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Chocolate Intoxication

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Pets may be exposed to a wide variety of chocolate and cocoa products, including candies, cakes, cookies, brownies, baking supplies (*e.g.* chocolate chips, cocoa powder), and cocoa bean mulches. Not surprisingly, most accidental chocolate exposures in pets occur around holidays, especially Valentine's Day, Easter, Halloween and Christmas, when chocolate is more prevalent in the household. Cocoa bean hull mulches are attractive to many dogs and may be ingested as dogs dig through them.¹ Because of their indiscriminate eating habits; dogs are far more commonly affected than cats. The toxic compounds in chocolate are methylxanthines, specifically theobromine and caffeine.

Methylxanthines' mechanisms of action

Competitive inhibition of cellular adenosine receptors is thought to cause most signs seen in animals with methylxanthine toxicosis, including central nervous system stimulation, diuresis, and tachycardia.² Methylxanthines also inhibit cellular calcium reuptake, which increases the free calcium concentration and enhances cardiac and skeletal muscle contractility.² Methylxanthines may also exert their effects by competing for benzodiazepine receptors within the central nervous system and by inhibiting phosphodiesterase, resulting in increased intracellular cyclic adenosine monophosphate.²

Susceptibility and clinical signs

The relative amounts of theobromine and caffeine vary with the form of chocolate (Table 1). In most chocolate compounds theobromine is the predominant toxic component, and caffeine is present in much lower concentrations. For animals that have ingested chocolate products made in the home or in bakeries or produced as a prepackaged mix, it may be difficult to identify the exact amount and type of chocolate used. In these cases estimate the methylxanthine dose based on a worst-case scenario. Likewise, with assorted chocolates - which include filled candies and chocolate-covered nuts - it is often safest to calculate the

amount of chocolate as if the total amount were solid chocolate of the most concentrated form (*e.g.* if the assortment includes dark- chocolate-covered products, make calculations by using the theobromine concentration for dark chocolate). Add the theobromine and caffeine amounts to determine the total amount of methylxanthine ingested (Example 1).

Theobromine and caffeine each have an LD₅₀ of 100 to 200 mg/kg,³ but severe and life-threatening clinical signs may be seen well below this dose. Based on ASPCA Animal Poison Control Center (APCC) experience, mild signs occur in animals ingesting 20 mg/kg of theobromine and caffeine, severe signs are seen at 40-50 mg/kg, and seizures occur at 60 mg/kg (ASPCA/APCC Database: Unpublished data). Accordingly, less than 1 oz of milk chocolate/lb (2 oz/kg) is potentially lethal to dogs; for baking (unsweetened) chocolate, less than 0.1 oz/lb (0.2 ounces/kg) is potentially lethal. Methylxanthines can cross the placenta and pass into the milk,⁴ so unborn or nursing offspring can be affected by chocolate toxicosis in the dam.³

Clinical signs usually occur within six to 12 hours of ingestion.³ Initial signs include polydipsia, vomiting, diarrhea, bloating, and restlessness. Signs progress to hyperactivity, polyuria, ataxia, tremors, and seizures.³ Other effects include tachycardia, premature ventricular contractions, tachypnea, cyanosis, hypertension, hyperthermia, and coma.^{3,5} Less commonly, bradycardia and hypotension may occur.³ Hypokalemia is possible late in the course of the toxicosis. Because of the high fat content of many chocolate products, pancreatitis is a potential sequela 24 to 72 hours after ingestion. Death is generally due to cardiac arrhythmias or respiratory failure.

Treatment

To treat chocolate ingestion, stabilize the patient, perform gastrointestinal decontamination, and provide supportive care. Control seizures with diazepam or a barbiturate as needed.⁵ Monitor cardiac status via electrocardiography, and treat arrhythmias when necessary. Because propranolol hydrochloride reportedly delays renal excretion of methylxanthines, metoprolol succinate or metoprolol tartrate (0.2 to 0.4 mg/kg orally b.i.d.)⁶ is the β -blocker of choice, if available.⁵ Hyperthermia secondary to excessive muscle activity generally resolves once the central nervous system signs are controlled, although ancillary cooling may be required. Aggressive attempts to treat hyperthermia (*e.g.* cold-water enemas or baths) are usually unnecessary and should be avoided.

