Herbal Medicine-Associated Lead Intoxication

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A female patient visited our hospital with abdominal pain and anemia. Examination for a gastrointestinal disease gave no diagnostic information. Laboratory studies of the parameters of heme biosynthesis revealed an enzymatic inhibition by lead. The diagnosis of lead poisoning was confirmed by detection of an elevated blood lead level. Excessive lead ingestion was thought to be caused by herbal medicines and/or by an earthen teapot.

(Key words: lead poisoning, herbal medicine, earthen teapot)

Introduction

Lead poisoning has been a well-recognized clinical entity since antiquity. Modern clinical experience with lead intoxication is limited, primarily due to improvement in monitoring systems for occupational lead exposure (1). There is, however, a continuing need for effective means of laboratory diagnosis and assessment of lead intoxication, because lead is still one of the most widely distributed pollutants in the environment (2). Non-occupational lead poisoning has occurred from a wide variety of sources, including painted furniture or toys, drinking water from lead pipes or tanks and lead-containing face powder (2, 3). The diagnosis of lead intoxication in sporadic cases can be delayed because this problem is infrequently encountered, the source is obscure, and the symptoms are non-specific. Although lead is being eliminated from various consumer products, we recently encountered a patient with lead poisoning due to herbal medicines and/or an earthen teapot which had been used to prepare herbal medicines. This report should alert physicians to the possibility of lead poisoning among patients with colicky abdominal pain and anemia of unknown origin.

Case Report

A 33-year-old woman visited our hospital in January 1995 because of colicky pain in the lower abdomen and increasing anorexia. Barium enema, gastro-duodenoscopy, ultrasonography and computerized tomography of the abdomen showed no significant abnormality. Laboratory studies revealed moderate anemia and slightly elevated serum aminotransferase and amylase levels. The patient was hospitalized for further evaluation.

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Received for publication June 3, 1996; Accepted for publication October 25, 1996
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On admission, her body temperature was 36.7°C, her height, 154.5 cm, and her weight, 42 kg. Her blood pressure was 136/80 mmHg, and her heart rate was regular at 84 beats/min. Physical examination showed a pale, ill-appearing housewife with mild discomfort. The abdomen was diffusely tender, and there was voluntary guarding without rebound tenderness. There was no hepatosplenomegaly. The remainder of the examination was unremarkable. Investigations showed hemoglobin at 8.5 g/dl with a mean corpuscular volume of 86.4, a white blood cell count of 5x10^9/l, a platelet count of 287x10^9/l, and 4.6% reticulocytes. Alanine aminotransferase was 54 IU/l, and total bilirubin was 1.5 g/dl (67% indirect). The remaining blood-chemistry findings were within normal limits. An electrocardiogram and chest X-ray films were normal. Plain films of the abdomen disclosed modest gaseous distension of the small and large intestines.

The subsequent examination revealed no diagnostic clue. The patient complained of persistent abdominal pain, loss of appetite and difficulty in falling asleep. These physical manifestations, in addition to the presence of anemia, led us to suspect the patient of porphyria or its related disorders. Then we investigated for the possibility of abnormalities of heme and porphyrin metabolism. Urinary δ-aminolevulinic acid (ALA) was greatly increased (39.7 mg/l; normal: <5 mg/l), but the level of porphobilinogen (PBG) was not increased (2.3 mg/day; normal: <2 mg/day), suggesting lead poisoning rather than acute intermittent porphyria, in which PBG is excreted in greater excess than ALA. Marked elevations of the urinary coproporphyrin level (2,018 μg/dl; normal: <100) and the zinc protoporphyrin level in erythrocytes (345 μg/dl) were also compatible with lead poisoning. Further investigation con-
firmed that the blood lead level was significantly elevated (64 μg/dl; normal: <30 μg/dl).

However, the patient’s occupational and home environments revealed no obvious source of lead. The other members of the family, including her husband, two sons and mother-in-law, showed normal blood lead levels. Although the ALA dehydratase activity in the erythrocytes of the patient was reduced, its in vitro activity was restored to normal by the reducing agent, dithiothreitol. On further inquiry, the patient admitted self-medication with herbal medicines because of hematuria for the past several years. The preparation of the herbal medicines involved boiling the herbs in water for about one hour using an earthen teapot. In the herbal medicine we tested so far, no significantly increased lead contamination was detected. However, a markedly elevated lead level was found in the herbal brew prepared by boiling in the earthen teapot, which the patient bought from a mail-order store two years ago (Table 1, discussed later). In fact, three weeks prior to her first visit to our hospital, the patient stopped taking the herbal medicine and also stopped using this teapot after feeling colicky pain in the abdomen and anorexia. Since the removal from further exposure to lead was confirmed and the symptoms of the patient abated, she was discharged without treatment with chelating agents. The blood lead level and the hemoglobin level of the patient returned almost to normal in the six months following the diagnosis of lead poisoning (Fig. 1).

