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Case Report

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Fungal peritonitis in dog caused by *Candida albicans* – a case report and literature overview

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Abstract: This clinical case concerns a male dog of Pointer breed, 10 years of age. The clinical examination revealed severe tenderness and a tension in the abdominal walls. The ultrasound examination detected fluid in the peritoneal cavity. The fluid collected from the peritoneal cavity displayed typical features of exudative fluid. In the cytological examination of the fluid, numerous stimulated endothelial cells, lymphocytes, and neutrophils were found. In the microbiological examination of the peritoneal fluid, *Candida albicans* was cultured. On the basis of the clinical signs, laboratory test results of the peritoneal fluid, and microbiological culture, the diagnosis of fungal peritonitis was made.

Key words: Dog, fungal peritonitis, *Candida albicans*

1. Introduction

Peritonitis is a disease in which inflammatory changes occurring in the peritoneal serous membrane are accompanied by accumulation of exudative fluid in the peritoneal cavity (1,2). Fungal peritonitis is a rare form of septic peritonitis (3). In human medicine, it accounts only for 1%–15% of the cases of peritonitis (4). Fungal peritonitis is a severe, and most commonly secondary, highly fatal complication following long-term antibiotic therapy; peritoneal dialysis; a break in the continuity of the alimentary tract, the urinary system, the reproductive system, or the biliary tract; and in diseases of the pancreas, liver, and spleen (3,4–10). In most cases, fungal peritonitis is caused by fungi of *Candida* spp., most often *Candida albicans* and *Candida parapsilosis* (3). Less frequently, the causes of this disease are the remaining species of *Candida*, *Aspergillus*, *Penicillium*, *Zygomycetes*, and *Paecilomyces*. The treatment of fungal peritonitis constitutes a great challenge to a veterinary doctor. This is due to the fact that, firstly, the clinical signs of this kind of peritonitis, which do not differ significantly from the clinical signs of bacterial peritonitis, and, secondly, the long time that is needed to identify the fungus, which does not allow early administration of proper treatment. The aim of this article is to present our own experiences connected with diagnosing fungal peritonitis in a dog based on a clinical case report.

2. Case history

The clinical case concerns a male dog of Pointer breed, 10 years old. The history revealed that the dog had had acute gastric dilation at night 2 days before. The dog was then taken to a private surgery where gastric lavage was attempted to remove residual chyme. After the introduction of the tube into the stomach proved unsuccessful, a puncture of the gastric wall was performed using a needle of 1.4 mm in diameter. Additionally, fluid therapy and antibiotics were administered. Unfortunately, despite the puncture and the applied therapy, the dog's condition became worse. On admission to our clinic the dog looked dull and was unwilling to move, eat, or drink. The physical examination showed tenderness and tension in the abdominal walls. The body temperature was 39.2 °C. The hematological tests, including a leukogram, showed a slightly increased absolute neutrophil count of 7.8 g/L (reference range: 1.2–6.8), and biochemical blood tests showed slightly increased activity of alkaline phosphatase of 228 U/L (reference range: <200 U/L), as well as a slightly decreased concentration of albumins at 23 g/L (reference range: 25–35). The ultrasound examination of the abdominal cavity showed a small amount of fluid in the peritoneal cavity and hepatomegaly. The fluid collected from the peritoneal cavity demonstrated features typical of exudative fluid. It was brownish blood-red (Figure 1), and its specific gravity was 1.035. Moreover, it was

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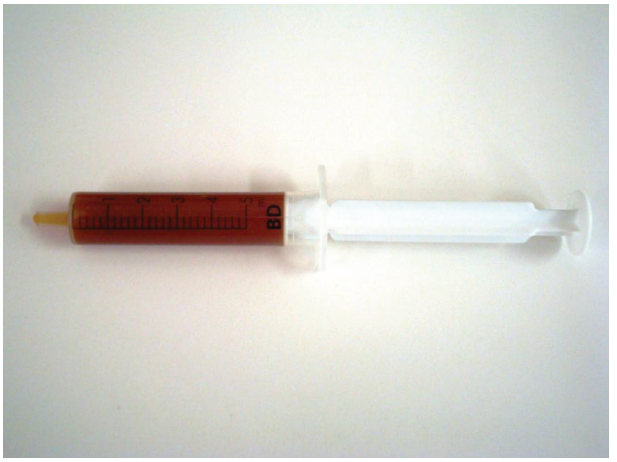

Figure 1. Brownish blood-red fluid collected from the peritoneal cavity of the dog with fungal peritonitis.

