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Original Article

Successful Treatment of Severe Lead Poisoning Children with Low Dosage of $CaNa_2EDTA$ -A Retrospective Study of 8 Cases from China

Peng Li , Shuxia Huang

Department of pediatrics, Beijing Chaoyang Hospital, Capital Medical University, Beijing, 100020, China

Correspondence

Shuxia Huang

Department of pediatrics, Beijing Chaoyang Hospital, Capital Medical University, Beijing, 100020, China

E-mail: shuxiahuang010@aliyun.com

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Abstract

Background: To analyze the clinical features, treatment and prognosis of 8 Chinese children with severe lead poisoning. **Methods**: 8 children with blood lead levels (BLLs) over 45ug/dL hospitalized at Beijing Chaoyang Hospital of Capital Medical University from January 2015 to December 2019 were diagnosed as severe lead poisoning. Detailed medical data were retrospectively studied. All patients accepted the chelation therapy with calcium disodium ethyleneaminetetraacetate ($CaNa_2EDTA$). **Results:** The onset age ranged from 3 months to 12 years old. BLLs ranged from 46.6ug/dL to 120.2ug/dL. The sources of lead exposure were different while 3 cases had taken Chinese herbs. 3 cases had symptoms of nervous system. 3 cases had anemia. 2 cases had abnormal liver function. All patients had normal renal function. All cases accepted the repeated treatment of consecutive intravenous $CaNa_2EDTA$ (20mg/kg/d, 5 days every month), until BLLs remained below 40ug/dL. 1 case One case got rash and one patient got transient elevated serum transaminase during the courses. All cases had BLLs under 45ug/dL on follow-up. **Conclusion**: Chinese herbs containing lead might be one of the attributing factors of lead poisoning in children. Low dosage of $CaNa_2EDTA$ was relatively safe and effective in dealing with lead poisoning in children. .

Introduction

Lead is one of the harmful minerals from the environment. Any detected level of blood lead might affect the health of children [1]. According to the guideline of CDC of United States in 2012, the normal value of blood lead was below 5ug/dL [2]. But the latest report showed that blood lead reference level of U.S. had been changed to 3.5ug/dl [3].

Elevated blood lead levels (BLLs) can damage the functions of multiple systems, including the digestive system, nervous system, blood system, urinary system, etc [4]. However, some cases with lead poisoning were asymptomatic [5], which might lead to late diagnosis of lead poisoning. For general pediatricians, it is important to find out the underlying patients with lead poisoning as early as possible. When BLLs goes above 45ug/dL, patients with lead poisoning should be hospitalized and accept chelation therapy [2,6].

To further understand the clinical features and therapeutics of lead poisoning, here we retrospectively studied 8 children with severe lead poisoning from China, who received the successful treatment with intravenous $CaNa_2EDTA$ in a relatively low dosage.

Materials and methods

Patient selection

Eight children with severe lead poisoning hospitalized in the Pediatric Department of Beijing Chaoyang Hospital from January 2015 to December 2019 were enrolled in this study. The clinical data were data were studied retrospectively, including etiology, clinical manifestations, laboratory findings, treatment interventions and prognosis. All patients had BLLs exceeding 45ug/dL on admission. The study was approved by the Medical Ethic Committee of Beijing Chaoyang Hospital. Informed consents were obtained from the patients' parents.

Treatment methods

General treatment included getting away from polluted environment, stopping the intake of lead containing food or herbs, and supplementing mineral elements such as calcium, iron, and zinc moderately. $CaNa_2EDTA$ was used for chelation therapy. 20mg per kg body weight per day, intravenous drip, lasting more than 3 hours. 5 days is a course. The course was repeated each month, till the BLLs went blow 40ug/dL. Patients with abnormal liver function were also treated with intravenous reduced glutathione. Patients

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with neurological symptoms also accepted the therapies from pediatric neurologists.

Statistical analysis

The measurement data were recorded by the median (quartile), and the rank sum test was adopted. The count data were represented by the percentage, and the fisher exact test was applied. P less than 0.05 is considered statistically significant.

Results

Clinical manifestations

The baseline data of 8 children with severe lead poisoning were shown in Table 1. There were 6 boys and 2 girls, aged from 3 months to 12 years, including 3 infants. Regarding the cause of lead poisoning, 3 cases had taken lead-containing Chinese herbs, 2cases were fed with lead-polluted water, 2 cases had always bite plastic toys, and 1 case got lead from mother milk. The onset symptoms were different but 3 cases had no obvious symptoms. The main laboratory findings before treatment were shown in Table 2. The BLLs were greater than 45ug/dL, including 2 cases over 100ug/dL. 3 cases had anemia. 2 cases had abnormal liver function. Renal function was normal. Only 2 cases underwent abdominal ultrasound examination, but no abnormal imaging was found.

Therapeutic effects and adverse reactions

Although the BLLs of some cases had a slight rebound during the chelation courses, all of them eventually dropped below 40ug/dL. The courses number differed from 3 to 16. The curves of BLLs in 8 children with severe lead poisoning were shown in Figure 1.

