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Topical Review

Marijuana Poisoning

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A B S T R A C T

The plant *Cannabis sativa* has been used for centuries for the effects of its psychoactive resins. The term ''marijuana'' typically refers to tobacco-like preparations of the leaves and flowers. The plant contains more than 400 chemicals but the cannabinoid δ-9-tetrahydrocannabinol (THC) is the major psychoactive constituent. ''Hashish'' is the resin extracted from the tops of flowering plants and generally has a much higher THC concentration. Marijuana is the most commonly used illicit drug in the United States. Currently, several states have passed legislation to decriminalize possession of small amounts of marijuana for both medical and personal use and several other states have similar legislation under consideration. The most common form of marijuana use in humans is inhalation of the smoke of marijuana cigarettes, followed by ingestion. In animals, although secondhand smoke inhalation is possible, the most common source of exposure is through ingestion of the owner's marijuana supply. The minimum lethal oral dose for dogs for THC is more than 3 g/kg. Although the drug has a high margin of safety, deaths have been seen after ingestion of food products containing the more concentrated medical-grade THC butter. There are two specific cannabinoid receptors in humans and dogs, CB_1 (primarily in central nervous system) and CB_2 (peripheral tissues). In animals, following oral ingestion, clinical effects begin within 60 minutes. All of the neuropharmacologic mechanisms by which cannabinoids produce psychoactive effects have not been identified. However, CB_1 activity is believed to be responsible for the majority of cannabinoid clinical effects. Highly lipid soluble, THC is distributed in fat, liver, brain, and renal tissue. Fifteen percent of THC is excreted into the urine and the rest is eliminated in the feces through biliary excretion. Clinical signs of canine intoxication include depression, hypersalivation, mydriasis, hypermetria, vomiting, urinary incontinence, tremors, hypothermia, and bradycardia. Higher dosages may additionally cause nystagmus, agitation, tachypnea, tachycardia, ataxia, hyperexcitability, and seizures. Treatment of marijuana ingestion in animals is largely supportive. Vital signs including temperature and heart rate and rhythm must be continually monitored. Stomach content and urine can be tested for cannabinoids. Gas chromatography and mass spectrometry can be utilized for THC detection but usually may take several days and are not practical for initiation of therapy. Human urine drug-screening tests can be unreliable for confirmation of marijuana toxicosis in dogs owing to the interference of a large number of the metabolites in canine urine. False negatives may also arise if testing occurs too recently following THC ingestion. Thus, the use of human urine drug-screening tests in dogs remains controversial. No specific antidote presently exists for THC poisoning. Sedation with benzodiazepines may be necessary if dogs are severely agitated. Intravenous fluids may be employed to counter prolonged vomiting and to help control body temperature. Recently, the use of intralipid therapy to bind the highly lipophilic THC has been utilized to help reduce clinical signs. The majority of dogs experiencing intoxication after marijuana ingestion recover completely without sequellae. Differential diagnoses of canine THC toxicosis include human pharmaceuticals with central nervous system stimulatory effects, drugs with central nervous system depressant effects, macrolide parasiticides, xylitol, and hallucinogenic mushrooms.

Introduction

For centuries, marijuana has been used both as a psychoactive intoxicant and for its hemp fiber used in rope.[1] In the United States, mention of the use of marijuana as an intoxicant can be found in the popular literature starting in the 1850s. By the 1930s, the US Federal Bureau of Narcotics began to characterize marijuana as harmful and addictive. Marijuana was listed as a Schedule I drug (high potential for abuse without any recognized medical value or purpose) by the Controlled Substances Act in 1970.[1]

For the last 40 years, the decriminalization and legalization of certain types of marijuana use has been a highly controversial topic. In addition, marijuana has been reported to be effective in the treatment of a variety of medical conditions.[2,3] Despite a nationwide ban on its growth, sale, and utilization, US marijuana consumption has skyrocketed since the 1960s. At present, marijuana is the most commonly used illicit drug in the US.[1,4] In one study, 40% of Americans older than 12 years admitted that they had tried the drug at least once.[1]

During the last 3 decades, public opinion regarding prosecution for possession of small amounts of marijuana for personal use has changed dramatically. Although for most parts of the country, possession of any marijuana is illegal and federal law bans the drug, some states such as Arizona, California, Colorado, and Wisconsin have allowed the medicinal use of marijuana under certain circumstances with more states expected to follow suit. Nevertheless, Arizona, in 1997, passed legislation nullifying a physician's right to prescribe Schedule I substances (such as marijuana) without federal approval. In Colorado, in the general

