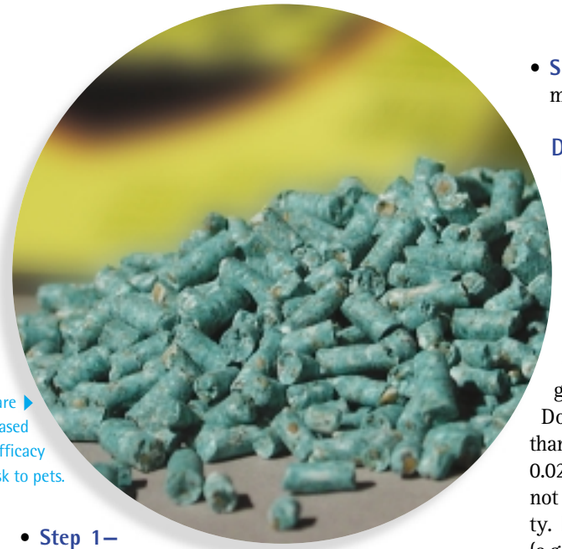
ANTICOAGULANT RODENTICIDES—

Now More Toxic to Pests and Pets

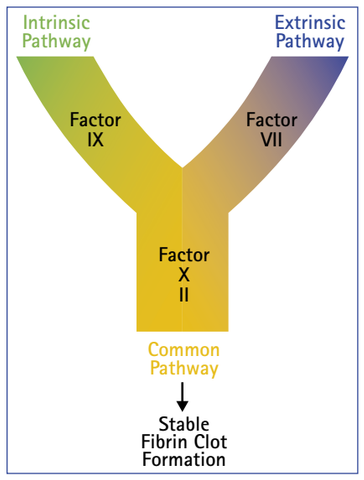


Newer anticoagulant rodenticides are more effective than warfarin-based products, but this improved efficacy also poses a greater risk to pets.

Margaret Moorman, CVT

Anticoagulant rodenticides are commonly used to kill rats and mice in homes, garages, barns, and storage buildings. Warfarin, discovered in the 1940s, was the first anticoagulant. Multiple ingestions of warfarin are generally required to cause intoxication in the rat or mouse, and the effects typically last for 2 weeks in dogs and cats.

Newer anticoagulants (e.g., pindone, chlorophacinone, brodifacoum, bromadiolone, diphacinone) are more toxic and longer lasting. Only a single feeding of these can cause signs, and the effects in dogs and cats last 3 to 4 weeks or longer.[1]



▲The basic clotting cascade

MECHANISM OF ACTION

Anticoagulant rodenticides cause the affected animal's blood to lose the ability to clot. Anticoagulants inhibit the enzyme vitamin K epoxide reductase so that vitamin K cannot be recycled or regenerated by the body.[2] There are four clotting proteins in the body that require vitamin K: II, VII, IX, and X. Factor VII has a half-life of 6.2 hours, so it and the extrinsic pathway will be affected first if enough rodenticide has been ingested. Prothrombin time (PT) tests the extrinsic pathway (normal PT time is generally 6 to 12 seconds[3]), so it is the best test for early detection of anticoagulant poisoning. The presence of circulating clotting factors that were produced prior to poison exposure is the cause of the delayed onset of signs (usually 3 to 5 days after ingestion[4]).

ASYMPTOMATIC PATIENTS

Calculating a Dose

In order to determine whether a dog or cat ingested a toxic amount, it is useful to calculate the dose of the anticoagulant involved:

- **Step 1—** Assume the worst-case scenario. What is the most that the animal could have consumed?
- **Step 2—**Multiply the percent of active ingredient by 10 to get the mg of active ingredient per gram of rodenticide.
- **Step 3—**Multiply mg/g by the amount of rodenticide ingested in grams.
- **Step 4—**Divide by kg of bodyweight to determine the dose ingested.

For example, a 20-lb dog ingests part of a box of brodifacoum rat bait weighing 0.88 oz. The concentration of the bait is 0.005%. The owner cannot say how much of the bait was left because she threw the box away, but she does not think the dog could have ingested more than 1 to 2 teaspoons.

- **Step 1—**The worst-case scenario is 0.88 oz (1 oz = 28.4 g; therefore, 0.88 oz = 25 g of bait).
- **Step 2—**0.005% x 10 = 0.05 mg active ingredient per gram of bait
- **Step 3—**0.05 mg/g x 25 g of bait = 1.25 mg active ingredient in 0.88 oz of bait
- **Step 4—**1.25 mg/9.1 kg = 0.14 mg/kg of bodyweight

