Management of Attention-Deficit Disorder and Attention-Deficit/Hyperactivity Disorder Drug Intoxication in Dogs and Cats

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KEYWORDS
• ADHD • ADD • Drug intoxication • Dog • Cat
• Amphetamines • Atomoxetine

Attention-deficit/hyperactivity disorder (ADD/ADHD) is defined as "a neurodevelopmental behavioral disorder resulting in a pattern of inattention and/or hyperactivity that causes impairment in social, emotional, cognitive, behavioral, and academic functioning,"[1] and it is treated with a variety of stimulants, in both immediate-release and extended-release formulations. The purpose of using the stimulant drugs is to improve brain levels of serotonin and norepinephrine.

Specific drugs prescribed for the management of ADHD include both amphetamine class stimulants and nonstimulants such as atomoxetine (Strattera) (**Table 1**).[1] When these drugs are ingested by dogs and cats, although the drugs differ in rate of absorption and time to onset of clinical signs, those signs are very similar and can be managed similarly. Key to the treatment of dogs and cats is to manage signs as they develop and not delay treatment while the ingested agent is identified.

Second-line therapy may include the use of antidepressant class medications such as imipramine, bupropion, or nortriptyline for patients who do not respond adequately to the first line stimulants or who have coexisting mood disorders. This article does not address these nonstimulant agents beyond noting that they may be included in the general grouping of "ADHD drugs" in the case of ingestion by a household pet.[1]

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Table 1
Amphetamine class ADHD drugs

Trade Name	Generic Name	Available Formulations
Adderall	amphetamine	5-, 7.5-, 10-, 12.5-, 15-, 20-, and 30-mg tablet
Adderall XR	amphetamine (extended release)	5-, 10-, 15-, 20-, 25-, and 30-mg capsule
Concerta	methylphenidate (long acting)	18-, 27-, 36-, and 54-mg tablets
Daytrana	methylphenidate patch	10, 15, 20, and 30 mg/9-h patch
Desoxyn	methamphetamine hydrochloride	2.5-, 5-, 10-, and 15-mg tablets; 5-, 10-, and 15-mg SR tablets
Dexedrine	dextroamphetamine	5-, 10-, and 15-mg Spansule XR
Dextrostat	dextroamphetamine	5- and 10-mg tablets
Focalin	dexmethylphenidate	2.5-, 5-, and 10-mg tablets
Focalin XR	dexmethylphenidate (extended release)	5-, 10-, 15-, 20-, 30-, and 40-mg XR capsules
Metadate ER	methylphenidate (extended release)	20-mg extended-release tablet
Metadate CD	methylphenidate (extended release)	10-, 20-, 30-, 40-, 50-, and 60-mg XR capsules
Methylin	methylphenidate (oral solution and chewable tablets)	2.5-, 5-, and 10-mg chewable tablets; 5-, 10-, and 20-mg tablets; 5 and 10 mg/tsp solution; 10- and 20-mg XR tablets
Ritalin	methylphenidate	5-, 10-, and 20-mg tablets
Ritalin SR	methylphenidate	20-mg SR tablet
Ritalin LA	methylphenidate (long acting)	10-, 20-, 30-, and 40-mg XR capsules
Strattera	atomoxetine	10-, 18-, 25-, 40-, 60-, 80-, and 100-mg capsules
Vyvanse	lisdexamfetamine dimesylate	20-, 30-, 40-, 50-, 60-, and 70-mg capsules

Abbreviations: SR, sustained release; XR, extended release.

AMPHETAMINE SALTS AND OTHER SIMILAR AGENTS

Use in Veterinary Medicine

Amphetamines were used in veterinary medicine to increase the respiratory rate and depth in animals undergoing anesthesia with barbiturates, due to its stimulatory effects on the medulla oblongata.[2] Methylphenidate has also been used for the treatment of narcolepsy in dogs, although it has been only partially effective when used as the sole treatment.[3] Amphetamine use was placed under strict control by the 1970 Controlled Substances Act. Amphetamines are no longer available for veterinary use in the United States.