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election of 2000, an amendment passed legalizing the sale and possession of marijuana for medical use. By 2010, there were 717 licensed medical marijuana dispensaries and 106,000 registered medical marijuana users in the state of Colorado.[5,6] In 2012, legislation passed in Colorado and Washington State decriminalizing the possession of small amounts of marijuana for personal use. Similar legislation in other states is expected. Dogs and cats are very susceptible to marijuana toxicosis but dogs are much more often affected. Marijuana poisoning in dogs results from inhalation of secondhand smoke; ingestion of the seeds, stems, leaves, and flowers; ingestion of products made from marijuana leaves (cookies, suckers, brownies, teas, etc.); and ingestion of products made with concentrated tetrahydrocannabinol (THC) or hashish oil. Because of the changes with regard to the legal status of marijuana making it more readily accessible, an increase in the number of accidental intoxications of pets (especially dogs) can be expected.

Sources

The plant *Cannabis sativa* is the source of marijuana. It has been used historically not only for its psychoactive resin but also for hemp fiber.[1,4] Cannabis was cultivated by the early North American colonists for use in making hemp ropes. "Marijuana" refers to any part of the plant, but generally, it has come to refer to the dried tobacco-like preparations of the leaves and flowers.[1,4,7] Marijuana in its raw form comprises the dried and chopped stems, leaves, and seeds of the plant. *C. sativa* plants produce more than 60 chemical substances called cannabinoids.[8,9] The major psychoactive constituent in the plant is the cannabinoid δ-9-THC.[4] The only other cannabinoids in marijuana shown to produce psychoactive effects are cannabinol and cannabidiol, with less than 10 times the potency of THC.[1,4] The THC content in marijuana can range from 0.4% to almost 20% depending upon the cultivation techniques (amount of light, moisture, soil type, soil pH, nutrients, elements, and fertilizers provided).[1,4,9] Hashish is made from the resin collected from the tops of flowering plants and often has THC levels that exceed 10%.[1,4,9] Hash oil contains much more concentrated THC with values often reaching 20% or even higher. A typical marijuana cigarette (a "joint") generally contains 500-1000 mg of crude plant material and 15-30 mg of THC (with an average 3% THC content).[4,10] Most commonly in humans, exposure occurs through inhalation of marijuana, smoke from cigarettes ("joints") or modified pipes ("bongs"). It may be ingested when present in brownies, cookies, candy, and food products. Many of these food items are now available in the licensed medical marijuana dispensaries and sold to registered medical marijuana patients. Marijuana is known by a variety of street names: "grass," "weed," "hemp," "reefer," "pot," "herb," "MJ," and "Mary Jane." "Sinsemilla" is seedless marijuana with a fairly high THC content. Sinsemilla marijuana accounts for 85% of domestic production in the United States.[11] By 2010, a variety of synthetic cannabinoids had appeared upon the scene. Initially marketed as an herbal incense and sold in gas stations, head shops, and tattoo parlors, these potent synthetic cannabinoids had names like JWH-11 and others, "Spice," "K2," "Skunk," "Wild Greens," "Head Trip," "Purple Haze," and "Zombie Matter."[9] Smoking these incenses produced more severe effects than traditional marijuana although the products were clearly marked "not for human consumption." The paranoia, hallucinations, tremors, seizures, injury, and death caused by these substances resulted in many formulations being banned with the passage of the Synthetic Drug Control Act in 2011.[12]

Although secondhand smoke exposure is possible, the main route of animal marijuana exposure is through ingestion of the owner's supply ("stash").[6,10] Even though smokers of marijuana can control their level of intoxication by how much they smoke and how often they inhale, and because the effects of the active ingredient are more rapidly achieved, oral ingestion of THC is much more insidious. The drug is baked inside food products and ingested, usually knowingly (humans), and for the most part unintentionally (animals). Unlike inhalation, psychoactive effects following ingestion are not immediate.[1,4,6,9] Peak brain levels of THC may not be achieved for a few hours but may last longer than through inhalation.[4] Thus the person or animal ingesting marijuana cannot control the level or length of the intoxication and this makes it difficult for medical providers.

