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Primary mesenchymal chondrosarcoma in the pericardium of a dog

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A 7-year-old, 15.5 kg, castrated male schnauzer was referred to the University of Florida Veterinary Medical Teaching Hospital with a 2-month history of progressive dyspnea, lethargy, exercise intolerance, and inappetence. Diarrhea had developed 2 weeks prior to presentation. The dog had been kicked in the chest by a cow 2 months earlier.

A physical examination revealed a thin dog in mild respiratory distress. The respiratory rate was 60/min and the pulse was 120/min. The femoral pulse was slightly weak but no pulse deficit was detected. Auscultation revealed muffled heart sounds and loud expiratory sounds. Abdominal palpation was unremarkable.

A complete blood count, serum chemistry profile, and survey thoracic and abdominal radiographs were obtained. The hemogram was normal except for a monocytosis (2,820/μl), a mild lymphopenia (880/μl), and an increase in fibrinogen (500 mg/dl). The chemistry profile was normal except for an increase in alkaline phosphatase (851 IU/liter). Survey thoracic radiographs revealed a greatly enlarged, globoid cardiac silhouette with a small volume of pleural effusion. Moderate hepatomegaly with smooth margination was noted in the abdominal radiographs. Differential diagnoses at this time included benign pericardial effusion, atrial hemangiosarcoma with pericardial hemorrhage, dilated cardiomyopathy and a thoracic or cardiac tumor.

An ultrasound-guided fine needle aspirate of the mass was obtained. Wright–Giemsa-stained fine needle aspirates of the pericardial mass revealed moderate numbers of neoplastic round to spindle-shaped cells that were arranged individually and in small clumps within a lightly stippled, eosinophilic background. These cells were characterized by round to oval nuclei with a high nuclear to cytoplasm ratio, coarse nuclear chromatin pattern, and prominent often multiple nucleoli. Anisokaryosis and anisocytosis was moderate to marked. The cytoplasm was deeply basophilic and some of the cells contained variably sized purple granules. Multinucleated cells were also noted, containing from 2 to more than 100 nuclei (Fig. 1). Amorphous, pink, extracellular material was noted around a few of the cellular clumps. A cytologic interpretation of malignant mesenchymal neoplasia was made. The owners declined further evaluation and the dog was euthanatized. A complete necropsy was performed.

Approximately two-thirds of the thoracic cavity was occupied by a large, firm intrapericardial mass that displaced the lungs dorsad and caudad. Incision of the pericardium revealed posterior displacement of the heart by a 14 × 11 × 6-cm multilobulated, off-white to tan and dark-red mass that filled the pericardial space (Fig. 2). The mass appeared to arise from the fibrous pericardium and was attached extensively to the cranial parietal pericardium. The cut surface of the mass was variegated red, off-white and black with multifocal gelatinous and friable regions. Multiple adhesions between the mass and the epicardium of the right ventricle were present and easily separated. A small amount of red tinged fluid was present in the pericardial space. The surface of the heart was dull and granular with multifocal, slightly raised, velvety tissue proliferations. The lungs were partially atelectatic. The liver had a moderately accentuated lobular pattern and was slightly firmer than expected. Grossly visible metastases were not detected. The skeleton and other visceral organs had no macroscopic changes.

Histologically, the mass was composed of intersecting bundles of fusiform cells in a variably myxomatous to collagenous stroma closely associated with numerous lobules of cartilagenous tissue (Fig. 3). The chondroid tissue consisted of irregularly arranged chondrocytes located within lacunae and of a pale, basophilic, intercellular matrix. The chondrocytes had abundant pale-staining cytoplasm, moderate anisokaryosis, and vesicular nuclei with large nucleoli. The areas of tumor comprised of fusiform cells were highly cellular. These cells had oval, hyperchromatic to vesicular nuclei with prominent nucleoli. In some regions of the tumor, the fusiform cells streamed around vascular spaces. Large numbers of multinucleated giant cells were present within the mass (Fig. 4). Mitotic figures were rare at less than 1 per 10 high-powered fields. The mass had multiple, variably-sized foci of hemorrhage and necrosis with mineralization. The histologic diagnosis made was mesenchymal chondrosarcoma of the pericardium.

Histologic examination of the epicardium revealed extensive proliferation of fibrovascular tissue and a nodule of neoplastic tissue resembling the fusiform cell component of the pericardial mass. No microscopic evidence of metastasis to other organs was detected. The liver had moderate centrolobular sinusoidal congestion, hepatocellular drop-out and fibrosis suggestive of chronic passive congestion.