Mechanism of Toxicity

Amphetamines cause release of catecholamines, resulting in the stimulation of the cerebrospinal axis, especially the brain stem, cerebral cortex, medullary respiratory center, and reticular activating system.[2,4] Amphetamines cause marked increased in the release of norephinephirine, dopamine, and serotonin from presynaptic terminals.[5,6] Monoamine oxidase is also inhibited, which is one of the metabolic pathways

of catecholamine metabolism.[6] This increase in catecholamine release and inhibition of reuptake cause both α and β stimulation. This results in vasoconstriction with sequelae of hypertension, tachycardia, cardiac dysrhythmias, and central nervous system (CNS) stimulatory signs. Cardiac output is generally not appreciably affected, due to reflex bradycardia.[7] Methylphenidate is a CNS stimulant that is structurally related to amphetamines.[8] Methylphenidate is "thought to block the reuptake of norepinephrine and dopamine into the presynaptic neuron and increase the release of these monoamines into the extraneuronal space."[9]

Pharmackokinetics, Toxicity, and Metabolism

The LD_{50} for orally administered amphetamine sulfate in dogs is 20 to 27 mg/kg.[10] Generally, the LD_{50} for most amphetamines is between 10 and 23 mg/kg.[11] The LD_{50} for methylphenidate has not been established. Experimentally, healthy beagle dogs survived dosage regimens of greater than 20 mg/kg/day for 90 days.[12]

Following rapid absorption from the gastrointestinal tract, amphetamines enter the cerebrospinal fluid at up to 80% of plasma concentrations.[13] Amphetamines are primarily excreted in the urine without any biotransformation. However, in vivo research shows that amphetamines do undergo oxidative deamination and aromatic hydroxylation in the liver of dogs.[14] Deaminated metabolites are oxidized to benzoic acid and excreted in the urine as the glycine conjugate of huppuric acid. Amphetamines are weak bases and urinary excretion is pH dependent.[13] Because the metabolism varies widely between species that were studied, these data cannot be extended to cats.

Clinical Signs

Clinical signs commonly seen with amphetamine intoxication are cardiovascular signs, including significant hypertension, tachycardia, occasionally reflex bradycardia secondary to hypertension, and tachyarrhythmias; CNS stimulatory signs are common, including hyperactivity, agitation, mydriasis, circling, head bobbing, apprehension, and tremors. Seizures can occur but are rare. Lethargy, depression, and coma have been reported later in the course of intoxication. Gastrointestinal upset can also be seen, as well as anorexia. Animals may be hyperthermic secondary to stimulatory signs. Disseminated intravascular coagulopathy (DIC) can be seen as sequelae to the hyperthermia.

Diagnosis

Diagnosis is supported by history of exposure or recovery of pills or capsules in the vomitus. One study group took a human on-site urine multidrug test and evaluated it for the use in dogs; it was found to be sensitive and specific for the detection of amphetamines. It has not been validated for use in cats.[15] Thin layer chromatography is commonly used, and immunologic assays can also be used for urine and plasma. Gas chromatography–mass spectrometry can also be used for detecting amphetamines in urine or plasma samples, especially in legal cases.[10] Necropsy findings in experimental dogs showed subendocardial and epicardial hemorrhage and myocardial necrosis.[10]

Differential Diagnoses

Differential diagnoses include pseudoephedrine, cocaine, methamphetamine, phenylpropanolamine, methylxanthines (caffeine, theobromine, theophylline), *ma huang*, and serotonergic medication intoxications.

ASPCA Animal Poison Control Center's Experience

A review of the ASPCA Animal Poison Control Center's (APCC) toxicology database from 2006 to 2011 found amphetamine salt and methylphenidate toxicity cases involving 202 dogs and 176 cats.[16] These cases involved exposure to one agent (an amphetamine or methylphenidate) only and were assessed as medium or high suspect cases (history of exposure and clinical signs were consistent with amphetamine or methylphenidate toxicosis). These cases were not confirmed via analytical methods.

