

## Research Article

### Investigation of the Clinical Signs and Symptoms of Lead Poisoning in Patients Referred to Baqiyatallah Hospital, Tehran, Iran in 2016-2017

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#### Abstract

##### Background

Lead poisoning is one of the most important problems worldwide, caused by occupational poisoning and opioid addiction.

##### Materials and methods

This descriptive, analytical, cross-sectional study was performed among patients with lead poisoning, who were referred to Baqiyatallah Hospital of Tehran, Iran during 2016-2017.

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#### Results

The study population consisted of 200 patients, including 32 females (14%) and 168 males (86%), who were referred to the Poisoning Department of Baqiyatallah Hospital during 2016-2017. The blood lead level of patients ranged from 9µg/dL to 180µg/dL. Overall, 18% of patients suffered from muscular weakness (peripheral neuropathy), and 95% had a history of oral opioid use.

#### Conclusion

Based on the findings, lead poisoning should be taken into account in opioid addicts, experiencing abdominal pain and constipation. Considering the high rate of poisoning following the oral use of opioids, it is recommended to refer addicts to addiction treatment clinics and provide them with psychiatric counseling.

#### Introduction

Lead poisoning is one of the most serious problems around the world, which is majorly associated with mental problems in children [1]. This metal and its compounds can be found in different environments. The highest level of lead exposure has been reported among lead mine workers, battery factory workers, printing press workers, automobile mechanics, traffic control officers, and oral opioid users [2].

In recent years, the prevalence of lead poisoning has increased among opium users in Iran. Research shows that every gram of opium contains about 3.55 milligrams of lead [3]. Generally, lead can enter the body through the digestive route, inhalation and, coetaneous absorption. If the level of lead exceeds 20µg/dL in 100mL of blood, a continuum of signs and symptoms may appear depending on its concentration:

- At blood lead levels below 40µg/dL, no specific symptoms appear in adults, whereas mental retardation may develop in children
- Blood lead levels of 40-50µg/dL in children and 40-60µg/dL in adults produce gastrointestinal symptoms such as abdominal pain and constipation, besides blood disorders including subclinical anemia due to the inhibition of red blood cell enzymes. In addition, the Central Nervous System (CNS) symptoms include fatigue, restlessness, slow conduction of motor neurons, and muscular pain
- Blood lead levels of 50-70µg/dL in children and 60-100µg/dL in adults are associated with signs and symptoms, including abdominal pain, constipation, weight loss, loss of appetite, mild anemia, fatigue, decreased concentration, peripheral neuropathy, hypertension, nephrotoxicity, and reduced vitamin D metabolism
- At blood lead levels above 70µg/dL in children and above 100µg/dL in adults, the following signs and symptoms may develop: Abdominal colic, vomiting, severe anemia, encephalopathy, delirium, ataxia, and coma. Hypertension, nephrotoxicity and reduced vitamin D metabolism have been also reported [4-7]

Lead is first transferred to soft tissues and then deposited in the bones. With the aid of radiography and laboratory markers, the poisoning threshold can be identified without any presentations in patients. It should be noted that most symptoms of poisoning are recurrent [8]. One of the common approaches for the detection of lead poisoning is to measure the blood lead level in adults. The blood lead level is generally classified as follows [9,10]: Normal, <20µg/dL; mild poisoning, 20-45µg/dL; moderate poisoning, 45-100µg/dL; and severe poisoning, >100µg/dL.

The main treatment for lead poisoning is the removal of the source of lead exposure. However, in symptomatic cases, chelating agents, such as succimer, dimercaprol (BAL), calcium disodium (CaNa<sub>2</sub> EDTA), and D-penicillamine, can be used [11]. Generally, the first-line drugs for the treatment of lead poisoning include succimer, BAL, and CaNa<sub>2</sub> EDTA, which are very expensive considering the limited financial resources of the Ministry of Health. The only other available drug is D-penicillamine, which is not a first-line treatment for lead poisoning, and few studies have examined its efficacy. There are also several reports of its adverse side effects, such as renal failure, bone marrow dysfunction (leading to leukopenia and thrombocytopenia), and skin complications [12-14].

As mentioned earlier, owing to the increased prevalence of lead poisoning among opium addicts, this type of poisoning has become a major health problem in Iran. On the other hand, treatment with expensive chelating agents has major financial burdens for the health-care system and patients. With this background in mind, due to the scarcity of first-line chelating agents in Iran, we aimed to investigate the signs and symptoms of lead poisoning among patients and to compare the effectiveness of different chelating agents [15].

