Concurrent lymphosarcoma and *Salmonella enteritidis* infection in a cat: a case report

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ABSTRACT: Concurrent lymphosarcoma and salmonellosis in a 12-year-old female neutered domestic shorthair cat in Grenada is described. Clinically, the cat was emaciated, and had a history of vomiting and diarrhea of two months duration. Clinical examination revealed a large palpable mass in the craniodorsal abdomen and fluid in the thoracic cavity. Gross lesions consisted of moderate pyothorax and pyoabdomen with variably-sized, single to multiple, soft, white masses in the mesentery adjacent to the pancreas, on the serosal surface of the stomach, and on the quadrate lobe of the liver. Histopathological findings associated with these masses were compatible with lymphosarcoma. Sheets of neoplastic round cells, some with intracytoplasmic eosinophilic granules, were found in the masses associated with the omentum, stomach, and liver. *Salmonella enteritidis* was isolated in pure culture from the thoracic fluid, collected during clinical examination, and mesenteric mass, collected during necropsy, and both isolates showed similar antimicrobial susceptibility patterns.

Keywords: cat; lymphosarcoma; salmonella

Cats have high intrinsic resistance to salmonellosis, therefore, asymptomatic carrier state, and subclinical disease are more common in adult cats. However, clinical disease can occur, and clinical syndromes described for cats include gastroenteritis, bacteremia/endotoxemia, pyrexic episodes lasting several days that are sometimes accompanied by vomiting, localized infection in extraintestinal organs, conjunctivitis, abortion, stillbirths, and fading kittens (Chandler et al., 1993; Tilley et al., 2004). In feline lymphosarcoma (lymphoma), sepsis is a possible complication (Tilley et al., 2004), and *Salmonella* septicemia has been reported in Canada in a cat that was diagnosed with lymphoma (Hohenhaus et al., 1990). The current report describes a case of lymphosarcoma with pyothorax and pyoabdomen in an adult cat from Grenada, West Indies, which yielded pure growth of *Salmonella* in samples collected from thoracic fluid and abdominal mass.

Case presentation

A 12 year-old, fully vaccinated (rabies and feline viral rhinotracheitis, calcivirus, panleukopenia [FVRCP vaccine]), female cat with a two to three months history of emaciation, and a recent history of vomiting was brought to the Small Animal Hospital of the St. George's University (Grenada, West Indies). The cat was not tested for serological status with respect to FeLV (feline leukemia virus) and FIV (feline immunodeficiency virus). The cat had a palpable abdominal mass and fluid in the thoracic cavity. Thoracic fluid was submitted for bacteriological culture and sensitivity. Because of the poor prognosis, the animal was euthanized.

Pathological examination

On postmortem examination, Infiltrating lymphosarcoma was diagnosed on the basis of postmortem

lesions and histopathology. Significant postmortem findings included gastric, mesenteric, hepatic, and omental neoplasia with pyothorax and pyoabdomen. The mesentery had a large (7 cm × 5.5 cm × 2 cm), white soft mass, with purulent exudate on cut surface. There were four smooth, white nodules, 0.5 to 1 cm in diameter, on the serosal surface of the stomach (Figure 1). The abdominal cavity had approximately 100 ml of thick, light yellow, foul smelling fluid. Similarly, the thoracic cavity had 100 ml of thick, light brownish-yellow foul smelling fluid. There were two white nodules, 0.5–1 cm in diameter, in the greater omentum adjacent to the spleen, and one white-tan nodule, of 1.5 cm in diameter, in the quadrate lobe of the liver. Dark-reddish gelatinous material and congestion were seen in the lungs and tracheobronchial tree. No significant alterations were found in other organs and tissues including intestines, mesenteric lymph nodes, and spleen. Samples of the masses were submitted for histopathology and cytology. A sample of abdominal mass was also submitted for bacteriological culture Tissues were collected and preserved in 10% neutral buffered formalin. Following routine processing and paraffin embedding, 5 µm sections were cut and stained with hematoxylin and eosin.

