TOP 20 TOXIC TITANS… AND HOW TO TREAT THEM: PART II SCIENTIFIC: TOXICOLOGY

Justine A. Lee, DVM, DACVECC

INTRODUCTION

Pet Poison Helpline, a 24/7 animal poison control located out of Minneapolis, MN, receives phone calls from both pet owners and veterinarians regarding toxicity cases from accidental or intentional misuse of over-the-counter (OTC) or prescription medications, common garden or outdoor toxins, and common household products. In this two part session, the top 20 small animal toxins seen by Pet Poison Helpline will be reviewed.

In veterinary medicine, the primary treatment for toxicant exposure should be decontamination and detoxification of the patient. The goal of decontamination is to inhibit or minimize further toxicant absorption and to promote excretion or elimination of the toxicant from the body. Decontamination can only be performed within a narrow window of time for most substances; therefore, it is important to obtain a thorough history and time since exposure. Decontamination categories may include ocular, dermal, inhalation, injection, gastrointestinal (GI), forced diuresis, and surgical removal to prevent absorption or enhance elimination of the toxicant. For further review on decontamination and specific treatment, attendees are referred to a veterinary toxicology book for more detailed review.

Plants

As different plants have different mechanisms of action or levels of toxicosis, Pet Poison Helpline should be consulted for plant ingestions that veterinarians are unaware of. While the majority of plants often just result in GI signs, some plant ingestions can be fatal. The most deadly plant is sago palm, which is found in warm weather locations (e.g., Southern USA), and can result in acute hepatic failure. The prognosis is grave once clinical signs of liver failure have developed, and long-term outcome is poor. Oleander, which contains a cardiac glycoside, can result in profound cardiovascular signs (brady- or tachyarrhythmias), electrolyte abnormalities (e.g., hyperkalemia), GI signs (e.g., nausea, hypersalivation, vomiting), or central nervous system (CNS) signs (e.g., tremors, seizures). Japanese yew, which is commonly used as a landscaping shrub, results in profound GI, CNS, and cardiovascular signs also due to the toxic taxins (alkaloids). *Dieffenbachia* and *Philodendron*, commonly known as mother-in-law's tongue or dumb cane, contain insoluble calcium oxalate crystals which result in profuse pain to the oropharynx. This differs from soluble calcium oxalate-containing plants (e.g., star fruit, rhubarb, etc.) which can result in calcium oxalate deposition in the kidneys and secondary acute renal failure (in cats or patients with underlying renal insufficiency). Certain spring bulbs (e.g., daffodils, tulips, *Narcissus*, etc.) can result in profuse GI signs, and with large ingestions, cardiotoxicity or neurotoxicity.

Household cleaners

Most surface cleaners are generally benign, and when ingested directly from the bottle, can result in minor GI signs. However, certain concentrated cleaners can be highly toxic or corrosive. Household bleach is a GI irritant, but "ultra" bleach can be corrosive, resulting in severe esophageal or upper GI damage. Concentrated lye products, toilet bowl cleaners, and oven cleaners are also corrosive, and immediate flushing out the mouth for 10-15 minutes should be performed prior to veterinary visit to minimize tissue injury. Appropriate pet-proofing (such as keeping toilet seats down or securing cleaners in a bathroom cabinet) are the easiest way to prevent this specific toxicosis.

Metaldehyde

This slug and snail bait, commonly used in California and warm weather locations, results in "shake and bake" syndromes of agitation, tremors, seizures, and secondary hyperthermia. These pellets are often radiopaque, and radiographs can be performed to evaluate for the presence of material within the GI tract. Aggressive supportive care, including decontamination (e.g., gastric lavage and enemas), anti-convulsants (e.g., phenobarbital), muscle relaxants (e.g., methocarbamol), and monitoring of hepatic function should be performed.

Insecticide/organophosphates

Many insecticides are low-concentration pyrethrins or pyrethroids, and generally only result in mild GI signs when directly ingested. However, some products (particularly rose or plant fertilizer/insecticide combination products) may contain carbamates or organophosphates, which competitively inhibit acetylcholinesterase and pseudocholinesterase. This then results in acetylcholine accumulation at nerve junctions, resulting in severe clinical "SLUDGE" signs (e.g., salivation, lacrimation, urination, defecation, gastrointestinal). Add to the fact that gardeners often mix these insecticides/fertilizers with additional bone or blood meal (which is highly palatable to pets), thus

resulting in increased ingestion of the toxin. Aggressive therapy with 2-PAM and atropine is imperative, along with 24-hour supportive care.

