



TOXICOLOGY BRIEF

Death by Chocolate? Methylxanthine Toxicosis

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ost veterinary professionals and pet owners are familiar with the notion that chocolate is poisonous to dogs and cats. What is it about chocolate that makes it hazardous to pets? Are some varieties of chocolate more dangerous than others? How much must be consumed to cause poisoning? This column addresses all these questions and provides some practical advice on how to manage patients that have consumed this delicious but potentially dangerous food.

Sources

The methylxanthines theobromine and caffeine can be found in a variety of substances (e.g., chocolate, cocoa and coffee beans, over-the-counter sleep prevention aids, asthma medications [theophylline, aminophylline]).^{1,2} This column focuses on the significance of theobromine and caffeine in chocolate ingestions. Methylxanthine concentrations can vary widely among forms of chocolate. Table I provides amounts of theobromine and caffeine in some of the more common sources.^{1,2}

Kinetics

Methylxanthines are rapidly absorbed through the gastrointestinal tract and metabolized in the liver. They also undergo a process called *enterohepatic recirculation* in which a substance is reabsorbed through the ileum and returned to the circulating

bloodstream via the hepatic portal system. Their metabolites are eliminated mainly through the kidneys. The half-lives of caffeine and theobromine in dogs are 4.5 and approximately 17.5 hours, respectively.^{1,2} Half-life data pertaining to cats are currently unknown. Although the eating habits of dogs probably predispose them to chocolate toxicosis, cat exposures to chocolate do occasionally occur.

Toxicology

The median lethal doses of caffeine and theobromine in dogs are approximately 140 mg/kg and 250 to 500 mg/kg, respectively.¹⁻³ The minimum toxic doses for these methylxanthines have not been established for dogs and cats. However, ingestion of 1 oz/kg of milk chocolate is believed to be enough to cause clinical signs of toxicosis in dogs; a milk chocolate dose of approximately 2 oz/kg (0.2 oz/kg of

baking chocolate) could be lethal to dogs.^{1,2} Another extremely important hazard of chocolate ingestion is the potential for pancreatitis resulting from the high fat content in various types of chocolate.

Methylxanthines inhibit adenosine receptors, causing central nervous system stimulation, tachycardia, and vasoconstriction. In addition, they inhibit the enzyme phosphodiesterase, stimulating catecholamine release. Methylxanthines increase free calcium of muscle cells, thereby increasing muscular contractility.⁴ Clinical signs of methylxanthine overdose include vomiting, diarrhea, polyuria, polydipsia, hyperactivity, ataxia, tachycardia, tachypnea, hypertension, weakness, cardiac arrhythmias, tremors, seizures, coma, and death (generally from cardiac arrhythmias and/or respiratory failure). Hypokalemia can also occur from polyuria and vomiting.^{1,4} Patients

TABLE I
Methylxanthine Concentrations in
Different Forms of Chocolate^{1,2}

Source	Caffeine	Theobromine
White chocolate (1 oz)	0.85 mg	0.2 mg
Milk chocolate (1 oz)	6 mg	44–56 mg
Semisweet chocolate (1 oz)	22 mg	238 mg
Baking chocolate (1 oz)	35–47 mg	393 mg
Cocoa ^a	5–42 mg/oz	130–737 mg/oz
Coffee beans ^a	1%–2%	Not available

^aMethylxanthine levels in these sources can vary depending on environmental/growth conditions and the type of bean.

may even appear to bounce when dropped on their feet from a few inches.^{1,2}

Diagnosis

History of recent exposure; presence of clinical signs; and/or analysis of stomach contents, urine, or plasma for the presence of caffeine or theobromine can help establish exposure to chocolate products.

Management

Emesis should be induced in asymptomatic animals that have ingested harmful amounts of chocolate within the past 4 hours. Activated charcoal with a cathartic should then be administered because of the enterohepatic recirculation of caffeine and theobromine^{1,4}; repeated doses (every 4 to 6 hours, then every 8 to 12 hours) of activated charcoal may decrease the half-life of theobromine. Plain activated charcoal is dosed at 1 to 2 g/kg body weight. If using 10% suspension (100 mg/ml), the dose is 10 to 20 ml/kg, or one 240-ml container per 12 to 24 kg (25 to 50 lb) body weight.^{1,4}

Animals with clinical signs should be stabilized before decontamination measures are taken. Cardiac function should be monitored with echocardiography. Bradycardia can be treated with intravenous (IV) atropine (0.01 to 0.02 mg/kg). If needed, IV β -blockers (e.g., metoprolol, propranolol) may be administered (0.04 to 0.06 mg/kg) but should not exceed 1 mg/2 minutes and the patient should be closely monitored for hypotension. IV lidocaine (1 to 2 mg/kg followed by a 0.1% solution administered at 30 to 50 μ g/minute) can also be used (in dogs only) if β -blockers fail to control tachycardia.^{1,4} Corticosteroids are generally contraindicated because they can interfere with methylxanthine excretion. IV diazepam (0.5 to 2 mg/kg), IV phenobarbital (2 to 6 mg/kg slowly), or other barbiturate or even gas anesthetics can be used to control seizures.

Catheterizing the urinary bladder and administering fluids may aid methylxanthine excretion and prevent reabsorption through the urinary bladder.^{1,2,4} Controlling vomiting and maintaining hydration and electrolyte balance are also important, particularly in severely affected animals. Pancreatic enzymes should be monitored because of the risk for pancreatitis due to the high fat content in various types of chocolate.

The key point to remember with chocolate toxicosis (or any other poisoning situation) is to treat the *patient*, not the toxicant. Providing thorough, symptomatic, and supportive care is crucial in helping patients through any medical crises.

About the Author

Ms. Farbman is a graduate of the veterinary technology program at Parkland College, Champaign, Illinois. She has been on staff at the National Animal Poison Control Center since January 1998. When not at work, she spends time with her husband Shawn, her cat Akasha, and her three border collies, Sedona, Mesa, and Phoenix.

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