Death by Chocolate – Chocolate poisoning in dogs

Dr Caryn Rademeyer
BVSc Cert AVP EM

Chocolate toxicosis is one of the most common causes of dog poisoning reported[5] although many species are susceptible including cats, rabbits and rodents[7]. Deaths have also been reported in livestock-fed cocoa byproducts and animals consuming mulch from cocoa bean hulls[3]. Seasonal celebrations such as Valentine's Day, Easter and Christmas create tempting opportunities as owners have more chocolate products available for these special events. At least 20 % of all chocolate poisoning cases are diagnosed and treated in December. The severity of the poisoning is directly influenced by the amount of chocolate eaten, the weight of the dog and the type of chocolate (milk or dark) consumed[1]. Milk and dark chocolate differ greatly in the amount of theobromine they contain, which in turn is reflected in the toxic dose[7].

Chocolate – the toxin

Chocolate is derived from the roasted seeds of Theobroma cacao. The toxic components of chocolate are the methylxanthine alkaloids, theobromine and caffeine[4]. Although the concentration of theobromine in chocolate is 3–10 times that of caffeine, both constituents contribute to the clinical syndrome seen in chocolate toxicosis[3].The half-life of theobromine in dogs is 18 hours and caffeine 4.5 hours[1]. The amounts of caffeine and theobromine in chocolate vary depending on the overall percentage of cocoa solids in the chocolate product, in addition to the environmental growing conditions of the cocoa plant, cocoa bean sources, and the variety of the cocoa bean used in the chocolate product[9].

Therefore, different types of chocolate will contain different amounts of caffeine and theobromine and this in turn will affect the toxic dose ingested. Generally, the darker the chocolate, the higher the risk of toxicosis is to dogs.

The type of chocolate is defined by the percentage of cocoa solids as per law [4 6 7]:

- **White chocolate** does not contain any cocoa solids. It is made primarily of cocoa butter, sugar and milk solids. Theobromine poisoning is not a risk. The high-fat content may increase the incidence of pancreatitis or gastrointestinal disturbances 24-72 hours post-ingestion.
- **Milk chocolate** contains a minimum of 20% - 25 % cocoa solids.
- **Dark chocolate** is made without milk and contains a minimum of 35% cocoa solids.
- **Baking chocolate** is made with at least 50% cocoa solids.

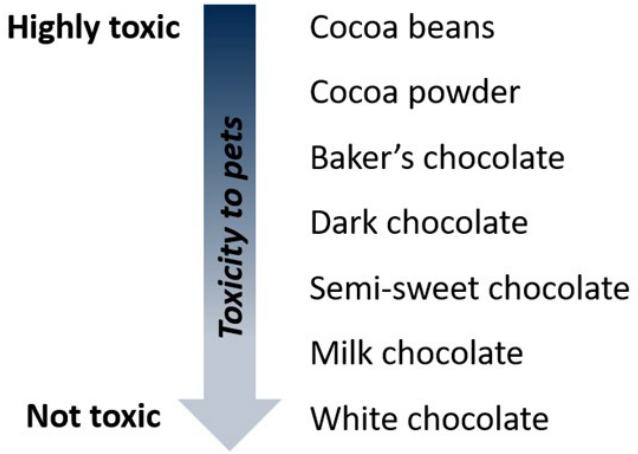

Diagram showing the toxicity of chocolate in different products [9]

The toxins, theobromine and caffeine, are readily absorbed from the gastrointestinal tract and widely distributed throughout the body, affecting the central nervous system, the cardiovascular system and the respiratory system[2].

Methylxanthines are metabolized in the liver and undergo enterohepatic recycling, before being excreted in the urine as metabolites and unchanged parent compounds[3]. *The toxins* competitively inhibit cellular adenosine receptors, resulting in CNS stimulation, diuresis, and tachycardia. Methylxanthines may also compete for benzodiazepine receptors within the CNS and inhibit phosphodiesterase, resulting in increased levels of cyclic adenosine monophosphate[3] (cyclic AMP).

The LD_{50} of both caffeine and theobromine is reportedly 100–200 mg/kg, but severe signs and deaths may occur at much lower dosages, as individual sensitivity to methylxanthines varies[3]. The general guideline is with dark chocolate ingestion of greater than 3.5g/kg and milk chocolate ingestion greater than 14 g/kg, immediate veterinary treatment is advised.

