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False morel poisoning in a cat

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SUMMARY
The material of this case consisted of a 3.5 kg male Chinchilla cat which brought to Selcuk University Veterinary Faculty Animal Hospital with the complaints of anorexia, stagnation, incoordination, watery diarrhea and severe vomiting. Mushroom intoxications suspected according to the anamnesis. False morel poisoning was diagnosed as a result of physical examination and laboratory test and it was confirmed by presence of ingested spore of morel in fecal flotation examination. As a treatment, 0.9% isotonic NaCl (Polyplex, Polifarma®) solutions 40 ml/kg via IV, maropitant (Cerenia, Zoetis®) 1 mg/kg as an antiemetic and to reduce visceral pain via SC, N-acetylcystein (Nacosel, Haver Farma®) 140 mg/kg via IV, vitamins and amino acid supplementation (Duphalyte, Zoetis®) via IV are administered. For liver health supplementation SAMe and silybin (Denamarin, Nutramax®) 15 mg/kg via PO for 21 days prescribed. On re-examination, the cat was fully recovered. It was concluded that false morel poisoning may cause liver damage, neurologic findings along with the primary gastrointestinal system disorders. Anamnesis, presence of the ingested spore of morel observed during fecal examination is very important in the diagnosis and the prognosis is affected by the magnitude of liver damage.

Key words: cat, false morel, *Gyromitra*, poisoning, intoxication.

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Отравление кота ложными сморчками

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РЕЗЮМЕ
Данный случай произошел с котом породы шиншилла весом 3,5 кг, который был доставлен в лечебницу факультета ветеринарной медицины Университета Сельчук с жалобами на отказ от корма, вялость, нарушение координации, водянистую диарею и сильную рвоту. На основании анамнеза подозревалось отравление грибами. В результате осмотра и лабораторного тестирования было диагностировано отравление ложными сморчками (строчками), впоследствии диагноз подтвердили, обнаружив споры данных ядовитых грибов при флотационном исследовании фекалий. Для лечения вводили внутривенно 40 мл/кг 0,9%-го изотонического раствора хлорида натрия (Polyplex, Polifarma®); в качестве противорвотного и для уменьшения висцеральной боли – подкожно 1 мг/кг маропитанта (Cerenia, Zoetis®); внутривенно 140 мг/кг N-ацетилцистеина (Nacosel, Haver Farma®), а также витамины и аминокислоты (Duphalyte, Zoetis®). Для поддержания функции печени в течение 21 сут, согласно назначению, вводили перорально S-аденозин-L-метионин (SAMe) и силибин (Denamarin, Nutramax®). При повторном обследовании было установлено, что кот полностью выздоровел. Был сделан вывод о том, что отравление ложными сморчками (строчками) наряду с основными нарушениями работы желудочно-кишечного тракта может вызывать поражения печени и неврологические расстройства. Для диагностики очень важен анамнез и выявление проглоченных спор сморчков при флотационном исследовании фекалий, прогноз течения болезни обусловлен степенью поражения печени.

Ключевые слова: кот, ложные сморчки, строчки *Gyromitra*, отравление, интоксикация.

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INTRODUCTION

Mushrooms can be classified as edible or poisonous for both humans and animals. The toxicity of a mushroom depends on its toxin and the dose consumed. Common hepatotoxic mushrooms such as *Amanita ocreata* and *Amanita phalloides* (death cap) contain mainly cyclopeptides (amatoxins) causing acute liver failure both in humans and animals. Mushrooms containing hydrazines (e.g. *Gyromitra* spp., also known as false morel), psilocin and psilocybin (e.g. *Psilocybe* spp., *Panaeolus* spp., *Conocybe* spp. and *Gymnopilus* spp.) and isoxazoles (e.g. *A. pantherine*, *A. muscaria*) are considered neurotoxic. Gastroenterotoxic mushrooms such as *Agaricus* sp. and *Boletus* sp. contain toxins which mainly cause gastrointestinal signs [1]. In general, it is widely known that cats are susceptible to toxicosis from all edible and non-edible mushrooms. However, there is no information to specify the toxic mushroom species for cats or their toxic doses [2].

