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### Ethylene Glycol Poisoning

**VetSpeak. By Linda Aronson, DVM**

In the last column I discussed the importance of getting the correct diagnosis. This is especially vital in the case of the two most common causes of poisoning in dogs, antifreeze and rat poison, where too often the dog is presented too late for the veterinarian to do much to help.

Ethylene glycol is the primary component of most antifreeze and also engine coolant products, and is estimated to cause between 10,000 and 45,000 cases of poisoning in dogs each year. It is also found in various industrial solvents, rust removers, color film processing fluids and heat exchange fluids. Be aware that the so-called safe antifreeze products are not completely safe, and although a dog can consume more before it gets ill, they are still far better avoided.)

Ethylene glycol is rapidly absorbed from the intestines and distributed throughout the body. It reaches maximal blood levels within 1 to 4 hours of ingestion and nearly all will be metabolized and excreted 18 to 24 hours after it was swallowed. As metabolism occurs, the first noticeable effect is that glycol crosses into the brain producing a euphoria and narcotic effect similar to that of alcohol/ethanol consumption – in other words the dog acts drunk. Several of the intermediate products are acidic, causing a metabolic acidosis and immediate damage to the kidneys. Further breakdown produces oxalate that binds to plasma calcium to make calcium oxalate crystals in the blood vessels and renal tubules damaging the latter. This causes an increase in blood urea nitrogen (BUN) within 3 days. The approximate lethal dose of ethylene glycol for a dog is about 4.5 to 6.5 mL/kg or about 9 oz for a 40lb Bearded Collie. However, most antifreeze products are diluted in the car radiator.

It is very hard to diagnose ethylene glycol poisoning from signs alone, so if it is at all possible your dog has drunk antifreeze inform your vet by phone and take him straight to his office. Delaying treatment frequently means the difference between life and death. The substance isn't very irritating to gastric mucosa so dogs rarely vomit. They may appear somewhat drunk between 20 minutes and 6 hours after ingesting antifreeze. (May be sleepy, stagger, weave, stumble and even fall, be uncoordinated, disoriented and have reduced tendon reflexes. The dog will be less responsive and urinating



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excessively as well as being unusually thirsty. Heart and respiration rates may be increased too.)

As the glycol continues to be metabolized more serious signs will replace these about 4 to 6 hours after the dog took the poison. Metabolic acidosis may result in either increased or decreased heart rate and may even cause death due to collapse of the cardiovascular system. Fluid may be heard in the lungs at this point too. Both these initial stages are easily missed by owners if they are unaware the dog might have drunk antifreeze. The dog may even seem a bit off and then appear to recover completely. Sadly this is followed by a rapid deterioration. The dog won't eat, is depressed and becomes hypothermic. He loses coordination and becomes more and more weak. The kidneys fail, and the dog slips into a coma. This is usually when the dog is presented for treatment, but the likelihood the dog will survive the incident has been decreasing since he first swallowed the antifreeze. Important time is lost as the veterinarian searches for a diagnosis. Treatment must be initiated within 8 to 12 hours of ingestion for it to be successful. It is usually started on suspicion rather than proof of poisoning because equipment to test for ethylene glycol and its by-products is rarely available. The dog may be painful in the region of the kidneys on palpation and they may appear swollen on radiographs. Another common finding is elevated blood sugar as the calcium in the blood drops as it binds to oxalate and this inhibits insulin secretion.

If the dog is seen within 2 hours of ingestion inducing vomiting is helpful. Washing his stomach and giving colonic enemas may be tried but the dog must be sedated and there is a risk you could rupture his stomach. Giving large quantities of activated charcoal is usually a better bet. Intravenous fluids to flush the blood should be started immediately. 20% ethanol (5.5mL/kg every 4 hours for 5 treatments and then 4 more treatments every 6 hours) or vodka (usually 37% alcohol so you need less) should be given to compete with the ethylene glycol for the first enzyme in its metabolism. You can administer this orally (via syringe, stomach tube or mixed in palatable food) or intravenously. The unmetabolized ethylene glycol will then be excreted in the urine. There is an FDA approved antidote for ethylene glycol called Antizol-Vet (generic fomepizole). Unfortunately, while much safer than ethanol it is so expensive (veterinarian's cost is \$240 for a vial which would leave little over after treating a single bearded collie sized dog) that few vets keep it in stock. Fluid therapy is essential to maintain urine flow and also for addressing metabolic



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acidosis. Other treatments may also be necessary depending upon the dog's state at presentation.

If a dog survives for a week and is still eating and active it's likely that the kidney damage will not be significant. However, kidney function should be monitored for 6 months after presentation so that damage can be addressed as soon as possible.

Most cases of rat poison toxicity involve the anti-coagulant type poisons. Rodents tend to move inside as the weather gets cooler so fall is a time when you are liable to see this problem. Also many cases occur when owners have recently moved into a new home. Before you move always inspect the new property thoroughly, particularly the kitchen, closets and basement for any suspect substances. Basically these poisons work by inhibiting the recycling of Vitamin K1, a fat-soluble vitamin needed to make clotting factors II, VII, IX and X. Without these factors any little nicks and scrapes in the internal blood vessels (or external injuries) cannot be repaired and the animal will gradually bleed to death. Dogs are usually presented one to three days after eating the poisoned bait. Nosebleeds, difficulty breathing, black stool and pale mucous membranes are the most common signs, but blood blisters, swollen joints and hemorrhaging may be seen too. (If the latter is internal this may be noted as fluid in the belly.)

Prolonged clotting time is characteristic of rat poisoning. Confirmation comes from a reduction in serum levels of the specific clotting factors, and presence of the poison in the serum or liver. The toxic dose varies for the different poisons, so it is helpful if you still have the box to bring it with you when you take the dog to the vet. This helps him/her determine the appropriate dose of Vitamin K1 and the duration of treatment. For example, taking some of the most common types of anticoagulant, warfarin requires 4 to 6 days of treatment, whereas bromadiolone requires 3 weeks and diphacinone and brodifacoum 3 to 4 weeks. Giving the vitamin intravenously can cause an anaphylactic shock and it must be administered subcutaneously or intramuscularly. The smallest gauge needles should be used to prevent excessive bleeding. Giving the vitamin orally in a fatty meal (like canned dog food) increases its bioavailability four or five fold. At the same time, transfusions of fresh, or fresh frozen plasma can be helpful to replenish diminished levels of the clotting factors. Fluid therapy may be needed if there has been substantial blood loss. If the dog has trouble breathing, supplemental oxygen should be given, but if the cause is bleeding



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within the chest cavity, fluid must be withdrawn with a needle through the chest wall. Dogs should be kept warm and quiet to prevent further injury. After Vitamin K1 treatment has been stopped clotting times should be checked after 36 and again 48 hours. This is to ensure that low levels of the rodenticide are no longer present in the body being released from the liver. While it should seem obvious, the property should be carefully checked and all potential sources of poison removed.

Once upon a time the most common presentation for poisoning involved strychnine, now it's usually rat poison or antifreeze. This may be malicious, but far more often it is the result of an accident that should be avoidable with forethought and care. Ethylene glycol tastes sweet and dogs can consume large quantities quickly when it is available. Rat poisons are presented in baits to be taste tempting to rodents, species that are very wary of what they eat. (Actually, if they survive the poison they will never eat any substance again that has made them sick. This means if you are trying to kill rats or mice you need to change the brand frequently to prevent such learning.) Unfortunately, dogs aren't very good at learning from past mistakes, as a friend learned when she called because her dog had consumed a whole chocolate sheet cake last night. Now that's another potential poison – chocolate.