Clinical symptoms

Clinical signs of chocolate poisoning in dogs can begin 2-24 hours after ingestion[9]. Initial signs may include polydipsia, vomiting, diarrhoea, abdominal distention, and restlessness[3]. As theobromine is also a diuretic it will also contribute to the development of dehydration[6 7]. Theobromine further stimulates the myocardium and the CNS, leading to hyperactivity, pyrexia and hypertension.

Potentially life-threatening cardiac arrhythmias and severe tachycardia may also develop. In extreme cases, CNS dysfunction occurs with muscle rigidity, tremors and seizures[3]. Fatal chocolate poisoning causing heart failure and comas are uncommon[6 7 9] with usually a single case reported annually[6].

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Diagnosis

As there is no readily accessible diagnostic test for chocolate toxicosis, diagnosis is based on the history of exposure and ingestion with correlating clinical signs.

Treatment

Treatment is essentially supportive and symptomatic with the emphasis on rehydration, reducing the stimulant effects with sedatives and monitoring of vital signs[1 3 6 7 9]. Ongoing support will be needed until the methylxanthines have been urinary excreted from the body, therefore severe cases will need intravenous fluid support and hospitalization for a few days as in severe cases, clinical signs can persist for up to 72 hours[1].

Should the animal be presented within one hour of chocolate ingestion, emesis should be induced with apomorphine or xylazine[8]. For many patients, removing the undigested chocolate from the stomach converts the neurological toxicity to a gastrointestinal disturbance that is much more easily managed[1]. If the animal has been sedated due to seizure activity, then warm water gastric lavage should be considered.

Activated charcoal 1–4 g/kg, PO four hourly, must be administered as the methylxanthines have an enterohepatic recirculation. This can be continued as long as the patient shows clinical signs[6 7]. Vomiting may be controlled with metoclopramide, 0.2–0.4 mg/kg, SC, IM, IV every 6 hours as needed. Intravenous fluids are needed to rehydrate and maintain hydration levels and electrolyte balances[9].

Diazepam 0.5–2 mg/kg, slow IV may be used for tremors and/or mild seizures and methocarbamol 50–220 mg/kg, slow IV at no more than 330 mg/kg per day. For severe seizures, barbiturates or other general anaesthetics may be required[3].

As a wide range of cardiac abnormalities may result from chocolate poisoning, an ECG is recommended. Arrhythmias should be treated as needed with the administration of propranolol 0.02–0.06 mg/kg, slow IV. For tachyarrhythmias metoprolol 0.2–0.4 mg/kg, slow IV and atropine 0.01–0.02 mg/kg is required for bradyarrhythmia. For refractory ventricular tachyarrhythmias[3], lidocaine 1–2 mg/kg, IV, followed by 25–80 mcg/kg/minute IV CRI is recommended.

The placement of a urinary catheter should be considered in severe poisoning cases as methylxanthines and their metabolites can be reabsorbed via the bladder[3].

Severe chocolate toxicosis cases may need to be referred to a 24-hour veterinary specialist facility in order for the patient to receive ongoing monitoring and treatment, especially indicated for unstable cardiac patients needing ECG monitoring.

Post Mortem Lesions

Chocolate toxicosis does not cause any specific post-mortal lesions. Hyperaemia, haemorrhages, or congestion of multiple organs may occur as a result of agonal changes. Severe arrhythmias may result in pulmonary oedema or congestion. Chocolate or cocoa bean hulls may be present in the gastrointestinal tract at necropsy.

Differential diagnosis

Accidental ingestion of other human drugs such as amphetamines, cocaine, pseudoephedrines and antihistamines could be considered[3].

Prognosis

The prognosis is good for dogs having ingested small amounts of chocolate, with mild clinical signs and becomes guarded in dogs with the development of seizures, collapse or arrhythmias after ingestion of chocolate[6 7 9].

The use of one of the many online chocolate toxicity calculators will be of value as the calculator requires the input of the type of chocolate, the amount of chocolate and the weight of the dog. This will help determine the degree of toxicity that requires treatment. As owners are often not sure how much chocolate was consumed, err on the higher amount when estimating[1 4] chocolate consumption.