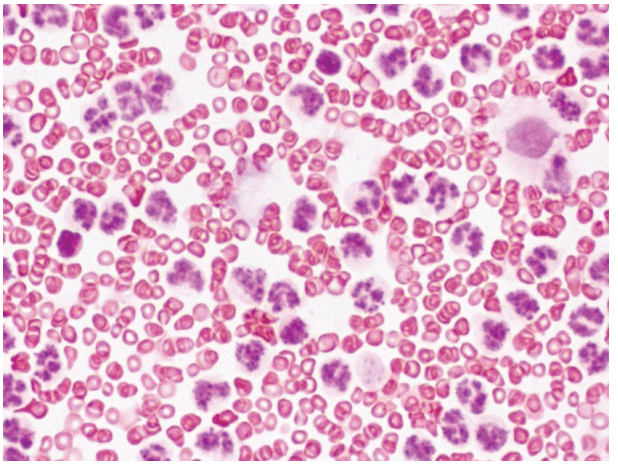

Figure 2. Smear of peritoneal fluid sediment. Numerous erythrocytes, neutrophils, and individual peritoneal cells are visible. H&E staining, magnification 400×.

characterized by a high concentration of total protein at 54 g/L, a low concentration of albumins at 17 g/L, and a low concentration of glucose at 1.05 mmol/L. An increased number of leukocytes was also noted, being 78 g/L in the fluid. The cytological examination of the fluid showed numerous stimulated endothelial cells, lymphocytes, and neutrophils, which were observed all over the visual area (Figures 2 and 3). The microbiological examination of the peritoneal cavity fluid did not show any bacterial growth; however, *Candida albicans* was cultured. Based on the results of the clinical examination, laboratory blood tests, physicochemical examination of the peritoneal fluid, and microbiological examination, fungal peritonitis (peritonitis mycotica) was diagnosed. Prior to getting the results of the microbiological examination, the dog was given symptomatic treatment with Ringer fluid in a dose of 90 mL/kg b.w. intravenously once daily and metronidazole in a dose of 10 mg/kg b.w. intravenously twice per day. After obtaining the microbiological examination results, fluconazole was administered in a dose of 2.5 mg/kg b.w. orally once daily as the causal treatment. Unfortunately, 2 days after administration of the causal treatment, the animal died. The owners did not give consent to perform a necropsy.

3. Results and discussion

Fungal peritonitis is a very rare disease in small animals. Only a few cases of this disease have been reported in the veterinary literature so far (3). This fact was confirmed by Lanz et al. (11), who observed the growth of fungi via microbiological examination of the peritoneal fluid in only 1 of 19 dogs with septic peritonitis.

The causes of septic peritonitis, one of the forms of which is fungal peritonitis, are various. In the discussed clinical case, the cause of the fungal peritonitis was the passage of chyme into the peritoneal cavity during the stomach puncture. The passage of chyme into the peritoneal cavity due to an alimentary tract perforation is the most common causes of septic peritonitis, as it accounts for 38%–75% of peritonitis cases. The most common causes of alimentary tract perforation include ulceration (24%–35% of the causes of peritonitis), resection and faulty anastomosis, alimentary tract neoplasms, alimentary tract wall necrosis, sharp-ended foreign bodies, uremic gastropathy, traumas, and iatrogenic activities (e.g., stomach puncture in the discussed dog) (3–10).

