How to Be Prepared for Most Toxic Exposures in Dogs and Cats

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It can be daunting to try to figure out what you need to have on hand to treat toxicologic cases. When making decisions, it is most helpful to break down the treatment into 2 phases: decontamination and clinical management. In the decontamination phase, treatments are focused on removing the toxin before it can be absorbed further and/or diluting the toxin to reduce local irritation. In the management phase, clinical signs need to be reversed or minimized.

A surprising number of the medications needed to treat intoxications may already be present in the hospital’s pharmacy, as many are used for other indications in veterinary medicine. The medications needed for treating toxicoses fall into 2 groups: (1) those to keep on hand for emergencies and (2) those that should be quickly obtainable when warranted. The latter group are either readily available at a human pharmacy or hospital (cholestyramine and N-acetylcysteine), are not needed peracutely (pamidronate), or are extremely expensive and only used for rare toxicoses (digoxin immune Fab).
INVENTORY TO KEEP ON HAND

Decontamination

Liquid Dishwashing Detergent and Shampoo

Bathing a pet with liquid dishwashing detergent, antiseborrheic shampoo, or a follicular flushing shampoo is helpful in removing any greasy or oily substances from the hair coat. Bathing is often recommended when it is necessary to remove topical flea medication from the hair coat, such as for a cat exposed to a permethrin product. All patients should be stabilized before bathing, and care should be taken to prevent chilling, especially with small or young pets.

Sterile Eye Irrigation Solution

Ocular exposure to irritating or corrosive substances may require 20 to 30 minutes of ocular flushing with a sterile eye irrigation solution, with breaks as needed to help reduce the stress to the pet. This may require copious amounts of irrigation solution, which may be unreasonable to have on hand. As an alternative, sterile saline or room-temperature water can be used to flush the affected eye(s).

Apomorphine

Apomorphine is a centrally acting emetic. Inducing emesis is contraindicated in cases where the patient has ingested a petroleum distillate or caustic substance; in patients that are already vomiting, are showing clinical signs, or have underlying health issues that would make emesis unsafe; and in species that are unable to vomit.

Apomorphine can be very helpful in preventing the absorption of a toxin by inducing emesis in asymptomatic dogs that have recently ingested toxins. Emesis in dogs is mediated through dopamine receptors in the chemoreceptor trigger zone, which are stimulated by apomorphine. Apomorphine can cause sedation, which in some cases can be excessive and make emesis unsafe because of the risk of aspiration. Naloxone can safely be given to dogs to reverse this sedation without reversing the emetic effects of the apomorphine.

It is important to note that apomorphine is not an effective emetic for cats because emesis is mediated by α2-adrenergic receptors in the chemoreceptor trigger zone in this species. α2-Adrenergic agonists, such as xylazine and dexmedetomidine, are better choices for attempting to induce emesis in cats.

Activated Charcoal

The large surface area of activated charcoal makes it very useful in adsorbing toxicants that are still in the GI tract or that undergo enterohepatic recirculation. Activated charcoal should be considered in asymptomatic pets with recent exposures to toxicants with the potential to cause serious clinical signs. Activated charcoal is not beneficial in cases in which heavy metals, corrosive agents, hydrocarbons, fluoride, xylitol, ethanol, and/or petroleum distillates are ingested. Activated charcoal is contraindicated with salt or paintball toxicosis, as it adds to the risk of hypernatremia.

The risk of aspiration should be considered in animals that are unable to swallow or to protect their airway or in cases of uncontrolled vomiting or regurgitation. The risk of hypernatremia, which can be life-threatening, should also be considered prior to administration, especially with pets that are small, dehydrated, or have ingested osmotically active substances (e.g., chocolate, sugar). Serum sodium monitoring and fluid administration should be considered when activated charcoal is given.