Table 1
Human Medical Conditions Proposed Helped by Cannabindiols

Proposed	Actually Approved for
• Anxiety	• Anorexia-chacexia syndrome (HIV)
• Depression	• Chemotherapy-induced nausea and vomiting
• Insomnia	• Glaucoma
• Epilepsy	• Multiple sclerosis
• Head injury	
• Migraine headaches	
• Arthritis	
• Chronic pain	
• Muscle spasms	
• Parkinson disease	
• Tourette syndrome	

Abbreviation: HIV, human immunodeficiency virus.

Increasingly, dogs through their ingestions of marijuana products are becoming exposed to baked goods made with medical-grade THC butter. This is made by boiling parts of the plant to extract the highly lipophilic THC.[6,9] Butter is then added to absorb the THC and allow the psychoactive agent to infuse into the butter. Then the butter, sautéed in THC and with the plant material strained out, can be used to make food items free of the crunchy taste of the plant and very high in THC. The butter can achieve THC concentrations higher than in the plant. Although the margin of safety following marijuana ingestion in animals has always been documented to be very high, recently 2 deaths have been reported in dogs after eating foods containing THC butter.[6]

The cannabinoids have been proposed and championed for a variety of medical conditions, most notably glaucoma and arthritis.[2,3] Currently, they are only approved for control of chemotherapy-related vomiting and nausea, appetite stimulation in patients with human immunodeficiency virus who have anorexia-cachexia syndrome, some patients with glaucoma, and for patients with multiple sclerosis. For these conditions, purified THC analogues are available and prescribed.[1,9,11] Dronabinol (Marinol), pure synthetic THC and a Schedule III drug, and Nabilone (Cesamet), a synthetic cannabinoid and a Schedule II drug, are routinely prescribed for certain human medical conditions. Sativex® (not marketed in the US) is a mouth spray for multiple sclerosis (MS) patients used to treat neuropathic pain, spasticity, and overactive bladder that contains tetrahydrocannibol (THC) and cannabidiol. Medical use of marijuana and its constituent real and synthetic cannabinoids remains controversial. The claims of the benefits of THC in the treatment of a wide array of other medical conditions have not been supported by robust clinical evidence.[1] Table 1 shows a list of human conditions proposed to be helped by cannabinoids.

Toxic Dose

THC has a wide safety margin in dogs with the minimum lethal oral dose greater than 3 g/kg.[13] This dose is 1000 times the

dosage where behavioral effects are observed. Nevertheless, providing a true toxic dose for THC in mg/kg proves difficult because the degree of purity for marijuana varies so greatly and also depends upon the route of exposure. It should be pointed out that medical-grade THC butter used in baked goods may have a higher concentration of THC than of marijuana alone.[6]

Toxicokinetics and Mechanism of Toxicity

Almost all effects of a single exposure to marijuana (like most animals experience) can be predicted by the dose.[4] THC is absorbed readily when smoked. Oral ingestion produces similar pharmacologic effects, but the absorption after ingestion is slower and more erratic than by smoking.[1,4,6,9] The onset of psychoactive effects following cannabis ingestion is unpredictable when compared with smoking. Oral absorption of THC can be increased with the ingestion of fatty foods.[9] In dogs, following THC ingestion, the onset of effects usually begins within 60 minutes.[6,9]

THC is highly lipid soluble and is distributed into fat, liver, brain, and kidney.[1,4,6,9,14] The majority of THC is metabolized by the liver, with the THC converted to the primary metabolite, 11-hydroxy-Δ-9-THC.[15] THC and its metabolites are excreted in the urine and feces. Enterohepatic recirculation is a prominent feature of marijuana metabolism.[1] Following ingestion, 15% of THC is excreted in the urine and the remainder in feces through biliary excretion.[4] Adipose storage produces a biological half-life for THC of approximately 30 hours.[16] In dogs, 80% of THC is excreted from the body in about 5 days (approximately 5 half-lives).[14]

Two specific cannabinoid receptors have been identified: CB_1 and CB_2.[1,17] CB_1 receptors are distributed throughout the brain, particularly in the basal ganglia, substantia nigra, globus pallidus, hippocampus, cerebellum, and frontal regions of the cerebral cortex. CB_2 receptors are found peripherally and are not detected in the central nervous system (CNS). This may give THC a potentially analgesic effect.[1] The CB_2 receptors are found peripherally in splenic macrophages, peripheral nerve terminals, and the vas deferens. The CB_2 receptors are also found in the tonsils and thymus gland. Peripheral CB_2 receptors may play a role in mediating release of cytokines. In addition, recent studies have identified cannabinoid receptor ligands as well as cannabinoid receptor agonists and antagonists.[18] Both receptors inhibit adenyl cyclase and stimulate potassium channel conductance.[1] CB_1 receptors are found on the presynaptic side of CNS synapses, and once activated, they inhibit acetylcholine, L-glutamate, gamma-aminobutyric acid, noradrenaline, dopamine, and serotonin. CB_2 receptors are believed to be involved in the regulation of immune system responses and inflammation.[1]