Microscopic examination

Cytological examination of the impression smears from the masses revealed a proliferation of highly pleomorphic cells with many intact spindle-shaped and round cells. Although the degree of autolysis made it difficult to differentiate the exact cell type, these cytological findings were consistent with a malignant round cell tumor. Histologically, the normal gastric architecture was disrupted by a diffuse neoplastic lymphocytic infiltration that had replaced the mucosa and submucosa and extended to and invaded the tunica muscularis of the stomach. There was effacement of the mucosa and submucosa by a diffuse infiltration of round cells with moderate to abundant cytoplasm, some of which often contained abundant eosinophilic cytoplasm and eccentric nuclei. Some neoplastic lymphocytes were well differentiated and had centrally-located round to oval hyperchromatic nuclei with prominent nucleoli and a moderate rim of lightly pink to pale basophilic cytoplasm. There was a predominance of plasmacytoid cells and large granular lymphocytes (LGLs). Some of the submucosal lymphatic and blood vessels contained round cell tumor emboli. The mesenteric mass consisted of proliferation of sheets of round cells comprising large and small lymphocytes, and plasma cells. The proliferating round neoplastic cells were similar to those seen in the stomach, containing abundant eosinophilic cytoplasm. Some of the neoplastic lymphocytes in the mesenteric mass contained eosinophilic cytoplasmic granules, consistent with LGLs. In the mesentery, there were perivascular lymphocytes with eosinophilic cytoplasmic granules. There was multifocal to focally extensive necrosis within this mass with intralesional bacterial colonies seen as basophilic rods, consistent with *Salmonella* spp.

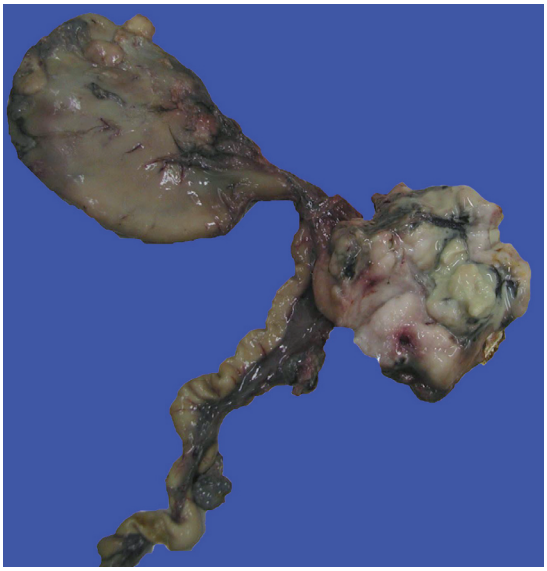

Figure 1. The serosal surface of the stomach showing smooth, white nodules, and the mesentery showing a white mass, with purulent exudate on cut surface

Bacteriological examination

The thoracic fluid and the abdominal mass samples were plated on Columbia agar with 5% sheep blood, and MacConkey agar (Remel Inc., Lenexa, KS, USA), and incubated aerobically at 37°C for 24 h. Both samples yielded pure, moderate growth of grey, smooth, medium sized, non-hemolytic colonies with circular periphery or with slightly irregular edges on blood agar. MacConkey agar plates yielded pure, moderate growth of small to medium sized, round, smooth non-lactose fermenting colonies. The colonies from both samples were identified as *Salmonella* based on results from a commercial enteric bacteria identification system, API-20E

(BioMérieux SA, Mary-l'Etoile, France) after initial tests (i.e. a negative reaction for urease), and agglutination with *Salmonella* O Antiserum Poly A-I and Vi (Difco Laboratories Inc., Detroit, MI, USA). Serogrouping was done at the Minnesota Veterinary Diagnostic Laboratory (Saint Paul, MN, USA) utilizing a commercial kit, Bacto Salmonella Antisera (Difco Laboratories). Serotyping was done at the National Veterinary Services Laboratories (Ames, IA). The isolates from both thoracic fluid and the abdominal mass were identified preliminarily as belonging to *Salmonella* group D1. Serotyping led to their identification as *Salmonella enteritidis*.