## Materials and Methods

This descriptive, analytical, cross-sectional study was conducted on all patients with lead-induced poisoning, who were referred to Baqiyatallah Hospital, a governmental hospital in Tehran, Iran, during 2016-2017. The sample size was calculated to be 200, based on the Cochran's sample size formula. Data were collected using a researcher-made data collection form, which was completed based on the patients' medical records. All patients received Chelator therapy. The standard first-line Chelator therapy in Iran is BAL and EDTA, but there are too expensive and have limited source. So we limited them only in severe lead toxicity and in other cases succimer was used and if not available, it would be replaced with D-penicillamine. In all patients, the blood levels of lead, creatinine, and hemoglobin were measured. Blood samples were collected into heparinized and stored at -20°C. Blood lead content was analyzed by atomic absorption spectrometry.

The inclusion criteria for the patients were as follows: 1) age above 18 years; and 2) confirmation of lead poisoning by measuring the blood lead level (>10µg/dL). On the other hand, the exclusion criteria were concurrent poisoning with other drugs and incomplete medical records. Data were analyzed using Chi square test in SPSS version 18.

## Results

The study population consisted of 200 patients; including 32 females (14%) and 168 males (86%), who were referred to Baqiyatallah Hospital during 2016-2017. All patients were admitted at least

24 hours. The majority of patients were in the age range of 35-65 years (84%). The level of hemoglobin ranged from 7g/dL to 13.1g/dL, and the lead level ranged from 9µg/dL to 180µg/dL. In addition, the creatinine level was within the range of 1.1-3.8mg/dL, which is nearly 60% above the normal range; the average creatinine level was 1.8mg/dL.

Based on the findings, 5% of patients had amnesia, and 85% experienced abdominal pain. On the other hand, 18% of patients had muscle weakness (peripheral neuropathy), and three cases had paraplegia. Three patients experienced seizures, while five patients showed ataxia. As the findings indicated, 95% of patients had a history of oral opium use, and 28% consumed opium tincture, which contained lead levels was 12-45µg/dL. 5% of all patients received BAL and EDTA, 35% received succimer and 60% treatment with D-penicillamine. Time provided for the length of D-penicillamine therapy was 2-4 weeks.

The lead levels were measured to be 40-70µg/dL following D-penicillamine therapy. In addition, the lead level was reported to be 40µg/dL after a week of treatment with succimer. Based on the findings, the lead level dropped from 90µg/dL to 73µg/dL after three days of treatment with BAL and EDTA.

## Discussion and Conclusion

While occupational poisoning was recognized as the major cause of heavy metal poisoning in previous years, use of lead-contaminated opioids has recently led to increased lead toxicity [2]. In 2007, Madan K et al., reported the case of a 24-year-old young patient with symptoms of lead poisoning, including digestive and neurological symptoms and anemia. The symptoms of this patient resolved after six weeks of treatment with succimer. In our study, the patients presented with normochromic normocytic anemia, which is consistent with the mentioned study [7].

In the present study, the majority of patients with lead poisoning were male, and their most common symptom was abdominal pain, which is similar to a study by Hayatbakhsh et al., from Kerman, Iran in 2016 [16]. On the other hand, in a study by Farzaneh and colleagues in 2016 from Ardebil, Iran, the most common symptoms were sleep disorder and irritability [17].

In the present study, peripheral neuropathy was the most common neurological manifestation. In a study by Björklund G and colleagues in 2017, concurrent use of BAL and succimer was more effective in the treatment of neurological symptoms, induced by lead, mercury, and other heavy metals [8]. Moreover, Arnold J et al., introduced a case in 2015, which was successfully managed using BAL and succimer; in this patient, the blood lead level dropped from 148µg/dL to 47µg/dL within four days of treatment [12].

According to the Gold frank protocol (2016), the best response to treatment in the event of severe toxicity can be achieved by the use of EDTA and BAL; our patients also responded well to this treatment regimen. Based on our findings, patients with lead poisoning responded well to D-penicillamine treatment, and no major side effects were attributed to this type of treatment. This finding is similar to the study by Farzaneh and colleagues from Ardebil, Iran in 2016, in which all patients were treated with 250mg of D-penicillamine three times a day [17].

Considering the high rate of lead poisoning following the oral use of opioids, it is recommended to refer addicts to addiction treatment clinics and provide them with psychiatric counseling. Overall, lead poisoning should be taken into account in people with oral opioid use, experiencing abdominal pain and anemia. A comparative study is also suggested on the efficacy of D-penicillamine and the conventional treatment regimen.

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