Morchella, which are the true morels, is a genus of edible sac fungi closely related to the order *Pezizales*. These fungi have a honeycomb appearance due to the network of ridges composing their caps abundance [3]. Like *Morchella*, false morels are also members of the *Pezizales*, but within that group represent the families *Morchellaceae*, *Discinaceae*, and *Helvellaceae*, most often *Gyromitra*. In Turkey, China, North America, India, and Pakistan these fungi are found in abundance. In Turkey, especially in Beyşehir, Konya region, the gathering of *Morchella* occupies an important place economically and touristically [4].

Gyromitra esculenta (*G. esculenta*) is a member of a group of fungi known as false morels. The hat of morel is 5–9 cm long, 5–10 cm in diameter, in colors ranging from red brown to dark brown. The hat is hollow. The stem is 2–3 cm long and 1–3 cm in diameter. In *Morchella* species, the hat is in the form of a petitious hollow, while in the *Gyromitra esculenta* type it is in the form of cerebral folds. When eaten raw it is deadly [5]. False morels were considered to be edible in the past. But according to the studies this has been rejected. Therefore, poisoning cases and deaths still are being reported. Poisonings caused by false morels have been studied and the responsible toxin gyromitrim is identified. The severity of the symptoms depends on the quantity of the ingested substance and the time spent after consumption. In human, the mortality rate approximates to 10% of the patients who have poisoning symptoms. The symptoms of false morel, especially *G. esculenta*, poisoning range from gastroenteritis to death [6, 7]. Gyromitrin's toxic metabolite is monomethylhydrazine (MMH). Monomethylhydrazine binds and inhibits pyridoxal phosphokinase, thereby inhibiting activation of vitamin B6 (as pyridoxal 5-phosphate) from functioning as the key co-factor in the synthesis of GABA. Hydrazines, like MMH, may also form hydrazones and hydrazides that can cause further organ damage. Hydrazones induce lipid peroxidation in the liver causing acute liver injury [8]. The first signs appear after 5–12 h or up to 53 h [9]. Acute liver injury can occur over the next 2 days in most of the cases, also acute kidney injury may occur. A cytolytical hepatitis is sometimes accompanied by a hemolysis. In severe cases of intoxication, neurological disorders, such as nervousness, delirium, coma and convulsions may be seen, as a consequence of MMH [8, 9].

Physical exam findings are often non-specific but may include depression, dehydration, muscle tremors, dry mucous membranes, abdominal distention and confusion. Vomiting and watery diarrhea may be observed [10]. Jaundice is a late finding, typically in more severe cases after the 3 days post-ingestion. Large ingestions may exhibit signs of central nervous system involvement, including nervousness, ataxia and seizures. In human, the mortality rate approximates to 10% of the patients who have poisoning [7].

The treatment must be symptomatic. The hemodynamics, the blood ionic concentration, the azotemia, the creatinemia, and the blood gases must be monitored to compensate for the hydroelectrolytic loss. Acute liver injury and hemolysis can be diagnosed by early serum biochemistry analysis of biological indicators (increase in AST, ALT, bilirubin, triglycerides, LDH) [7].

TEST RESULTS

The material of this case consisted of a 3.5 kg male Chinchilla cat which brought to Selcuk University Veterinary Faculty Animal Hospital with the complaints of anorexia, stagnation, incoordination, watery diarrhea and severe vomiting. In the anamnesis, it was learned that normally, the cat is fed with canned food and occasionally goes out of the house. The owner of the cat did not witness ingestion of the false morel but it was learned that in the area where the house is located (Beyşehir, Konya) false morel can be found in abundance. Approximately 8 h after going out of the house, the cat returned home depressed and with a significant saliva increase observed by the owner.

In the physical examination of the cat, hypersalivation, weakness, abdominal distension and depression were detected. Following the physical examination, blood gases, hemogram, biochemical analysis, fecal flotation examination, abdominal ultrasonography and radiographic examination were performed. In fecal flotation examination plant debris and spores of morels were seen, any other parasite eggs did not observed (Fig. 1).

In the radiographic examination of the abdomen, thickening of the gastric mucosa and abdominal distension were observed (Fig. 2).

With the abdominal ultrasound examination, rugal fold thickening, gastric mucosal edema and abdominal distension (Fig. 3) were confirmed.

Although blood gas and hemogram parameters were within the reference range, anemia and mild leukocytosis were noticed (Table 1).

