https://doi.org/10.23934/2223-9022-2019-8-3-332-336

A Case of Mass Poisoning with Thallium

M.M. Potskhveriya[1], Yu.N. Ostapenko[1, 2], S.S. Petrikov[1, 3], A.Yu. Simonova[1, 2], L.B. Zavaliy[1], K.K. Ilyashenko[1, 2], T.I. Dikaya[1], M.V. Gayduk[1]*

Department of Acute Poisonings Treatment and Somatopsychiatric Disorders
[1] N.V. Sklifosovky Research Institute for Emergency Medicine of the Moscow Health Department
3 Bolshaya Sukharevskaya Square, Moscow 129090, Russian Federation
[2] Scientific and Practical Toxicology Center of the Federal Medical and Biological Agency
bulding 7, 3 Bolshaya Sukharevskaya Square, Moscow 129090, Russian Federation
[2] A.I. Yevdokimov Moscow State University of Medicine and Dentistry of the Ministry of Health of Russian Federation
20 building 1 Delegatskaya St., Moscow 127473, Russian Federation

*** Contacts:** Anastasia Yu. Simonova, Candidate of Medical Sciences, Leading Researcher of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department. E-mail: simonovatoxy@mail.ru

ABSTRACT We report the results of studies of clinical manifestations, chemical and toxico-logical tests, efficacy of complex treatment, which included antidote therapy, intestinal lavage and symptomatic treatment in patients with acute thallium poisoning, who were admitted to the Department of Acute Poisonings Treatment of the N.V. Sklifosovsky Research Institute for Emergency Medicine or underwent outpatient treatment.

Keywords: acute mass poisoning, thallium, poisoning with thallium, polyneuropathy, al-opecia

For citation Potskhveriya MM, Ostapenko YuN, Petrikov SS., Simonova AYu, Zavaliy LB, Ilyashenko KK, et al. A Case of Mass Poisoning with Thallium. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2019;8(3):332–336. https://doi.org/10.23934/2223-9022-2019-8-3-332-336 (in Russ.)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments The study had no sponsorship

Affiliations

Mikhail M. Potskhveriya	Candidate of Medical Sciences, Head of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0003-0117-8663
Yuri N. Ostapenko	Candidate of Medical Sciences, Leading Researcher of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0002-7578-911
Sergey S. Petrikov	Doctor of Medical Sciences, Professor of the Russian Academy of Sciences, Director of N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, Head of the Department of Anesthesiology, Intensive Care and Emergency Medicine of A.I. Yevdokimov Moscow State University of Medicine and Dentistry of the Ministry of Health of the Russian Federation, https://orcid.org/0000-0003-1141-2919
Anastasia Yu. Simonova	Candidate of Medical Sciences, Leading Researcher of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0003-4736-1068
Lesya B. Zavaliy	Candidate of Medical Sciences, Senior Researcher of N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0002-8572-7094
Kapitalina K. Ilyashenko	Doctor of Medical Sciences, Professor, Scientific Consultant of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0001-6137-8961
Tatyana I. Dikaya	Candidate of Medical Sciences, Senior Researcher of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0002-5800-5133
Maria V. Gayduk	Clinical Resident of the Department of Acute Poisonings Treatment and Somatopsychiatric Disorders, N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, https://orcid.org/0000-0002-4772-0529

INTRODUCTION

Poisoning with thallium compounds, which are widely used in semiconductor technology and in the electrical industry, is uncommon, therefore, each case is difficult from the point of view of diagnosis and treatment, and the prognosis is far from always favorable. The feature of acute or subacute poisoning with thallium compounds is that the moment of poisoning, or ingestion of a toxicant in the human body, often goes unnoticed if there is no clear medical history, and characteristic symptoms appear rather late. In this regard, the diagnosis of thallium poisoning in the early stages presents significant difficulties [1-3]. Often this leads to its use for a criminal purpose. In addition, the ability of thallium salts to penetrate through the respiratory system, intact skin and mucous membranes contributes to the occurrence of group or mass poisoning in the workplace when working with the specified substance without observing safety measures [4].

The first symptoms of poisoning are quite diverse and non-specific, which makes differential diagnosis difficult. Therefore, victims are treated for various gastrointestinal, gynecological, surgical and neurological diseases, which exacerbates the situation and can lead to an unfavorable outcome [5, 6]. And only when a characteristic sign of thallium poisoning, alopecia, appears on the 10-14th day, they turn to a toxicologist [6-8].

The main mechanisms for thallium poisoning are neurotoxic, enterotoxic, nephrotoxic, as well as impaired keratin formation in the hair follicles. Excretion of thallium is carried out through the kidneys and intestines. According to the literature, the lethal dose of thallium when taken orally is 14–20 mg/kg. However, in clinical practice, this information is almost always unknown.

