

Acute Tellurium Toxicity From Ingestion of Metal-Oxidizing Solutions

Mark C. Yarema, MD*‡, and Steven C. Curry, MD*‡§

ABSTRACT. Tellurium is an element used in the vulcanization of rubber and in metal-oxidizing solutions to blacken or tarnish metals. Descriptions of human toxicity from tellurium ingestion are rare. We report the clinical course of 2 children who ingested metal-oxidizing solutions containing substantial concentrations of tellurium. Clinical features included vomiting, black discoloration of the oral mucosa, and a garlic odor to the breath. One patient developed corrosive injury to the esophagus secondary to the high concentration of hydrochloric acid in the solution. Both patients recovered without serious sequelae, which is typical of tellurium toxicity. An awareness of situations in which children may be exposed to tellurium and its clinical presentation may assist clinicians in the diagnosis of this rare poisoning. *Pediatrics* 2005;116:e319–e321. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-0172; tellurium, child, poisoning, metals, garlic.

ABBREVIATIONS. HR, heart rate; RR, respiratory rate; BP, blood pressure.

Tellurium is a naturally occurring element found most commonly as a byproduct from the electrolytic refining of copper. Its main uses are in the vulcanization of rubber (in which it increases resistance to heat, abrasion, and aging) and in alloys of copper, steel, lead, and bronze (by making them more resistant to corrosion). In addition, tellurium is used in metal-oxidizing solutions to blacken or tarnish metals (eg, in jewelry manufacturing). Historically, tellurium was used in the treatment of syphilis and leprosy.

Acute human ingestions of tellurium are rare. The majority of descriptions of toxicity from tellurium are either from intravenous or inhalational exposure.^{1–4} We present 2 cases of toxicity in young children from ingestion of metal-oxidizing solutions that contained substantial concentrations of tellurium.

From the *Department of Medical Toxicology, Banner Good Samaritan Medical Center, Phoenix, Arizona; ‡Department of Emergency Medicine, Maricopa Medical Center, Phoenix, Arizona; and §University of Arizona College of Medicine, Phoenix, Arizona.

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Address correspondence to Mark Yarema, MD, Department of Emergency Medicine, Foothills Medical Centre, Room C231, 1403 29th St NW, Calgary, AB, Canada, T2N 2T9. E-mail: mcyarema@ucalgary.ca
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CASE REPORTS

Case 1

A 20-month-old boy, weighing 11.2 kg, was noted by his father to ingest an unknown quantity of Silver-Black metal-oxidizing solution (Fig 1). There was no child-proof cap on the bottle. His father immediately washed the child's face and hands. The child then experienced several episodes of hematemesis and developed progressive odynophagia, followed by a refusal to swallow. He was taken to the emergency department.

On arrival at the referring hospital 1 hour postingestion, his vital signs were: heart rate (HR), 123 beats per minute; respiratory rate (RR), 22 respirations per minute; oxygen saturation, 96% on room air; and temperature, 36.5°C (97.7°F). Blood pressure (BP) was not measured. His episodes of emesis continued. Burns were noted to his upper and lower lips. No comment was made about discoloration to his oral mucosa. The remainder of his examination was normal. He was rehydrated with intravenous normal saline and transferred to our children's hospital for additional management.

On examination 7 hours postingestion, his vital signs were: BP, 92/73 mm Hg; HR, 126 beats per minute; RR, 24 respirations per minute; and temperature, 36.5°C (97.7°F). His emesis had resolved, and he appeared well hydrated. Burns were noted to his upper and lower lips. A distinct garlic odor to his breath was



Fig 1. Metal-oxidizing solutions ingested by the patients.

noted. The dorsal surface of the tongue was black. The remainder of his examination was normal. A complete blood count, electrolytes, and renal and hepatic chemistry tests were normal.

The patient underwent upper gastrointestinal endoscopy 20 hours postingestion, which showed erosions and exudate of the posterior oropharynx, the esophagus, and the dependent portion of the stomach, consistent with a caustic ingestion.

The patient's dysphagia continued to improve, and he was able to tolerate oral intake over the next 24 hours. The garlic odor and darkened tongue persisted during his hospital stay. He was transferred back to the referring hospital for ongoing care. On telephone follow-up with his parents 7 months later, the child was well, but a garlic odor was still noticeable on the child's breath.

