NOTE

Internal Medicine

Huge myxosarcoma arising from the greater omentum in a dog

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ABSTRACT. A 13-year-old intact Pomeranian bitch presented with a 2-month history of abdominal distension and anorexia. Ultrasonography and computed tomography revealed a large tumor in the abdominal cavity without metastases. The tumor was surgically resected and histopathologically characterized by spindle-shaped to atypical-shaped neoplastic cells with basophilic stroma in the omental adipose tissue. Immunohistochemistry revealed that the neoplastic cells were positive for vimentin but negative for cytokeratin, S-100 protein, and α-SMA. The bitch was diagnosed as a myxosarcoma arising from the greater omentum. Postoperatively, metronomic chemotherapy with cyclophosphamide and piroxicam was initiated. The tumor recurred on postoperative day 49. Although the bitch died 102 days after the initial examination, her general condition was maintained until death.

KEY WORDS: canine, greater omentum, myxosarcoma

Myxosarcoma is a malignant tumor derived from fibrous connective tissue and is classified as a soft tissue sarcoma. It is characterized by an abundant intercellular matrix of mucin [5]. It is rare in dogs but can reportedly arise from various connective tissue sites in the body [11, 14, 20]. The most common sites for myxosarcomas in dogs are the skin and subcutaneous tissue, but other cases have been reported in the heart, spleen, brain, orbit, and spine [1–4, 6, 9, 13, 17, 18, 21, 22, 25, 26]. The prognosis is generally poor because of the high rates of local recurrence and metastasis [10, 15]. The major sites for metastasis are the lung and local lymph nodes. In a retrospective study of 32 dogs with myxosarcoma, the local recurrence rate was 40.6%, and the lymph node or lung metastasis rate was 25% [15].

Primary malignant omental tumors are rare in humans and domestic animals [7, 12, 16, 19, 23, 24, 27]. There have only been a few reports of primary malignant tumors arising from the greater omentum [7, 12, 16, 19, 23, 24, 27], but no reports detailing the clinical signs, biological behavior, or prognosis of canine myxosarcomas arising from the greater omentum. Here, we report a case of myxosarcoma arising from the greater omentum of a bitch, with a focus on the clinicopathological findings.

A 13-year-old intact Pomeranian bitch was referred to us with a 2-month history of abdominal distension and anorexia. Her symptoms had progressively worsened, but she had received no treatment. At presentation, she showed decreased appetite, respiratory distress, and difficulty in standing. Physical examination revealed a thinly built bitch with abdominal distension (body weight: 5.6 kg). The complete blood count revealed normocytic and normochromic anemia (red blood count, 4.7×10^{12} cells/l; mean corpuscular volume, 62.3 fl; mean corpuscular hemoglobin concentration, 33.1 g/dl), decreased hematocrit (29.3%) and hemoglobin level (9.7 g/dl), and neutrophilia (17.3×10^9 cells/l). Serum biochemical analysis revealed reduced albumin (2.4 g/dl) and elevated alkaline phosphatase (1,118 U/l) and C-reactive protein (15 mg/dl) levels. Abdominal ultrasonography revealed a nonuniform echogenic mass occupying the abdominal cavity, but the whole mass was not visualized. Computed tomography performed 3 days after the initial examination revealed a huge mass occupying the liver caudal to the pelvic cavity (Fig. 1A, 1B). The mass was $17.3 \times 12.2 \times 21.3$ cm in size, and adjacent organs were displaced. Tumor invasion was not observed. The tumor origin could not be determined because of the large size of the mass. The mass showed non-uniform contrast enhancement and was mostly poorly enhanced. No metastases were observed in the lungs or lymph nodes.