Primary and metastatic tumors of the pericardium are rare in dogs. Reported canine pericardial neoplasms include hemangiosarcoma, mesothelioma, chemodectoma, thyroid carcinoma, carcinoma, fibroma, and lipoma.[4,9–11]

Extraskeletal chondrosarcomas are extremely rare in both humans and domestic animals.[2,12] Canine extraskeletal chondrosarcomas have been reported to occur in the mitral leaflet, right atrium, aorta, larynx, lung, and omentum.[1,6,8,12,14,16] Two distinct histologic subtypes of soft tissue chondrosarcomas, myxoid and mesenchymal, have been described in man.[2] Myxoid chondrosarcomas are characterized as multilobular, well circumscribed masses composed of small uniform cells with a thin rim of vacuolated eosinophilic cytoplasm. The cells are separated by variable amounts of mucoid ground substance. Differentiated chondrocytes within distinct lacunae are not observed. Mesenchymal chondrosarcomas, on the other hand, are composed of undifferentiated mesenchy-

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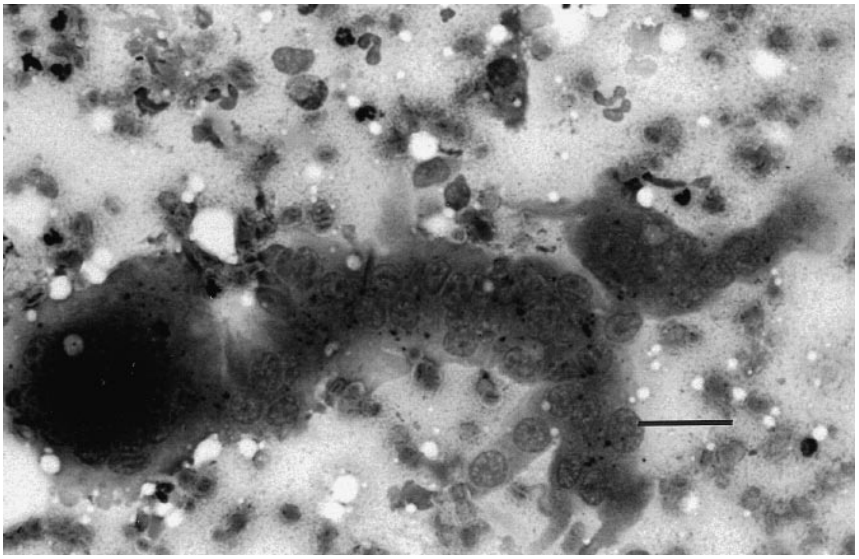

Figure 1. Tissue aspirate of the pericardial mass from a dog. A pleomorphic multinucleated cell, typical of those seen throughout the preparation, is in the center of the field. The background has a granular, proteinaceous appearance with a mixture of erythrocytes, nondegenerate neutrophils, and occasional individualized mesenchymal cells. Wright–Giemsa stain; bar = 30 μm.

mal cells, islands of malignant and well-differentiated chondrocytes and areas resembling a vascular tumor, such as hemangiopericytoma.[2] In dogs, 2 types of extraskeletal chondrosarcomas have also been recognized, mesenchymal and regular.[12] Canine extraskeletal mesenchymal chondrosarcomas have been described in the lung and omentum and are histologically similar to the mesenchymal chondrosarcomas in humans.[12] Mesenchymal chondrosarcomas have also been described in the sinonasal region of dogs.[13] Not all reports of extraskeletal chondrosarcomas in dogs have attempted to classify the tumor into mesenchymal or regular types.

In humans, the biological behavior and response to treatment of extraskeletal chondrosarcomas varies with subtype, with the myxoid variant carrying a better prognosis.[2,7] Too few cases of specific subtypes of soft tissue chondrosarcomas have been reported in the dog to make similar distinctions regarding biological behavior.

To our knowledge, this is the first report of an extraskeletal chondrosarcoma occurring in the pericardium of a dog. The large size of the mass and its intimate association with the fibrous pericardium, along with the lack of other tumors, supports a diagnosis of primary extraskeletal chondrosarcoma. The histologic appearance of this tumor was similar to that described for mesenchymal chondrosarcoma in humans

