The Veterinarian's Guide

to accidental rodenticide ingestion by dogs & cats

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NOTE: The information in this brochure does not represent labeling and does not replace information on rodenticide labels relating to exposure of non-target species to anticoagulants.

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Preface

This brochure addresses the problem of accidental rodenticide ingestion by dogs and cats. It is intended to be of help to veterinarians faced with treating rodenticide-poisoned animals and is based on the research and experience of leading experts in the fields of rodent control and veterinary science. This revision of the guide includes new brands in the marketplace and additional toxicity information.

Despite efforts by all parties concerned to reduce the risk of accidental poisonings by improving product labels, packaging and use patterns, such incidents continue to occur. The US Environmental Protection Agency now requires rodenticides marketed to consumers to be pre-packaged with tamper-resistant bait stations [32], which is expected to significantly reduce the potential for exposure to both children and pets. The new EPA rules also limit the types of rodenticide that may be sold to consumers, which is intended to further reduce the risks to children and pets, and also the potential risk to non-target wildlife from primary exposure (direct eating of bait) or secondary exposure (feeding on poisoned or dead rodents). Even with these precautions, veterinarians will continue to play a vital role in case diagnosis and saving animals exposed to rodenticides.

Recent work indicates that multiple exposures to anticoagulant rodenticides, over the course of multiple days, result in greater toxicity than is reflected by the standard single-dose acute oral toxicity LD_{50} test [33]. Veterinarians should consider this factor, especially for secondary exposure to dogs, cats and wildlife. Even though the amount of rodenticide contained in a poisoned rodent is small, repeated consumption over a prolonged period may result in toxicity to the predator or scavenger.

This brochure is intended to help veterinarians understand the differences in toxic action between the various active ingredients. Tables 1 and 2 (pages 2 & 3) compare the acute toxicities of first- and second-generation anticoagulant rodenticides for dogs and cats. A table is also included outlining recommendations for treatment of rodenticide poisoning. This edition includes updated active ingredient trade names in the tables and corresponding footnotes to better reflect brands now found in the marketplace.

Preparation of the first edition of the 'Vet Guide' would not have been possible without special input from W. Jean Dodds, D.V.M. and Stephen C. Frantz, Ph.D. who served as Chief of Laboratory of Hematology and Rodent & Bat Specialist, Wadsworth Center for Laboratories and Research, New York State Department of Health (NYSDH) respectively at the time of these studies. Dr. Dodds received many awards for excellence in the field of veterinary medicine and has published more than 150 papers in the field of blood disorders. Dr. Frantz conducted research and taught rodent behavioral ecology and integrated pest management in the United States and abroad. He was technical consultant for Center for Disease Control's (CDC) Federal Rat Evaluation Laboratory. Drs. Dodds and Frantz have also conducted research on poisoning of animals by anticoagulant rodenticides; the clinical data and recommendations reported here are drawn largely from their work.

We also wish to express our appreciation to those people who have reviewed this brochure and for their valuable comments, including R. O. Baker, R.A. Green, P.L. Hegdal, W.W. Jacobs, R.E. Marsh, M.E. Mount and V. Perman. Special credit is due Keith Story for his overall guidance and editorial input. We'd also like to acknowledge Dr. Cheryl Roge for her expertise and assistance with the most recent updates to this guide.

Liphatech, Inc. has sponsored the production of this brochure as a service to veterinarians. As a leading developer and marketer of first- and second-generation anticoagulant rodenticides, as well as other rodent control products, we are committed to helping achieve effective and safe rodent control worldwide. By providing this information to veterinarians, we hope it will help maintain the good safety record, not only for our innovative rodenticides, but for all anticoagulants. While veterinary skills, if applied in time, can prevent most animal deaths, we recognize our responsibility to continue product improvements and user education aimed at minimizing exposure incidents. We thank everyone who, through their guidance and research efforts, made this brochure possible.

