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Emergency medical management of accidental ingestion of bromadiolone poisoning in a dog: A case study

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Abstract
Rodenticide, or rat poison, is used to control rodents in areas like kitchens and food storage. Anticoagulant rodenticides, some of the most toxic household substances, are categorized into first, second, and third generations. Bromadiolone, a second-generation anticoagulant known as super warfarin, is highly potent and long-acting. It has a high lipid solubility, allowing it to cross the blood-brain barrier, and a maximum half-life of 56 days. Bromadiolone poisoning in dogs can lead to central nervous system toxicity and organ haemorrhages. Diagnosis includes prolonged prothrombin time and aPTT. Treatment involves vitamin K1 due to bromadiolone's long half-life. An accidental ingestion case in a two-month-old male Spitz showed congested mucous membranes and prolonged clotting time. Treatment included activated charcoal, emesis, and fluids, followed by vitamin K1 and tranexamic acid. The dog showed improvement after three days. Long-term management involves continued vitamin K1 and activity restriction.

Keywords: Haemorrhages**,** Long, vitamin

Introduction
Rodenticide, or rat poison, is commonly used to control rodents in areas like the kitchen, storeroom, and feed/food storage in a house. They are some of the most toxic and hazardous substances commonly found in households. Anticoagulant rodenticides are classified based on their active ingredients into first, second, and third generations. Bromadiolone is a potent second-generation long-acting anticoagulant rodenticide, widely known as super warfarin. Bromadiolone has a high potency and long-acting anticoagulation effect, which depends on the level of vitamin K in the body. Super warfarin is 100 times more potent than warfarin and has a long half-life. The liver can detoxifies warfarin slowly due to its lipophilic property. The maximum half-life of bromadiolone is 56 days (mean 20–30 days). Central nervous system toxicity can occur due to its high lipid solubility; it might easily diffuse across the blood-brain barrier. Clinical signs are tissue and organ haemorrhages, such as skin mucosa, digestive tract, and haematuria [6]. Laboratory examinations show prolonged prothrombin time and aPTT for bromadiolone poisoning. The patient needs long-term treatment with vitamin K1 because of the long half-life period of bromadiolone. Despite its effectiveness in rodent control, bromadiolone poses a significant risk of poisoning in non-target species, particularly dogs. Accidental ingestion of bromadiolone-containing baits or contaminated rodents can lead to life-threatening toxicity in dogs. This article aims to provide a comprehensive overview of bromadiolone poisoning in dogs, including its clinical manifestations, diagnostic approaches, and treatment strategies.

Case history and observations
A two-month-old male Spitz with the history of accidental ingestion of rat bait cube (HIT)^{R} kept aside in home to control rat an hour before presentation to the medicine outpatient unit of the Veterinary Clinical Complex, Veterinary College and Research Institute, Tirunelveli. Clinical examination revealed congested mucous membranes, hypersalivation and restlessness.

Physical parameters showed rectal temperature (38.2 ˚C), heart rate (104 bpm) and increased respiratory rate (74/min). The rodenticide content was confirmed as bromadiolone (second-generation anticoagulant rodenticide) with the help of owner from the photograph of the wrapper of the rodenticide. Blood sample was collected in a glass test tube to check the whole blood clotting time which was recorded as more than 20 minutes. Blood parameters were within the normal range.

Third day blood sample was collected to check out hematobiochemical changes and to measure clotting time. The Whole blood clotting time was recorded as six minutes. The complete blood count and biochemistry values were within the normal range. Diagnosing bromadiolone poisoning in dogs requires a thorough clinical evaluation, including a detailed history of potential exposure to rodenticides. In this case we had a proper evidence and history of accidental ingestion of rodenticide poisoning.

Table 1: Hematobiochemical parameters observed in the dog before and after treatment

S.No.	Parameters	Measured Values before treatment	Measured Values after treatment	Reference valves Fielder *et al.* 2022 [8]
1	Hb (g/dL)	11.7	13.1	11.9-18.9
2	RBC ($x10^6$ µl)	5.94	6.99	4.95-7.87
3	PCV (%)	42.3	46	35-57
4	WBC ($x10^3$ µl)	11.3	9.6	5-14.1
5	MCV (fL)	71.3	66.9	66-77
6	MCH (pg)	19.6	18.7	21-26.2
7	MCHC (g/dL)	27.6	28	32-36.3
8	Platelet ($x10^3$ µl)	6.45	4.78	211-621
9	BUN (mg/dL)	9.75	10	8-28
10	Creatinine (mg/dL)	0.6	0.56	0.5-1.7
11	ALT (IU/L)	52	46	10-109
12	ALP (IU/L)	391	314	1-114
13	Total protein (g/dL)	4.9	4.8	5.4-7.5
14	Albumin (g/dL)	2.87	2.75	2.3-3.1

Treatment and Discussion

The management of bromadiolone poisoning in dogs focuses on preventing further absorption of the toxin, restoring normal haemostasis, and providing supportive care. Initial treatment may involve decontamination measures such as inducing emesis, administering activated charcoal, or performing gastric lavage to remove unabsorbed bromadiolone from the gastrointestinal tract. Immediately after arrival to hospital, the activated charcoal was administered at the dose rate of 2g /kg orally as universal antidote for adsorption of the ingested toxic substances in the stomach to prevent further absorption of toxins to systemic circulation. Emesis was induced with the help of saturated salt solutions and the animal vomited once with frothy contents containing small green colour pieces of ingested materials.