The clinical signs of fungal peritonitis are nonspecific and very similar to the ones accompanying bacterial infection of the peritoneum. Depending on the cause and duration of the disease, they may have a different intensity. Symptoms include hypoactivity, decrease in or lack of appetite, vomiting, diarrhea, increased body temperature, abdominal tenderness, abdominal wall tension, and abdominal deformation (1,3). In the described clinical case, the dog demonstrated a slightly increased body temperature, abdominal tenderness, and tension. The abdominal tenderness is one of the first symptoms of peritonitis. It may originate in the peritoneum, the retroperitoneal tissue, and internal organs in the abdominal cavity. The location and intensity of the tenderness are conditioned by the kind and amount of fluid, the rate at which it accumulates in the abdominal cavity, the reaction of the parietal and visceral peritoneum, and the general condition of the animal (12).

In the described clinical case, the animal did not show any disorders related to the blood erythrocytic and coagulation system; the leukocyte count was normal. However, neutrophilia found in the blood smear indicated an infectious cause of the disease. A hematological

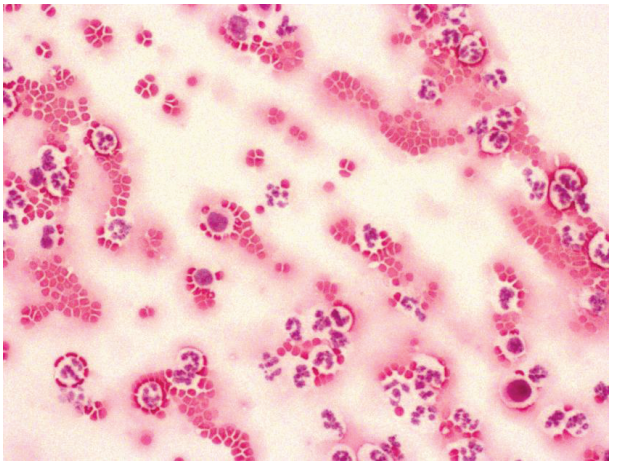

Figure 3. Smear of peritoneal fluid sediment. Erythrocytes, neutrophils, and individual lymphocytes are visible. H&E staining, magnification 200×.

examination in septic peritonitis often shows anemia, leukocytosis with neutrophilia, blood coagulation disorders, and hypovolemia (1,3). Leukocytosis may not be diagnosed in the early stage of septic peritonitis. However, in the long-term course of the disease, leukopenia may be observed. The listed hematological disorders result from a passage of pathogens and toxins to the blood, which first leads to stimulation and next to impairment of the systems and internal organ function. The entry of toxins into the blood causes complex body reactions, namely immunological, humoral, metabolic, and hemodynamic reactions (8). Changes in the blood vessel endothelium occurring directly due to the activity of toxins, proinflammatory mediators, and cytokines lead to ischemia, hypoxia, and metabolic disorders, and finally to organ damage. Initially, functional disorders appear, which are reversible after successful treatment of the infection; however, at a later stage of the disease, an irreversible damage to the structures and multiorgan insufficiency are observed.

Biochemical blood tests in animals with septic peritonitis show that the observed disorders are dependent on the cause and progress of the disease. The common disorders found in the biochemical test include hypoalbuminemia, electrolyte disorders, increased concentrations of urea and creatinine, glucose metabolism, and increased activity of hepatic enzymes (2). These observations were confirmed by the discussed clinical case, in which the biochemical blood test showed hypoalbuminemia and increased activity of alkaline phosphatase. The activation of an arachidonic acid cascade and increased release of prostaglandins and leukotrienes are observed in infectious peritonitis due to the release of endotoxins, exotoxins, and proteases by pathogens proliferating in the peritoneal cavity (3). As a result of immunological system stimulation, macrophages release a tumor necrosis factor, which activates the release of other proinflammatory cytokines, which in turn intensify the inflammatory reaction and lead to increased permeability of the peritoneal capillaries. Consequently, hypovolemia, hypoalbuminemia, and disorders in the perfusion of blood through the internal organs are observed.