**Table 1. Measurements of Lead Content in Residual Solution after Boiling Herbs in Distilled Water in the Earthen Teapot**

<table>
<thead>
<tr>
<th>Vessel for boiling</th>
<th>Herbs included in solution</th>
<th>Residual solution volume (ml)</th>
<th>Content of lead (μg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaker</td>
<td>yes</td>
<td>320</td>
<td>37.8</td>
</tr>
<tr>
<td>Earthen teapot of patient</td>
<td>yes</td>
<td>150</td>
<td>2,041.3</td>
</tr>
<tr>
<td>Earthen teapot of patient</td>
<td>no</td>
<td>155</td>
<td>833.0</td>
</tr>
<tr>
<td>Another earthen teapot</td>
<td>yes</td>
<td>245</td>
<td>15.1</td>
</tr>
<tr>
<td>Another earthen teapot</td>
<td>no</td>
<td>255</td>
<td>11.6</td>
</tr>
</tbody>
</table>

**Figure 1.** Clinical course of the patient. Hb: hemoglobin, BLL: blood lead level.

**Discussion**

The present case exemplifies some of the difficulties that may arise in the initial diagnosis or subsequent assessment of non-occupational clinical lead intoxication. Basophilic stipplings of red cells due to pyrimidine accumulation within the red cells, which should have been a useful clue for diagnosis, was lacking. The physical examination on admission also revealed no gingival “lead line” characteristic of this intoxication. The patient later recalled the presence of blue-black deposits in her gums before hospitalization. Consequently, the investigation of heme synthesis metabolism for anemia provided the first and most suggestive findings for an increased lead burden in our case (2). The diagnosis of lead poisoning was finally confirmed by the elevated blood lead level, which must have peaked prior to admission at the time of transient appearance of gingival lead lines.

The ambient environment of the patient seemed to contain no significantly raised level of inorganic lead due to industrial waste or gasoline exhaust. The blood lead levels of the other members of the family were all within normal limits. A hypersensitivity to the lead burden in the patient was suspected at first. Heterozygotes for ALA dehydratase deficiency are well known to be predisposed to lead poisoning (4). ALA dehydratase is a zinc metalloenzyme whose activity is inhibited by lead, which replaces the zinc atoms, as well as by the oxidation of critical thiol groups (5). Although the patient revealed a very low level of ALA dehydratase activity, it was restored to the normal level in vitro by incubation with zinc atoms and a potent reducing agent, such as dithiothreitol. Consequently, the possibility of ALA dehydratase deficiency with increased sensitivity to normal lead exposure was excluded. As an alternative pathogenesis, we focused on an exogenous source of lead contamination specific to the patient.

Cases of lead poisoning from Chinese herbal medicines (6–8) or Mexican folk remedies (9, 10) have been documented. The herbal medicine which the present patient had taken as therapy for chronic renal disease was finally considered to be the most possible source of exposure to lead. We examined the lead content of the extract obtained by boiling one pack of herbs in 600 ml of distilled water for 50 minutes in accordance with the directions. When prepared by boiling in a beaker the herb-containing solution revealed no elevated lead content. However, after boiling an herb-free solution in the earthen teapot which the patient had been using, the solution showed a high level of lead contamination (Table 1). It should be noted that the herb-containing solution boiled in the teapot showed an even higher lead level, suggesting the possibility that some component of the herb exerts a chelating effect which enables the lead in the earthen teapot to be easily extracted. Another earthen teapot used as a control did not result in lead contamination of the herbal brew.
The long-term habit of boiling the herbs in the lead-containing teapot might cause a gradually increased lead burden. However, considering the acute onset of the clinical manifestations characteristic of lead poisoning in our patient, we think that the lead level in the herbal tea prepared in the earthen teapot was not sufficiently high. We cannot exclude the possibility of lead contamination from other components of the herbs, leading to deposition of lead on the earthen teapot. Effort is underway to disclose other herb components with a high lead content, which could have initiated the acute lead intoxication.

References

1) Rempel D. The lead-exposed worker. JAMA 262: 532, 1989 (see comments).