Decontamination and Laboratory Testing

For any anticoagulant other than warfarin, start decontamination when suspected doses of 0.02 mg active ingredient/kg bodyweight or higher were ingested.[a] For warfarin, start decontamination when suspected doses of 0.5 mg active ingredient/kg or higher were ingested.[a] Dogs and cats that ingest doses less than 0.5 mg/kg of warfarin or less than 0.02 mg/kg of other anticoagulants are not expected to develop signs of toxicity. If there are no contraindications (e.g., seizure disorder, lethargy, megaesophagus) and the exposure occurred within 2 to 4 hours, induce emesis using apomorphine or 3% hydrogen peroxide and give activated charcoal, which binds to the poison and prevents it from being absorbed into the system as it moves through the intestinal tract. If the exposure occurred within 4 to 8 hours, it may still be beneficial to give activated charcoal. With any exposure, run a baseline PT and repeat at 48 and 72 hours.[1] In cases in which the amount or time of ingestion is unknown, supplementation with vitamin K_1 can be started immediately; however, a PT should be run 48 and 72 hours after the last prescribed dose of vitamin K_1 to ensure that the animal is not still affected by the rodenticide. Be aware that giving vitamin K_1 can make a PT test appear normal, so a 48-hour lag time between giving vitamin K_1 and pulling blood for a PT is recommended. The recommended dose of vitamin K_1 is 3 to 5 mg/kg daily PO, divided into two to three doses and given with a small, fatty meal (such as canned food) to increase absorption. Although vitamin K_1 can be administered parenterally, the bioavailability and onset of action of oral vitamin K_1 is roughly the same as that of the parenteral form and is less likely to cause anaphylaxis.[1] The injectable form can be given subcutaneously or intramuscularly but is not currently labeled for intravenous use due to the number of anaphylactic reactions seen.[5]

SYMPTOMATIC PATIENTS

Clinical Signs of Toxicosis

Healthy adult animals usually do not become symptomatic until 3 to 5 days after exposure due to a stored supply of clotting factors,[4] although signs have been noted within 1 day. The signs relate to the body's inability to clot and depend on where the bleeding occurs. Acute death is usually a result of bleeding into the cranium or thorax. More common signs are lethargy, anorexia, or pale mucous membranes. Other signs include dyspnea due to lack of oxygen secondary to anemia or bleeding into the lungs, hematemesis or hematochezia due to bleeding into the intestinal tract, and lameness or stiff, swollen joints because of bleeding into joint capsules or around joints. In addition, ecchymosis or petechiation may be seen when subcutaneous bleeding occurs.

Toxicity

AGENT	ACUTE ORAL LD_{50}[a] Dog	Cat
Brodifacoum[1]	0.25–3.6 mg/kg	25 mg/kg
Bromadiolone[3]	0.5–15 mg/kg	25 mg/kg
Chlorophacinone[3]	3–20 mg/kg	15 mg/kg
Diphacinone[1]	3 mg/kg	15 mg/kg
Pindone[3]	5–75 mg/kg	Not available
Warfarin[1]	5–50 mg/kg	5–50 mg/kg

[a]LD_{50} values indicate 50% death in a population of animals. Severe intoxication does occur at oral dosages below the LD_{50}.

Treatment

In a symptomatic animal, fresh frozen plasma or whole blood may be necessary to support the animal until the new clotting factors are produced. New clotting factors will start to form 6 hours after administration of vitamin K_1. Keep the patient warm and quiet until stabilized, and use oxygen if necessary in animals that are severely dyspneic. A chest tap may be necessary if blood accumulation occurs in the pleural cavity. Anticoagulants are highly protein bound. Therefore, highly protein-bound drugs, such as furosemide, corticosteroids, and some sulfonamides, should be avoided to prevent worsening of the clinical signs.

HOME CARE

There are several instructions for the owner after the dog is released from the hospital:

- It is recommended that vitamin K_1 be given with a fatty meal, such as canned dog or cat food.
- Restrict exercise until the final PT has confirmed that the animal is no longer affected by the anticoagulant. This is especially pertinent for very active dogs. Leash walks with no heavy play are recommended to prevent any injury that may cause bleeding.
- Vitamin K_1 must be given until the prescription is finished, even if the animal's appearance and behavior is normal.

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[a]Doses are based on information gathered from the ASPCA Animal Poison Control Center database.

Toxicology Brief is contributed by veterinary technicians at the American Society for the Prevention of Cruelty to Animals–Animal Poison Control Center, 1717 S. Philo Rd., Suite 36, Urbana, IL 61802; hotline: 888-4ANI-HELP (888-426-4435) or 900-680-0000 (a $45 consultation fee is charged to the caller's telephone bill); email: callen@napcc.aspca.org (for nonemergency information only); web site: www.apcc.aspca.org.

REFERENCES

1. Beasley VR: *A Systems Affected Approach to Veterinary Toxicology*. Urbana, University of Illinois Press, 1999, pp 910–917.
2. Dorman DC: Anticoagulant, cholecalciferol, and bromethalin-based rodenticides. *Vet Clin North Am Small Anim Pract* 20(2): 339–352, 1990.
3. Hare WR: Rodenticides. *Proc Annu Fall Conf Short Course Vet*, 1995.
4. Sheafor S, Couto C: Clinical approach to a dog with anticoagulant rodenticide poisoning. *Vet Med* 94(5):1–5, 1999.
5. Burgess TM, Meyer EK: Practitioner report involving intravenous use of vitamin K_1 prompts label review and revision. *JAVMA* 218(11):1767–1770, 2001.

About the Author

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