Two patients developed elevated alanine aminotransferase (cases 2 and 7, both nearly 200 IU/L), which returned to normal after hepatoprotective treatment; one patient developed transient rash (case 6); none of the patients had renal function damage.

Follow-up

After 2 years of follow-up, the 5 patients with clinical symptoms gradually relieved, and the blood lead level remained lower than 45ug/dL.

Discussion

Lead poisoning can be caused by a couple reasons, including polluted water, petrol gas, plastic toys , traditional medicine, etc [7]. In this study, 3 cases had taken Chinese herbs containing lead. This reminded us that children should be paid more attention when taking Chinese medicine.

Table 1. *Baseline data of 8 children with severe lead poisoning*

	Sex (M/F)	Age (months)	Height(cm)	Weight(kg))	Main Symptoms	Cause of lead poisoning	BLLs(ug/dL)
Case 1	M	48	112	19	Asymptomatic	Plastic toys	46.6
Case 2	F	12	75	10	Sleep disorder	Polluted water	50.2
Case 3	M	144	150	44	Tourette syndrome	Chinese herbs	56.8
Case 4	M	3	61	7	Asymptomatic	Mother milk	61.9
Case 5	F	132	155	57	Convulsion	Chinese herbs	63.1
Case 6	M	6	75	11	Asymptomatic	Plastic toys	71.1
Case 7	M	23	81	10	Growth retardation	Polluted water	107.6
Case 8	M	18	80	9	Vomiting, diarrhea, bellyache	Chinese herbs	120.2

Figure 1. *Changes of blood lead levels after chelation therapies with CaNa2EDTA*

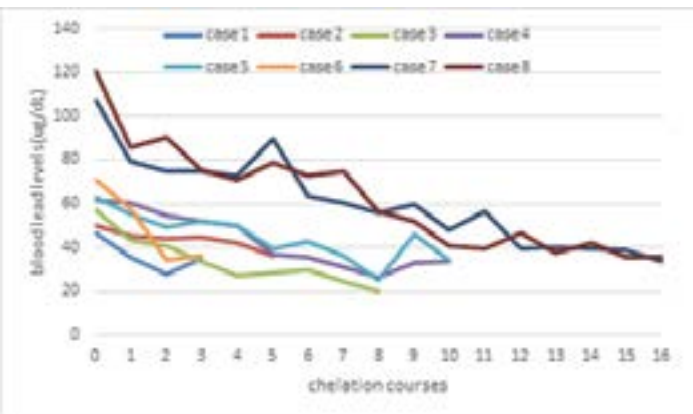

Table 2. *Main laboratory findings of 8 children with severe lead poisoning before treatment*

	ALT (IU/L)	TBIL (umol/L)	BUN (mmol/L)	Cr (umol/L)	Hb (g/L)	WBC ($\times10^9$/L)	PLT ($\times10^9$/L)	BLLs (ug/dL)
Case 1	11	8.3	3.09	30.6	121	10.32	361	46.6
Case 2	19	7	6.13	23.7	124	11.57	231	50.2
Case 3	108	7.4	6.78	50.7	117	4.84	254	56.8
Case 4	20	9.9	1.34	20.3	114	11.32	464	61.9
Case 5	37	15.2	4.15	29.8	149	12.36	361	63.1
Case 6	30	8.6	1.18	18.6	114	10.39	335	71.1
Case 7	32	4.1	5.46	20.6	93	8.52	312	107.6
Case 8	107	5.1	1.70	18.5	91	6.98	359	120.2

Children with lead poisoning might got such symptoms as anemia, indigestion, abdominal pain, constipation, or seizures [8]. In this study, 4 cases developed neurological symptoms and 1 case had gastrointestinal symptoms. However, 3 cases did not have obvious clinical symptoms. The elevated BLLs were found on routine examination. So we encouraged that BLLs of children should be monitored at fixed times in developing countries.

$CaNa_2EDTA$ is frequently used for lead chelation in patients under 15 years of age [9]. The general dosage is 1000-1500mg/m^2/day or 35-50mg/kg/day, and the single course of treatment is usually 5 days [2,10]. Since the blood lead levels and urine lead levels may rise temporarily during the treatment of chelation, which may do harm to liver function or renal function. In order to reduce the potential side effects of chelation treatment, we adopted a relatively low dosage of $CaNa_2EDTA$, namely 20mg/kg. The adverse reactions are less. Only 2 cases had a transient increase in alanine aminotransferase, which returned to normal after treatment with reduced glutathione. None of the 8 cases had abnormal renal function. The effects are positive, but it needed at least 3 courses of chelation.

This study yet had some shortcomings. Firstly, there were only 8 cases included. The sample size was small. Secondly, this study was a retrospective study with incomplete clinical data. Abdominal X-ray examinations were not performed in most cases.

In conclusion, lead-containing Chinese herbs is one of the causes of severe lead poisoning in children; lower dosage of $CaNa_2EDTA$ (20mg/kg/d) was an alternative for chelation therapy on severe lead poisoning.

Conflict of interest

The authors declared no conflict of interest.

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