DISCUSSION

Salmonellosis in cats has been associated with a wide variety of serotypes, most frequently *S. typhimurium* (Philbey et al., 2008). There have been reports of isolation of *S. enteritidis* from cats from commercial sources, and from stray cats (Fox and Beaucage, 1979; Kinde et al., 1996). *Salmonella enteritidis* is one of the major causes of bacteremia in critically ill cats (Dow et al., 1989). Interestingly, *S. enteritidis* strains have been shown to produce cytotoxins that damage mammalian cells (Hariharan et al., 1995). Whether the strain isolated from the present case produced cytotoxins or not, could not be determined. Gross pathological findings in the present case included pyothorax. Among the unusual bacteria associated with pyothorax in cats, *S. typhimurium* has been isolated from pleural fluid in a retrospective study of 27 cases of feline pyothorax in Australia (Barrs et al., 2005). In humans and dogs, salmonellosis is associated with immunosuppression caused by neoplasia and chemotherapy, hospitalization, and oral antibiotic therapy (Aserkoff and Bennett, 1969; Baine et al., 1973; Calvert and Leifer, 1982). Signs of salmonellosis in dogs with lymphosarcoma include vomiting, diarrhea, neutropenia, anorexia and fever (Calvert and Leifer, 1982). Salmonellosis associated with lymphoma in a cat has been reported previously (Hohenhaus et al., 1990).

The anatomic forms of lymphosarcoma in cats are mediastinal, alimentary, multicentric, and extranodal (ocular, nasal, neural, renal) with the alimentary form being the most common presentation. Cats with alimentary lymphosarcoma tend to be older (over seven years), have a solitary or multifocal mass or diffuse gastrointestinal infiltration, with or without involvement of mesenteric lymph node, spleen, or liver, accompanied by gastrointestinal signs (e.g., weight loss, vomiting, diarrhea, anorexia, melena, and palpable abdominal masses) (Fry and McGavin, 2007). The clinical presentation and the gross and histopathologic findings in the present case are consistent with alimentary lymphosarcoma involving the stomach, mesentery, and liver. Histologically, there was a preponderance of neoplastic lymphocytes with discernible eosionphlic cytoplasmic granules compatible with LGL lymphoma. Although the most common gross findings in LGL neoplasia include splenomegaly, mesenteric lymphadenopathy, and thickening of the small intestinal mucosa, it was not so in this case. Although the exact origin of LGLs is unknown, studies have shown that LGLs can express cytoplasmic markers for cytotoxic T lmymphocytes and natural killer cells. Lymphomas of LGLs are rare clonal mymphoproliferative neoplasms often derived from either of these cell lineages. Some LGL mymphomas are negative for all lymphocyte markers.

Previous reports of feline salmonellosis have implicated hospitalization, immunosuppression by feline leukemia virus or diabetes mellitus in the pathogenesis of the disease. In a case reported previously (Hohenhaus et al., 1990), the authors pointed out that the disruption of the normal intestinal barrier by neoplastic infiltration might have allowed vascular invasion by the pathogen. Tumor cells or their products may be immunosuppressive as they can produce transforming growth factor-α which inhibits the proliferation and function of lymphocytes and macrophages. Tumors can also produce Fas ligand which can bind to Fas receptors on nearby T lymphocytes triggering their apoptosis. Tumor antigens released into the circulation can form immune complexes which can also be immunosuppressive (Kuswitt and Rush, 2007). In addition, LGLs can exert NK-cell activity and have an important role in antibody dependent-cell mediated cytotoxicity. In diseases involving LGLs, compromise of these functions is associated with immunodeficiency, which can augment opportunistic infections. The cat in the present study could have been a carrier of *Salmonella*, and decreased cell-mediated immunity associated with lymphosarcoma may have reduced the normal bactericidal mechanisms, and predisposed the cat to sepsis. Vomiting, diarrhea, and weight loss, frequently associated with feline salmonellosis (Mauldin

and Mooney, 2001) were seen in the present cat. However, the extent to which the gastric neoplasm contributed to vomiting is unknown.