Table 1

Acute Oral Toxicities (LD_{50}) of Anticoagulant Rodenticides to Dogs

Generic Name (Active Trade Name[a])	LD_{50} of Active Ingredient (mg/kg)[b]	Usual % Active Ingredient in Bait	Quantity of Bait to Give LD_{50} in 10 kg (22 lb) Dog	Source of Data for LD_{50} Info *(see Endnotes)*
brodifacoum (d-Con®, Final®, Havoc®, Jaguar®, Ratak®, Talon®-G, Weatherblok® XT)	0.25-1.0 0.25-2.5 1.09-3.6	0.005[c]	50 g (1.8 oz) to 720 g (25.4 oz)	4, 5, 20 15 13
bromadiolone (BootHill®, Brigand™, Contrac®, Hawk®, Just One Bite®, Kaput® Doom, Maki®, Ratimor®, Ratoxin®, Resolv®, Revolver™)	11-15[d] 15-20 15-20 8.1	0.005	2,200 g (77.6 oz) to 4,000 g (141.1 oz)	14 2, 29 24 30
chlorophacinone (A-C Formula 90™, Borderline™, Rozol®)	50-100 50-100 50-100	0.005	10,000 g (352.7 oz) to 20,000 g (705.5 oz)	29 22 29
difenacoum (Di-Kill®, Multi-Kill®, Sorexa™)	50	0.005	10,000 g (352.7 oz)	19
difethialone (BlueMax™, d-Con®, FastDraw®, FirstStrike®, Generation®, Hombre™)	4 11.8	0.0025	1,600 g (56.4 oz) to 4,720 g (166.5 oz)	17 31
diphacinone (Ditrac®, Kaput®-D, Ramik®, TomCat®)	0.88 3.0-7.5 5-15	0.005	176 g (6.2 oz) to 3,000 g (105.8 oz)	21 18, 27, 29 6, 9, 23
warfarin (Kaput®, Rodex™)	20-50[e]	0.025	800 g (28.2 oz) to 2,000 g (70.5 oz)	7, 8, 20, 28

Table 1 Footnotes

- **a.** See the inside of the front cover for additional information regarding trademark ownership and affiliation.
- **b.** Underscored LD_{50} range used in calculating 'Quantity of Bait to Give LD_{50} in 10 kg Dog.'
- **c.** This active ingredient is also available in .0025 (100 g to 1,440 g to reach LD_{50} in 10 kg dog.)
- **d.** This is derived from a study which was not designed to obtain an LD_{50}.
- **e.** This LD_{50} range was originally established by the U.S. Fish and Wildlife Service, 1949.

Table 2

Acute Oral Toxicities (LD_{50}) of Anticoagulant Rodenticides to Cats

Generic Name (Active Trade Name[a])	LD_{50} of Active Ingredient (mg/kg)[b]	Usual % Active Ingredient in Bait	Quantity of Bait to Give LD_{50} in 2 kg (4.4 lb) Cat	Source of Data for LD_{50} Info *(see Endnotes)*
brodifacoum (d-Con®, Final®, Havoc®, Jaguar®, Ratak®, Talon®-G, Weatherblok® XT)	25	0.005[c]	1,000 g (35.3 oz)	3, 5, 20
bromadiolone (BootHill®, Brigand™, Contrac®, Hawk®, Just One Bite®, Kaput® Doom, Maki®, Ratimor®, Ratoxin®, Resolv®, Revolver™)	25[d]	0.005	1,000 g (35.3 oz)	1
chlorophacinone (A-C Formula 90™, Borderline™, Rozol®)	unknown	0.005	--	--
difenacoum (Di-Kill®, Multi-Kill®, Sorexa™)	100	0.005	4,000 g (141.0 oz)	19
difethialone (BlueMax™, d-Con®, FastDraw®, FirstStrike®, Generation®, Hombre™)	>16	0.0025	1,280 g (45.2 oz)	25
diphacinone (Ditrac®, Kaput®-D, Ramik®, TomCat®)	5-15 15	0.005	200 g (7.1 oz) to 600 g (21.2 oz)	6, 9, 23 3
warfarin (Kaput®, Rodex™)	5-50[e] 6-40 200-300 2.5 - 20	0.025	20 g (0.71 oz) to 2,400 g (84.7 oz)	7, 10 20 9 16

