



Case #87

NAME Educational Activities Committee

Submitted by:

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And the members of the NAME Ad hoc Forensic Toxicology Committee

Photos courtesy of the Connecticut Office of the Chief Medical Examiner,
Farmington, CT.

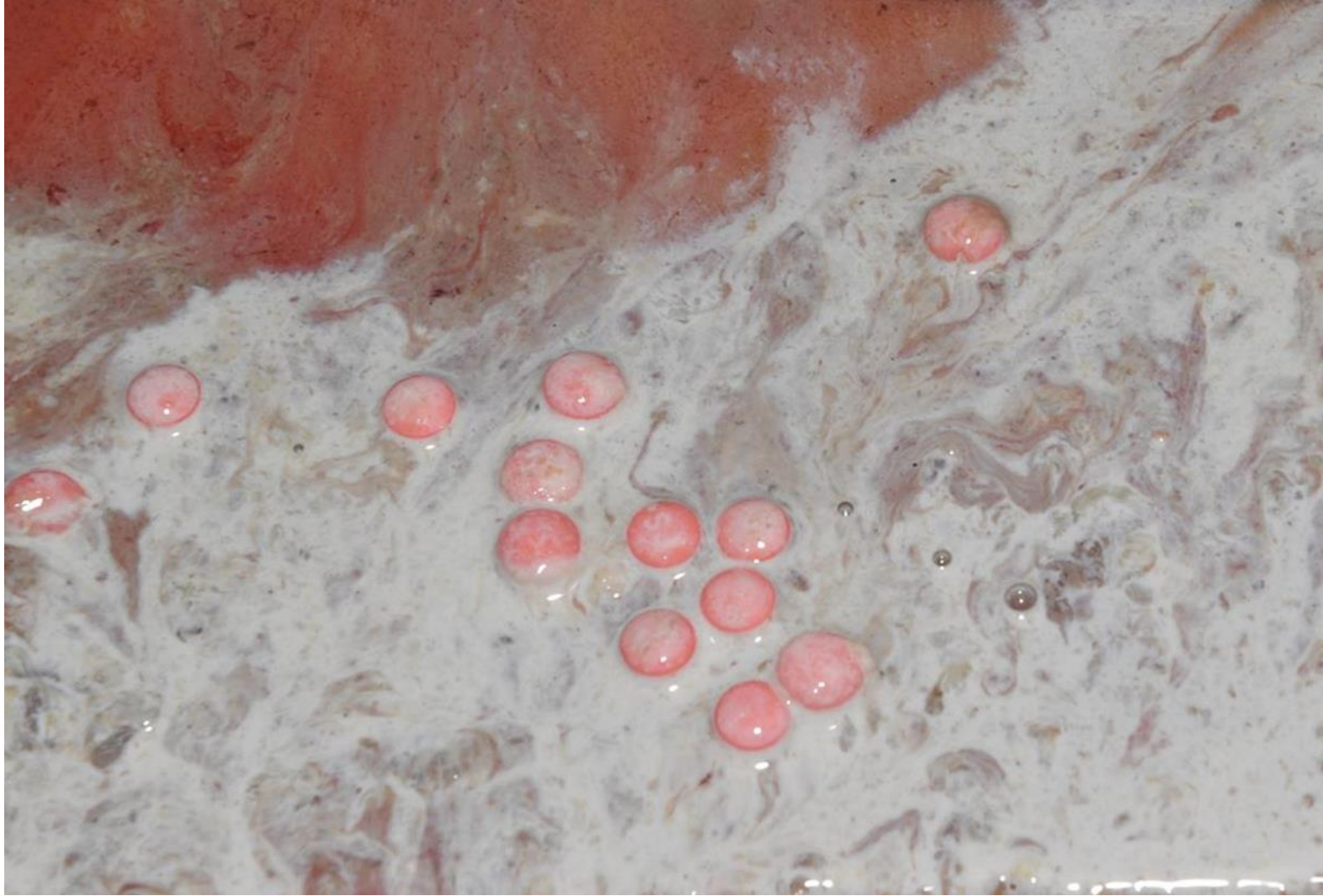


Image 1



Image 2

CASE HISTORY:

A 62-year-old man is found unresponsive in the driver's seat of his parked vehicle. The keys were in the ignition and the battery had been depleted. The center console had empty bottles of losartan and aspirin, and there was a strong chemical odor inside the vehicle. The decedent's son reported that he seemed more depressed lately, but "never did say much because he's a stoic farmer."

At autopsy, opening the stomach revealed approximately 600 mL of thick, white, mucoid contents with multiple partially-digested pink pills (see photographs) and an aroma described by a forensic technician as "pine cleaner or turpentine". Otherwise, the external and internal examinations were essentially unremarkable; there was no discoloration of lividity, respiratory or gastrointestinal tract mucosal erosion/ulcer, hemorrhage, or trauma.

Toxicology testing was performed, with results as follows:

Matrix	Toxicology Results
Peripheral Blood	Amlodipine – presumptive positive Duloxetine – 130 ng/mL Zolpidem – 26 ng/mL Trazodone – 0.46 mcg/mL Volatiles – none detected Carboxyhemoglobin screen – 0% Saturation
Gastric Fluid	Salicylate – 1.5 mg/mL (900 mg) Zolpidem – 0.015 mg/mL (9 mg) Trazodone – 0.24 mg/mL (144 mg) Trazodone metabolite (mCPP) – 0.0007 mg/mL (0.42 mg)

Based on the case history and the completed toxicology results, what additional toxicology testing is most likely to reveal a positive and forensically significant result?

- A. Endosulfan
- B. Brodifacoum
- C. Nitrate/Nitrite
- D. Dichloromethane
- E. Paraquat

Answer...