In serum biochemistry, increased lactate dehydrogenase (LDH), creatine phosphokinase (CPK), aspartate transaminase (AST), alanine aminotransferase (ALT), alkaline

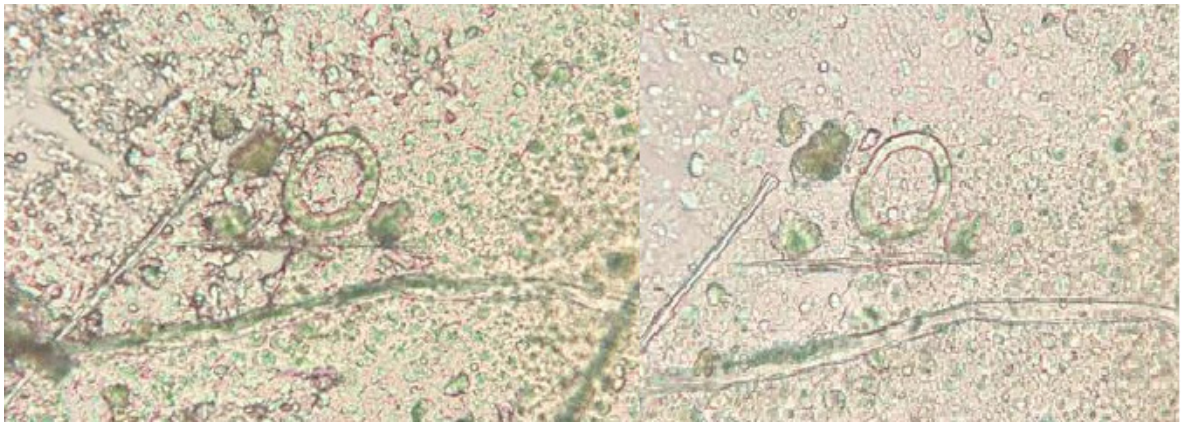

Fig. 1. Image of the spores of morel and plant debris in light microscope (×40 magnification, unstained)

Рис. 1. Изображение спор сморчков и остатков растений при исследовании под световым микроскопом (увеличение ×40, неокрашенные)

phosphatase (ALP) levels, hyperbilirubinemia and hypertriglyceridemia were observed. Other parameters were in the normal reference range (Table 2).

To rule out other diseases cause similar non-specific symptoms, qualitative detection of FeLV antigen/FIV antibody (Asan Easy Test, Asan Pharm) and FIPV antibody (FASTest FIP Ab, Vetlab Supplies) tests were performed and resulted negative.

As a treatment, 0.9% isotonic NaCl (Polyplex, Polifarma®) solutions 40 ml/kg via IV, maropitant (Cerenia, Zoetis®) 1 mg/kg as an antiemetic and to reduce visceral pain via SC, N-acetylcystein (Nacosel, Haver Farma®) 140 mg/kg via IV, vitamins and amino acid supplementation (Duphalyte, Zoetis®) via IV are administered. The cat was discharged from the hospital after admission in good general condition and appetite. For liver health supplementation SAMe and silybin (Denamarin, Nutramax®) 15 mg/kg via PO for 21 days prescribed. After prescribed drug usage, on re-examination, the cat was fully recovered.

DISCUSSION

Mushroom intoxications in animals, and especially in cats, are underreported. In the majority of feline mushroom toxicoses reported, mushrooms were characterised as of unknown origin and were not identified [1]. Cats are potentially susceptible to toxicosis from all edible and non-edible mushrooms; however, there is no information to specify the toxic mushroom species for cats or their toxic doses. In general, mushrooms can cause a variety of non-specific clinical and clinicopathologic signs, which make diagnosis of a mushroom-specific toxicosis difficult [10].

Morels are edible mushrooms, which can be toxic when poorly cooked or eaten raw. Ingestion of raw or poorly cooked morels may cause gastrointestinal disorders (nausea, vomiting, abdominal pain, diarrhea, etc.) with a time to onset that has never been clearly documented. In the previously reported cases, neurological effects appeared after a median of 10 h (12 h in our series) after consumption of *Morchella* sp. Signs and symptoms were very similar to those observed in the present series and included dizziness, tremors, gait or postural instability and gastrointestinal or ocular disorders [11, 12]. In this present report gastrointestinal symptoms were remarkable.