Seven days after the initial examination, all of the macroscopically seen abdominal mass and most of the greater omentum was surgically removed. It was white, fragile, and jelly-like and occupied most of the abdominal cavity (Fig. 2A). Grossly, it originated from the greater omentum near the splenic hilum and involved the spleen (Fig. 2B). It included the greater omentum and spleen with mild adhesions to the liver, kidneys, gastrointestinal tract, ovaries, uterus, bladder, and abdominal wall. The removed mass was fixed in 10% formalin and subjected to routine histopathological examination. Hematoxylin and eosin-stained sections revealed neoplastic cells, mainly spindle- and atypical-shaped cells, that had predominantly infiltrated and replaced the
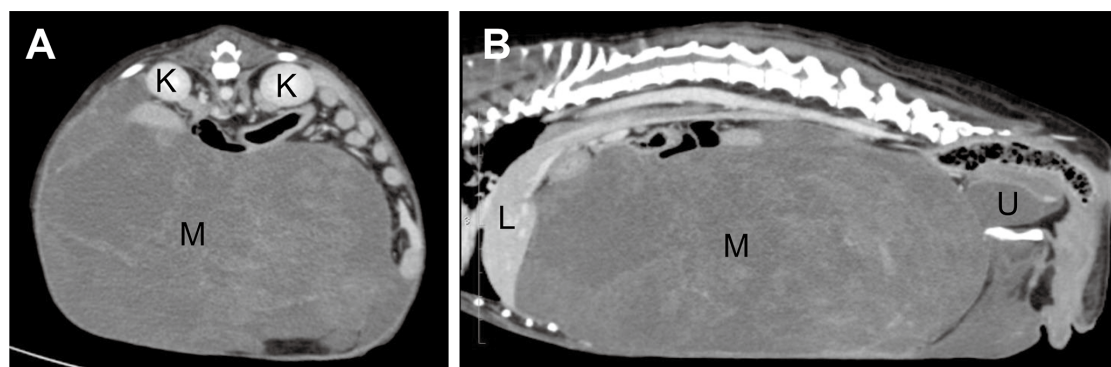
Fig. 1. Computed tomography showing a huge mass in the abdomen. (A) Transverse plane. (B) Sagittal plane. M, mass; K, kidney; L, liver; U, urinary bladder.
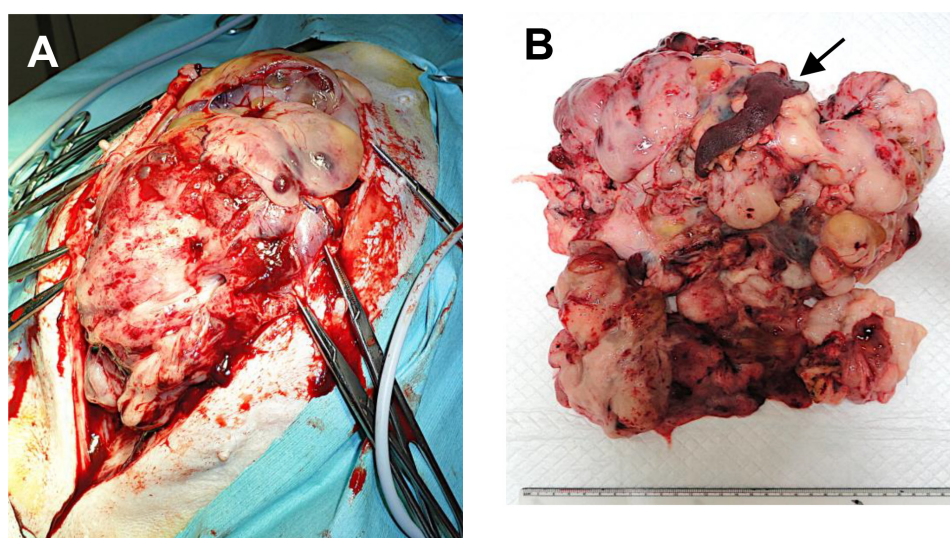

Fig. 2. Macroscopic findings. (A) Gross examination shows the mass arising from the greater omentum and occupying the abdominal cavity. (B) The mass includes the spleen (arrow).

omental adipose tissue (Fig. 3A). Proliferating neoplastic cells were arranged to form a complex bundle with a striform pattern. The cells had a clear nucleolus with moderate anisocytosis and anisokaryosis. There were two to three mitotic figures per high-power field. An abundant basophilic matrix was observed around the cells. The extracellular matrix was stained with alcian blue (Fig. 3B). Histopathologically, extensive necrotic areas were observed in the resected tumor tissue. No neoplastic cell infiltration was observed in the spleen. The surgical margins of the tumors were incomplete. Immunohistochemical staining for vimentin (clone V9, Dako, Glostrup, Denmark), cytokeratin (clone AE1 and AE3, Leica Biosystems, Nussloch, Germany), S-100 protein (Dako), and α-smooth muscle actin (α-SMA, clone ASM-1, Leica Biosystems) showed that all neoplastic cells expressed vimentin (Fig. 3C) but not cytokeratin (Fig. 3D), S-100 protein (Fig. 3E), or α-SMA (Fig. 3F). Based on the histopathological and immunohistochemical features, the present bitch was diagnosed with myxosarcoma arising from the greater omentum.