Table 2 Footnotes

a. See the inside of the front cover for additional information regarding trademark ownership and affiliation.

b. Underscored LD_{50} range used in calculating 'Quantity of Bait to Give LD_{50} in 2 kg Cat.'

c. This active ingredient is also available in .0025 (2,000 g to reach LD_{50} in 2 kg cat.)

d. This figure is actually the maximum tolerated oral dosage (MTD).

e. Cats are generally regarded as being as susceptible as dogs to warfarin. The range of LD_{50} may be partly explained by increased susceptibility to poisoning during estrus (Spencer, 1950).

Recommendations for Treatment

The principles of treatment and management of anticoagulant rodenticide poisoning are summarized in the table below. Basically, once blood samples have been collected for the requisite diagnostic tests, the affected animal should receive a parenteral injection of vitamin K_1. This form of the vitamin is preferred because vitamin K_3 has little or no effect for the acute stages of poisoning [26]. Also, vitamin K_1 should not be given intravenously, as the manufacturer's insert clearly recognizes the hazard of anaphylaxis from intravenous use of this product. On numerous occasions, the authors have been informed of situations where anaphylaxis was associated with intravenous vitamin K_1. Treatment with vitamin K_1 should continue for up to 4-6 weeks unless laboratory monitoring of coagulation shows that values have returned to normal limits sooner. In cases where the toxicant is known to be warfarin rather than generically referred to as such, vitamin K_1 supplementation is usually needed for up to 5-7 days. However, when identity of the toxicant is unknown, it is prudent to assume that one of the more toxic, longer-lasting products is involved.

The dosage of vitamin K_1 given should generally not exceed 1 mg/lb/day, or at least should be given cautiously if higher doses are deemed necessary [11]. Doses exceeding 2 mg/lb/day may be dangerous and have been shown recently to induce Heinz body hemolytic anemia [12]. In our extensive experience with the monitoring and treatment of rodenticide poisoning cases, we have not had to exceed 1 mg/lb/day of vitamin K_1 for successful control of bleeding [11]. This regimen is about half the dosage recommended by Mount and Feldman [26, 27]. Regardless of the anticoagulant involved, it is important to initiate therapy promptly. When the product has not been identified, as frequently occurs, it is necessary to follow the regimen of prolonged treatment outlined in the table below to avoid relapse and to reduce the overall cost to the client.

For severely poisoned cases, bleeding may have caused serious anemia and therefore also necessitates one or more transfusions with fresh compatible whole blood. In addition to transfusions, where animals have bled in the pulmonary, pleural or pericardial cavities, surgical intervention may be necessary to remove blood to give space for lung or cardiac function. Once the poisoned animals are under treatment and are recovering, it is important to keep them quiet, confined and on a softened diet, for another 2-7 days (depending on the toxicant involved) to minimize hemorrhage in locations such as the central nervous system. As vitamin K_1 replenishes circulating clotting factors in a time course consonant with their respective synthetic half-lives, it takes several days for severely depleted animals to resynthesize these factors and no longer be at risk for bleeding complications.

Treatment of Rodenticide Poisoning

Therapy	Dosage	Comments
Vitamin K_1	Parenteral initial dose*, not to exceed 1 mg/lb/day, and followed by the same parenteral or oral dosage for another six days. Reduce to ½ mg/lb/day for the second week and then reduce by ½ for another two weeks. After 1 month of treatment dosage is continued 2-3 times a week for another 2 weeks.	Six weeks of therapy needed to correct long-term effects of the more potent products. If less toxic anticoagulants are known to be involved or monitoring of coagulation tests shows return to normal values sooner, the length of treatment can be reduced accordingly.
Whole blood transfusions	Compatible fresh blood given at 5-7 cc/lb body weight, if needed in severe cases.	The blood should be fresh to ensure the activity of clotting factors, which are labile on storage.

* Given subcutaneously and not intravenously (see above).

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