The precise effect that THC and the cannabinoids have upon the nervous system causing the well-known marijuana toxidrome, remains unknown. Nonetheless, activity at CB_1 receptors is thought to be the cause of all the clinical effects of THC.[18,19] In humans, these effects are interruption of cognition and memory, disrupted motor activities, and regulation of nociception, nausea, and vomiting.[1,20] In addition to neurologic effects, ingestion of large amounts of plant material may irritate the gastrointestinal tract and cause vomiting. One dog that presented to our practice had swallowed a plastic baggie full of marijuana that caused a gastrointestinal foreign body obstruction requiring surgical intervention.

Clinical Signs

The various effects of THC exposure, including time of onset, duration of effect, and severity of clinical signs, depend upon the dose and the route of administration of the drug. In dogs, clinical signs include ataxia and incoordination, hypersalivation, depression, disorientation, hypothermia, mydriasis, bradycardia, vomiting, and tremors.[6,9,10,14] In one study, nearly half of the dogs displayed urinary incontinence.[6] The authors postulated that dogs exposed to medical-grade marijuana may have a higher incidence of urinary incontinence on account of active THC metabolites. Signs may vary with dosage, size and age of the dog, and underlying medical conditions. Other signs that can be seen with marijuana ingestion in dogs are stupor, nystagmus, apprehension, vocalization, hyperexcitability, tachypnea, tachycardia, and hyperthermia.[14] Occasionally, dogs may present completely obtunded and comatose. In a recent retrospective study, ataxia and depression were the most common clinical findings at presentation for dogs with THC poisoning.[6] In addition, 48% of dogs presented following marijuana ingestion displayed mydriasis.[6] Cardiovascular effects produced by THC exposure have been well documented in humans and in dogs. A sinus tachycardia is often seen in dogs upon an electrocardiographic study following TCH ingestion.[1,4,6,9,14] Higher dosages have been shown to be capable of causing bradycardia and hypotension.[14] No long-term cardiovascular effects have been described following acute cannabis ingestion.[9,14] For dogs, onset of clinical signs usually occurs within 1-2 hours of exposure.[6,9,14] Again, for canines the duration of clinical signs can range from 1-3 days, with 24 hours being the average time for signs to persist.[9,14] Dogs may also show hyperesthesia with heightened sensitivity to motion, light, and sound.[6]

Minimum Database

Although THC intoxication is not reflected in either a complete blood count or a biochemical blood panel, blood should be drawn in marijuana suspects to rule out other causes for the clinical signs or the presence of concurrent medical conditions. Body temperature and heart rate and rhythm must be continually monitored during the course of therapy.[9,14]

Confirmatory Tests and Diagnostics

Taking a medical history is an essential skill. For a variety of reasons, owners may give histories that are inaccurate, unreliable, and sometimes purposely deceitful. Owners may deliberately falsify a history owing to fear of legal repercussions and potential grounds for prosecution.[21] Nowhere is there a greater potential for an untruthful history as in the case of an animal's ingestion of an illicit drug. Veterinary clinicians must gain the confidence of the client quickly so as to obtain a valid history.

Stomach contents can be sampled for cannabinoids.[1,4,14] A relationship with a reliable diagnostic laboratory is encouraged and consultation with a toxicologist or a diagnostic toxicology laboratory is recommended before sample collection and submission of any specimens. Urine can be tested for the presence of cannabinoids.[1,4,9,14] Owing to their lipophilic nature and enterohepatic recirculation, THC can be detected in the urine for several days following acute ingestion.[17] The use of human urine drug-screening test has been brought into serious question by a recent retrospective study of THC toxicosis in dogs.[6] One type of qualitative urine drug-screening test is a 5-channel urine dipstick with a colorimetric bar and a control. It was designed for humans to test for illicit drugs. In the retrospective study, numerous dogs known to have ingested marijuana had negative urine drug screen tests. It was suggested that these false negatives occurred if the testing was too recent after exposure.[6] It was also postulated that these false negatives occurred and the test was

not effective owing to the large number of THC metabolites in dog urine. This altered metabolite in dog urine may produce false negatives when using a human urine drug-screen. Finally, it was pointed out that samples tested for THC must be handled appropriately because THC can bind to rubber stoppers and glass giving false negative results.[1,6,9] The use of human urine drug-screening tests in dogs remains controversial. The findings of the retrospective study suggest that the human urine drug-screen test may be unreliable in dogs and only helpful if the test is positive.[6] Furthermore, various human urine drug-screen tests are available and these may vary in specificity and sensitivity.[6]