Of the canine cases, full recovery was noted in 13 cases and follow-up was not available on 189 cases. The most commonly reported clinical signs (incidence over 5%) were hyperactivity in 78 (38.6%) of 202, agitation in 61 (30.2%) of 202, hyperthermia in 52 (25.7%) of 202, tachycardia in 49 (24.2%) of 202, panting in 31 (15.3%) of 202, disorientation in 25 (12.3%) of 202, restlessness in 25 (12.3%) of 202, mydriasis in 24 (11.9%) of 202, head bobbing in 20 (9.9%) of 202, pacing in 17 (8.4%) of 202, hypertension in 15 (7.4%) of 202, circling in 14 (6.9%) of 202, anxiety in 13 (6.4%) of 202, hypersalivation in 13 (6.4%) of 202, behavior change in 12 (5.9%) of 202, vomiting in 11 (5.4%) of 202, and lethargy in 10 (5.0%) of 202.

With the 176 feline cases, 17 made a full recovery, 2 were continuing to show signs at the time of the follow-up, and for 157, follow-up was not available. The most commonly reported clinical signs (incidence over 5%) were mydriasis in 72 (40.9%) of 157, tachycardia in 53 (30.1%) of 157, agitation in 47 (26.7%) of 157, disorientation in 27 (15.3%) of 157, vocalization in 27 (15.3%) of 157, hyperactivity in 26 (14.8%) of 157, hyperthermia in 22 (12.5%) of 157, tachypnea in 21 (11.9%) of 157, panting in 19 (10.7%) of 157, pacing in 18 (10.2%) of 157, lethargy in 16 (10.1%) of 157, restlessness in 13 (7.6%) of 157, hypertension in 13 (7.6%) of 157, circling in 12 (6.8%) of 157, hyperesthesia in 12 (6.8%) of 157, hypersalivation in 12 (6.8%) of 157, anorexia in 11 (6.3%) of 157, and 9 of (5.1%) 157 for each of vomiting, head bobbing, anxiety, and ataxia.

Clinical signs with amphetamine salt medications started at 0.09 mg/kg with hyperactivity, agitation and restlessness. Tachycardia, hyperthermia, mydriasis, tachypnea, head bobbing, pacing, disorientation, vocalizing, tachypnea, anxiety, hypersalivation, staring, and hiding were seen starting at dosages from 0.15 to 0.2 mg/kg. Circling and hyperesthesia were seen at dosages starting at 0.21 to 0.3 mg/kg, and tremors and seizures were seen starting at 0.3 to 0.5 mg/kg.

Clinical signs with methylphenidate started at slightly higher doses than with amphetamines. Tachycardia and hyperthermia were seen starting at 0.26 mg/kg, hyperactivity at 0.56 mg/kg, anxiety and vomiting at 0.6 mg/kg, head bobbing at 0.7 mg/kg, tachypnea at 0.78 mg/kg, vocalizing at 0.97 mg/kg, hypertension at 1.3 mg/kg, circling at 1.6 mg/kg, and seizures at 13.7 mg/kg.

A case report involving a dog ingesting 19 mg/kg amphetamine (Adderall) in the literature showed increased alanine aminotransferase (ALT), alkaline phosphatase (ALP), and metarubricytosis. The dog was also mildly hypoglycemic. The metarubricytosis was attributed to pyrexia with ensuing damage to the bone marrow sinusoidal epithelium and vacular endothelium. The increased ALT may have occurred due to direct thermal damage to hepatocytes or secondary to hypoprofusion. The increased ALP was attributed to release of endogenous corticosteroids.[17] The blood work abnormalities resolved without treatment. No such bone marrow abnormalities were found in the APCC database.

Treatment Recommendations

There is no specific antidote for amphetamine toxicosis. When a pet is suspected to have ingested a stimulant medication, the immediate response depends on whether

there are clinical signs on presentation for evaluation, the potential dose, and the formulation.

The goal of treatment is to prevent absorption of the medication, control the stimulatory signs, treat hyperthermia, treat cardiovascular effects, and protect the kidneys.