The material safety data sheet for this solution listed its contents as 1.7% tellurium dioxide in 60% hydrochloric acid. The pH was measured to be between 0.5 and 1.5 using pH strips. A blood tellurium level 8 hours postingestion measured by inductively coupled plasma-mass spectrometry was 200 $\mu\text{g/L}$ (normal: $<0.25 \mu\text{g/L}$), and spot urine tellurium concentration was 56 $\mu\text{g/L}$ (normal: 0.2–1.0 $\mu\text{g/L}$). Blood levels of arsenic, selenium, and chromium were normal.

Case 2

A 21-month-old boy, weighing 13 kg, ingested ~2.5 mL of Win-Ox Miracle Oxidizer metal-oxidizing solution that his father kept in the home to blacken jewelry (Fig 1). The father had dispensed some of the liquid into a bowl with a spoon; the patient then ingested the solution from the bowl. He had an immediate onset of coughing and sputtering, followed by repetitive episodes of nonbloody vomiting and refusal to take oral fluids.

He was taken to the referring hospital and examined. His vital signs at the referring hospital 1 hour postingestion were: temperature, 36.7°C (98°F); HR, 90 beats per minute; RR, 32 respirations per minute; and oxygen saturation, 99% on room air. BP measurement was not performed. He was crying and had ongoing vomiting. The physician noted some blisters to his upper and lower lips. There was no comment about any discoloration of the oral mucosa. The remainder of his examination was normal. He was given an intravenous bolus of normal saline and transferred to our children's hospital for additional management.

On examination 7 hours postingestion, his vital signs were: BP, 85/50 mm Hg; HR, 89 beats per minute; RR, 25 respirations per minute; oxygen saturation, 99% on room air; and temperature, 37°C (98.6°F). He was sleeping comfortably with no evidence of stridor or dyspnea. His vomiting had resolved without any treatment. A garlic odor was evident on his breath and throughout his room. No oral burns or blisters were noted on examination of his oropharynx. His lips and tongue were black. The remainder of his examination was normal, as were his complete blood count, electrolytes, and renal and hepatic chemistry tests. The solution that the child ingested was yellow and expressed an acidic, garlicky odor.

He was able to drink fluids without difficulty 16 hours postingestion. Because the contents of the solution were initially unknown and presumably an oxidant, he was observed for an additional 24 hours to ensure that there was no development of hemolysis or methemoglobinemia. He was discharged 40 hours postingestion. At discharge, the black discoloration to his lips and tongue and garlic odor to his breath persisted but had lessened.

The ingested solution was analyzed by inductively coupled plasma-mass spectrometry and was found to contain 5.86% tellurium, 0.07% selenium, and 31.9% hydrochloric acid. The pH of the solution was not measured. A spot urinary tellurium concentration collected on arrival was 260 $\mu\text{g/L}$ (laboratory normal: $<1.0 \mu\text{g/L}$).

DISCUSSION

Elemental tellurium has the appearance and physical properties of a metal but has the chemical properties of a nonmetal or metalloid. Its chemistry is similar to selenium in that it may form compounds in multiple oxidation states, namely, -2 (tellurous), $+2$ (telluride), $+4$ (tellurite), and $+6$ (tellurate).

Clinical features of acute tellurium toxicity include a metallic taste, nausea, vomiting, blackened oral

mucosa and skin, and corrosive gastrointestinal tract injury from acidic solvents. Although tellurium-induced inhibition of sweating has been described, we were unable to locate any objective studies or measurements documenting this symptom in the scientific literature. The discoloration of the oral mucosa and skin is thought to be a result of deposition of elemental tellurium in the dermis and subcutaneous tissue and may involve the webs of the fingers as well as the neck after topical contact.³ Our patients exhibited many of the characteristic features of tellurium toxicity, namely, vomiting, garlic odor of the breath, blackened oral mucosa, and benign clinical course. The caustic injury noted on upper gastrointestinal endoscopy in patient 1 was likely related to the low pH of the solution secondary to the high concentration of hydrochloric acid.

