showed no basophilic stippling and the blood lead level had fallen to 30 μg%. His 24-hour urine lead excretion was 5,168 μg. At follow up two months later he was asymptomatic.

On questioning he said that a new cooking utensil had recently been acquired and was used exclusively for cooking 'rasam'. The patient consumed about 150–200 ml of rasam daily. This was considerably more than the amount taken by the other three members of the household. His abdominal symptoms began 3 months after the family started using this vessel for cooking. A sample of rasam prepared in the usual way by the family was found to contain 200 μg% lead. The other three members of his family were asymptomatic and had no clinical evidence of lead intoxication. However, some of their laboratory studies were abnormal as outlined below:

1 The patient's mother: Haematocrit 46%, reticulocyte count 6%. Blood lead level 25 μg%.
2 The patient's brother: Haematocrit 34%, reticulocyte count 4.5%, blood picture showed no basophilic stippling and the blood lead level was 95 μg%.
3 The patient's younger brother: Haematocrit 39%, reticulocyte count 4.5%, and blood picture did not show basophilic stippling and blood lead level 50 μg%.

DISCUSSION

The alimentary form of lead poisoning is generally

recognized by the classic 'lead colic' [18] which is believed to be due to intestinal spasms. The aetiology of the intestinal spasms remains conjectural. It has been suggested that lead competes for transport with calcium and other divalent cations such as magnesium and zinc. This, in turn, interferes with mitochondrial oxidative phosphorylation and intracellular signalling processes which affects intestinal motility [19]. The five patients in this report highlight the fact that colicky abdominal pain is not always present, that the pain can be situated over any part of the abdomen and can vary considerably in severity (Case 1 and 3). The uncharacteristic nature of the abdominal pain can delay arriving at the right diagnosis as one pursues the investigation for other conditions associated with abdominal pain, such as pancreatitis and renal colic. Additionally, abdominal pain may be the result of lead affecting the visceral autonomic nervous system or lead-induced interstitial pancreatitis [20]. It is generally believed that abdominal colic and pain may occur when blood levels are greater than 40 μg% and is present when levels are greater than 80 μg%. This is not always so as illustrated by the brothers of Case 5 who had blood levels of 50 and 95 μg/dl respectively but were asymptomatic.

Blood lead levels reflect recent rather than cumulative absorption since approximately 90% of absorbed lead is deposited in soft tissue and the skeleton [21]. The nutritional status of the individual can influence an individual's response to a toxic substance. Hypocalcaemia, iron deficiency and deficiency of trace metals such as zinc and copper may exacerbate the toxic effects of lead. We did not measure circulating trace metal levels in our patients. The composition of an individual's diet may also play a role in the response to lead exposure [4, 22]. These factors may explain variations in the degree of lead poisoning seen in individuals with similar lead exposure as evidenced by the fact that family members of Cases 2 and 5 remained asymptomatic despite some of them having high lead levels. The suggestion that there is a correlation between the blood lead concentrations of the index case and blood lead levels of other household members [23] is not borne out in the one family (Case 5) where we had an opportunity to study other family members. It is also possible that individuals may have a genetic susceptibility to lead poisoning [24]. Ethnic and environmental factors may also play a role.

On a peripheral blood smear, the anemia of lead poisoning is typically microcytic and hypochromic. Basophilic stippling is not specific for lead poisoning and has been reported in other conditions including pyrimidine nucleotidase deficiency, B12 deficiency and thalassemia.

The cases reported illustrate the fact that lead poisoning may present with misleading symptoms. In our patients it prompted investigation for a diagnosis of a depressive illness (Case 1, insomnia, abdominal pain and anorexia), colonic malignancy (Case 4, constipation of recent onset and marked weight loss). It can also present with symptoms which are not typical of any illness (Case 5). Case 3 serves to reinforce previously published reports that neuropsychiatric manifestations and encephalopathy, although more frequently reported in the paediatric literature [4], can also occur in adults. Weight loss in patients with lead poisoning has been reported but its aetiology remains unclear.