After decontamination via emesis or gastric lavage, administer activated charcoal (1 to 4 g/kg orally).⁶ In some cases, large quantities of chocolate may coalesce in the stomach, forming a large mass that may not be easily vomited or removed by lavage.⁵ Additionally, if the dog ingested wrapped candy, the effects of methylxanthines may be delayed by several hours or days. For this reason, and because methylxanthines undergo enterohepatic recirculation,⁴ giving repeated doses of activated charcoal is usually beneficial in symptomatic animals (vomiting may need to be controlled with metaclopramide hydrochloride).³

Administering intravenous fluids at twice the maintenance levels will support the cardiovascular system and enhance urinary excretion. Because caffeine can be reabsorbed from the bladder, place a urinary catheter in moderately to severely affected animals.⁵ Serum electrolytes should be monitored, and any imbalances corrected as needed. In severe cases, clinical signs may persist for up to 72 hours because of the long half-life of theobromine in dogs (17.5 hours vs. 4.5 hours for caffeine).³ Monitor for secondary complications (*e.g.* rhabdomyolysis, exacerbation of previously existing cardiac problems, disseminated intravascular coagulopathy) in symptomatic animals. With appropriate and aggressive treatment of chocolate intoxication, most animals will make a full recovery.

References

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Example 1

Calculating the methylxanthine dosage: A case study

Raster, a 3-year-old border terrier weighing 19.8 lb (9 kg), was found eating his owner's Valentine's Day candy. All but seven of the 25 pieces are missing (two rolled under a counter where Raster couldn't reach them, and the owner had eaten five pieces), and the net weight of the box of candy is 10 oz. The candy contains milk- and dark chocolate- covered nuts and fillings and solid chocolate pieces. Estimate the total amount of methylxanthines Raster ingested. Is this a cause for concern?

- □□ First, calculate the amount of chocolate ingested: $10 \text{ oz} \div 25 \text{ pieces} = 0.4 \text{ oz/piece}$.
- Next, calculate the amount of methylxanthine ingested on a worst-case-scenario basis. Since the box contains a variety of solid and filled dark and milk chocolate candies, assume that all the candies were solid dark chocolate: $18 \text{ pieces} \times 0.4 \text{ oz/piece} = 7.2 \text{ oz chocolate ingested}$; $7.2 \text{ oz} \times (130 \text{ mg theobromine} + 20 \text{ mg caffeine in dark chocolate}) = 1080 \text{ mg}$; methylxanthine ingested: $1,080 \text{ mg methylxanthine} \div 9 \text{ kg} = 120 \text{ mg/kg}$. □□
- At this level of methylxanthine, Raster is in danger of developing serious clinical signs if he is not promptly treated.

Table 1. Relative Amounts of Methylxanthines in Various Forms of Chocolate*

Compound	Theobromine (mg/oz)	Caffeine (mg/oz)
White chocolate	0.25	0.85
Milk chocolate	58	6
Dark, sweet chocolate	130	20
Semi-sweet chocolate chips	138	22
Baker's (unsweetened) chocolate	393	47
Dry cocoa powder	737	70
Instant cocoa powder	136	15
Cocoa beans	600	Not available
Coffee beans	0	600
Cocoa bean hulls	255	Not available

*The exact amounts of methylxanthines will vary because of natural variation of the cocoa beans and variation within brands of products.

Source: References 1 and 3 and Hershey Foods Corporation: Caffeine and theobromine contents of Hershey's products on a per-serving basis. <http://www.hersheys.com/consumer/nutrition/index.html>; Oct. 2000.

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