Toxicity from exposure to hydrogen telluride gas is different from other forms of tellurium. Small exposures may result in only mucous membrane and pulmonary irritation. In animals, large exposures to hydrogen telluride have resulted in hemolysis, hemoglobinuria, anuria, jaundice, and pulmonary edema, a presentation similar to toxicity from inhalation of arsine or stibine.⁵

Fatalities from tellurium exposure are rare. Keall et al² reported 3 poisonings in individuals accidentally injected with sodium tellurite during retrograde pyelography. Two of these patients died. Their clinical course before death comprised a garlic odor, cyanosis, vomiting, loss of consciousness, and apnea.

Tellurium, selenium, and, to a lesser extent, arsenic toxicity are characterized by a garlic odor secondary to their respective metabolites (dimethyl telluride, dimethyl selenide, monomethyl and dimethyl arsenic acid). After the ingestion of alcohol, the garlic-breath odor of tellurium has been stated to increase from the formation of ethyl telluride.⁶ The differential diagnosis of tellurium toxicity includes toxicity from selenium and arsenic. Similar to tellurium salts, acute ingestions of arsenic salts or selenium salts also produce emesis and a garlic odor. The corrosive action of the acid solvent commonly used in tellurium-containing metal-darkening solutions could mimic the more severe gastroenteritis and shock accompanying severe arsenic poisoning. Pulmonary edema, coma, respiratory failure, hypotension, and death may be seen in children who accidentally ingest as little as 5 mL of gun-bluing solutions containing 2% selenious acid.^{7,8} A garlic odor may also result from exposures to organic and inorganic phosphorous compounds, lewisite, pyridine, dimethyl sulfoxide, and garlic.

Treatment of tellurium toxicity is supportive. Am-dur¹ reported the use of 2,3-dimercaptopropanol (British antilewisite) for chelation of 3 patients with inhalational tellurium toxicity. However, the diagnosis was delayed for at least 48 hours. By this time their symptoms included only mild headache, epigastric pain, and garlic odor to the breath and sweat. No benefit from chelation in these patients was demonstrated. Ascorbic acid may remove the garlic odor by reducing tellurite and tellurate to elementary tellurium; however, it is not commonly recommended.⁹

Patients exposed to tellurium must be informed that the garlic odor to their breath and urine may persist for several weeks or months after exposure. Reisert¹⁰ reported the persistence of a garlic-breath odor 237 days after ingestion of 3 doses of 5 mg of tellurous oxide over the course of 6 hours. Similarly, Muller et al⁶ reported a persistent garlic-breath odor for 10 months after ingestion of a small amount of meat contaminated with 800 to 1000 $\mu\text{g}/\text{kg}$ of tellurium. His patient also developed temporary alopecia. To our knowledge, alopecia has not been otherwise associated with tellurium toxicity.

CONCLUSIONS

The clinical courses of 2 children accidentally exposed to tellurium in metal-oxidizing solutions are presented. Clinical features included vomiting, black discoloration of the oral mucosa, and a garlic odor to the breath. Both patients had a benign clinical course typical of tellurium toxicity. An awareness of situa-

tions in which people may be exposed to tellurium and its clinical presentation may assist clinicians in the diagnosis of this rare poisoning.

REFERENCES

1. Amdur M. Tellurium: accidental exposure and treatment with BAL in oil. *Occup Med.* 1947;3:386–391
2. Keall J, Martin N, Tunbridge R. A report of three cases of accidental poisoning by sodium tellurite. *Br J Ind Hyg.* 1946;3:175–176
3. Blackadder E, Manderson W. Occupational absorption of tellurium: a report of two cases. *Br J Ind Med.* 1975;32:59–61
4. Shie M. The importance of tellurium as a health hazard in industry—a preliminary report. *Public Health Rep.* 1920;35:939–954
5. Cerwenka EA Jr, Cooper WC. Toxicology of selenium and tellurium and their compounds. *Arch Environ Health.* 1961;3:189–200
6. Muller R, Zschiesche W, Steffen H, Schaller K. Tellurium-intoxication. *Klin Wochenschr.* 1989;67:1152–1155
7. Nantel A, Brown M, Dery P, Lefebvre M. Acute poisoning by selenious acid. *Vet Hum Toxicol.* 1985;27:531–533
8. Carter R. Acute selenium poisoning. *Med J Aust.* 1966;1(13):525–528
9. DeMeio R. Effect of ascorbic acid on the tellurium breath. *J Ind Hyg Toxicol.* 1947;29:393–395
10. Reisert W. The so-called bismuth breath. *Am J Pharm.* 1884;56:177–180

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