Emesis can be induced with apomorphine or hydrogen peroxide, if the exposure to a prompt release product was very recent (<30 minutes). Animals ingesting an extended-release product may benefit from emesis for up to 2 hours postexposure, if clinical signs are not yet being shown. Animals that are showing stimulatory signs, such as hyperactivity, pacing, or tremoring, are at risk for aspiration, and emesis should not be induced. Activated charcoal can be given. With extended-release products, a second half-dose can be given 8 hours after the first dose if stimulatory signs are still observed, but the pet should be monitored for signs of hypernatremia. With very high doses, gastric lavage can be performed under anesthesia with a cuffed endotracheal tube in place, if emesis cannot be safely induced. Activated charcoal can then be instilled via the orogastric tube before anesthesia is discontinued.

Phenothiazines should be considered the mainstay of controlling stimulatory signs with amphetamine intoxication. Phenothiazine tranquilizers are effective due to their effects on dopamine. They inhibit its release, block postsynaptic binding, and increase the turnover of dopamine in the CNS. Additionally, they also help to block the α-adrenergic activity induced by amphetamines.[18] Acepromazine can initially be given at 0.05 mg/kg IV and titrated to effect for stimulatory signs. The dose can be gradually increased to 0.1 to 1.0 mg/kg if clinical signs do not resolve with lower doses. Blood pressure should be monitored at higher doses to ensure that hypotension does not occur. Chlorpromazine can be used as an alternative treatment and is given at 0.5 mg/kg IV initially, and it may also be titrated up as needed to control stimulatory signs. Large doses of phenothiazines may be needed to control the clinical signs. Chlorpromazine has also been shown to have antiarrhythmic effects because it protects the heart from β_1 simulation due to an excess of epinephrine and norepinephrine, which can help alleviate tachycardia and tachyarrhythmias. Phenothiazines can also cause hypotensive and hypothermic effects, both of which are helpful in the treatment of amphetamine intoxication, due to the potential for hypertension and hyperthermia.[19]

Another important part of amphetamine toxicosis involves treatment for cardiac arrhythmias, although they often resolve with the treatment of the CNS stimulatory signs.[10] If the pet has been treated with phenothiazines and is resting quietly but still showing significant tachycardia, propranolol at 0.02 to 0.06 mg/kg slowly IV can be used. The total dosage is based on the clinical response of the tachycardia; monitoring an electrocardiogram (ECG) may be needed while giving propranolol, so it can be titrated to the target heart rate. Do not use this in hypertensive animals, as administration of propranolol can further worsen the hypertension. Treatment of tachycardia with propranolol has not been shown to improve survival in amphetamine intoxication cases.[11] Esmolol, which is a specific β_1-blocking agent, can be used if propranolol is not helping to resolve the tachycardia (25 to 200 μg/kg/min constant rate infusion).

Intravenous fluids should be instituted to help maintain normal hydration status, enhance renal excretion of the medication, and help protect the kidneys, should myoglobinuria occur. If giving fluids above the maintenance rate to a hypertensive animal, the lungs should be monitored for pulmonary edema.

Animals should be kept in a dark and quiet area of the hospital to decrease stimulation, especially in hyperesthetic animals. Thermoregulation in the form of fans

and cool towels should help to cool hyperthermic animals. Control of stimulatory signs will usually also help prevent the worsening of hyperthermia.

The use of diazepam is generally avoided in patients showing stimulatory signs as its use can increase the chances of paradoxical hyperactivity and dysphoria.[10] If seizures are seen, they should be controlled with barbiturates. Phenobarbital can be dosed at 3 to 4 mg/kg IV. Gas anesthesia or proprofol can be used for seizures that are refractory to barbiturates. Diazepam, though not generally used with patients showing stimulatory signs can also be used with seizing patients. Antiepileptics will stop the physical signs of the seizures until levels of the amphetamines in the brain drop and the seizures are controlled in the brain. Tremors can be controlled with methocarbamol 50 to 220 mg/kg IV, given slowly to effect. The rate of infusion should not exceeded 2 mL/min.