Fluid therapy was started with normal saline @ 30 ml /kg bwt., tranexamic acid @ 10 mg/kg bwt., pantoprazole @ 1 mg/kg bwt., Vitamin B -complex 1ml and vitamin C @ 10mg/kg as iv. Vit K (Phytomenadione) @ 2 mg/kg bwt as s/c at different sites to prevent coagulation disorders. Activated charcoal was administered orally once again @ 2g /kg bwt. and the animal was kept under observation and Inj. Vit K (Phytomenadione) was given after three hours at the dose rate of 2 mg/kg bwt as s/c and the animal was discharged from hospital.

Bromadiolone decreases blood coagulation factors (II, VII, IX, X) of vitamin K-dependent proteins by inhibiting vitamin K epoxide reductase, which plays a role in anticoagulation. Bromadiolone has the property of slow elimination from the body due to its high lipid solubility and high affinity towards hepatic tissue. Phytomenadione, also known as Vitamin K1, is a medication that is commonly used as an antidote for anticoagulant rodenticide poisoning. Anticoagulant rodenticides, such as warfarin, chlorphacinone, and diphacinone, inhibit the synthesis of Vitamin K-dependent clotting factors in the liver, leading to uncontrolled bleeding. Phytomenadione acts as a cofactor for the enzyme gamma-glutamyl carboxylase, which is responsible for the carboxylation of glutamate residues on Vitamin K-dependent proteins to form gamma-carboxyglutamate residues. These residues are necessary for the calcium-binding function of the clotting factors. By replenishing the body's supply of Vitamin K, phytomenadione allows the liver to resume the synthesis of clotting factors, thereby reversing the effects of the rodenticide [1, 2, 3, 4].

Tranexamic acid (TXA) is a synthetic derivative of the amino acid lysine that acts as an antifibrinolytic by reversibly binding to plasminogen. This prevents plasminogen from binding to fibrin and being converted to plasmin, thereby inhibiting fibrin degradation and preserving the framework of fibrin's matrix structure. It's important to note that while TXA could potentially be used as an adjunctive treatment in dogs with rodenticide poisoning, it should not replace the standard treatment of Vitamin K1 and supportive care [7]

On second day animal was treated with normal saline @ 20 ml /kg bwt., pantoprazole @ 1 mg/kg bwt. and Vitamin B -complex 1 ml as slow iv and Vit K (Phytomenadione) @ 2 mg/kg bwt as s/c. Activated charcoal was administered at the dose rate of 2g /kg PO. On third day the animal was treated with normal saline @ 10 ml /kg bwt., pantoprazole @ 1 mg/kg and Vitamin B -complex 1 ml as IV. Vit K (Phytomenadione) @ 2 mg/kg bwt as s/c. Pet showed clinical improvement after treatment and the client was advised to give oral tablets of vitamin K (Phytomenadione) 10 mg for every 12 hours for next 21 days with N- Acetyl cysteine 300 mg in every 12 hours for seven days.

N-acetylcysteine (NAC) is a medication that serves as a precursor to glutathione, a potent antioxidant that plays a crucial role in detoxification within the body. In the context of rodenticide poisoning, treatment with N-Acetyl Cysteine has shown promising results. The pooled results of randomized controlled trials (RCTs) showed a significant recovery rate. Furthermore, meta-analysis of randomized controlled trials and retrospective studies showed a significant reduction in mortality. N-Acetyl Cysteine supporting for the management of rodenticide poisoning [5].

The owner was also advised to restrict the activities of pet during the course of treatment and to bring the animal for review after three weeks for blood check-up. The blood values observed in the dog before and after treatment was presented in the table 1.

Conclusion

Bromadiolone poisoning is a serious medical emergency in dogs that requires prompt recognition and intervention. Veterinary practitioners should maintain a high index of suspicion for rodenticide toxicity in dogs presenting with unexplained bleeding or coagulopathy. Timely diagnosis, aggressive treatment, and supportive care are essential for optimizing patient outcomes and minimizing morbidity and mortality associated with bromadiolone poisoning. Additionally, efforts to educate pet owners about the dangers of rodenticide exposure and the importance of safe storage and disposal practices can help to prevent accidental poisonings in dogs.

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