CPK elevation could have been a consequence of muscle damage due to muscle tremors. Increased AST, ALT, ALP levels and hyperbilirubinemia could have been

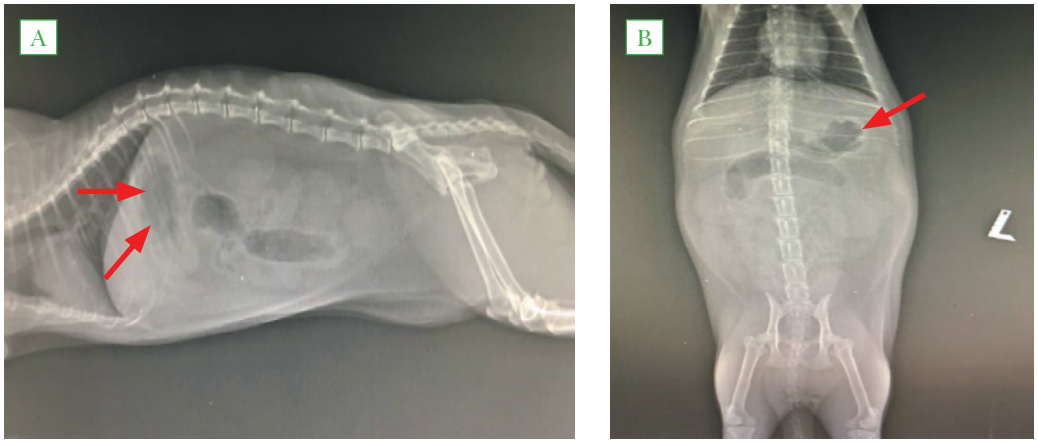

Fig. 2. Radiographic radiopaque (A) latero-lateral and (B) ventrodorsal image of the gastric wall thickening

Рис. 2. Рентгенографическое исследование: А – рентгеноконтрастное в боковой проекции и В – вентродорсальное изображение утолщения стенки желудка

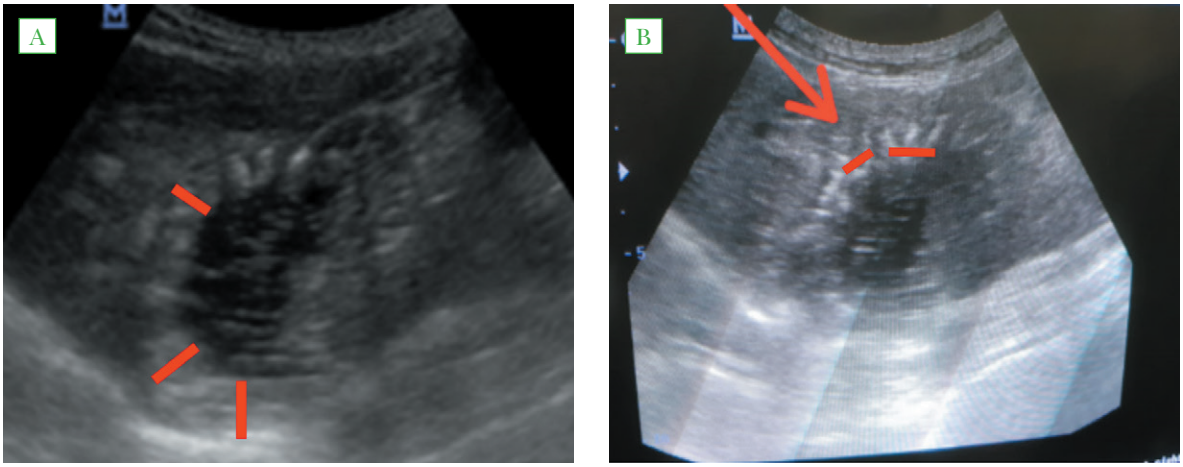

Fig. 3. (A) Rugal fold thickness (5–6 mm) and (B) interrugal thickness (3–4 mm) in the abdominal ultrasonographic images

Рис. 3. Ультразвуковое исследование брюшной полости: А – утолщение складки слизистой желудка (5–6 мм), В – утолщение между складками слизистой желудка (3–4 мм)

the result of hepatotoxicosis or a reactive hepatic consequence of the gastrointestinal inflammation [10]. False morel consumption was thought to be the evidence of the anamnesis by the owner and abundance of the false morel in the area where the house is located, also the presence of the spores of morel in fecal examination. Furthermore, infectious diseases such as FeLV, FIV and FIPV were ruled out grossly through laboratory investigation.

