

CASE REPORT

Elemental mercury-induced subcutaneous granuloma. A case report and review of the literature

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The authors report a case of suicidal elemental mercury injection in the antecubital fossa, resulting in granuloma formation, which was treated with delayed resection.

A 21-year-old man presented with a granuloma in the antecubital fossa after a suicide attempt by self-injection of elemental mercury. The patient was treated surgically with excision of the necrotic skin and granuloma under X-ray guidance, with good result. Despite the fact that human exposure to mercury has been ongoing for centuries, the deposition of metallic mercury into the skin and subcutaneous tissue, causing cutaneous granuloma formation is uncommon, with fewer than 100 reports presented in the dermatologic, toxicologic and general medical literature. On the contrary, there is a lack of reports of this soft-tissue injury in the orthopaedic literature.

INTRODUCTION

Subcutaneous injection of elemental mercury is rare and poses a definite health hazard. Clinical signs of systemic mercury toxicity are usually absent (1) unless inadvertent intravenous injection has occurred (2). Direct subcutaneous injection causes local granulomata and abscesses (5). The diagnosis may be difficult if a history of a penetrating injury by objects containing elemental mercury cannot be obtained. In that case it will depend on the examination of the tissue removed by surgery (14).

The treatment should include prompt necrotic skin and granuloma excision under X-ray guidance (2), monitoring for manifestations of acute syste-

mic toxicity (1), a long-term follow-up evaluation and psychiatric consultation and treatment when indicated (14).

We report a case of a suicidal, subcutaneous elemental mercury injection resulting in formation of a granuloma which was treated with delayed resection, without the patient developing any clinical signs of systemic mercury toxicity.

CASE REPORT

A 21-year-old man presented with a 3-year history of a painless, palpable mass over the volar aspect of his left antecubital fossa. There was a clear history of a suicidal attempt by self-injection of an unknown quantity of elemental mercury, which he obtained by breaking thermometers. There was no history of symptoms suggesting systemic mercury toxicity. The patient had already received psychiatric treatment and on admission he was on active military duty.

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Fig. 1. — Preoperative anteroposterior radiograph of the patient's left elbow.

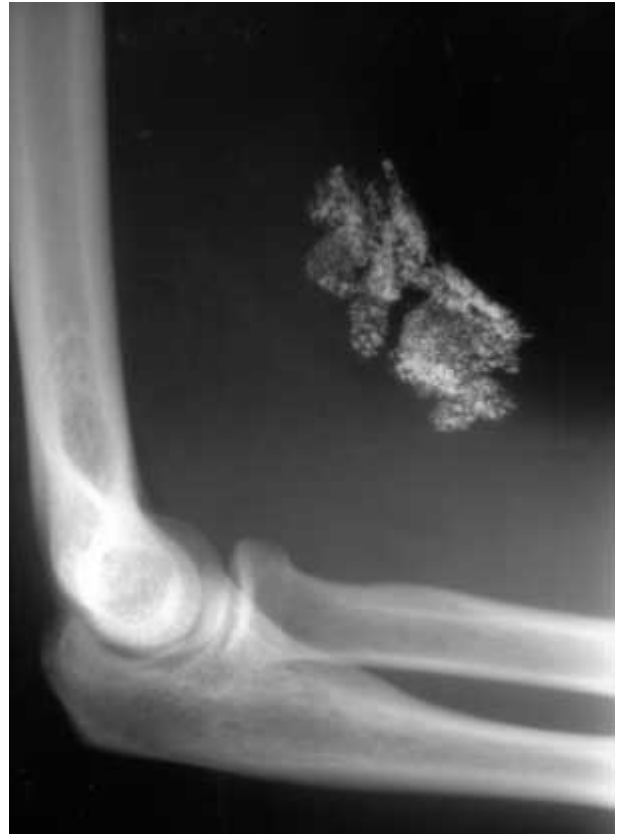


Fig. 2. — Preoperative lateral radiograph of the patient's elbow showing multiple radiopaque particles.

Physical examination revealed a solid mass in the antecubital fossa, measuring about $7 \times 4 \times 2$ cm, which was fixed to the overlying skin. The skin exhibited an area of breakdown and a sinus tract without discharge. There were no signs of acute inflammation around the lesion. The remainder of the physical examination was unremarkable.

X-ray films of the patient's elbow showed multiple radiopaque particles, without evidence of osteomyelitis (fig 1, 2). Chest radiogram was normal, with no evidence of metallic densities in the lung fields. Routine laboratory examinations revealed no abnormalities. The serum mercury level was $0.011 \mu\text{g/ml}$, with normal values reported to be $< 0.2 \mu\text{g/ml}$ (7).