Gas chromatography-mass spectrometry is also used in humans to detect marijuana but it may take several days to perform and obtain results.[1] This is not helpful in directing appropriate therapy. In addition, the use of this test in dogs has been reported to be of questionable value. Likewise, invalid results have been obtained using enzyme-linked immunosorbent assay.[6] Currently, there is no single scientific laboratory test (enzyme-linked immunosorbent assay, gas chromatography, liquid chromatography, or mass spectrometry) that reliably detects THC in the urine of dogs.[6,9,14] As a result, interpretation of dipstick human urine drug-screening tests must be made with caution. Until a reproducible and reliable laboratory test is developed that can consistently detect THC in dog urine, no cage-side tests can be validated. Obtaining a urine drug screen is no substitute for a thorough history, physical examination, documentation of minimum database, and establishing a list of differential diagnosis. These components remain essential to confirming a diagnosis of marijuana intoxication.

Treatment

There is no specific antidote for cannabis.[1,4,9,14] Emesis may be unrewarding; THC has been shown to have a significant antiemetic effect.[22] Emesis can be initiated if the ingestion was recent (within the last 2 hours) but should never be employed if signs of CNS stimulation are present, if the animal is severely agitated, or if the animal is severely depressed or unresponsive. Treatment objectives in cases of marijuana toxicosis are prevention of further absorption and supportive care. Activated charcoal may be given to reduce absorption and THC half-life by blocking enterohepatic recirculation.[9,14] Just as emesis must be undertaken judiciously, administration of activated charcoal must be prudent and not given if the animal is somnolent, dramatically agitated, or showing severe anxiety. Charcoal aspiration can turn a minor exposure into severe morbidity or mortality. The risk of aspiration due to emesis or activated charcoal administration must not outweigh the benefit of the intervention. For the majority of cases of marijuana poisonings, even without such gastrointestinal intervention, the toxicosis is not fatal.[9] Treatment must never be more dangerous than the intoxication. Animals not badly agitated may be managed simply by a quiet, supportive, and protective environment.[6,14] Dogs experiencing acute anxiety and severe CNS stimulation can be treated with a benzodiazepine (diazepam 0.25-0.5 mg/kg, intravenously [IV]) to achieve sedation.[14] Chlorpromazine (0.5-1.0 mg/kg IV) has likewise been recommended to counter acute anxiety. Intravenous fluids may be given to counter dehydration in animals that have vomited severely and also to counter hypothermia. Hypothermic animals may require warming fluids until normal temperature has been achieved. Animals whose vomiting becomes persistent or severe may be treated with antiemetics (maropitant at 1 mg/kg, subcutaneously every 24 hours or ondansetron at 0.1-0.2 mg/kg IV every 8-12 hours). While hospitalized, temperature, pulse rate, and respiration should be monitored every 2 hours. In addition to temperature, animals must be observed closely for respiratory depression. Recovery is dependent upon the dose ingested and may take 24-72 hours.[9,14] Longer recoveries of up to 5 days are not uncommon in animals exposed to a very large dose.[14]

Table 2
Treatment of Acute Marijuana Intoxication

- Emesis may be induced if ingestion was within last 2 hours (apomorphine 0.04 mg/kg IV).
- Activated charcoal may interrupt enterohepatic recirculation of THC and reduce its half-life.
- Intravenous fluids can be administered if animal is dehydrated secondary to vomiting and to control body temperature.
- Animals should be closely monitored during hospitalization for body temperature, respiration, and heart rate.
- Sedation may be required for animals with severe CNS stimulation, agitation, and anxiety. (Diazepam 0.25-0.5 mg/kg IV.)
- Antiemetic agents may be given to animals with persistent vomiting.
- In severely poisoned animals, intravenous lipid therapy may be of benefit.

