

Rat Poison

ANTICOAGULANT RODENTICIDES AND YOUR PET

Mankind and the rat have been at odds for thousands of years. Rats spread disease, eat our crops, leave droppings and make nests in our storage areas, and infest our homes. Rodent removal services are an important part of pest extermination even now in the 21st century. Rat poison can be obtained in most hardware stores, grocery stores, and even for free from city agencies in some areas. While one may want to get rid of rats, one certainly does not want a hazard to the children or pets of the family. Research continues to create a product that fits this bill but in the meantime one should be aware of the signs of rat poisoning particularly if your pet travels with you to places outside the home where bait may be left out.

There are several types of rodenticides available. The traditional products are called “anticoagulant rodenticides” and are discussed here. If one intends to use a rodenticide we encourage you to choose this type over others as there is a readily available antidote for the anti-coagulant rodenticides. Other rodenticides are more toxic and no antidotes are available.



THE PRODUCTS SHOWN ABOVE ARE ANTICOAGULANT RODENTICIDES.

Typical active ingredients are: brodifacoum, diphacinone, warfarin, bromadiolone, and others. Most of these products include green dyes for a characteristic appearance; however, dogs and cats have poor color vision and to them these pellets may look like kibbled pet food.

Anticoagulant rodenticides do not produce signs of poisoning for several days after the toxic dose has been consumed.

Anticoagulant rodenticides cause internal bleeding. A poisoning victim will show weakness and pallor but bleeding will likely not be obvious externally.

HOW DOES RAT POISON WORK?

To understand what these poisons do, it is necessary to have some understanding of how blood clots. A blood vessel is sort of like a pipe carrying rapidly flowing blood along its path. The “pipe” is lined by smooth flat cells called “endothelial cells” which facilitate the smooth flow of the blood. If the pipe breaks, the structure of the pipe below the lining is exposed to the flowing blood inside. From there the sequence of events is as follows:

— next page —

1. The blood vessel automatically constricts and spasms. This restricts the blood flowing to the damaged area and helps minimize blood loss.
2. The exposed “pipe” attracts circulating platelets, cloud-like cells that circulate ready to assist in clotting should the need arise. Platelets clump together over the tear in the blood vessel forming a plug within the first 5 minutes of the injury. This is all a good thing but the platelets will stay in place unless a substance called “fibrin” can be made to bind them.
3. Platelets have on their surface binding sites for coagulation proteins, which also circulate normally in inactive forms. These coagulation proteins must be activated in order to produce fibrin. There are two ways to do this: a so-called “intrinsic pathway” and a so-called “extrinsic pathway.” There are twelve clotting factors involved between these two pathways and we will not confuse you by reviewing these steps but suffice it to say that calcium is one of the factors as are 4 enzymes called “serine proteases.” It is the serine proteases which are relevant to rat poisoning. The end product of these pathways is protein fiber called “fibrin” which binds the platelets and serves as a scaffolding for the permanent healing of the vessel tear.

ABOUT THOSE SERINE PROTEASES:

Clotting factors are identified by number and the serine proteases (also called “K-dependent” factors for reasons which are about to become clear) are factors II, VII, IX, and X. These factors are produced in an inactive state by the liver and go happily circulating through the bloodstream awaiting activation. When a vessel tears and it becomes necessary to form a clot, these factors are activated in a process that requires Vitamin K (a fat soluble vitamin not as famous as its fat-soluble cousins Vitamins A and E). As the clotting factors are activated, Vitamin K is inactivated but later recycled by another set of enzymes to be ready to participate in clotting factor activation again later.

**As long as there is plenty of Vitamin K,
the serine proteases can be activated and clotting can proceed normally.**

**The anticoagulant rodenticides abolish Vitamin K recycling.
This means that as soon as one’s active Vitamin K reserves are depleted,
there can be no meaningful blood clotting.**

In cases of poisoning one would expect symptoms to be nearly immediate but in the case of anticoagulant rodenticide poisoning, it takes several days to deplete Vitamin K. After that, even the smallest of jostles and traumas can lead to life-threatening bleeds.

SYMPTOMS

Most of the time external bleeding is not obvious and one only notices the pet is weak and/or cold. If one looks at the gums, they are pale. Sometimes bloody urine or stool is evident or nose bleeds may be seen. Signs of bleeding in more than one body location are a good hint that there is a problem with blood coagulation and appropriate testing and treatment can be started.