Postoperatively, the dog's condition improved rapidly and significantly, and she was discharged 7 days later. On postoperative day (POD) 15, metronomic chemotherapy with cyclophosphamide (15 mg/m^2/day, orally) and piroxicam (0.3 mg/kg orally, once daily) was initiated because of the positive surgical margin. However, on POD 49, abdominal ultrasonography revealed a recurrent tumor mass in the upper right abdomen. A nonuniform echogenic mass 2 × 4 cm in size was present adjacent to the stomach and right kidney. The owner did not consent to reoperation. Therefore, metronomic chemotherapy was continued. The bitch died suddenly on POD 95 (102 days after the initial examination). The bitch's general condition was maintained until just before her death.

Myxosarcoma is a rare malignant tumor that arises from various connective tissues in the body. Distinguishing between myxoma and myxosarcoma is a diagnostic challenge [4, 6, 21]. In this case, the degree of anisocytosis and anisokaryosis, high number of mitotic figures, and aggressive biological behavior were consistent with malignancy. The presence of an abundant mucinous matrix helped distinguish myxosarcoma from fibrosarcoma. In this case, the extracellular matrix was confirmed to be a mucopolysaccharide using alcian blue staining. Immunohistochemical analyses revealed that the neoplastic cells were positive for
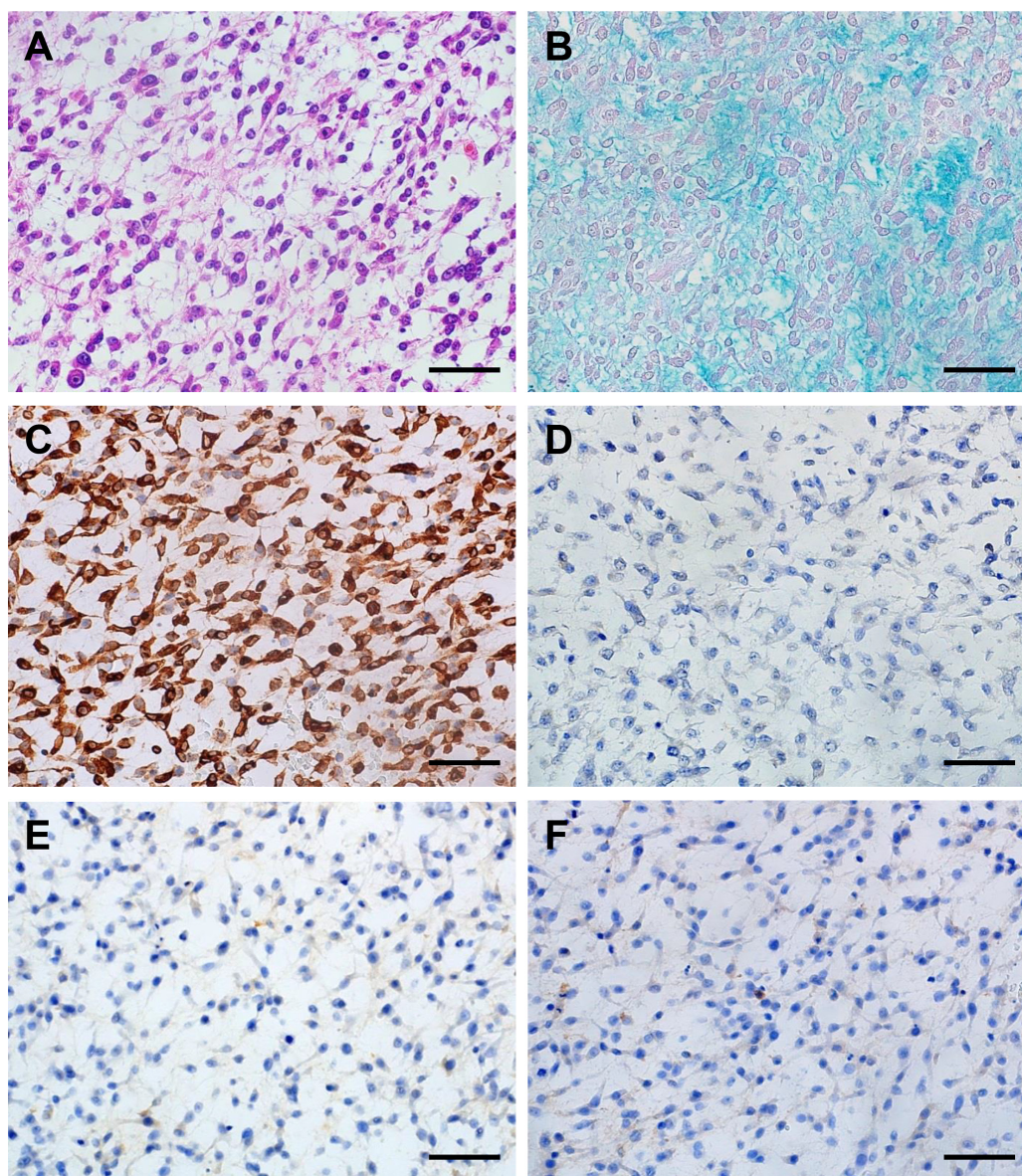
Fig. 3. Histopathological and immunohistochemical findings. Bars, 50 µm. (A) The tumor consists of spindle- to atypical-shaped neoplastic cells with abundant basophilic matrix. Hematoxylin and eosin. (B) The extracellular matrix is stained using alcian blue, indicating mucopolysaccharide. Alcian blue. (C) Immunohistochemistry for vimentin. Neoplastic cells are positive. (D) Immunohistochemistry for cytokeratin. Neoplastic cells are negative. (E) Immunohistochemistry for S-100 protein. Neoplastic cells are negative. (F) Immunohistochemistry for α-SMA. Neoplastic cells are negative.