Table 1
Blood gases and hemogram findings

Таблица 1
Газовый состав и данные общего клинического анализа крови (гемограмма)

Parameters	Findings	Reference
pH	7.434	7.35–7.45
K, mmol/L	4.2	3.4–5.6
Na, mmol/L	153	150–165
Cl, mmol/L	119	104–128
Lactate, mmol/L	1.8	0–2
Hct, %	29.8	29–48
Base (Ecf), mmol/L	–9.9	–4÷4
Base (B), mmol/L	–8.8	–4÷4
HCO_3^- (P, st), mmol/L	17.3	19–24
HCO_3^- (P), mmol/L	14.3	19–24
WBC, m/mm³	**21.32 ↑**	5.0–19.0
RBC, m/mm³	**3.50 ↓**	4.0–9.0
MCV, fl	43.3	35.5–55.0
Hct, %	24.4	24.0–45.0
MCHC, g/dl	33.9	28.0–40.0
RDW	9.3	8.0–12.0

pH – hydrogen ion concentration (концентрация ионов водорода), K – potassium (калий), Na – sodium (натрий), Cl – chlorine (хлор), Hct – hematocrit (гематокрит), HCO_3^- – bicarbonate (бикарбонат), WBC – white blood cell (лейкоциты), RBC – red blood cell (эритроциты), MCV – mean corpuscular volume (средний объем эритроцитов), MCHC – mean corpuscular hemoglobin concentrarion (средняя концентрация гемоглобина в эритроцитах), RDW – red cell distribution width (ширина распределения эритроцитов по объему).

Table 2
Serum biochemistry findings

Таблица 2
Показатели биохимического анализа сыворотки крови

Parameters	Findings	Reference
BUN	26.5 mg/dL	14–36
Creatinin	1.0 mg/dL	0.6–2.4
AST	**214 U/L ↑**	10–100
ALT	**184 U/L ↑**	10–100
ALP	**114 U/L ↑**	6–102
Amylase	658 U/L	100–1,200
Glucose	150 mg/dL	64–170
Magnesium	1.7 mg/dL	1.5–2.5
LDH	**780 U/L ↑**	20–500
Total bilirubin	**0.9 mg/dL ↑**	0.1–0.6
Direct bilirubin	**0.5 mg/dL ↑**	0–0.4
Phosphorus	4.4 mg/dL	2.4–8.2
Cholesterol	157 mg/dL	75–220
Albumin	2.9 mg/dL	2.5–3.9
Calcium	7.8 mg/dL	8.2–10.8
Triglycerid	**248 mg/dL ↑**	25–160
Gamma glutamyl transferase	1 U/L	1–10
Protein	6.8 g/dL	5.2–8.8
CPK	**2,162 U/L ↑**	50.00–450.00

CONCLUSION

True morels are widely gathered and considered safe for consumption by amateur mycologists, and true morels can be distinguished from toxic false morels by their appearance (*G. esculenta*, wrinkled cap with brain-like folds). False morel poisoning is characterized by gastrointestinal disorders appearing 6–12 h after ingestion, and in severe cases may be associated with hepatitis, nephritis and neurologic disorders such as tremors, incoordination and seizures [13]. It is generally accepted that the development of neurological signs or symptoms is a dose-dependent effect [14].

Mushroom toxicosis was considered to be the most likely diagnosis. The weak point of this case report is the absence of systematic mycological identification. Prognosis depends on the quantity of the ingested substance, the time spent after consumption and the presence of any concurrent disease of the animal [10]. The Veterinary Poisons Information Service in the United Kingdom has received 867 dog enquiries related with mushroom poisoning, while this number is only 57 in cats [15]. For this reason, it is very important to share mushroom toxicity cases or studies in cats in the scientific world. Finally, it was concluded that anamnesis, presence of the false morel in the area where the animal lives, presence of the ingested spore of the morel in fecal examination are very important in the diagnosis and serum biochemistry analysis in the prognosis as many mushroom poisonings are underrated.

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