Abstract

A 6.5-year-old pet rabbit (Oryctolagus cuniculus) was presented for severe weakness, dysorexia, and weight loss. The rabbit had been treated for diarrhea and anorexia 3 weeks before. Pale mucous membranes and a 2-cm abdominal mass cranial to the caecum were noted on clinical examination. Blood tests revealed a severe nonregenerative anemia with neutrophilia and thrombocytosis suggestive of an ongoing inflammatory process, and an elevation of liver enzymes. Abdominal ultrasonography showed an enlarged heterogenous spleen and mild abdominal effusion. Initial stabilization required intravenous fluid therapy and a blood transfusion, associated with broad spectrum antibiotics and analgesia. An exploratory laparotomy was performed and revealed whitish disseminated lesions in the splenic parenchyma. Splenectomy was performed during the exploratory laparotomy using a vessel sealing device and a second blood transfusion was administered. Bacterial culture, cytology, and histopathological examination were diagnostic of a yersiniosis due to Yersinia pseudotuberculosis, with a severe splenitis and a mild hepatitis. Postoperative care included supportive care, analgesia, and antibiotics. Clinical signs resolved after 6 days of hospitalization. The rabbit died 20 months later from an unrelated condition. Copyright 2018 Elsevier Inc. All rights reserved.

Key words: rabbit; splenitis; yersinia pseudotuberculosis; intensive care; splenectomy
On physical examination, rectal temperature was 39.3°C (reference range: 38°C to 40°C), which was considered high as the rabbit was very lethargic. Mucous membranes were pale and capillary refill time was not evaluable. Moderate tachypnea (130 ppm; reference range: 32 to 60 ppm) was noted. Cardiothoracic auscultation revealed a systolic left apical heart murmur (grade II/VI). A 2-cm firm irregular mass was identified in the medium left abdomen, just cranially to the caecum. The rabbit showed no abdominal pain.

A complete blood count revealed a severe nonregenerative anemia with a packed cell volume (PCV) of 13% (reference range: 33% to 50%; Table 1). In addition, a heterophilic and monocytes leukocytosis as well as a thrombocytosis were noted (Table 1). Blood biochemistry showed moderately increased ALT activity (236 U/L; reference range: 25 to 65 U/L), consistent with moderately increased ALT activity (236 U/L; reference range: 25 to 65 U/L). Blood biochemistry showed moderately increased ALT activity (236 U/L; reference range: 25 to 65 U/L), consistent with liver damage. Thoracic survey radiographs were unremarkable. Abdominal ultrasonography revealed a marked splenomegaly with a heterogeneous hypoechoic parenchyma and a highly vascularized area (Fig. 1). A moderate amount of anechoic peritoneal effusion was also revealed.

Initial therapy included intravenous fluid therapy (lactated ringer, 5 mL/kg/h; B.Braun Medical France, Boulogne-Billancourt, France), trimethoprim sulfamethoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfamethoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Boulogne-Billancourt, France), trimethoprim sulfa methoxazole (30 mg/kg, orally, twice daily; Bactrim, Roche, Bu...
(30 mg/kg, orally, twice daily), and syringe feeding (15 mL/kg, orally, every 4 hours). After the second blood transfusion, PCV reached a value of 30%.

On day 3, the rabbit was still lethargic, anorectic, and tachypneic. Rectal temperature was persistently within the high values of the normal range (39.2°C to 39.5°C). Spleen cytology revealed a lymphoid hyperplasia associated with a moderate nonspecific inflammatory infiltrate. The effusion was characterized as pyo-granulomatous. Based on these results, an infectious etiology was strongly suspected. Given the absence of improvement of the rabbit’s condition with the current antimicrobial treatment, antibiotherapy was modified for intravenous metronidazole (20 mg/kg, twice daily; Flagyl 0.5%, Sanofi-Aventis, Gentilly, France) and marbofloxacin (5 mg/kg, twice daily; Marbocyl FD, Vetoquinol, Lure, France).

On day 4, rectal temperature decreased (37.5°C to 38.5°C) and respiratory rate slowed down significantly (80 to 84 mpm). The rabbit’s condition gradually improved and analgesic coverage was progressively decreased. Constant rate infusion of analgesic was replaced by morphine (1 mg/kg, subcutaneously, every 4 hours).

On day 6, blood biochemistry revealed a persistent elevation of ALT activity (195 U/L) and PCV value was stable (29%). Bacterial culture yielded pure growth of *Yersinia pseudotuberculosis*, with antimicrobial sensitivity to most antibiotics, including marbofloxacin and trimethoprim sulfamides. Morphine was switched to buprenorphine (0.03 mg/kg, subcutaneously, every 6 hours) and fluid therapy was continued with subcutaneous administration (20 mL/kg, every 6 hours) based on adequate appetite and fecal production. Metronidazole was given orally and marbofloxacin was administered subcutaneously, at the same dosages.