Surgical removal of the necrotic skin, the involved subcutaneous tissue and granuloma was per-

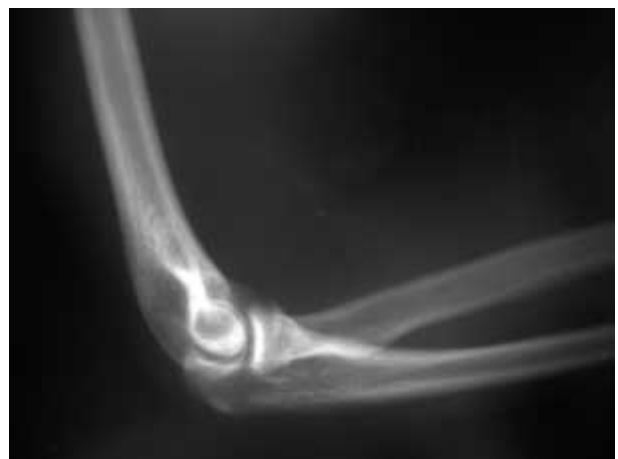


Fig. 3. — Intraoperative lateral radiograph of the patient's elbow at the end of the procedure.



Fig. 4. — Surgical removal of the necrotic skin, the involved subcutaneous tissue and granuloma.

formed under X-ray guidance to ensure complete mercury removal (fig 3). The skin was closed directly.

Grossly, the specimen was oedematous, with tiny silver pellets visualised at the time of surgery embedded in the inflamed tissue (fig 4). Microscopic evaluation of the tissue revealed focal areas of necrosis and granulation tissue formation around dark-gray homogenous pellets.

There were no complications and the incision was healed well three weeks after surgery. The patient was asymptomatic two years following the operation. Subsequent mercury levels were not obtained, since the levels were normal at the time of surgery.

DISCUSSION

Elemental mercury-induced cutaneous granulomas, although rare, with fewer than a hundred reports presented in the world literature (2), have been well described in the dermatologic, toxicologic and general medical literature (15). On the contrary, there is a characteristic lack of reports in the orthopaedic literature, although an orthopaedic surgeon may occasionally be involved in the diagnosis and treatment of these soft tissue injuries (13, 16).

Elemental (metallic) mercury has the unique characteristics of being the only metal existing in the liquid form and capable of evaporating at room

temperature (11). Metallic mercury is used in thermometers, manometers, dental materials and some paints (17).

Mercury exposure can occur in several forms: ingestion, inhalation, injection or topical application (4). Mercury poisoning has variable and multiple manifestations, depending on the route of entry into the body and the subsequent metabolism of its compounds, since they affect different target organs of the human body (9).

While oral intake of metallic mercury is usually of no consequence to the patient's health, subcutaneous or intravenous injection of metallic mercury is always harmful, causing a local abscess and granuloma formation (5). Subcutaneous deposition of metallic mercury may occur by extravasation during attempted IV injection (12) or directly without an intravascular component (5).

A review of the published literature on cutaneous granuloma involving penetration of the skin by metallic mercury revealed that the vast majority of these cases, as in our case, represent a deliberate attempt at injecting the metal, typically with accompanying suicidal ideation (2). More unusual scenarios of deliberate injections of elemental mercury include a previous assault with mercury tipped bullet (2), protection against assault with bullets (10) and misguided attempts to make a boxer's punches "quicker" (8).

Various accidental causes of cutaneous mercury granuloma include injury by a broken mercury thermometer (14, 16), following an anaerobic blood sampling procedure in which mercury was used as a sealant in the syringes (3), dog bite wound (4), repeated application of mercuric ointments and creams to cutaneous wounds (2).

Subcutaneous mercury deposits are also systematically absorbed, sometimes causing pulmonary and visceral organ embolism (5, 6, 8), except in the brain (9). These result in greatest concentrations of mercuric salts in the kidneys, spleen and liver (9) and in elevated serum (5, 6, 9) and urine mercury levels (5, 6, 8, 9), as well as signs and symptoms of mercury poisoning which can have serious and even fatal consequences (6).

Renal tubular epithelium is more vulnerable to the mercuric salts, and acute tubular necrosis may

ensue (9). Despite increased blood and urinary levels of mercury, functional impairment may not be present (10) and signs of systemic toxicity have been reported in only five patients (1).

Surgical excision of the mercury granulomas significantly lowered serum and urine mercury levels (9) or returned them to normal values (5).

The diagnosis of a cutaneous mercury granuloma from metallic mercury can be made easily, if a history of exposure is obtained. In its absence, the diagnosis will depend on the examination of the tissue removed by surgery (14). Often metallic mercury can be seen in the cut section of the excised tissue as dark grey to black globules within the tissue spaces surrounded by collagen necrosis (10) or encased in an eosinophilic capsule-like material (14). A granulomatous foreign body giant cell reaction and a mixed inflammatory cellular infiltrate composed of neutrophils, lymphocytes, plasma cells and occasionally eosinophils are usually present (1, 10).