Management

Acepromazine

Acepromazine is a phenothiazine sedative. It is helpful for treating the clinical signs of stimulation in a wide number of toxicoses, including amphetamine, selective serotonin reuptake inhibitor (SSRI), 5-hydroxytryptophan (5-HTP), selective serotonin and norepinephrine reuptake inhibitor (SSNRI), and phenylpropanolamine (PPA) toxicoses. Acepromazine can cause hypotension, and blood pressure monitoring should be considered, especially if treating a toxicosis that can also cause hypotension.
Atropine

Atropine is an anticholinergic medication that is a competitive antagonist to acetylcholine at muscarinic receptor sites. It is used to treat SLUDDE signs (salivation, lacrimation, urination, defecation, dyspnea, emesis) associated with organophosphate and carbamate toxicosis, *Solanum* plant toxicosis, and clitocybe and inocybe mushroom toxicosis. It can be used at lower doses to correct bradycardia caused by other toxins. Atropine is contraindicated in patients with reflex bradycardia secondary to hypertension.

Atipamezole

Atipamezole is an α₂-adrenergic antagonist that can be used to reverse α₂-adrenergic agonists, such as those used in veterinary medicine like amitraz and xylazine. Atipamezole can be used to reverse sedation, bradycardia, and hypotension caused by α₂-adrenergic agonists. It is also useful to reverse the effects of human medications, such as clonidine and tizanidine (synthetic imidazoline derivatives used to treat hypertension and ADHD), and imidazoline decongestants in eyedrops.

Vitamin K1

Vitamin K1 (phytonadione) is used to treat coagulopathy caused by anticoagulant rodenticide toxicosis, and/or warfarin overdoses. These anticoagulants block vitamin K–dependent clotting factor synthesis by inhibiting the K 1-2,3-epoxide reductase enzyme. This halts the recycling of vitamin K1 and causes a deficiency. Supplementation with high doses of vitamin K1 corrects this deficiency. Vitamin K1 is not stored in the liver, so daily or twice daily dosing is indicated. With cases of recent exposure to an anticoagulant, it can be used to prevent clinical signs from developing. In animals with evidence of active bleeding, it will take 6 to 12 hours to start to produce additional clotting factors and appropriate supportive care and blood transfusions should be considered until the prothrombin time (PT) returns to normal. Vitamin K1 can also be used with coagulopathy secondary to liver failure (such as with severe xylitol toxicosis).

Methocarbamol

Methocarbamol is a centrally acting skeletal muscle relaxant. It is used for tremor and rigidity in animals with permethrin, metaldehyde, tetanus, tremorgenic mycotoxin, hops (*Humulus lupulus*), and strychnine intoxications. Methocarbamol can provide relief for tremors in some situations when other medications are unlikely to be effective.

Injectable Beta Blockers

Beta blockers block β-1 (and some nonselective beta blockers also block β-2) adrenergic receptors in the myocardium. Beta blockers are indicated for reducing tachycardia. Injectable propranolol and/or esmolol are the most commonly stocked beta blockers for the treatment of toxicoses. They are especially useful for the treatment of tachycardia in albuterol, amphetamine, and methylxanthine toxicoses.

Naloxone

Naloxone is an opioid antagonist that competes with and displaces opioids at mu, kappa, and sigma receptors. The reversal of opioids occurs within a few minutes, and significant clinical signs should be rapidly apparent. Naloxone also can be used in dogs to reverse central nervous system (CNS) effects associated with high-dose ibuprofen toxicosis.

Injectable Benzodiazepines

Benzodiazepines (eg, diazepam) increase the action of gamma-aminobutyric acid (GABA) by binding to A-type GABA receptors and opening the membrane channels, allowing the entry of chloride ions and hyperpolarizing the cell. The increased GABA activity results in CNS depression and depressed spinal reflexes. Benzodiazepines are useful for their antiepileptic and sedative properties when used to treat toxicoses in veterinary patients. They are indicated for controlling seizures in these cases. However, they should be used with caution to control signs of amphetamine toxicosis other than seizures, as it can worsen the disorientation and clinical signs of stimulation.
Dextrose

Dextrose can be used to prevent or treat hypoglycemia secondary to toxicosis caused by xylitol, sulfonylureas (such as glimepiride, glipizide, and glyburide), sago palm (*Cycas revoluta*), amphetamines, or death cap mushrooms (*Amanita phalloides*) and hypoglycemia secondary to acute liver injury. Dextrose may also be hepatoprotective in cases of sago palm or xylitol toxicosis.

