

## Pulmonary Embolism Caused by Elemental Mercury

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Intravenous mercury administration is a rare occurrence that is typically associated with accidental injections or suicide attempts. We report the case of a 42-year-old man who attempted suicide by injecting mercury into the left cubital vein. Upon arrival at the emergency department, he was in a state of alcohol intoxication and there were signs of vein puncture and cellulitis in his left arm. He had no respiratory symptoms. A chest x-ray revealed numerous metallic opacities dispersed throughout both lungs. He was admitted to hospital and treated with chelating agents (dimercaprol) and hemodialysis. A month later, the patient returned to the emergency department with respiratory symptoms, and a chest x-ray revealed right pleural effusion.

**Key words:** *Mercury. Pulmonary embolism. Treatment.*

### Introduction

Mercury is a heavy metal which is found in nature in 3 forms: as elemental or metallic mercury (traditionally used in thermometers, barometers, electrical switches, and dental amalgams), in inorganic compounds or mercury salts, and as organic mercury.<sup>1</sup> Exposure to all forms of mercury may occur through any route, as the metal can be absorbed via the gastrointestinal system, the respiratory system, or the dermis.<sup>2</sup> Absorption of elemental mercury via the skin and digestive tract is poor (<0.01%). The principal route is the respiratory tract, as 80% of the inhaled dose penetrates the alveolocapillary membrane when mercury vapor produced spontaneously at ambient temperature is inhaled. In the blood, mercury enters the red cells, where mercury ions form in a reverse oxidation process. Elimination is primarily via urine and feces, although a small amount of mercury vapor may also be eliminated from the lungs.<sup>3</sup> Below we describe the case of a patient who injected elemental mercury into a vein.

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### Embolia pulmonar por mercurio elemental

La administración intravenosa de mercurio es un hecho infrecuente que suele asociarse a inyecciones accidentales o a intentos de suicidio. A continuación presentamos el caso de un varón de 42 años que se administró mercurio intravenoso en la vena cubital izquierda con fines autolíticos. Acudió al servicio de urgencias por intoxicación etílica. Presentaba signos de venopunción con celulitis en el brazo izquierdo y se encontraba asintomático desde el punto de vista respiratorio. La radiografía de tórax mostraba múltiples opacidades metálicas dispersas en ambos pulmones. El paciente fue ingresado y tratado con quelantes (dimercaprol) y hemodiálisis. Al mes acudió de nuevo a urgencias con clínica respiratoria y presencia de derrame pleural derecho en la radiografía de tórax.

**Palabras clave:** *Mercurio. Embolia pulmonar. Tratamiento.*

### Case Description

A 42-year-old male bricklayer with a smoking history of 20 pack-years and moderate alcohol abuse came to the emergency department with symptoms of alcohol intoxication and with pain and erythema in his left forearm. He was hemodynamically stable, afebrile and eupneic, and his vital signs were normal. Arterial oxygen saturation (SaO<sub>2</sub>) breathing ambient air was 98%. Cardiopulmonary auscultation and a neurological examination revealed no abnormalities. The remainder of the physical examination revealed no anomalies other than an erythematous area on the left forearm, hot and painful to the touch and indicative of cellulitis. There were signs of vein puncture and a number of scars in the same arm resulting from previous suicide attempts.

Laboratory analyses revealed no abnormalities of note, and both the hemogram and hemostasis parameters were within normal limits. Markers of kidney and liver function and electrolytes were normal, except for elevated concentrations of lactate dehydrogenase (1052 U/L) and creatine kinase (255.6 U/L). Arterial blood gas analysis (breathing ambient air) gave the following results: PaO<sub>2</sub>, 82 mm Hg; PaCO<sub>2</sub>, 38 mm Hg; pH, 7.40; and SaO<sub>2</sub>, 96.1%. A chest x-ray showed several metallic densities of different sizes in both lung fields, with radiodense areas that depicted the branches of the bronchi in some parts of the lungs (Figure 1). An x-ray of the left arm showed numerous metallic deposits in the cubital fossa, soft tissue, and



Figure 1. Chest x-ray showing numerous metallic densities scattered throughout both lung fields.



Figure 2. Lateral and anterior x-rays of the left arm showing metallic deposits in the cubital fossa, soft tissue, and vasculature.

vasculature (Figure 2). During history taking the patient reported that he had injected 6 mL of mercury into his left arm in an attempt to commit suicide earlier that afternoon.

In view of the alcohol abuse, cellulitis in the left forearm, and possible intravenous mercury poisoning, treatment with intramuscular dimercaprol (3 mg/kg)—as a chelating agent for the heavy metal—and hemodialysis were initiated. Following intramuscular injection of dimercaprol, the patient began to feel nauseous, vomited his food, and complained of heartburn. Heavy sweating and restlessness were also observed. He responded to intravenous administration of metoclopramide, dexchlorpheniramine and ranitidine. During examination, the patient remained hemodynamically stable, with no changes evident in cardiopulmonary auscultation and with SaO<sub>2</sub> of 98% breathing room air.

The patient was transferred to the intensive care unit for monitoring. Hemodialysis was performed the same day, the left upper arm was debrided, and penicillamine (250 mg/6 h) was administered orally. To prevent subsequent reabsorption, 2 incisions were made in the medial and lateral sides of the left forearm under local anesthesia, and substantial amounts of precipitated mercury were extracted. The cellulosic area was then debrided. Samples for microbiological cultures were taken and antibiotic coverage was provided intravenously (amoxicillin–clavulanic acid, 2 g/8 h). The patient's condition evolved favorably in the intensive care unit. He was transferred to the ward after 2 days, and was eventually discharged following psychiatric evaluation.