Overall, the current report provides evidence suggesting that *Salmonella* can cause generalized infection in cats with lymphosarcoma, if the cat was a carrier or exposed to infection. It should be noted, however, that the prevalence of fecal carriage of *Salmonella* in cats can be as low as 1% as found in one major study involving 206 cats (Hill et al., 2000); therefore, all cats with lymphoma may not develop salmonellosis. This case is of particular interest due to the fact that it is the first report of salmonellosis in a cat in Grenada, and the isolate belonged to serotype Enteritidis, and the cat had concurrent lymphosarcoma.

REFERENCES

Aserkoff B., Bennett J.V. (1969): Effect of antibiotic therapy in acute salmonellosis on the fecal excretion of salmonellae. New England Journal of Medicine, 281, 636–640.

Baine W.B., Gangarosa E.J., Bennett J.V., Barker W.H. (1973): Institutional salmonellosis. Journal of Infectious Diseases, 128, 357–360.

Barrs V.R., Allan G.S., Martin P., Beatty J.A., Malik R. (2005): Feline pyothorax: a retrospective study of 27 cases in Australia. Journal of Feline Medicine and Surgery, 7, 211–222.

Calvert C.A., Leifer C.E. (1982): Salmonellosis in dogs with lymphosarcoma. Journal of American Veterinary Medical Association, 180, 56–58.

Chandler E.A., Gaskell C.J., Gaskell R.M. (1993): Feline Medicine and Therapeutics. 2nd ed. Blackwell Scientific Publications, Oxford, U.K. 560–561.

Dow S.W., Curtis C.R., Jones R.L., Wingfield W.E. (1989): Bacterial culture of blood from critically ill dogs and cats: 100 cases (1985–1987). Journal of American Veterinary Medical Association, 195, 113–117.

Fox J.G., Beaucage C.M. (1979): The incidence of *Salmonella* in random-source cats purchased for use in research. Journal of Infectious Diseases, 139, 362–365.

Fry M.M., McGavin M.D. (2007): Bone marrow, blood cells and lymphatic system. In: McGavin M.D. (ed.): Pathologic Basis of Veterinary Disease. 4th ed. Mosby, St. Louis, MO, USA. 801 pp.

Hariharan H., Heaney S.B., Singer J.T. (1995): Toxigenicity of culture filtrates of *Salmonella enteritidis* isolates on three mammalian cell lines. Microbiologica, 18, 261–266.

Hill S.L., Cheney J.M., Taton-Allen G.F., Reif J.S., Bruns C., Lappin M.R. (2000): Prevalence of enteric zoonotic organisms in cats. Journal of American Veterinary Medical Association, 216, 687–692.

Hohenhaus A.E., Rosenberg M.P., Moroff S.D. (1990): Concurrent lymphoma and salmonellosis in a cat. Canadian Veterinary Journal, 31, 38–40.

Kinde H., Read D.H., Ardans A., Breitmeyer R.E., Willoughby D., Little H.E., Kerr D., Gireesh R., Nagaraja K.V. (1996a): Sewage effluent: likely source of *Salmonella enteritidis*, phage type 4 infection in a commercial chicken layer flock in southern California. Avian Diseases, 40, 672–676

Kuswitt D., Rush L. (2007): Neoplasia and tumor biology. In: McGavin M.D. (ed.): Pathologic Basis of Veterinary Disease. 4th ed. Mosby, St. Louis, MO, USA. 253–298.

Mauldin G.E., Mooney S.C. (2001): Management of lymphoma patient with concurrent disease. In: August J.R. (ed.): Consultations in Feline Internal Medicine. 4th ed. W.B. Saunders Company, Philadelphia, PA, USA. 506–519.

Philbey A.W., Mather H.A., Taylor D.J., Coia J.E. (2008): Isolation of avian strains of *Salmonella enterica* serovar Typhimurium from cats with enteric disease in the United Kingdom. Veterinary Record, 162, 120–122.

Tilley L.P., Smith Jr. F.W.K. (2004): The 5-Minute Veterinary Consult Canine and Feline. 3rd ed. Lippincott Williams and Wilkins, Baltimore, MD, USA. 792–793, 1158–1159.

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