The clinical picture of thallium poisoning: the gastrointestinal tract involvement such as nausea, vomiting, epigastric pain, constipation or diarrhea, manifested 3-4 hours before 1-2 days after taking it. Sometimes there are dysfunctions of the cardiovascular system such as arterial hypertension, tachycardia, heart rhythm disturbance. Disorders of the nervous system function (asthenia, insomnia, tremor, painful paresthesia in the upper and lower extremities, pain in the thigh muscles, chest muscles and joints, as well as cramps and mental disorders) join this symptomatology. At the same time, signs of toxic encephalopathy are increasing. Loss of appetite, fatigue, inadequate behavior, headaches, dizziness, decreased visual acuity and diplopia are often noted. Damage to the central nervous system is usually accompanied by persistent subfebrile condition. In addition to alopecia, there may be changes in the nails: growth retardation, dullness, a yellowish tint and white transverse lines. In severe cases (from 7–10 days to 1–2 months), coma and paralysis of the respiratory and skeletal muscles, damage to the kidneys and liver develop [1, 9].

There is no unanimous opinion of experts on the effectiveness of accelerated elimination methods adopted for metal poisoning: hemodialysis, hemosorption, and the unithiol antidote (sodium dimercaptopropanesulfonate) [1, 10–13]. Moreover, given the presence of the enteroenteric cycle of thallium kinetics in the body, according to the generally accepted opinion in clinical toxicology, enteric detoxification may be effective in this case. For this purpose, intestinal lavage, the use of nonspecific enterosorbent (activated carbon), specific antidotes based on potassium-iron hexacyanoferrate (Prussian blue, "thallium antidote", ferrocyan, ferrocin) are preferred, which are preferred from the point of view view of efficiency [1, 13, 14]. The composition of antidote therapy also includes oral administration of a 3-5% solution of sodium or potassium iodide with the goal of forming poorly soluble thallium iodide compounds, as a result of which its absorption from the intestine is sharply slowed down. In domestic clinical practice, in the treatment of acute thallium poisoning, sodium dimercaptopropanesulfonate (unitiol) is used as an antidote. There is practically no experience of using the domestic preparation of ferrocin as an antidote in Russia, referring to only a few cases (no more than 2-3) without a subsequent assessment of its effectiveness. According to literature data, in case of severe thallium poisoning, hemodialysis is necessary, which contributes to a significant acceleration of its elimination from the body [1, 13, 15].

Objective: to study the clinical picture, diagnosis and effectiveness of the complex treatment of victims of thallium poisoning.

MATERIAL AND METHODS

An analysis of 44 clinical observations of patients with poisoning with thallium compounds of varying severity (32 women and 12 men aged 19 to 50 years) who were admitted to the Center for Acute Poisonings Treatment of the N.V. Sklifosovsky Research Institute for Emergency Medicine. All the victims were examined by toxicologists, consulted by a neurologist, according to indications, some were examined by an ophthalmologist and gynecologist. In addition to routine clinical and biochemical studies, quantitative and qualitative determination of thallium in blood plasma and urine was carried out by inductively coupled plasma spectrometry during the initial treatment of patients in a hospital and again against the background of complex treatment [16].

RESULTS

All the victims worked in Taganrog in the same office building, used the same source of drinking water (office cooler), their professional activity was not connected with thallium in any way. The victims could not provide accurate data on the cause of the poisoning and the route of thallium entry into the body. This gave reason to regard the case as criminal poisoning. One could assume the oral route of entry of the toxicant (possibly with drinking water), approximately 3–3.5 months before going to the toxicological center. Of the 35 patients (79.5%) who sought help, they complained of general weakness, including weakness and pain of varying severity in the limbs, mainly the lower ones. The most common complaints were pain in the chest (29 patients; 65.9%), abdomen (22; 50%), and legs (33; 75%). In addition, patients noted distraction, visual impairment, pain in the epigastric region, menstrual irregularities in women. All had increased hair loss, 3 patients had total alopecia. A 33-year-old male patient could not move independently due to severe pain and weakness in the lower extremities; in addition, a dignificant heart rhythm disturbance similar to paroxysmal tachycardia developed and was managed by cardioversion.

A neurologist examined 30 patients. An objective assessment of the neurological status revealed damage to the motor sphere in only half of them, mainly in the form of lower distal paraparesis. Polyneural sensitivity disorders were found in every second patient mainly in the legs. Impaired coordination was also observed in every second patient. Patients noted visual impairment in the form of a decrease in visual acuity, double vision, headache and dizziness. Every fifth patient was troubled by tremors in their hands. Along with neurological disorders, 28 patients had severe asthenic syndrome. An ophthalmologist examinied 25 patients: an objective assessment of their ophthalmic status revealed retinal angiopathy of toxic genesis in 15 patients (34%).