TESTING

Blood clotting tests of the intrinsic and extrinsic pathways are called the PTT (“partial thromboplastin time”) and PT (“prothrombin time”) respectively. If both of these pathways show disruption, rat poisoning is the most common cause as serine proteases are factors in both pathways. The serine protease called “clotting factor VII” is the least stable of the serine proteases and is involved in the extrinsic pathway. This means that the PT test becomes abnormal before the PTT test becomes abnormal, a fact that is helpful in monitoring treatment.

Another test called the “PIVKA” (“Proteins Induced by Vitamin K Antagonism”) test is more specific. The PIVKA test detects inactive serine proteases. If an unusually high amount of inactive serine proteases are circulating that would indicate something is wrong with Vitamin K recycling.

THERAPY

If the patient has only just ingested the poison, he or she may be made to vomit it up. Cathartics and adsorbants can be used to prevent the poison from entering the patient’s system. Still, it is prudent to use the antidote anyway. Certainly, if there is evidence that the patient is bleeding, the antidote obviously is required.

The antidote is simply Vitamin K.

Vitamin K is generally started as an injection and when the patient is stable. Tablets are prescribed. The human formulation, available at most drug stores by prescription, is a 5mg tablet. The veterinary strength is a 25mg tablet. Blood transfusions may be needed to stabilize a patient who has suffered significant blood loss.



Bags of packed red blood cells are ready for shipping at the Northwest Veterinary Blood Bank.

There are many blood banks available for pets plus many animal hospitals keep blood donors and/or do their own blood banking.

There are different classes of anticoagulant rodenticides and they remain in the body for several weeks. It is hard to know when to discontinue therapy, especially if the particular rodenticide is not known. After a couple of weeks of therapy, medication is discontinued. Forty-eight hours later a PT test is run. If there is still rodenticide in the patient’s system, the PT will be abnormal but the patient will not yet have started to bleed. The results of the PT test will tell the veterinarian whether or not another couple of weeks of Vitamin K are needed.

**It is very important to return for the recheck PT test on schedule.
Waiting an extra day or two will allow internal bleeding to recur.**

**There is no point to doing the PT test while the patient is still taking Vitamin K.
The test must be done 48 hours after discontinuing the medication.**

When the PT test has returned to normal it is safe to discontinue therapy.

VITAMIN K1 VS. VITAMIN K2 VS. VITAMIN K3

There are three forms of vitamin D but only Vitamin K1 is used therapeutically. Vitamin K1 is a natural form of Vitamin K which is found in plants and absorbed nutritionally. Its more technical name is "phylloquinone." Vitamin K2("menaquinone") is also natural and is produced by one's intestinal bacteria but apparently not in amounts adequate for rescue from the anticoagulant rodenticides. Vitamin K3 ("menadione") is a synthetic version which may be injected or taken orally. You may even see it available as a vitamin supplement tablet.

Within the body Vitamin K1 and Vitamin K3 are converted to Vitamin K2. Vitamin K3 might seem like an inexpensive way to treat a pet with rat poisoning but unfortunately, K3 is sometimes toxic and can actually lead to red blood cell destruction. Inexpensive Vitamin K3 pills on the drugstore shelf for over-the-counter sale are not acceptable antidotes. Vitamin K1 is used because it is absorbed early in the GI tract and concentrates directly in the liver which is where the serine proteases are activated. It is only Vitamin K1 which should be considered to be the antidote for anticoagulant rodenticide poisoning.

OTHER RODENTICIDES

While anticoagulant rodenticide poisoning is a life-threatening event, at least there is an antidote readily available. Other rodenticides are not as readily reversed. Other rodenticides on the market include:

- Vitamin D Analogs (Rat-B-Gone, Quintox)
- Bromethalin
- Strychnine (gopher bait)
- Zinc Phosphide (gopher bait)

THE PET THAT EATS THE POISONED RODENT

We are commonly asked about the risk to a cat or dog who eats a rodent that has been poisoned with an anticoagulant rodenticide. The rodent might have already died or simply not have died yet given that several days are required to feel the effect of these poisons. The fact is that when one is talking about the newer generation anticoagulant rat poisons such as diphacinone, the risk is very real. A greedy rat can eat enough poison to kill 20 rats before he starts to feel sick and if a dog or cat eats the rat, the poison is transferred. The good news is that most rats are not this greedy and do not overindulge this much. The usual patient for secondary poisoning is a pet (or predator) that depends heavily on rats for food (a barn cat, for example). If a long acting anticoagulant rodenticide is used and the pet eats multiple rodents a problem could certainly occur. There is some controversy over how often this actually happens as most pets do not consume numerous rats.



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