In the diagnostic procedure of septic peritonitis, including fungal peritonitis, examination of the fluid accumulating in the peritoneal cavity is of great importance (1,3). Peritoneal fluid analysis in the discussed dog revealed leukocytosis with neutrophilia, hyperproteinemia, hypoalbuminemia, and hypoglycemia. An increased number of leukocytes and neutrophils observed in the peritoneal fluid examination indicates an infectious origin of peritonitis. Moreover, neutrophils are degenerated, which is caused by toxins produced by microorganisms multiplying in the fluid during septic peritonitis development. Those toxins bring about the cellular membrane damage and consequent changes in its permeability, which leads to edema of a cell and/or a cellular nucleus, nucleus fragmentation, and nuclear chromatin acidophilia. Studies by numerous authors confirm the usefulness of peritoneal fluid cytological examination as a very good method for diagnosing septic peritonitis, as its sensitivity reaches 57%– 100%. The low concentration level of glucose in the peritoneal fluid may also indicate septic peritonitis (2). This is caused by the increased use of glucose by leukocytes and pathogens multiplying in the fluid. If the concentration of glucose in the peritoneal fluid is lower by more than 1.12 mmol/L than the concentration of glucose in the blood serum, septic peritonitis is strongly suggested (13). The observed increased concentration of total protein and decreased concentration of albumins in the peritoneal fluid noted in septic peritonitis are caused by an increased concentration of globulins, firstly of the gamma-globulin fraction: immunoglobulins and C-reactive protein. This is characteristic of infectious peritonitis (2).

Fungi are common microorganisms found in animals. They are a part of the normal skin or mucosa microflora but in some cases they may become a pathogenic factor. They may be responsible for many diseases, from minor dermatophytoses to fatal systemic mycoses. *Candida* spp. are dimorphic fungi of the family Cryptococcaceae and often colonize the upper respiratory tract, alimentary tract, and the reproductive system (14,15). In animals, they are found in the entire alimentary tract where they may appear as a) temporary flora, when they come from food, do not colonize the alimentary tract, and are soon eliminated; b) residential flora, when they colonize the alimentary tract and multiply to some degree but do not cause disease

signs; and c) pathological flora, when they colonize the alimentary tract and penetrate into the host tissues bringing about disease signs (3,6). Infection with *Candida* spp. may take on a form of sepsis, either disseminated candidiasis with numerous affected organs or localized candidiasis with one affected organ. Infection with *Candida* spp. may be a reason for inflammation of biological structures such as the retina, kidney, central nervous system, lungs, bones, myocardium and epicardium, veins, and peritoneum.

Criteria facilitating the diagnosis of fungal peritonitis do not differ significantly from bacterial peritonitis and comprise peritonitis clinical signs, turbid fluid in the peritoneal cavity of exudative nature (over 100 leukocytes/mL including over 50% of polynuclear leukocytes), possible presence of anascogenic yeasts in the cytological fluid examination, and identification of fungi in the microbiological culture (final diagnosis) (2). Identification of fungi in the culture may provide some diagnosis, but usually with much delay related to the slow growth rate of the fungal colony and a long period, from 7 days up to even several weeks, necessary for microorganism identification. Serological tests are faster, yet their results are difficult to interpret and not very reliable. Very useful methods in diagnosing fungal infection are molecular biology methods like detection of the fungal cellular wall components or its genetic material using the polymerase chain reaction method (1,3). However, they are seldom used at present.

In summary, peritonitis, though very rare in dogs, should always be taken into consideration when finding exudative fluid in the peritoneal cavity. It should also be noted that, at present, the final diagnosis of fungal peritonitis is based on microbiological culture and microorganism identification, which does not allow institution of a proper therapy due to often being time-consuming. Hence, there is a necessity to develop new, faster, and more reliable methods for fungal peritonitis diagnosis.

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