Batteries
Battery ingestions occur quite frequently by dogs. This is often witnessed by the owner, or a chewed battery may be found by the owner. Often times, the pet owner may notice that the remote control is chewed on and the batteries are missing. When the casing for a battery is punctured, there is risk for alkaline or acidic material to leak out, resulting in severe ulceration to exposed tissues. The most common battery ingestion is of an alkaline dry cell battery (e.g., 9-volt, D, C, AA, AAA) or button/disc batteries. Alkaline dry cells (the majority of household batteries) contain potassium hydroxide or sodium hydroxide. When the compounds come in contact with tissue, liquefaction necrosis occurs, causing deeply penetrating ulcers. In addition, newer types of "disc shaped" batteries can allow an electric current to pass to the tissues of the GIT as the battery is passed. This can result in a current-induced necrosis, resulting in tissue damage or even perforation of the oropharynx, esophagus, stomach or small intestine. Lithium button type batteries are the most dangerous, as one 3 volt battery can result in severe necrosis to the GIT or esophagus within 15-30 minutes of contact. Finally, certain batteries contain heavy metals (such as mercury, zinc, cobalt, lead, nickel or cadmium). Heavy metal toxicity can occur, albeit rare, if the battery remains in the GIT for more than 2-3 days.

With any type of battery ingestion, the pet owner should seek veterinary attention immediately. A thorough oral exam and physical exam should be performed. Oral ulcerations may not be present for hours. The presence of black powdered material may be seen in the mouth, and occurs when dry cell batteries are punctured. The mouth should be thoroughly flushed and lavaged for 15-20 minutes with tepid tap water. A lateral abdominal radiograph (including the caudal esophagus in the chest) should be performed to evaluate the presence of the battery in the abdomen. Ideally, prompt removal should occur to prevent further corrosive injury. The use of endoscopy or surgery may be necessary. Emesis induction is not typically recommended, as corrosive injury may occur to the esophagus and oropharynx. Treatment includes removal of the battery, anti-ulcer medication (including H_2 blockers and sucralfate) for 5-7 days, a bland or high-fiber diet, and analgesic therapy if necessary.

Fire starter logs
Fire starter logs typically do not pose a "toxicosis" risk, but rather a foreign body obstruction (FBO) risk. Most types (e.g., Duraflame®) are made of compressed sawdust and wax, and do not break down in the stomach, resulting in a FBO. Rarer types of fire starter logs may contain heavy metals to provide a "color sparkle" to the fireplace. With recent ingestion, emesis induction should be performed to prevent FBO. If unknown ingestion or prolonged ingestion has occurred, abdominal radiographs should be performed to evaluate for the presence of gastric contents or FBO. If the material has passed out of the stomach, the use of a high-fiber diet, anti-emetic therapy, and careful monitoring (based on clinical signs, radiographic evidence of obstruction, etc.) should be performed. With massive ingestions demonstrating evidence of FBO, surgical intervention may be necessary.

Hydrocarbons
Hydrocarbons consist of chemicals containing a hydrogen and carbon group as their main constituents. Examples include liquid fuels such as kerosene, engine oil, tiki-torch fuels, gasoline, diesel fuels, paint solvents, wood stains, wood strippers, liquid lighter fluids, asphalt/roofing tar, etc. These are often referred to as "petroleum distillates" based on their viscosity, carbon chain length, and lipid solubility. It is *contraindicated* to induce emesis with hydrocarbon toxicity, due to the risks of aspiration pneumonia; due to the low viscosity of hydrocarbons, these compounds are more easily aspirated, resulting in respiratory injury and secondary infection. In general, hydrocarbons are GIT irritants, but can also be irritants to the respiratory system (if inhaled), eyes, and skin also. Clinical signs include vomiting, nausea, tachypnea, and dermal or ophthalmic irritation. Typically, GIT irritation is self-limiting. Patients should be treated with anti-emetic therapy, possible subcutaneous fluid therapy (to assist in hydration), fasting (no food per os), and initiation onto a bland diet. Patients demonstrating any coughing, retching, or tachypnea post-ingestion should have chest radiographs performed to rule out aspiration pneumonia, of which treatment is supportive (e.g., oxygen therapy, IV fluids, antibiotic therapy, nebulization and coupage, etc.).

