



Case report

Childhood lead poisoning associated with traditional Chinese medicine: A case report and the subsequent lead source inquiry

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ABSTRACT

Background: Traditional medicines or ethnic remedies, such as Ayurvedic drug of India, have been reported in numerous cases to be one of the main exposure risks for severe lead poisoning.

Methods: We describe the poisoning of 2 young children from a Chinese family in Guangzhou as a result of the use of traditional Chinese medicine instead of baby powder.

Results: A 3-y-old boy with blood lead levels (BLLs) of 303 µg/l and his 6-month-old sister with BLLs of 385 µg/l were hospitalized. Laboratory tests showed that the powder, which was purchased in Ganzhou during a family visit, contained a lead concentration of 214,000 mg/kg. A subsequent inspection revealed that the lead contamination was in fact achieved by the addition of Hongdan to talcum. In Ganzhou, it was a popular practice for young children to apply this leaded powder on their skins in order to treat and prevent dermatitis. We sampled 16 Hongdans and observed an average lead content of 817,000 mg/kg that was comprised mainly of lead tetraoxide (Pb₃O₄). Lead tetraoxide is also an accessible raw material for paint and battery industries.

Conclusions: The health authority of China should reevaluate the safety of such traditional remedy and weigh its toxicity versus its potential benefits. Clinicians should be aware of this leaded powder when treating a lead poisoning case that shows no explainable cause.

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1. Introduction

Leaded gasoline was once the main source of lead poisoning in children worldwide. However, as a result of the phase-out of leaded gasoline, both the rate of lead poisoning (≥ 100 µg/l, Centers for Disease Control & Prevention, [1]) and the average blood lead levels (BLLs) of children have declined remarkably [2–4]. Nevertheless, other unexpected sources have increasingly been identified as the cause of occasional cases of childhood lead poisoning. Traditional medicines or ethnic remedies are among the novel lead exposure risks that could result in severe lead poisoning in both children and adults. Yurvedic drug of India, for instance, has been associated with several cases of lead poisoning [5]. Although Chinese traditional medicine, which like Indian medicine focuses on herbalism, is very popular in China and in Chinese communities abroad and has rarely been associated with childhood lead poisoning, there have been numerous reported cases of lead-contaminated Chinese herbs to date [6–8].

2. Cases report

A 3-y-old boy in Guangzhou, China, who had been suffering from chronic constipation and abdominal pain for 6 months, was taken to

the local children's hospital several times by his parent but was not cured. He was otherwise in good health without behavioral or developmental delays. The pain in his abdomen was episodic, diffuse and had no clearly aggravating or relieving factors. Cardiopulmonary physical examination showed no abnormal noise, lump, or tenderness in the abdomen. The patient's hemoglobin was 12.3 g/dl, his hematocrit was 36.5%, and the mean red blood cell corpuscular volume was 76 fl. X-ray of the chest and abdomen showed no specific findings. The doctor in charge then planned a colonoscopy procedure for further diagnosis. However, before performing the colonoscopy, the doctor recommended a blood lead level test which showed that the boy had a BLL of 330 µg/l, corresponding to a Class III ("moderate") lead poisoning level (based on the regulations from the Centers for Disease Control and Prevention) [1]. This unexpected finding led the other members of the family, including his father, his mother and his 6-month-old sister, to have their BLLs checked as well. Results showed BLLs of 45, 61, and 248 µg/l for the father, the mother and the sister, respectively. Accordingly, the cases were referred to the regional Center for Disease Control and Prevention to investigate and consequently affirm that the baby powder that the mother had purchased in her hometown was the source of the lead exposure. The 2 patients were transferred to the Children Environmental Medical Center of Xinhua Hospital located in Shanghai Jiaotong University, which is the most eminent pediatric clinic in China specializing in lead poisoning treatment. The BLLs were measured again by graphite furnace atomic absorption spectrometry with Zeeman

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back-ground correction (GFAAS; Thermo Elemental, Solaar MQZ) in the hospital. The BLLs were 303 and 385 $\mu\text{g/l}$ for the boy and the girl, respectively. As a result of the long period of lead exposure, the children were hospitalized for 5 days and administered with an intravenous chelating agent CaNa_2EDTA (1000 $\text{mg/m}^2/\text{day}$) to reduce the blood lead concentrations (118 $\mu\text{g/l}$ and 88 $\mu\text{g/l}$ for the boy and the girl after treatment, respectively). The parents were advised to discontinue using the medicated baby powder and to use a certified powder instead. In our study, we followed up the 2 children for 2-y. We observed that the BLLs of both the brother and the sister reduced steadily. The brother's BLLs reduced relatively slowly whereas the sister's reduced relatively rapidly (Table 1), a consequence of a longer lead exposure period for the brother. The reduction of BLLs in the boy was accompanied by the disappearance of his abdominal symptoms.