Urine acidification may be helpful, as amphetamine elimination in the urine is enhanced at a pH between 4.5 and 5.5. This can be achieved with ammonium chloride administration at 100 to 200 mg/kg/day PO divided 4 times daily or ascorbic acid 20 to 30 mg/kg PO, SQ, IM, or IV. Urinary acidification should not be attempted if the pet is acidotic, if acid-base status cannot be monitored, or if rhabdomyolosis or evidence of acute renal failure is present.[11]

Monitoring of the Patient

Pet should have blood pressure and heart rate monitored closely. An ECG should be instituted in all pets with noted tachycardia or reflex bradycardia. Pets should be monitored for hyperactivity and CNS stimulation signs.

Urinalysis can be performed to watch for myoglobinuria. Pets with poorly controlled signs or pets that were significantly hyperthermic may need to have complete blood count and coagulation profile monitored to detect DIC.

Pets may require hospitalization, monitoring, and treatment for up to 72 hours depending on the dosage and whether the medication is a prompt- or extended-release product.

Prognosis

Prognosis is generally good, as long as CNS stimulation and CV signs can be controlled. Seizures and seizure-like activity and cardiac failure pose the highest risk to the pet. Pets with underlying cardiac disease may be at increased risk of developing life-threatening arrhythmias and may be more susceptible to severe signs.[10] Cause of death in amphetamine toxicity is generally attributed to DIC secondary to hyperthermia and respiratory failure.[20] No long-term effects are expected in animals making a full recovery.

ATOMOXETINE

Very little information has been published about the toxicity, mechanism of action, or treatment of atomoxetine in dogs and cats; therefore, information is generally limited to clinical experience in the treatment of atomoxetine intoxication and human data. Atomoxetine is a selective norepinephrine reuptake inhibitor that is used to treat ADHD. The exact mechanism by which produces its therapeutic effects in ADHD is unknown.[21]

Pharmacokinetics and Metabolism

Atomoxetine was well absorbed from the gastrointestinal tracts of dogs. Atomoxetine is highly protein bound at 97% in dogs. The bioavailability in the dog was about 74%.

This appears to have great variability between species and cannot be extrapolated to the cat. Atomoxetine is highly metabolized in the liver of dogs by *N*-demethylation, aromatic ring hydroxylation, benzylic ring hydroxylation, glucoronidation, and sulfonation. Atomoxetine and its metabolites were excreted 48% in the urine and 42% in the feces of dogs. The fecal excretion appears to be due to biliary elimination and not due to unabsorbed drug. In fact, very little atomoxetine was eliminated intact.[20]

Mechanism of Action

Atomoxetine is a methylphenoxy-benzene propanamine derivative with antidepressant activity. Atomoxetine purportedly enhances noradrenergic function via selective inhibition of the presynaptic norepinephrine transporter. The mechanism of action by which produces its therapeutic effects in ADHD is unknown.[16]

ASPCA Animal Poison Control Center's Experience

A review of the APCC toxicology database from 2006 to 2011 found atomoxetine toxicity cases involving 32 dogs and 14 cats.[16] These cases involved exposure to one agent (atomoxetine) only and were assessed as medium or high suspect cases (history of exposure and clinical signs were consistent with atomoxetine toxicosis). In the 32 canine cases, 2 dogs had a full recovery, but in 30 cases follow-up was not available. Signs were seen at doses starting at 1.2 mg/kg. The signs that were most commonly seen were mydriasis in 7 (21.9%) of 32 cases, agitation in 6 (18.8%) of 32, hyperactivity in 6 (18.8%) of 32, vomiting in 6 (18.8%) of 32, tachycardia in 5 (15.6%) of 32, hypersalivation in 4 (12.5%) of 32, lethargy in 4 (12.5%) of 32, and tremors, polydipsia, ataxia, and disorientation were all seen occasionally in 2 (6.3%) of 32. Finally, the following signs were rarely seen (in 1 [3.1%] of 32): anorexia, anxiety, apprehension, fasciculations, head bobbing, hesitancy to move, hyperesthesia, hypertension, hyperthermia, nystagmus, pacing, panting, paranoia, premature ventricular contractions, pruritis, seizure, staring, subdued, and trembling. In the 14 feline cases, 1 case was followed up successfully and that pet made a full recovery. The signs that were most commonly seen were hypersalivation in 4 (28.6%) of 14, mydriasis in 4 (28.6%) of 14, tremors in 2 (14.3%) of 14, vomiting in 2 (14.3%) of 14, shaking or trembling in 2 (14.3%) of 14, agitation in 1 (7.1%) of 14, anxiety in 1 (7.1%) of 14, hyperactivity in 1 (7.1%) of 14, hypertension in 1 (7.1%) of 14, lethargy in 1 (7.1%) of 14, and tachypnea in 1 (7.1%) of 14. No deaths were reported in these cases. With the feline and canine cases, lethargy and hypersalivation were seen starting at 1.2 mg/kg, ataxia was seen starting at 1.9 mg/kg, hypertension at 2.0 mg/kg, hyperactivity and agitation at 3.5 mg/kg, vomiting at 4.0 mg/kg, mydriasis and tachycardia at 4.4 mg/kg, head bobbing at 8.8 mg/kg, and tremors starting at 24 mg/kg.

