Antifreeze Poisoning: Diagnosis, Treatment & Prevention

Drs. Foster & Smith Educational Staff

Antifreeze ingredients

Antifreeze products usually contain one of three active ingredients:

- Ethylene glycol
- Propylene glycol
- Methanol

Ethylene glycol

Toxicity: Ethylene glycol is the ingredient found in most antifreeze products, usually at a concentration of 95-97%. It is an extremely dangerous toxin. The lethal dose for dogs is 2-3 ml/lb, and for cats it is 0.64 ml/lb. There are 15 ml in a tablespoon, so 2 tablespoons (30 ml) could be lethal for a 15-pound dog, and less than one-half of a tablespoon is lethal to a 10-pound cat. Smaller quantities can still make an animal critically ill. Antifreeze containing ethylene glycol has a sweet taste that animals and children like.

Ethylene glycol is metabolized by the liver. The metabolites that are produced cause damage to organs and the subsequent symptoms. The metabolites (in the form of oxalates) are most toxic to the kidneys. Ethylene glycol causes severe damage to the kidney, termed "acute renal tubular necrosis." Ethylene glycol also changes the pH of the blood to be more acidic (metabolic acidosis). Many brands of antifreeze also contain phosphorus rust inhibitors, which may increase the phosphorus levels in the bloodstream.

Signs of poisoning: There are three stages of ethylene glycol poisoning:

- Stage 1: 0-12 hours after ingestion, nervous system signs develop including mild depression, ataxia, knuckling, seizures, hyperexcitability, stupor, rarely coma, and death. These signs are similar to acute alcohol intoxication and resemble drunkenness. Other symptoms may include lack of appetite, vomiting, drop in body temperature, and an increase in drinking and urination.
- Stage 2: 12-24 hours after ingestion, cardiovascular system signs including increased heart rate and an increased respiratory rate can be seen.
- Stage 3: 12-72 hours after ingestion, kidneys are affected. Symptoms include severe depression, vomiting, diarrhea, dehydration, kidney failure, and death.

Diagnosis: A test kit for dogs is available which detects ethylene glycol, but not its metabolites, in dogs. It is useful within 30 minutes to 12 hours after ingestion. Before or after that time period, a false negative test result may occur because either the ethylene glycol has not yet entered the bloodstream, or it has already been broken down into its metabolites. Peak levels of ethylene glycol in the blood generally occur 1-4 hours after ingestion. To perform the test, various chemicals are added to a blood sample, and if ethylene glycol is present, a color change occurs. This test is not sensitive enough for use in cats. Some human hospitals, or large veterinary hospitals or emergency clinics have more sensitive tests that can be used for cats.

A veterinarian may conduct other laboratory tests to assess kidney function (BUN, creatinine), pH of the blood (blood gases), and look for the presence of oxalate crystals in the urine (urinalysis).

Treatment: If ingestion of ethylene glycol is suspected in a pet, induce vomiting and seek veterinary attention immediately. The veterinarian may continue the induction of vomiting, perform gastric lavage, and administer activated charcoal.

Supportive treatment will be given and may include correcting hydration and the acid-base balance by administering IV fluids and sodium bicarbonate. Oxygen is given as needed. Peritoneal dialysis helps remove the ethylene glycol from the body, if used early.

Fomepizole (Antizol-Vet®, 4-methylpyrazole) is the treatment of choice for ethylene glycol poisoning in dogs. It is given intravenously for 36 hours, and stops the metabolism of ethylene glycol into its damaging metabolites. Ethanol is the treatment of choice for cats and is administered for up to 64 hours. With Fomepizole or Ethanol treatment, starting treatment early before permanent kidney damage occurs, usually within 8 hours of ingestion, is essential. Supportive care may need to be given for weeks. Some veterinarians may refer the pet to a specialized veterinary center for treatment.

Propylene glycol

Propylene glycol is safer than ethylene glycol. Antifreeze products containing propylene glycol, usually at a concentration of 50% or less, such as SierraTM and Prestone LowTox® are safer and are unpleasantly flavored to prevent ingestion. These safer products will not metabolize into oxalate, but could cause other problems including nervous system injury resulting in incoordination and possibly seizures, and Heinz body anemia.

Methanol
For cats and dogs, methanol is the least toxic of the ingredients, however, it is very toxic to humans. Methanol can also be found in some windshield washer fluid. The toxic dose in dogs is 3.6 gm/lb; the toxic dose in cats has not been determined. If only a small amount is ingested, only mild gastric upset is seen. In any case of suspected ingestion, contact your veterinarian immediately. Larger amounts may cause metabolic acidosis, retinal damage, and seizures, requiring immediate veterinary attention.

Prevention of antifreeze poisoning:

- Clean up any antifreeze spills immediately and dispose of any antifreeze-contaminated rags or paper towels in a sealed container.
- Regularly check your vehicle(s) for antifreeze leaks.
- Store antifreeze in sealed, clearly marked containers, out of the reach of children and pets.
- Never allow pets access to the area when draining radiator fluid from a vehicle.
- Use products that do not contain ethylene glycol.
- Do not allow pets to drink out of or walk through puddles as water runoff may contain antifreeze from other vehicles. Wash the pet's paws when finished with the walk.
- Do not let your pet roam.
- If ingestion of antifreeze or engine coolant by a pet is suspected, seek veterinary attention immediately.