Bone or blood meal
Bone meal and blood meal are by-products from the meatpacking industry that are widely utilized as soil amendment products, fertilizer components, or as deer, rabbit and wildlife repellants. Bone or blood meal are "organic" compounds, and with the increased use of organic products in lawn and gardening, have resulted in

increased exposure opportunities for animals. These are often considered low-level toxicities, but can result in FBO, severe pancreatitis, or GIT irritation with ingestion. A thorough history must be obtained from the pet owner, as these products are often mixed with more toxic agents (such as organophosphates found in rose fertilizers) which result in severe toxicosis. Bone meal and blood meal are highly palatable to dogs and can result in unintentional, large ingestions. Tulip, daffodil and hyacinth bulbs are often "dusted" in bone meal when planted to fertilize and aid in repelling squirrels. The scent of bone meal may entice dogs to dig up newly planted bulbs and subsequently ingest both the potentially toxic bulb and bone meal. Large ingestions of bone meal can congeal into a solid ball in the stomach, resulting in a FBO. Large ingestions of blood meal can congeal into a gelatinous FBO. Decontamination is recommended with recent large ingestions or with dogs with a prior history of pancreatitis. Radiographs should be performed to determine if the material has passed out of the stomach, and to evaluate for the presence of gastric contents or FBO. With massive ingestions demonstrating evidence of FBO, surgical intervention may be necessary. In general, decontamination and symptomatic and supportive care are indicated.

Toad poisoning

The *Bufo* toad is found in warm locations such as Florida, Texas, Hawaii, and along areas in California. While toad identification is often difficult (particularly if ingested or macerated!), ingestions in these locations should be treated as toxic due to the bufotoxin, which acts like a cardiac glycoside. Toxicosis has been seen even when dogs have ingested the water that toads have sat in. Immediate flushing of the mouth is necessary, as the toxin is easily absorbed by the mucous membranes. Cardiovascular signs such as brady- or tachycardia can rapidly develop, along with respiratory signs (e.g., tachypnea, dyspnea) and neurologic signs (e.g., ataxia, nystagmus, recumbency, tremors, and seizures).

Ethylene glycol

Accidental or malicious poisoning with antifreeze is common, as the public is generally well aware of the narrow margin of safety with antifreeze. As little as a tablespoon can result in severe acute renal failure in canine patients. While the antidote, fomepizole (also known as 4-MP) is expensive, it is life-saving when administered within the first 8-12 hours of ingestion. In cats, the antidote (either ethanol or 4-MP) must be administered within 3 hours of ingestion to be effective. Ethanol, which also competes with alcohol dehydrogenase, thereby preventing metabolism of ethylene glycol into its more toxic metabolites, can also be used. Once a patient has already developed azotemia, the prognosis is generally poor to grave without hemodialysis.

Alcohol

Pet owners are generally smart enough to avoid giving mixed drinks to their pets. Often, the source of alcohol actually stems from baking. Ingestion of unleavened bread dough can result in a mass of doughy material in the stomach, resulting in a possible foreign body or bloat. When the bread dough sits in the warm, moist environment of the stomach, the stomach acts as an "oven," causing the dough to rise. Rarely, gastric dilatation-volvulus (GDV) can occur from gas production. Gastric lavage with cold water may stop this process, and assist in removal of dough from the stomach. Rarely, surgery is necessary to remove the foreign material. Another risk of bread dough ingestion is the risk of ethanol toxicosis. When the yeast is metabolized, it produces alcohol and carbon dioxide, which is rapidly absorbed from the stomach, resulting in ethanol toxicity. Clinical signs include vocalization, behavioral changes, ataxia, recumbency, hypoglycemia, and coma.

Strychnine

This toxicosis is rarely seen anymore, but can result in severe clinical signs of tremoring, seizuring, and death. Intentional baiting of raw meat laced with strychnine is often used in the western USA to kill coyotes, and dogs (and other wildlife) are often secondarily affected. Treatment includes decontamination, thermoregulation (cooling measures, if needed), muscle relaxants and anti-convulsants. Patients should be placed in a low-stimuli environment, as noise, light, and activity may result in stimulation of seizures.

CONCLUSION

Pet owners should be appropriately educated on how to pet-proof the house, and be trained on what common household products and kitchen items are poisonous. Pet owners should also be appropriately educated on crate training to help minimize toxin exposure. Once a pet is exposed to a toxicant, it is imperative to determine if emesis is appropriate, and to understand when it may be contraindicated (e.g., symptomatic patient, delayed time since exposure, hydrocarbons, etc.). Knowledge of the underlying mechanism of action, the pharmacokinetics (including

absorption, distribution, metabolism, and excretion), and the toxic dose of the toxicant are imperative in determining appropriate decontamination and therapy for the patient.

References available upon request.