The sources of lead reported to be implicated in lead poisoning are numerous and include contaminated water [25], soil, glazed pottery which gives up lead in large quantities to food such as pickles and sour fruits and is possibly related to the acid medium [14], lead contaminated foods, inhalation of lead fumes, paint and illicit alcohol beverages. Cases 2 and 5 emphasize that cooking utensils can be a source of lead. Lead poisoning as a result of lead contaminated folk remedy has been reported previously [18]. We were able to demonstrate a high lead content in the indigenous medicinal powder that Case 4 had been taking as a general tonic. Folk medicine is still used extensively in India, and increasingly in other parts of the world. This may be due to a variety of reasons including the high cost of prescription medications, restricted physician access and reports of unwanted side effects of prescription medication [26]. Additionally, there appears to be the innate, albeit mistaken, belief that botanical products, being 'natural,' are safe. No home visits were made to identify the source of lead in Cases 1 and 3 in whom no obvious source of lead was found.

In recent years some folk remedies and Ayurvedic medications have been shown to be contaminated with heavy metals, including lead [18, 27, 28] and their use has resulted in toxicity. 14 of 70 Ayurvedic herbal medicinal products sold in South Asian grocery stores in Boston had potentially harmful levels of lead, mercury and/or arsenic [28]. Additionally, there are well-documented instances of lead toxicity due to herbal medication ingestion [18, 27, 29]. There is little data on the chemical composition of these powders and little is known of lead blood levels in the community. It may be that some patients diagnosed with non-ulcer dyspepsia or abdominal pain of unknown origin are, in fact, patients with lead poisoning.

Our report confirms the efficacy of the chelating agent CaEDTA in the treatment of lead poisoning. It also emphasizes the fact that symptomatic recurrences are an ever-present danger because circulating lead that gets rapidly deposited in the skeletal system [30] is excreted very slowly, making bones act as a reservoir from which lead re-enters the circulation leading to relapses (Case 1). More recently, BAL (British antilewisite) has been shown to be an

effective alternative to CaEDTA and D-penicillamine is a useful agent to mobilize stored lead once the patient is asymptomatic.

Identifying the source of lead in patients with lead toxicity and avoiding further exposure are the only definitive measures for preventing further lead poisoning. However, as in two of our patients, identifying the source of lead is not always easy and in such situations regular follow up of blood lead levels and treatment with a chelating agent when indicated is appropriate.

We report these cases to remind practitioners in tropical and less well-developed countries to keep lead-poisoning in mind when confronted with symptoms such as those experienced by our patients, and to be aware of the possibility of lead poisoning from their environment. Patients are unlikely to volunteer pertinent history and, if this diagnosis is not borne in mind, a preventable and treatable condition can have fatal consequences.

DECLARATIONS

The material for this manuscript was obtained when the author was a staff physician in the Department of Medicine at the Christian Medical College and Hospital, Vellore 632004, Tamil Nadu, India.

