Case Report

Mercury poisoning from artisanal gold mining equipment

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ABSTRACT

Artisanal and small-scale gold mining uses mercury to isolate gold from ore. Although uncommon in the United States, it is more common in poor and undeveloped countries. This practice requires heating mercury, which vaporizes into an odorless gas that can be inspired and absorbed into the blood. Inspired mercury vapors place individuals at risk of acute mercury toxicity and its subsequent chronic sequelae. We report a case of incidentally detected mercury foreign bodies in a 56-year-old male with a prior history of accidental mercury poisoning due to prior contact with artisanal gold mining equipment.

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Introduction

Mercury toxicity can occur through several mechanisms. Mercury exists in elemental (metallic) and organic forms. Several mechanisms of mercury poisoning have been reported, including exposure during school science projects [1,2], broken thermometers or barometers [3], and intravenous injection [4]. Metallic mercury is unique among metals in that it exists as a liquid at room temperature; liquid mercury can evaporate, allowing for the inhalation of mercury vapors [5]. These vapors are easily absorbed into the blood during respiration, leading to widespread effects, including respiratory, gastrointestinal, cardiovascular, renal and neurological manifestations [5,6].

Artisanal gold mining uses liquid mercury to form an amalgam with gold containing ore. Subsequent heating evaporates the mercury, leaving behind the gold contained within the ore [7]. We present the unique case of mercury toxicity in a patient exposed to artisanal gold mining equipment.

Case report

A 56-year-old male presented to the emergency room with chest pain. Computed tomographic angiography of the thorax was performed to rule out pulmonary embolism. The computed tomographic angiography images revealed innumerable millimeter sized metallic foreign bodies scattered throughout the thorax, representing diffuse foreign body deposition (Figs. 1A–C). The largest deposits measured up to 2745 Hounsfield Units in density. A review of the patient’s prior

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Fig. 1 – CT thorax images demonstrating innumerable bilateral millimeter-sized metallic foreign bodies with axial (A) and coronal (B) lung windowing and coronal soft tissue windowing (C).

Upon further questioning, it was found that the patient's father was an artisanal gold miner. Several years ago, the patient's father had died and the patient was tasked with cleaning the father's home and workshop. Shortly thereafter, the patient became acutely short of breath and developed nausea, vomiting, and a severe headache. This required hospitalization where he was diagnosed with mercury poisoning due to inhalation. He was treated with dimercaprol and made a full recovery.

Fig. 2 – Prior PA view right wrist radiograph demonstrating many subcutaneous millimeter-sized metallic foreign bodies.

imaging studies also demonstrated diffuse tiny metallic foreign body deposition (Figs. 2–4).

Fig. 3 – Prior abdominal radiograph demonstrating pulmonary, abdominal and pelvic millimeter-sized metallic foreign bodies. Prior lumbar fusion hardware present as well.
Discussion

Mercury exposure may occur in the inorganic form (metallic, vapor or salt) or the organic form, if bound to a carbon containing molecule [5]. The harmful effects of mercury exposure depend on the type of exposure, as well as the dose and rate of exposure [5]. Organic mercury exposure primarily occurs by the ingestion of contaminated fish [5]. Inorganic mercury exposure primarily occurs with the use of dental amalgams, coal burning and mining [5]. This case describes the accidental exposure of an individual to inorganic mercury in the dust and vapor derived from artisanal gold mining equipment. Artisanal gold mining uses metallic mercury to form an amalgam with gold containing ore. Heating of this amalgam causes the mercury to evaporate and leave behind the gold contained in the ore [7]. The mercury-containing vapor is heavier than air and is odorless, allowing for the undetectable accumulation of mercury in poorly ventilated or low-lying areas [6]. Once inhaled, mercury can dissolve in serum or attach to erythrocyte membranes; it is thus widely distributed throughout the body and can easily pass the blood-brain barrier [5].

Pneumonitis may occur within hours of mercury inhalation, resulting in dyspnea, chest pain and a dry cough; it may be associated with several other symptoms, including fever, chills and headache. Additionally, gastrointestinal manifestations include salivation, pain, nausea and diarrhea. Acute renal failure, tachycardia and hypertension may also be seen [6].

Mercury is detected on radiography and CT imaging as small metallic foreign bodies. The differential includes other small metallic substances, such as barium aspiration, bullet fragments, bismuth, and contrast agents used in lymphangiography, myelograms and hysterosalpingograms [4,8]. It is important to correlate these radiographic findings with patient history to arrive at an accurate diagnosis.

After removing the patient from the site of exposure, patients are treated with supportive measures. Chelation therapy, usually with dimercaprol, is used for high dose mercury exposure [6]. Symptoms may resolve after treatment. However, chronic effects may be present as well, including pulmonary fibrosis and renal impairment. The ability of mercury to cross the blood brain barrier may also lead to chronic central nervous system abnormalities, such as erythema (abnormal irritability and responsiveness to stimulation), tremors, and cognitive and motor dysfunction [5–7].

Mercury exposure in the United States occurs chronically due to contaminated fish consumption [9]. However, the use of mercury in small-scale/artisanal gold mining results in more mercury pollution than any other route of mercury pollution [7]. It is an ancient practice that continues to be used in present day Asia, Africa and South America [7]. As demonstrated in this case report, mercury exposure as a result of small-scale/artisanal gold mining may also be seen in the United States. Therefore, Hg exposure should be considered when multiple metallic foreign bodies are present on imaging studies.

Patient consent

Written consent was obtained directly from the patient.

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