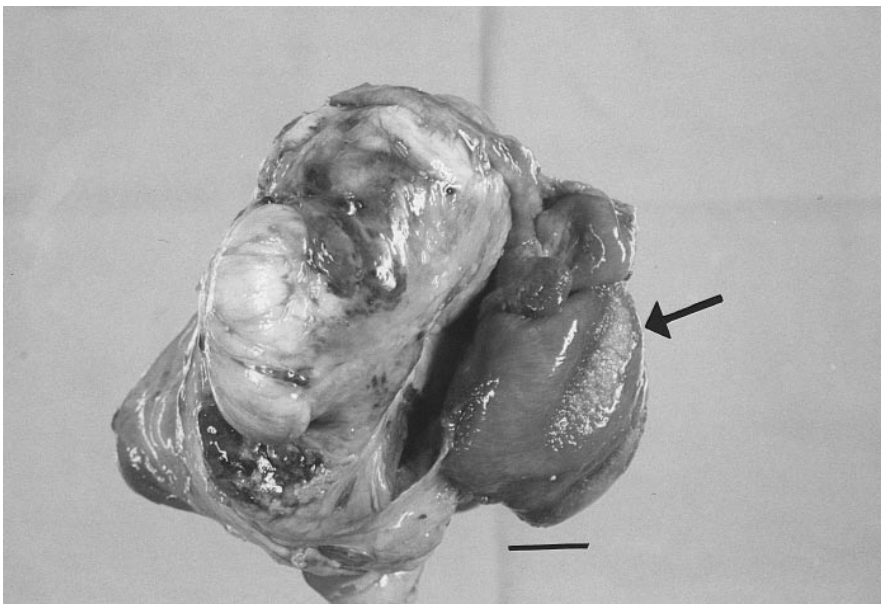

Figure 2. Photograph of the heart and pericardial tumor from a dog. The pericardium has been opened revealing the chondrosarcoma filling the pericardial cavity. Notice the reactive granulation tissue on the epicardium of the heart (arrow). Bar = 2.33 cm.

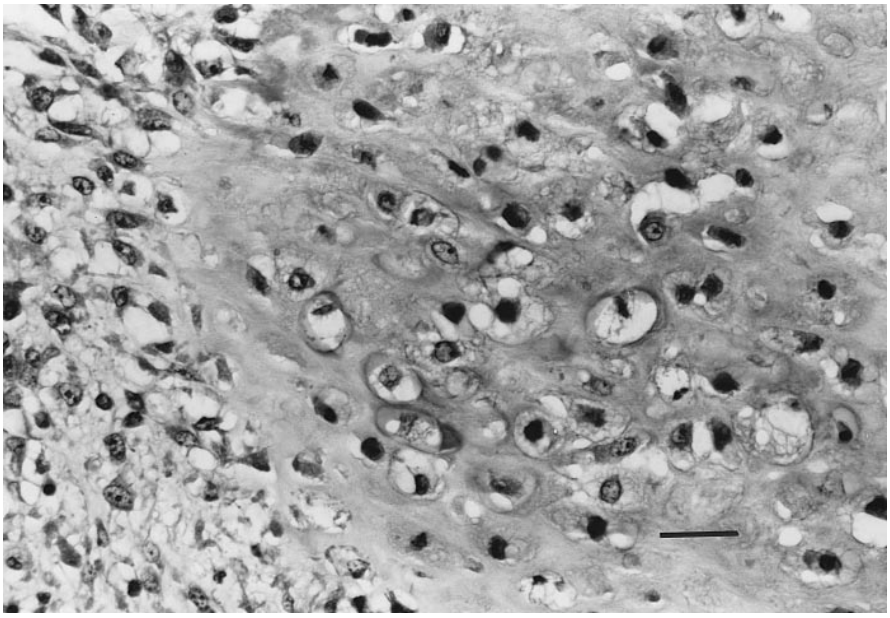

Figure 3. Photomicrograph of a pericardial chondrosarcoma in a dog. Neoplastic chondrocytes are embedded within a cartilaginous matrix. HE; bar = 30 μm.

and dogs. Distant metastasis was not detected. There was evidence of epicardial reaction, probably secondary to frictional irritation caused by the mass. A nodule of neoplastic spindle-shaped cells, presumably seeded from the larger pericardial mass, was embedded in the proliferative epicardial fibrovascular tissue. The signs of heart failure exhibited by the dog were due to the compressive effects of the pericardial mass and the pericardial effusion.