REFERENCES

1. Nriagu JO. Saturnine gout among roman aristocrats. Did lead poisoning contribute to the fall of the empire?. N Engl J Med 1983; 308: 660–663.
2. Joshua G.E, Ratnaike N, Benjamin V. Lead poisoning in a family of 18 members in Vellore town. Indian J Med Res 1971; 59: 1496–1507.
3. Flora SJ, Singh S, Tandon SK. Bal therapy in human lead poisoning. Indian J Med Sci 1985; 39: 187–191.
4. Woolf AD, Goldman R, Bellinger DC. Update on the clinical management of childhood lead poisoning. Pediatr Clin North Am 2007; 54: 271–294.
5. Whitfield CL, Ch'ien LT, Whitehead JD. Lead encephalopathy in adults. Am J Med 1972; 52: 289–298.
6. Selevan SG, Landrigan PJ, Stern FB, Jones JH. Mortality of lead smelter workers. Am J Epidemiol 1985; 122: 673–683.
7. Wedeen RP. Blood lead levels, dietary calcium, and hypertension. Ann Intern Med 1985; 102: 403–404.
8. Reyes PF, Gonzalez CF, Zalewska MK, Besarab A. Intracranial calcification in adults with chronic lead exposure. AJR Am J Roentgenol 1986; 146: 267–270.
9. Needleman HL, Gunnoe C, Leviton A, Reed R, Peresie H, Maher C, Barrett P. Deficits in psychologic and classroom performance of children with elevated dentine lead levels. N Engl J Med 1979; 300: 689–695.
10. Rubens O, Logina I, Kravale I, Eglite M, Donaghy M. Peripheral neuropathy in chronic occupational inorganic lead exposure: A clinical and electrophysiological study. J Neurol Neurosurg Psychiatry 2001; 71: 200–204.
11. Shiri R, Ansari M, Ranta M, Falah-Hassani K. Lead poisoning and recurrent abdominal pain. Ind Health 2007; 45: 494–496.
12. Karpatkin S. Lead poisoning after taking pb acetate with suicidal intent. Report of a case with a discussion of the mechanism of anaemia. Arch Environ Health 1961; 2: 679–684.
13. Beattie AD, Briggs JD, Canavan JS, Doyle D, Mullin PJ, Watson AA. Acute lead poisoning: Five cases resulting from self-injection of lead and opium. Q J Med 1975; 44: 275–284.
14. Vance MV, Curry SC, Bradley JM, Kunkel DB, Gerkin RD, Bond GR. Acute lead poisoning in nursing home and psychiatric patients from the ingestion of lead-based ceramic glazes. Arch Intern Med 1990; 150: 2085–2092.
15. Nortier JW, Sangster B, van Kestern RG.. Acute lead poisoning with hemolysis and liver toxicity after ingestion of red lead. Vet Hum Toxicol 1980; 22: 145–147.
16. Bastrup-Madsen P. Dimercaprol in acute lead poisoning. Lancet 1950; 2: 171–172.
17. Karlog O, Moller KO. Three cases of acute lead poisoning: Analyses of organs for lead, and observations on polarographic lead determinations. Acta Pharmacol Toxicol (Copenh) 1958; 15: 8–16.
18. van Vonderen MG, Klinkenberg-Knol EC, Craanen ME, Touw DJ, Meuwissen SG, De Smet PA. Severe gastrointestinal symptoms due to lead poisoning from Indian traditional medicine. Am J Gastroenterol 2000; 95: 1591–1592.
19. Garza A, Vega R, Soto E. Cellular mechanisms of lead neurotoxicity. Med Sci Monit 2006; 12: RA57–65.
20. Janin Y, Couinaud C, Stone A, Wise L. The "lead-induced colic" syndrome in lead intoxication. Surg Annu 1985; 17: 287–307.
21. Barry PS, Mossman DB. Lead concentrations in human tissues. Br J Ind Med 1970; 27: 339–351.
22. Rabinowitz MB, Kopple JD, Wetherill GW. Effect of food intake and fasting on gastrointestinal lead absorption in humans. Am J Clin Nutr 1980; 33: 1784–1788.
23. Goldberg A. Lead poisoning and haem biosynthesis. Br J Haematol 1972; 23: 521–524.
24. Onalaja AO, Claudio L. Genetic susceptibility to lead poisoning. Environ Health Perspect 2000; 108 (Suppl 1): 23–28.
25. Morse DL, Watson WN, Housworth J, Witherell LE, Landrigan PJ. Exposure of children to lead in drinking water. Am J Public Health 1979; 69: 711–712.
26. Marcus DM, Grollman AP. Botanical medicines—the need for new regulations. N Engl J Med 2002; 347: 2073–2076.
27. Hasegawa S, Nakayama K, Iwakiri K, An E, Gomi S, Dan K, Katsumata M, Mirnami M, Wakabayashi I. Herbal medicine-associated lead intoxication. Intern Med 1997; 36: 56–58.

28. Saper RB, Kales SN, Paquin J, Burns MJ, Eisenberg DM, Davis RB, Phillips RS. Heavy metal content of ayurvedic herbal medicine products. JAMA 2004; 292: 2868–2873.
29. Anderson NR, Gama R, Kapadia S. Herbal remedy poisoning presenting with acute abdomen and raised urine porphyrins. Ann Clin Biochem 2001; 38: 408–410.
30. Riess ML, Halm JK. Lead poisoning in an adult: Lead mobilization by pregnancy? J Gen Intern Med 2007; 22: 1212–1215.