3. Lead risk investigation

3.1. Home visit and lead exposure detection

The cases mentioned above were referred by the hospital to the regional Center for Disease Control and Prevention as unusual cases of childhood lead poisoning because the 2 patients were from the same family. We visited the family several times in order to investigate the source of lead exposure. Neither of the parents had a professional exposure to or worked with lead in their hobbies. Additionally, there were no smelters or other industrial sources of lead contamination in the surrounding areas. In addition to a questionnaire, a portable X-ray fluorescence analyzer (XRF, Innov- α 4000, Innov-X System Company, Woburn, MA) was used to screen the indoor environment, household products, drinking water and food. The family lived in a relatively new apartment, located on the 2nd floor, which the father alleged moving in two years ago. It had 4 rooms, 1 kitchen and 1 balcony. There were no signs of any broken or peeling furniture, floors or walls in any of the rooms in the apartment. Analysis of the household items by in situ XRF did not provide any noticeable lead readings with the exception of the guardrail's paint in the balcony and the sofa, which demonstrated lead concentrations of 8700 and 1741 mg/kg , respectively. However, the parents suggested that their young daughter would have had minimal contact with those lead exposure sources and that the guardrail paint was dry and completed. When we further consulted the parents about which items the children had exposure to, we discovered an unfamiliar red baby powder (generally white) that the mother acknowledged using to enhance the health of the skin and to treat her children's skin problems (Fig. 1). The powder was analyzed in a chemistry laboratory in Guangzhou Center for Disease Control and Prevention and was found to contain lead concentrations of more than 100,000 mg/kg by in situ XRF and 214,000 mg/kg by flame atomic absorption spectrometry (FAAS, Zeeman-5000, Hitachi Limited, Japan). The lead content of this powder was approximately 5000 times above the limit allowed by the National Cosmetic Hygienic Standard of China, which permits lead content below 40 mg/kg of total weight. The mother revealed, upon further questioning, that she had purchased the powder in her hometown of Ganzhou in Jiangxi province, which is approximately 800 km away from Guangzhou, where this kind of powder was believed to be unexpectedly effective in the prevention and treatment of skin problems.

Table 1

Blood lead levels of the family members during follow-up ($\mu\text{g/l}$).

	Birthday	Nov 2008	Mar 2009 ^a	May 2009 ^b	May 2010	May 2011
Boy	May 2005	330	303	118	190	116
Girl	Jul 2008	248	385	88	131	91
Father	Apr 1957		45			
Mother	Oct 1979		61			

^a The first home visit.

^b Considerably after the chelating therapy in the hospital. BLLs may be reduced dramatically, but are usually followed by rebound.



Fig. 1. Baby powder used on the 2 children (left) and the powder bought from supermarket (right).

An amount of roughly half a tablespoon was applied after the children's bath everyday (since birth) to the perineum, hip, armpit and neck skin areas. After the boy was 1 y, the powder was no longer applied after his daily bath but it was applied only when he showed signs of dermatitis such as eczema and miliaria. The parents never used the powder on themselves, but the mother was the one who usually applied the powder on the children, thus explaining her higher BLLs compared to levels in her husband. As a consequence, the baby powder was presumed to be the source of the lead exposure.

3.2. Lead source inquiry

In order to understand and determine the source of lead in the powder, we went to Ganzhou in March 2009. We visited 48 drugstores in 14 towns and discovered that 41 out of the 48 drugstores were selling medicated baby powder similar to the one in question. Unlike ordinary baby powder, which is always snow white in appearance, the medicated powder is sienna red. We found that the drugstores investigated were producing their herbal remedies on site. Although most workers or owners refused to tell us the ingredients of the powder or plainly said it was a mix of traditional Chinese medicines, we discerned that the red baby powder was actually a mixture of talcum and Hongdan (Fig. 2). We purchased 16 samples of Hongdan, 13 of medicated baby powders and 6 of talcum in different drugstores. All of the samples were tested for lead concentration by FAAS in the chemistry laboratory of Guangzhou Center for Disease Control and Prevention. Results showed that the Hongdan samples had the highest lead content with an average of 817,000 mg/kg , followed by the medicated baby powders with an average of 207,000 mg/kg and talcum with an average of 5 mg/kg (Fig. 3). Evidently, the lead found in the medicated baby powder came from Hongdan and was intentionally added for treatment efficiency purposes. Hongdan is the official term for red lead (Pb_3O_4) according to the pharmacopeia of traditional Chinese medicine. In addition to its use in



Fig. 2. Raw material: Hongdan (left) and talcum (right).

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