In addition to neurological and somatic symptoms, some patients with thallium poisoning had psychoemotional disorders that were characterized by syndromic heterogeneity with the development in some cases of astheno-depressive and anxiety-depressive states. Most patients complained of severe emotional disturbances, decreased mood, anxiety, general weakness, increased fatigue, impaired concentration, memory impairment, and sleep disturbance. In order to objectify psychoemotional disorders, 14 patients were offered a questionnaire survey on the hospital anxiety and depression scale *(HADS)*. Of these, 11 victims (78.5%) actively complained of a significant decrease in mood, irritability, tearfulness, emotional lability and a significant decrease in working capacity. Only 5 patients (35.7%) did not show signs of anxiety and depression, while the remaining patients showed psychoemotional disorders. Subclinical anxiety was determined in 2 patients (14.3%). Severe anxiety was recorded in 7 patients (50%), which in 6 patients (42.9%) was accompanied by depression of various degrees of severity, from subclinical forms (3; 21.4%) to clinically expressed (3; 21.4%).

All patients underwent a study of blood plasma and urine for thallium content both upon admission and after complex therapy. Of the 44 applicants, 7 with the highest concentration of thallium in the blood and urine were hospitalized. In the first study, the concentration of thallium in blood plasma exceeded the reference values (0.006-0.72 μg/l) 24 times on average, ranging from 8.3 to 26.67 μg/l, and exceeded the reference values in the urine by 134 times on average, amounting to from 48.72 to 356.1 μg/l (reference values 0.0–1.0 μg /l). Their condition was rated as moderate. Mild poisoning was diagnosed in 23 patients who were recommended outpatient treatment at the place of residence. The thallium level in the blood of these patients ranged from 0.325 to 6.11 μg /l, and in the urine from 2.8 to 68.48 μg/l. In 14 patients, at the time of examination, there were no clinical signs of thallium poisoning. The thallium concentration in these patients was within the reference values. The treatment complex of 7 hospitalized patients included CL using an enteric saline solution in an amount of 4.5 liters (two procedures on the 1st and 2nd day of treatment), on the 3rd day, antidote therapy of ferrocin was initiated with 1 g 3 times a day for 10 days followed by a single whole bowel irrigation session. All patients treated with ferrocin took laxatives daily to better cleanse the intestines, given indications of a tendency to constipation as a side effect of ferrocin. In addition, daily, during the entire period of inpatient treatment, an intramuscular injection with sodium dimercaptopropanesulfonate, 5% 5 ml was administered in all patients. By purpose neurologist performed following therapy: vitamins of group B, the preparations of alpha-lipoic acid, preparations improving microcirculation; 10 days after the start of treatment in the presence of a sensitivity disorder and the absence of pain, anticholinesterase drugs were prescribed for 10 days. For the treatment period, gastroprotective drugs were also prescribed. After the complex treatment, the concentration of thallium in the blood plasma in patients ranged from 1.58 to 9.09 μg/l, a decrease was noted on average by 3.3 times, or by 69.3%. The concentration of thallium in urine ranged from 9.33 to 59.81 g/l, a decrease in average in 6.2 times (84%). There was a subjective improvement in the well-being of patients who were discharged home for outpatient treatment. The duration of hospitalization ranged from 9 to 18 days. When re-examined after a month, patients noted a gradual and persistent improvement in condition. Objectively, there were residual effects of polyneuropathy, improved vision, restoration of the menstrual cycle and a decrease in the intensity of hair loss. For patients who were not hospitalized, treatment was recommended, including ferrocin and other drugs according to a similar scheme for hospitalized.

Thus, the clinical picture of acute thallium poisoning was consistent with the literature and was confirmed by laboratory studies. Due to the lack of data on contact with the toxicant, the treatment and diagnosis and treatment were delayed. The condition of the patients did not require intensive care, as well as hemodyalysis. The complex of therapeutic measures included specific (antidote) (sodium dimercaptopropanesulfonate, ferrocin), whole bowel irrigation and symptomatic therapy. The result of treatment can be assessed as successful, confirmed in addition to improving the health of patients a significant decrease in the level of thallium in blood plasma and urine by 69.3 and 84% respectively. The latter significantly exceeds the result we obtained earlier in the treatment of mass production of thallium poisoning, in which the toxicant concentration in the urine decreased by 51.5% without hemodyalysis and ferrocin and 51.2% when hemodialysis was included in the treatment complex, but without ferrocin [1]. The results obtained allow us to recommend the treatment complex used in our observation for moderate thallium poisoning without the use of extracorporeal detoxification methods.

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Received on 25.02.2019

Accepted on 16.04.2019