Diagnosis

Diagnosis is based on history and recovery of pills or capsules in the vomitus. There is no on-site test for this medication. Serum levels may be available at a human hospital.

Differential Diagnoses

This includes methylxanthines (caffeine, theobromine, theophylline) and serotonergic medication intoxications.

Monitoring

The onset of clinical signs is generally 30 minutes to 2 hours. The duration of signs is between 12 and 24 hours. Pets should have heart rate, blood pressure, and CNS status monitored. Electrolytes and hydration status should be monitored in pets with significant vomiting.

Treatment

Treatment is based largely on providing good supportive care to patients exhibiting clinical signs, as there are little published data about the treatment of atomoxetine toxicity in dogs and cats.

Emesis can be induced in asymptomatic animals (as discussed in the section on amphetamine treatment). Activated charcoal can be given following emesis, but the animals should be monitored for hypernatremia. If a high dosage has been ingested, gastric lavage can be performed with the animal under anesthesia with a cuffed endotracheal tube in place, if emesis cannot be safely induced. Activated charcoal can then be instilled via the orogastric tube before anesthesia is discontinued.

Vomiting can be managed symptomatically with antiemetic medications. Intravenous fluids should be given to help support the pet's cardiovascular system and to help prevent dehydration secondary to gastrointestinal upset.

Diazepam at 0.1 to 0.5 mg/kg IV to effect or methocarbamol 50 to 220 mg/kg IV to effect can be used to treat tremors. Nitroprusside 0.5 to 10 μg/kg/min in D5W titrated to effect can be used to treat hypertension. Diphenhydramine 2 mg/kg IM can be used for atomoxetine-induced dystonia (involuntary muscle spasms and contractions).

Affected animals should be kept in a dark and quiet area in order to decrease stimulation, if the animal is hyperesthetic. Thermoregulation in the form of fans and cool towels should help to cool hyperthermic animals. Control of stimulatory signs will also help prevent the worsening of hyperthermia.

Prognosis

Prognosis should be considered good and animals generally respond well to treatment. Animals with underlying liver disease, hypertension, tachycardia, or other cardiovascular or cerebrovascular disease may be more sensitive to this medication.[22] No long-term effects are expected.

SUMMARY

In summary, amphetamines or similar stimulants and the non-amphetamine atomoxetine are commonly used in the treatment of ADD/ADHD in humans. Because these medications are often found in homes, dog and cat exposure to these medications is a fairly common intoxication. Amphetamine intoxication can cause life-threatening CNS and CV stimulation, even when small amounts are ingested. This medication is quickly and well absorbed orally and the onset of clinical signs is generally 30 minutes to 2 hours with immediate release products. Treatment is aimed at preventing absorption, controlling the stimulatory signs, and protecting the kidneys. Prognosis is generally good, and treatment is very rewarding with control of the stimulatory signs.

Atomoxetine also has a fast onset of action with development of clinical signs within 30 minutes to 2 hours. Stimulatory signs, such as hyperactivity and tachycardia are often seen with atomoxetine toxicosis. Treatment is aimed at providing symptomatic and supportive care to patients showing clinical signs. Prognosis is generally good with animals receiving prompt and appropriate treatment.

