



Blue Ridge Poison Center's

# Tox Talks

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## SODIUM MONOFLUOROACETATE (COMPOUND 1080)

### DOES YOUR FACILITY HAVE TELEMEDICINE?

The Blue Ridge Poison Control Center offers CME-accredited toxicology lectures through telemedicine. To request a topic, schedule a lecture for your staff, or more information contact Heather Collier: 434-924-5185 or [HLC8E@virginia.edu](mailto:HLC8E@virginia.edu).

**THE UVA CENTER OF CLINICAL TOXICOLOGY** associated with the Blue Ridge Poison Center manages over 500 patients each year on site in the University of Virginia Health System - from outpatient clinic visits to critically ill inpatients managed in our pediatric and adult intensive care units. In addition, over 2,000 requests are made each year for consultation with our physicians from other healthcare facilities by phone or telemedicine. Our Boarded Medical Toxicologists are internationally known for the expertise in the care of poisoned patients. Call 1-800-222-1222 24 hours a day, every day.

[Cell users: 1-800-451-1428]

### IN CHARLOTTESVILLE

Reminder: At University of Virginia Hospital, the first Wednesday of every month features toxicology Grand Rounds. For more information, contact Heather Collier: 434-924-5185 or [HLC8E@virginia.edu](mailto:HLC8E@virginia.edu)

### Case

A 15 year old attempts suicide by ingesting a pesticide called SMFA that is used by her father, a certified pest remover. She develops nausea, vomiting, and abdominal pain within 30 minutes of ingestion followed by a grand mal seizure one hour later with associated tachycardia (150 beats per minute) and profuse diaphoresis. She is disorientated, demonstrates signs of psychomotor agitation, and over the ensuing 4 hours developed 3 additional grand mal seizures and then became comatose. She recovers, but develops a chronic cerebellar ataxia and computerized topography findings of moderate diffuse brain atrophy.

### Introduction

Sodium monofluoroacetate (also known as SMFA, ratbane 1080, and compound 1080), is a potent rodenticide initially derived from plants that is used commercially against vertebrate species in a number of countries, including the United States, Australia, New Zealand, Israel and Mexico. Although banned from use by the general public in the United States in 1972, it is currently restricted solely to Livestock Protection Collars to protect sheep and cattle from coyotes. There is currently concern for the potential use of SMFA by terrorist groups through the contamination of potable water or food.

### Properties

The synthetic form of the SMFA (CAS # 62-74-8) exists as a white powder (similar in appearance to flour or powdered sugar) that remains stable for long periods of time. It is odorless, tasteless, and readily dissolves into water. It is relatively insoluble in organic solvents such as ethanol or vegetable oils. The only reported distinguishing characteristic is that it has a weak vinegar taste when mixed with water. It is heat stable; it does not decompose until temperatures approach 200° C. SMFA is highly toxic to vertebrates, although the sensitivity of different species varies dramatically.

### **Routes of Exposure**

Compound 1080 is well absorbed from the gastrointestinal tract, the respiratory tract, open wounds, mucus membranes, and ocular exposure. The majority of human exposures reported in the medical literature have been through ingestion. Toxicity has been reported to be the same whether it is administered orally, subcutaneously, intramuscularly, or intravenously. Dusts containing SMFA are effectively toxic by inhalation.

### **Pathophysiology**

The toxicologic mechanism of SMFA involves disruption of cellular energy production resulting in multisystem organ failure. The parent compound, fluoroacetate, has very low cellular toxicity. However, once ingested and absorbed, enzymatic reactions within cells convert fluoroacetate to fluoroacetyl-CoA. Fluoroacetyl-CoA, in the presence of oxaloacetate, is converted by citrate synthase to fluorocitrate, a potent inhibitor of the enzyme aconitase. Aconitase catalyzes the reversible Krebs cycle reaction converting citrate to isocitrate. The inhibition of aconitase results in the interruption of the energy producing Krebs cycle and the buildup of citrate. Fluorocitrate also inhibits transport of citrate in and out of mitochondria, contributing to the buildup of citrate. Elevated citrate levels disrupt energy production via glycolysis by inhibiting the enzyme phosphofructokinase. Elevated citrate levels may also cause life threatening hypocalcemia. Because it takes time for the metabolic conversion of fluoroacetate to fluorocitrate, there is a delay from the time that the poison is ingested to the initial onset of signs and symptoms.

### **Clinical Manifestations**

Clinical signs and symptoms associated with SMFA poisoning are nonspecific. SMFA poisoning is characterized by a latent period of 30 minutes to 3 hours following the administration of the compound by any route. Even massive doses do not elicit immediate responses, although the latent period may be reduced. In animal studies, the early stages of poisoning are typically reported as displaying a range of signs including: lethargy, vomiting, trembling, excessive salivation, incontinence, muscular weakness, incoordination, hypersensitivity to nervous stimuli, and respiratory distress. Early neurological signs include muscular twitches often affecting the face, such as nystagmus and blepharospasm. These then progress to generalized seizures, initially tonic and then becoming cyclically tonic-clonic with periods of lucidity in between. Partial paralysis may be seen that lasts for prolonged time periods. Death typically results from depression of the respiratory center and/or ventricular fibrillation. In a retrospective study of 38 human cases of SMFA poisoning, Chi et al noted the most frequent symptom to be nausea and/or vomiting (74%). Electrocardiograph changes were quite variable ranging from mild nonspecific ST and T wave abnormalities (72%) to ventricular tachycardias and asystole. The most common electrolyte abnormalities included hypocalcemia (42%) and hypokalemia (65%). Seven of the 38 patients died in this series. Discriminate analysis identified hypotension, increased serum creatinine, and decreased pH as the most important predictors of mortality, with sensitivity of 86% and specificity of 96%.

### **Treatment**

There is no specific antidote for SMFA toxicity and therapy is primarily focused at supportive care. A number of different treatments have been explored for SMFA toxicity. Because SMFA induces hypocalcemia, calcium supplementation through administration of either calcium gluconate or calcium chloride has been shown to be of benefit. In animal models, sodium succinate has also been shown to be of benefit as a potential antidote to revive the Krebs cycle, especially when utilized with calcium. All patients with known oral exposure to SMFA should be observed for a minimum of 24 hours following exposure.