A month after discharge the patient returned to the emergency service, complaining of symptoms that had begun nearly 4 weeks earlier: cough, dyspnea in response to moderate effort, and right pleuritic pain, with no associated signs of infection. He was found to be hemodynamically stable, with vital signs within normal limits except for tachypnea of 28 breaths/min. The only other abnormality evident was diminished vesicular sounds in the base of the right lung. The only results of note from



Figure 3. Computed tomography slice showing numerous metallic pulmonary embolisms, with deposits in the pericardium and myocardium, and right pleural effusion.

the laboratory tests were elevated lactate dehydrogenase (400 U/L) and fibrinogen (417 mg/dL) concentrations. Arterial blood gas analysis (breathing ambient air) were as follows: PaO<sub>2</sub>, 81.4 mm Hg; PaCO<sub>2</sub>, 38.6 mm Hg; pH, 7.45; and SaO<sub>2</sub>, 96.4%.

A routine chest x-ray showed an organized pleural effusion and the previously identified metallic masses scattered throughout both hemithoraces. A transthoracic ultrasound confirmed the presence of a small organized pleural effusion. A pleural drain removed a few milliliters of bloody pleural fluid with a pH of 6.89 and a hemoglobin count of 8.4 mg/dL. Computed tomography of the chest and abdomen revealed right pleural effusion without signs of nodules or underlying alveolar consolidation; small metallic embolisms in the periphery of both lungs, the pericardium and the myocardium; and a paraseptal bullous pattern in both lungs (Figure 3).

The patient improved spontaneously and no further treatment was necessary. He regularly attends the outpatient clinic for monitoring.

## Discussion

Toxic substances self-administered intravenously with a view to committing suicide or for esthetic reasons (eg, subcutaneous injection of silicone<sup>4,5</sup>) represent a diagnostic challenge. Embolization or hematogenous dissemination of these substances occasionally gives rise to acute or subacute respiratory symptoms that might pose diagnostic problems for a doctor if a patient fails to cooperate with history taking, whether for psychiatric reasons (suicide attempt) or social reasons (voluntary subcutaneous injection of silicone for esthetic reasons without the supervision of health care professionals). Imaging techniques and clinical course are the basis for diagnosis and management of these infrequent syndromes.

Intravenous injection of elemental mercury is rare and has typically been reported in relation to psychiatric and suicidal patients.<sup>6</sup> The clinical picture will depend on the amount injected and the extent to which the metal has been distributed in the tissues. Noteworthy is the fact that most of the patients described in the literature who received intravenous mercury injections suffered relatively few toxic effects, despite the fact that in some cases the dose was high.<sup>7</sup> Many of the respiratory symptoms developing over the short term can be attributed to mercury embolisms trapped in the lung circulation and causing pulmonary embolism and infarction.<sup>8</sup> Cases have been described of patients with chest pain, dyspnea, dry cough, hypoxemia, and altered carbon monoxide diffusing capacity and ventilatory patterns.<sup>9,10</sup> On other occasions, however, patients had no respiratory symptoms, and embolism was revealed in radiographs.<sup>11</sup> Our patient presented with respiratory symptoms that developed 14 days after the intravenous mercury injection, with dyspnea, cough, chest pain, and right pleural effusion evident in a chest x-ray performed a month after discharge. The occurrence of the pleural effusion was probably related to the circulation of small mercury embolisms which would affect the more distal vascular areas of the lung parenchyma, causing posterior necrosis of the lung tissue, and hemorrhaging and edema in the air spaces.

Over the long term, granulomas may develop in response to the foreign bodies or sterile abscesses may appear at the vein puncture site.<sup>2</sup> Mercury can remain in the body for a long time, and the metallic densities can remain visible in chest x-rays for many years, only gradually to disappear.<sup>13</sup> It is believed that this is due to the slow biological oxidation of metallic mercury, leading, in turn, to the formation of soluble deposits that are subsequently excreted through the digestive system, kidneys, and salivary glands.<sup>8,11,14</sup>

The embolism is usually located in the lungs, although in some cases the mercury passes through the pulmonary vasculature and enters the systemic circulation to appear in the right side of the heart and subsequently in the kidneys, liver, intestine, or spleen, where it becomes visible in

radiological examinations.<sup>11,14</sup> In our patient the mercury was detected in the lungs, in the apex of the right ventricle, and in the pericardium and myocardium. This association between intrapulmonary and intracardiac mercury led to our diagnosis of embolism due to mercury.

Treatment with a heavy metal chelating agent can start once systemic absorption of a toxic dose is suspected or confirmed in tests. The most appropriate antidote is dimercaprol (British antilewisite), administered intramuscularly at a rate of 3 mg/kg every 4 hours for the first 48-hour period, every 6 hours for the second 48-hour period, and every 12 hours for a further 6 days.<sup>1</sup> After the first dose, our patient experienced nausea, vomiting, and sweating, all of which were interpreted as adverse reactions to dimercaprol and which responded to symptomatic treatment. As a second option, oral penicillamine was used as a chelating agent for a further 15 days. Clinical course was satisfactory, and no in-hospital medical complications occurred. The patient is currently asymptomatic, despite the fact that metallic densities are still present in his lungs and that residual right pleural effusion has been evident in follow-up radiological examinations.

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