A. Endosulfan (26.26% responses)

Comprehensive screening by GC/MS on the gastric fluid was performed. The data analyst noted two large peaks, which were identified as α -endosulfan and endosulfan through a library search. The case was certified as a suicide due to acute endosulfan intoxication.

Endosulfan is an agricultural organochlorine insecticide. It is a cream-colored solid in the form of crystals or flakes, which is applied to crops as a spray. It has a distinct odor similar to turpentine. Endosulfan ingestion is highly lethal unless immediate, aggressive treatment is initiated. It is a gamma-amino butyric acid (GABA) antagonist, leading to generalized brain hyperstimulation and seizures. It can also cause metabolic disturbances and cardiac dysrhythmias.

In this case, the endosulfan source was not discovered at the scene. It should be noted that there are many different agricultural pesticides for both plants and insects (organophosphates, carbamates, other organochlorine pesticides, etc.), and a case such as this should prompt a high index of suspicion for an ingested non-pharmaceutical poison, with an understanding that even extensive toxicology testing may yield negative results. Limitations of testing need to be acknowledged, and ultimately a thorough investigation of the death scene or the decedent's home/phone/computer may be more fruitful.

Other responses:

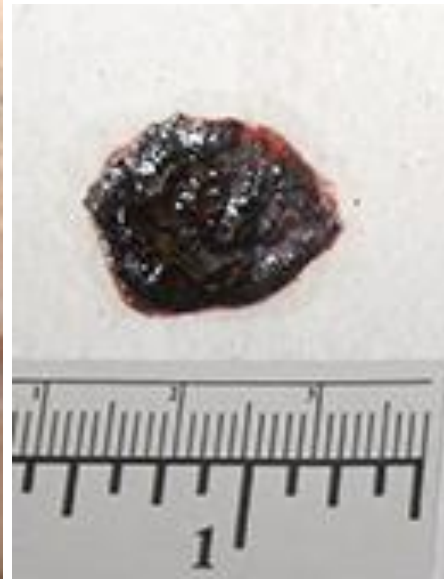
B. Brodifacoum (7.43% responses)

Brodifacoum, like warfarin, is a vitamin K antagonist anticoagulant which can cause internal hemorrhage and shock. Several vitamin K antagonist rat poisons were developed after rodents started showing resistance to warfarin, and currently these alternative anticoagulants are much more common in poison ingestions than warfarin. Rodenticide panels in forensic toxicology can test for short-acting (warfarin, dicumarol) and long-acting (brodifacoum, difenacoum, bromadiolone) coumarins as well as indandiones (chlorophacinone). This decedent did not have hemorrhage or signs of a bleeding diathesis at autopsy.

C. Nitrate/Nitrite (23.61% responses)

Sodium nitrite is a water-soluble crystalline powder that is used as a food additive and preservative, which is readily available to the public through online purchases. It is becoming very well known to medical examiner/coroner offices due to increasing use as an ingestion suicide method.

Excessive nitrates and nitrites can induce methemoglobinemia, metabolic acidosis, and cardiorespiratory collapse. Sodium nitrite is also noteworthy as it is one of the toxic deaths with a relatively frequent and distinct constellation of autopsy findings (see photographs). In postmortem blood, nitrite can be converted to nitrate, and combined nitrate/nitrite concentrations in normal individuals are typically less than 100 $\mu\text{mol/L}$. This decedent did not have any physical findings of sodium nitrite toxicity, and the stomach contents in such cases would not be expected to have a strong odor.



Autopsy findings in acute sodium nitrite toxicity after ingestion of a sodium nitrite mixture. There is dusky blue-gray facial discoloration, pulmonary edema, and dark brown "chocolate" discoloration of a blood spot (left) as compared to a control case (right).

D. Dichloromethane (17.51% responses)

Dichloromethane (also known as methylene chloride) is a colorless, volatile liquid with a sweet odor that is widely used as a solvent, and therefore can be found in multiple industrial products including paint strippers, metal cleaners, automotive products, pesticides, and aerosol containers.

Other than the smell of the gastric contents, there are two pieces of information in the question stem that make dichloromethane an unlikely answer. The first is that dichloromethane is ultimately metabolized into carbon monoxide (CO); the few reports of intentional ingestion describe carboxyhemoglobinemia with saturations up to 35%. The carboxyhemoglobin screen was negative in this case. Second, dichloromethane is frequently formulated with methanol; the absence of methanol from the initial forensic toxicology testing and volatiles panel also makes dichloromethane less likely. The variation in analytical scope for volatiles and special panels in different toxicology labs does, however, highlight a very important principle in postmortem toxicology testing – know what substances the tests do (and do not) cover!

E. Paraquat (25.2% responses)

Paraquat is an agricultural herbicide used worldwide, but primarily available in the U.S. as a blue-dyed liquid with sharp chemical odor (diesel fuel, gasoline, or ammonia-like smell) and an emetic agent to induce vomiting if ingested. Of note, paraquat from outside the U.S. may not have these safeguards. It is caustic and a large dose would be expected to cause some degree of corrosive injury to the oropharyngeal or gastrointestinal lining.

Poisoning could cause death within hours due to acute acidosis and multiorgan injury; however, paraquat is probably best known for its effect on the lungs. With survival intervals, paraquat is selectively accumulated in the lung where it is “redox recycled” (repetitive oxidation and reduction of the molecule), resulting in continuous free radical damage and refractory respiratory failure. Paraquat exposure may be a remote cause of death in someone with pulmonary fibrosis.

Although it is not the “one correct answer” to the question, paraquat is an excellent consideration in an agricultural worker who appears to have died of suicidal chemical ingestion – the color of the gastric fluid combined with lack of vomitus at the scene or gastrointestinal erosion/ulcer at autopsy makes endosulfan more likely.

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