The rabbit was discharged on day 7. Oral marbofloxacin and metronidazole were prescribed. The other rabbit of the household was preventively treated with trimethoprim sulfamethoxazole for 7 days.

On histopathological examination, the splenic parenchyma was severely modified by large multifocal to coalescent areas of necrosis with accumulation of cellular debris, fibrin, live and degenerated heterophilic granulocytes, and rare macrophages and lymphocytes (Fig. 3). Large

**FIGURE 1.** B-mode abdominal ultrasonographic image of a 6.5-year-old pet rabbit with a history of weakness, anorexia, and anemia. Splenomegaly with heterogenous parenchyma is noted (white arrowheads). The scale on the right side of the image indicates measurement in centimeters.
colonies of basophilic coccobacilli were observed in the center of the necrotic areas. These findings were consistent with a severe multifocal acute necrotizing and heterophilic hepatitis was also identified. Based on bacteriological and histopathological findings, a diagnosis of splenitis and hepatitis due to *Y. pseudotuberculosis* infection was made.

A week after discharge, physical examination revealed no significant abnormality. PCV was within normal ranges (44%) as well as ALT activity (41 U/L). Antibiotherapy was continued for another 2 weeks.

Four months after surgery, a complete blood count, a blood biochemistry, and an ultrasonography were within normal limits. The rabbit died 20 months after surgery from an unrelated condition.

**DISCUSSION**

Pseudotuberculosis, is an uncommon zoonotic infectious disease of domestic pets, but is considered as the most important cause of clinical disease in captive wildlife.6 The disease has been reported in a wide range of species and is commonly encountered in free-range lagomorphs.7,8 *Y. pseudotuberculosis* is a gram-negative, aerobic coccobacillus that belongs to the family Enterobacteriaceae.6,9 It is distributed globally but is particularly prevalent in Europe. Transmission mainly occurs through ingestion of foodstuff contaminated by feces of wild birds and rodents.6 In this case, the rabbit used to eat the leftover seeds from wild birds fed in the owners’ garden, which was the suspected source of contamination.

In rabbits, limited data are available regarding the clinical course of the disease. The bacterium seems to penetrate mainly through the epithelium of the duodenum and jejunum after oral contamination.10 In most species, yersiniosis is not characterized by any specific clinical signs. In experimental studies, rabbits exhibit signs of depression and isolation 5 to 7 days postinfection.11,12 Longer incubation times of 15 days or more are suggested by some authors.13 Rabbits also display weight loss, ruffled fur, and increase in body temperature between 39.2°C and 39.7°C.11,12 Pneumonia, enteritis with diarrhea, and palpable nodules on the liver have also been reported.13

In veterinary medicine, ante-mortem diagnosis of pseudotuberculosis has only been reported in a cat14 and was obtained by exploratory laparotomy with biopsies for histopathological examination and bacterial culture. In human medicine,
trimethoprim-sulfamethoxazole, chloramphenicol, and streptomycin. The spleen and continues as the left gastroepiploic artery toward the great curvature of the stomach. Splenic branches often arise as trunks in common with short gastric arteries. A vessel sealing device was used in this rabbit, such as reported in dogs. It is a safe tool for performing splenectomy in dogs, and enables a good hemostasis for vessels up to 7-mm diameter, with minimal to no need of surgical dissection before application and no remaining foreign material. This technique was used successfully in this rabbit and no long-term postoperative complication has been noted.

Splenectomy has been commonly performed in laboratory rabbits to study its consequences on the immune system. Spleen is the major site of antibody forming cells that subsequently migrates to the lymph nodes and thymus in splenectomized rabbits. Splenectomized rabbits are capable of mounting a satisfactory immune response.

Splenectomy is however associated with a lower resistance to septicemia. Before performing splenectomy in rabbits, higher sensitivity to bacterial infections need to be considered as an expected long-term complication and close monitoring of splenectomized rabbits is advocated.

To the authors’ knowledge, this is the first report of ante-mortem diagnosis and management of a splenitis due to *Y. pseudotuberculosis* in a pet rabbit in the veterinary literature. Findings in the rabbit of this report suggest that *Y. pseudotuberculosis* may be suspected in rabbits exhibiting diarrhea, weight loss, and anemia with an inflammatory leukogram. Also, splenectomy using a vessel sealing device provided a safe alternative surgical technique in this patient.

**REFERENCES**

9. Sykes JE, Chomel BB: Chapter 55 - Yersinia pestis (Plague) and Other Yersinioses, in Sykes JE (ed): Canine and Feline Infectious Diseases, St. Louis, MO, USA, W.B. Saunders, pp 531–536, 2014