The prognosis for dogs with pericardial tumors is poor. In reported cases of pericardial mesothelioma, treatment consisting of repeated pericardiocentesis variably followed by subsequent subtotal pericardectomy was unsuccessful.[10,11] The dogs of one report developed pleural effusion postsurgically and died. At necropsy, 1 dog had evidence of metastasis of the mesothelioma to the lung, epicardium, and diaphragm.[11] The clinical signs in these cases were due to pericardial effusion with cardiac tamponade and not the direct compressive effects of the tumor. Pericardectomy and tumor removal were performed in 5 cases of canine intrapericardial neoplasms with survival times varying from 1 day to more

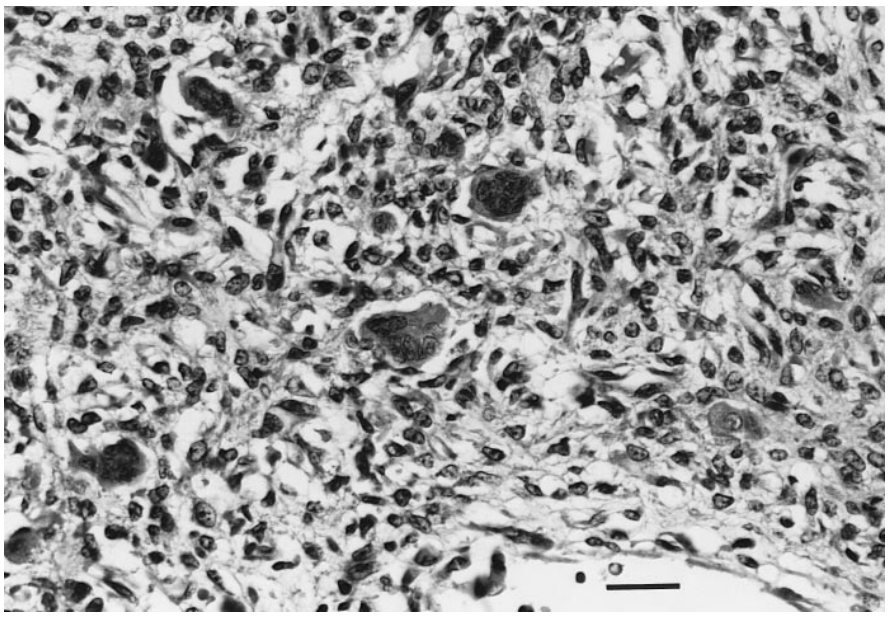

Figure 4. Photomicrograph of a pericardial chondrosarcoma in a dog. This portion of the tumor consists of sheets of neoplastic spindle-shaped cells and numerous multinucleated giant cells. HE; bar = 30 μm.

than 1 year.[4] Subtotal pericardectomy has been reported to be effective in resolving recurrent pericardial effusions and non-neoplastic mass lesions (cysts, abscesses, and granulomas). This procedure has been reported to be partially effective in treating accessible heart base tumors.[15]

The cause of canine extraskeletal chondrosarcomas is not known. Sarcomas following ocular trauma have been reported in cats.[5] In humans, some extraskeletal osteosarcomas are associated with a history of trauma.[3] The dog in this case sustained a kick to the chest 2 months prior to presentation and pericardial trauma may have occurred. Extraskeletal chondrosarcomas may potentially arise from de novo neoplastic transformation of pluripotential mesenchymal cells or from malignant transformation of metaplastic chondroid tissue.[8]

In this case, ante mortem diagnosis of a probable neoplastic mass was made by ultrasound examination and fine needle aspiration. Ultrasound examination is reported to be an effective method of diagnosis of canine intrapericardial mass lesions, but pericardial fluid cytology is less reliable in confirming the diagnosis.[4] The distinctive morphologic features of the tumor cells in the pericardial aspirate of this dog were critical in making an ante mortem diagnosis of malignancy.

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A comparison of lipoarabinomannan with other antigens used in absorbed enzyme immunoassays for the serological detection of cattle infected with *Mycobacterium paratuberculosis*

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Enzyme-linked immunosorbent assay (ELISA) protocols for the detection of antibodies to *Mycobacterium paratuberculosis* have employed a variety of antigens. These include crude protoplasmic antigens from *M. paratuberculosis* strains 18,[3,4] VRI 82/102-2,[10] and VRI 316/102-2.[5,6,11,13] The latter is used in a Commonwealth Serum Laboratories (CSL) kit[a] also available in the USA.[b] Other antigens include ammonium sulfate protoplasmic peptide antigens of strain 18,[19,21] which is also commercially available as paratuberculosis protoplasmic antigen (PPA-3)[c] for use in ELISA, a similarly prepared antigen from strain ATCC 19698,[19] antigens prepared from strain 18 by ion-exchange immunosorbent chromatography,[1] a 34-kD *M. paratuberculosis*-specific protein antigen,[7] and the polysaccharide lipoarabinomannan (LAM) antigen.[9,15,18]

Subsequent to the development of the commercially available kit, the question arose as to whether antigens other than

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