vimentin and negative for cytokeratin, α-SMA, and S-100 protein, indicating a mesenchymal origin. Consequently, the dog was diagnosed with myxosarcoma.

Primary malignant omental tumors are rare in dogs, and only a few cases of liposarcoma, rhabdomyosarcoma, leiomyosarcoma, and malignant peripheral nerve sheath tumors have been reported [7, 23, 24, 27]. To the best of our knowledge, this is the first report describing the biological behavior of a dog with primary myxosarcoma arising from the greater omentum near the splenic hilum. Myxosarcoma in dogs is generally considered to have a poor prognosis because of the high local invasion and recurrence rates, except in cases that occur in the skin or subcutaneous tissue [1–6, 9, 11, 13–15, 17, 18, 20–22, 25, 26].

Disease control is difficult when radical resection cannot be performed. In this case, radical resection was impossible because the tumor was large and diffusely expanded throughout the abdominal cavity. Sudden death occurred on POD 95. The cause of sudden death in this case was unknown. We speculate that it was associated with ischemia of the abdominal organs and blood insufficiency due to tumor regrowth. The efficacy of adjuvant treatment for canine myxosarcoma remains unclear. A previous study revealed no significant difference in the survival time of dogs with myxosarcoma when divided into groups of those treated with surgery alone; surgery and chemotherapy; surgery and radiation therapy; and surgery, radiation, and chemotherapy [15]. The chemotherapeutic

agents used in this study were chlorambucil, melphalan, doxorubicin, palladia, mastinib, rapamycin, and 1-(2-chloroethyl)-3-cyclohexyl-1-nitrosourea. However, more than half of the dogs treated with surgery and chemotherapy were censored, and the median survival time was not calculated.

Metronomic chemotherapy is an adjuvant treatment of choice for incompletely resected soft tissue sarcomas in dogs [8]. The disease-free interval in dogs treated with metronomic chemotherapy was significantly greater than that in untreated control dogs [8]. To date, there have been no reports on the effect of metronomic chemotherapy against intraperitoneal myxosarcoma. In this case, recurrence was observed after postoperative metronomic chemotherapy; however, it may have helped to maintain the dog's quality of life. Further studies are required to characterize this rare tumor and to accumulate data on the therapeutic response.

POTENTIAL CONFLICTS OF INTEREST. The authors have nothing to disclose.

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