REFERENCES

1. DRUGDEX System [intranet database]. Version 5.1. Greenwood Village (CO): Thomson Reuters (Healthcare) Inc.
2. Adams HR. Adrenergic agonists and antagonists. In: Riviere JE, Papch MG, editors. Veterinary pharmacology and therapeutics. Ames (IO): Wiley-Blackwell; 2009. p. 141–2.
3. Mitler MM, Soave O, Dement WC. Narcolepsy in seven dogs. J Am Vet Med Assoc 1976;168:1036–8.
4. Beasley VR, Dorman DC, Fikes JD, et al. A systems affected approach to veterinary toxicology. Urbana: University of Illinois; 1999. p. 133–4.
5. Volmer P. Human drugs of abuse. In: Bonaguara JD, Twedt DC, editors. Kirk's current veterinary therapy XIV. St Louis (MO): Elsevier; 2009. p. 144–5.
6. Diniz PP, Sousa MG, Gerardi DG, et al. Amphetamine poisoning in a dog: case report, literature review and veterinary medicine perspectives. Vet Hum Toxicol 2003;45:315–7.
7. Amphetamines. DRUGDEX System [intranet database]. Version 5.1. Greenwood Village (CO): Thomson Reuters (Healthcare) Inc.
8. Genovese DW, Gwaltney-Brant SM. Methylphenidate toxicosis in dogs: 128 cases (2001-2008). JAVMA 2010;12:1438–43.
9. Methylphenidate. In: POISINDEX® System (electronic version). Greenwood Village (CO): Thomson Reuters (Healthcare) Inc.; 2011. Available at: http://www.thomsonhc.com. Accessed January 12, 2012.
10. Bischoff K. Toxicity of drugs of abuse. In: Gupta R, editor. Veterinary toxicology: basic and clinical principles. Amsterdam: Elsevier; 2007. p. 401–3.
11. Wismer T. Amphetamines. In: Osweiler GD, Howvda, LR, Brutlag AG, et al, editors. Clinical companion: small animal toxicology. Ames (IO): Wiley-Blackwell; 2011. p. 125–30.
12. Teo SK, Stirling DI, Thomas SD, et al. A 90 day oral gavage toxicity study of D-methylphenidate and D,L methylphenidate in beagle dogs. Int J Toxicol 2003;22:215–26.
13. Kissebereth WC, Trammel HL. Toxicology of selected pesticides, drugs, and chemicals. Illicit and abused drugs. Vet Clin North Am Small Anim Pract 1990;20(2):405–18.
14. Green CE, LeValley SE, Tyson CA. Comparison of amphetamine metabolism using isolated hepatocytes from five species including human. Am Soc Pharmacol Exp Ther 1986;237:931–6.
15. Teitler J. Evaluation of a human on-site urine multidrug test for emergency use with dogs. J Am Anim Hosp Assoc 2009;45:59–66.
16. ANTOX: ASPCA Animal Poison Control Center's toxicology database. Urbana (IL): 2003–2011.
17. Wilcox A, Russell KE. Hematologic changes associate with Adderall toxicity in a dog. Vet Clin Pathol 2008;37:184–9.
18. Mensching D, Volmer PA. Neurotoxicity. In: Gupta R, editor. Veterinary toxicology: basic and clinical principles. Amsterdam: Elsevier; 2007. p. 135.
19. Gross ME, Booth NH. Tranquilizers. In: Adams HR, editor. Veterinary pharmacology and therapeutics. Ames (IO): Iowa State University Press; 1995.
20. Atomoxetine. In: POISINDEX® System (electronic version). Greenwood Village (CO): Thomson Reuters (Healthcare) Inc.; 2010. Available at: http://www.thomsonhc.com. Accessed January 12, 2012.
21. Mattuiz EL, Ponsler GD, Barbuch RJ, et al. Disposition and metabolic fate of atomoxetine hydrochloide: pharmacokinetics, metabolism, and excretion in the fischer 344 rat and beagle dog. Am Soc Pharmacol Exp Ther 2003;31:88–97.
22. Atomoxetine protocol. Urbana (IL): ASPCA Animal Poison Control Center.