**MEDICATIONS THAT SHOULD BE QUICKLY OBTAINABLE**

**N-Acetylcysteine**

N-Acetylcysteine is a glutathione precursor that can be used to prevent or treat methemoglobinemia associated with acetaminophen toxicosis in dogs and cats by maintaining or restoring glutathione levels. When the toxic metabolites of acetaminophen conjugate with glutathione, they are converted to nontoxic metabolites. N-Acetylcysteine can also be administered to attempt to reduce hepatotoxicity associated with ingestion of acetaminophen, xylitol, sago palm, or death cap mushrooms.

**Cholestyramine**

Cholestyramine is a resin that binds with bile acids in the intestine. It forms an insoluble complex with bile acids in the intestines, and they are excreted in the feces. Cholestyramine helps remove toxins bound to bile acids, thus helping to break up enterohepatic recirculation. It has been used off label in overdoses of cholecalciferol and potentially some NSAID toxicoses.

**Pamidronate**

Pamidronate is a bisphosphonate used to treat hypercalcemia. It binds to hydroxyapatite in bone and inhibits the osteoclastic bone resorption of calcium. It has been shown to reverse hypercalcemia and hyperphosphatemia in dogs exposed to cholecalciferol. Toxicoses from cholecalciferol rodenticides, vitamin D supplements, and vitamin D analogs (eg, calcipotriene) may require treatment with pamidronate. Pamidronate lowers calcium within 24 to 48 hours after administration.

**Digoxin Immune Fab**

Digoxin immune Fab (Digibind™) fragments are antidigoxin antibodies that bind directly to digoxin and inactivate it. Digoxin immune Fab can be used for the treatment of digoxin, bufotoxin (from bufotoxin-containing toads in the *Bufo* and *Rhinella* genuses), and digitalis glycoside-containing plant (such as *Nerium oleander*) toxicoses. Digoxin immune Fab has been used in small animals and has proven to be efficacious, but it is reserved for life-threatening cases of toxicosis, as it is quite expensive and less severe toxicities can often be managed medically. It can reverse severe bradyarrhythmias and tachyarrhythmias not responding to conventional therapies. Urine output should be monitored when digoxin immune Fab is used. The digoxin-antibody complexes are renally excreted and can dissociate if the animal is not eliminating them, causing recurrence of the clinical signs.

**Fomepizole (4-MP)**

Fomepizole is an inhibitor of alcohol dehydrogenase used to prevent ethylene glycol intoxication in small animals. Fomepizole binds to alcohol dehydrogenase and prevents it from metabolizing ethylene glycol into metabolites that cause acidosis and acute renal failure. Because fomepizole works by inhibiting the metabolism of ethylene glycol, it is most effective when used early, before ethylene glycol has been metabolized. Fomepizole is superior to ethanol for treatment of ethylene glycol intoxication as it does not worsen the depression or acidosis seen with ethylene glycol and does not cause hyperosmolality. Emergency hospitals that routinely see ethylene glycol cases may need fomepizole on hand at all times. For some day practices, it may make more sense to cooperate with other local day practices or emergency hospitals so it is readily available if needed.

**Levetiracetam**

Levetiracetam is a pyrrolidone nootropic antiepileptic. It can be helpful in some patients with seizures refractory to traditional antiepileptics. Because it is typically given to patients with severe seizures that are not likely
to be able to safely take medication orally, the injectable preparation should be stocked. Levetiracetam seems to be particularly helpful in the treatment of severe seizures seen with 5-fluorouracil toxicosis, although these can be refractory even to levetiracetam.8

SUMMARY

It is not necessary to have thousands of dollars of specialized medications on hand to be able to treat most toxicology emergencies. A small investment in some stock (many of the medications should already be in the hospital) and knowing where and how to obtain other medications quickly will give most veterinarians the confidence and ability to be prepared to deal with most toxicologic emergencies. TVP

References


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Dr. Laura Stern received her DVM from Michigan State University in 2005. After 4 years in small animal private practice, she decided to challenge herself by coming to work for the ASPCA Animal Poison Control Center in 2009. She has written a book chapter on attention-deficit hyperactivity disorder medications and articles on lamotrigine, hypertonic sodium phosphate enemas, and fipronil toxicosis in rabbits. She lives with her husband, daughter, 5 cats, and tiny dog.