Recently, the use of intralipid therapy in cases of severe THC toxicosis has been employed and reported.[6] Lipid therapy has been shown to be effective in treating other highly lipophilic substances in dogs and cats.[23,24,25] Intravenous lipid given in these instances is a sterile, nonpyogenic fat emulsion which has been used previously in parenteral nutrition. In the past decade, evidence has accumulated supporting the use of intravenous lipids to reverse, or at least lessen, the effects of various lipophilic toxins.[25,26] Exact mechanisms of action of lipid therapy in treating toxins is presently unelucidated, but it may work in several ways.[25] First, the lipid may create a sink for fat-soluble, highly lipophilic drugs. Intravenous lipid added to the serum is thought to "extract" lipophilic molecules from the aqueous serum into a lipid phase. This binding causes a gradient that may also facilitate movement of toxins from the interstitium, thereby decreasing their tissue availability. A recent study of canine ivermectin poisoning showed a rise in serum ivermectin after each administration of intravenous lipid.[23] This finding supports the idea that poisons are moving from the interstitium into the intervascular space. It may be that lipids move directly into the interstitium and further bind with toxins. In addition, intravenous lipid therapy may also be helpful in some poisonings because they have been shown to provide free fatty acids, a major substrate of cardiac and other muscular ATP production.[25] In a negative sense, intravenous lipids may bind with beneficial lipophilic drugs given and take them out of circulation (the lipid sink in reverse). Despite this development, at least theoretically, administration of intravenous lipids could be expected to hasten the resolution of clinical signs, thereby reducing medical costs, and reduce time of hospitalization. Although evidence exists showing few adverse reactions to intralipid therapy, the use of lipids in humans and dogs for marijuana poisoning remains investigational. Further studies are needed to assess the efficacy of lipid therapy in cannabinoid poisoning. In certain of these toxicologic instances, intravenous lipid therapy may prove to be quite useful. A summary of treatment protocol for marijuana toxicosis is included in Table 2.

Prognosis and Prevention

Although recovery in dogs following marijuana toxicosis may be prolonged (up to 5 days), the majority of dogs ingesting THC recover completely with no long-term adverse effects.[9,14] Severity of the poisoning is dose dependent, and animals exposed to higher dosages require longer and more aggressive therapy.[6]

Table 3
Differential Diagnoses for Marijuana Intoxication

- Opioids
- LSD
- Phencyclidine hydrochloride (PCP)
- Ethanol
- Tranquilizers
- Benzodiazepines
- Ethylene glycol
- Propylene glycol
- Hallucinogenic mushrooms
- Amphetamines
- Diethylene glycol
- Methanol
- Isopropanol
- Acetone
- Macrolide parasiticides (ivermectin)
- Xylitol
- Depressants
- Muscle relaxants

Abbreviation: LSD, lysergic acid diethylamide.

Dogs that ingest medical-grade THC butter and food products containing the butter have been shown to be more at risk for serious intoxication and require more involved and prolonged treatment.[6] Recovery time is closely dependent upon the dose ingested. Prevention of marijuana toxicosis in dogs depends upon educating the public about the potentially hazardous effects marijuana can have on pets that ingest it. Marijuana must never be kept in a dog's environment. Extra care must also be afforded to law-enforcement drug-detection dogs that may be overzealous and ingest discovered marijuana products.[27]

Histologic Lesions

For the majority of animals, intoxication with marijuana is an acute, 1-time event. As a result, no long-term histologic lesions have been described in animals poisoned by THC. In humans, where repetitive and chronic marijuana use is common, heavy marijuana smokers show a high prevalence of pulmonary immune cells. In addition, heavy marijuana smokers had a much higher incidence of bronchitis and precancerous cells in the bronchial epithelium.[4] In rats, high doses of THC administered during pregnancy resulted in increased numbers of stillbirths, decreased litter size, decreased birth weight, and increased malformations in the offspring.[4,28] Currently, no such studies have been conducted in dogs or cats.

Differential Diagnoses

A correct diagnosis of marijuana intoxication may be initially missed owing to a purposely misleading history by the owners, the nonspecific clinical signs characteristic of THC toxicosis, and the current paucity of reliable laboratory tests confirming this poisoning. Furthermore, the avenue of exposure in these cases is not always immediately evident. Potential look-alikes for marijuana toxicosis are numerous and differentials must include opioids, lysergic acid diethylamide, phencyclidine hydrochloride (PCP), amphetamine, ethanol, tranquilizers, ethylene glycol, propylene glycol, methanol, benzodiazepines, isopropanol, acetone, macrolide parasiticides (such as ivermectin), xylitol, muscle relaxants, depressants, and hallucinogenic mushrooms.[1,4,9,14] A list of differential diagnoses is included in Table 3.

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