Prevention

As chocolate consumption by dogs occurs accidentally, client education specifically during special celebrations and seasons should be actively implemented by the veterinary practice. Emphasis on the following will help prevent accidental poisonings:

1. Do not feed chocolate to any pets. Make sure that children are educated so that they are aware of the consequences that may occur with chocolate ingestion.
2. Advise clients to store all chocolate products in high or locked cupboards.
3. Avoid using garden mulches that contain cocoa shells.
4. If missing chocolate is noted or partially chewed chocolate wrappers are found, the animal should be taken to the vet immediately so that emesis can be induced; the owner should not attempt home treatment.

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MULTIPLE-CHOICE QUESTIONS

QUESTION 1

Chocolate positioning contains which toxins:

a. theobromine and caffeine
b. theobromine only
c. caffeine only
d. tartaric acid
e. none of the above

QUESTION 2

The amount of theobromine and caffeine in a chocolate product varies depending on:

a. the amount of cocoa solids used
b. the environmental growing conditions of the cocoa plant
c. the source of cocoa bean
d. the variety of cocoa bean
e. all of the above

QUESTION 3

In order of increasing toxicity:

a. cocoa beans, baking chocolate, dark chocolate, milk chocolate, white chocolate
b. milk chocolate, white chocolate, baking chocolate, cocoa powder
c. white chocolate, milk chocolate, dark chocolate, cocoa powder, baking chocolate
d. white chocolate, milk chocolate, dark chocolate, baking chocolate, cocoa powder
e. cocoa powder, dark chocolate, milk chocolate, white chocolate

QUESTION 4

Which statement is most correct regarding white chocolate:

a. white chocolate contains a few milk solids and therefore is considered a low risk for theobromine poisoning
b. white chocolate is completely safe to be consumed by animals and has no side effects
c. white chocolate has a high fat content and therefore may cause a pancreatitis 24 -72 hours post ingestion
d. white chocolate may cause gastro-intestinal disturbances if consumed in large amounts
e. white chocolate is highly toxic requiring immediate veterinary treatment if large amounts are consumed.

QUESTION 5

Which three statements are true:

i)Theobromine and caffeine are readily absorbed from the gastrointestinal tract
ii) are poorly distributed throughout the body.
iii) Methylxanthines are metabolized in the liver and kidneys
iv) theobromine undergoes enterohepatic recycling.
v) an affect is noted in the central nervous system, the cardiovascular system and the respiratory system

a. i, iii, v
b. ii, iii, v
c. i, iii, iv
d. iii, iv, v
e. i, iv,v

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QUESTION 6

The most likely clinical presentation is:

a. Onset within 1-2 hours with acute vomiting and diarrhoea seen
b. Onset after 24 hours with polydipsia and marked dehydration
c. Onset within 2-24 hours with vomiting, diarrhoea, restlessness and dehydration
d. Onset within 2- 24 hours with collapse and death
e. Gradual onset within 48 hours with vomiting, diarrhoea, restlessness and dehydration

QUESTION 7

In order to determine if treatment is needed:

a. Use an online chocolate toxicosis calculator
b. Assess the amount and type of chocolate consumed and the weight of the dog
c. Only treat if the dog has a cardiac arrythmia
d. Only treat if the dog is dehydrated
e. a + b

QUESTION 8

Chocolate poisoning prognosis:

a. The prognosis is poor for any chocolate ingested by a dog.
b. The prognosis is fair for large volumes of baking chocolate ingested
c. The prognosis is good for dogs presenting with seizures
d. The prognosis is poor for dogs presenting with dehydration, vomiting and diarrhoea
e. The prognosis is good for dogs with mild clinical signs, having consumed only small amounts of chocolate

QUESTION 9

Severe chocolate toxicosis will result in

a. CNS dysfunction, cardiac arrhythmias, heart failure and death
b. Renal failure
c. Severe gastrointestinal disturbances
d. Dehydration
e. Lung oedema with cyanosis

QUESTION 10

Treatment of chocolate poisoning:

a. Always requires referral to a 24-hour facility
b. Essentially supportive and symptomatic with the emphasis on rehydration, reducing the stimulant effects with sedatives
c. Requires metoclopramide, diazepam and intravenous fluids
d. Only requires 4 hourly administration of activated charcoal after gastric lavage/emesis
e. Seldom required as most dogs die before presentation at the vet

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