The gold lysis test (7, 10), scanning electron microscopy findings (2, 10) and emission spikes on energy-dispersive X-ray analysis are specific for the presence of mercury in the surgical specimen (7, 10, 14). On scanning electron microscopy (SEM), the mercury appears as spherical to egg-shaped globules measuring 400 to 900 nm in diameter (2).

The following guidelines for the management of cutaneous injury by metallic mercury are recommended :

1. Pre-operative and postoperative measurement of the mercury levels in blood and urine should be made in all cases, to determine systemic absorption (2, 5, 9, 10, 14).

2. Prompt excision of all accessible cutaneous and subcutaneous tissue containing mercury (2, 9, 12, 14). This is best accomplished under X-ray guidance to ensure complete mercury removal because the metal tends to disperse when the tissue is manipulated (2, 4).

3. There should be appropriate monitoring of the central nervous system, respiratory and renal functions for evidence of mercury poisoning (1, 9). Gastrointestinal complaints are often preminent and consist of a metallic taste in the mouth, thirst,

abdominal pain, nausea, vomiting, haematemesis, constipation or bloody diarrhea and anorexia (1, 4).

4. If poisoning is evident, the use of chelation therapy, although controversial (2), is recommended by some authors (9, 10, 14). Dimercaptol (BAL) intramuscular injection is used for high levels of exposure or acute poisoning, and oral penicillamine, 30 mg/kg/daily in three divided doses (4) for the treatment of subacute or chronic poisoning (14). This scheme of chelation therapy has been administered to patients after intravenous or intra-arterial injection of mercury, but without demonstrable evidence of benefit (2). Boyd *et al* (1) state that "there is no proof that such therapy (chelation) induces significant removal of subcutaneous mercury, and even in patients demonstrating increased elimination, clinical benefit may not be apparent. Treatment with DMSA (2, 3-dimercaptosuccinic acid) or DMPS (2, 3-dimercaptopropane-1-sulfate) is believed to be more useful in such patients."

5. Psychiatric consultation and treatment in those cases of deliberate self-injection either proved or suspected (9, 10, 14).

REFERENCES

1. Boyd AS, Seger D, Vannucci S *et al*. Mercury exposure and cutaneous disease. *J Am Acad Dermatol* 2000 ; 43 : 81-90
2. Bradberry SL, Feldmann MA, Braithwaite A, Shortland-Webb W, Vale JA. Elemental mercury-induced skin granuloma : A case report and review of the literature. *J Toxicol Clin Toxicol* 1996 ; 34 : 209-216
3. Buxton JTJr, Hewitt C, Gadsden RH, Bradham GB. Metallic mercury embolism. *JAMA* 1965 ; 193 : 103-105
4. Cole JK, Holbrook JL. Focal mercury toxicity : A case report. *J Hand Surg* 1994 ; 19 : 602-603
5. Hill DM. Self-administration of mercury by subcutaneous injection. *Brit Med J* 1967 ; 1 : 342-343
6. Johnson HRM, Koumides O. Unusual case of mercury poisoning. *Brit Med J* 1967 ; 1 : 340-341
7. Jun JB, Min PK, Kim DW, Chung SL, Lee KH. Cutaneous nodular reaction to oral mercury. *J Am Acad Dermatol* 1997 ; 37 : 131-133
8. Kern BF, Condo F, Michel SL. Mercury granuloma with systemic absorption. *JAMA* 1972 ; 222 : 88-89
9. Krohn IT, Solof A, Mobini J, Wagner DK. Subcutaneous injection of metallic mercury. *JAMA* 1980 ; 243 : 548-549
10. Lupton GP, Kao GF, Johnson FB, Graham JH, Helwig EB. Cutaneous mercury granuloma. *J Am Acad Dermatol* 1985 ; 12 : 296-303

11. Nakayama H, Shono M, Hada S. Mercury exanthema. *J Am Acad Dermatol* 1984 ; 11 : 137-139
12. Netscher DT, Friedland JA, Gusewicz RM. Mercury poisoning from intravenous injection : Treatment by granuloma resection. *Ann Plast Surg* 1991 ; 26 : 592-596
13. Roden R, Frasen-Moodie A. Self-injection with mercury. *Injury* 1993 ; 24 : 191-192
14. Sau P, Solivan G, Johnson FB. Cutaneous reaction from a broken thermometer. *J Am Acad Dermatol* 1991 ; 25 : 915-919
15. Suchard J, Wallace K, Graeme K *et al.* Cutaneous nodular reaction to oral mercury. *J Am Acad Dermatol* 1998 ; 38 : 784-785
16. Theodorou SD, Vlachos P, Vamvasakis E. Knee joint injury from a broken thermometer. *Clin Orthop* 1981 ; 160 : 159-162
17. Yotsuyanagi T, Yokoi K, Sawada Y. Facial injury by mercury from a broken thermometer. *J Trauma* 1996 ; 40 : 847-849