Canine Mesenchymal Chondrosarcoma of the Ribs

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ABSTRACT. The tumor of the thoracic cavity, which arose from the ribs, was diagnosed as mesenchymal chondrosarcoma. No distant metastasis was observed. Histologically, the tumor was characterized by the nests of well-defined cartilaginous tissue within a proliferation of primitive mesenchymal cells. Additionally, the deformed blood vessels compressed by the proliferating mesenchymal cells exhibited clear stag-horn appearance. Immunohistochemically, most neoplastic cells that formed multifocal cartilaginous islands were positive for S-100 protein, while the surrounding mesenchymal cells were negative. This is the first report of canine mesenchymal chondrosarcoma of the ribs. — KEY WORDS: canine, mesenchymal chondrosarcoma, rib.

Mesenchymal chondrosarcoma in human beings, first described in 1959 [4], is a rare malignant tumor of the soft tissues and bones as defined by the coexistence of nests of well-defined cartilaginous tissue within a proliferation of primitive mesenchymal cells. A similar neoplasm in dogs was also diagnosed as mesenchymal chondrosarcoma and was recognized as a separate entity in 1984 [8]. Currently, mesenchymal chondrosarcoma is accepted as an individual entity in chondrosarcoma by veterinary pathologists [14].

Recently we found mesenchymal chondrosarcoma within the left thoracic cavity, which arose from the ribs. In the present study, we have described the histological and immunohistochemical findings.

A three-year-old, male golden retriever dog weighing 31 kg came to the hospital at the school of veterinary medicine because of anorexia and swelling of the left thoracic wall. Clinicopathologic abnormalities included slight elevation of LDH and WBC. The plain thoracic radiograph revealed a huge well-defined mass of the left thoracic cavity between the fourth and eighth rib and the lysis of the seventh rib (Fig. 1). This mass oppressed the heart and the diaphragm. An aspiration biopsy was performed twice (on the first day and on the tenth day). The specimen of the latter (multiple small masses) was diagnosed as mesenchymal chondrosarcoma, because of its biphasic histological pattern: coexistence of the cartilaginous islands and the surrounding undifferentiated mesenchymal cells. After the histological diagnosis, the surgical excision was performed. The general conditions of the dog deteriorated after the surgery. Six days later, the dog was euthanized and a complete autopsy was performed.

For histological examinations, all tissue samples were fixed in 10% neutral buffered formaline, routinely embedded in paraffin and cut at 4 µm. The tumor mass, which involved the ribs, was decalcified, routinely embedded in paraffin, and cut at 5 µm. The tumor mass was sectioned as

Fig. 1. The VD radiograph. A huge well-defined mass of the left thoracic cavity.
much as possible. All sections were stained with hematoxylin and eosin (H. E.). Serial sections of selected specimens were placed on gelatin coated slides and used for immunohistochemical staining. Immunohistochemically, paraffin embedded sections were stained for the rabbit polyclonal antibody to S-100 protein (rabbit anti-bovine S-100 polyclonal antibody; DAKO Japan, Kyoto, Japan) by the peroxidase-conjugated avidin-biotin-peroxidase complex (ABC) method (Vectastain Elite ABC Kit, Vector Laboratories, Burlingame, CA, U.S.A.) for the rabbit polyclonal antibody. As a positive control slide, a S-100 control slide (human skin; DAKO) was stained simultaneously with the examined specimens mentioned above.

The tumor presented in the left thoracic cavity was a large smooth circumscribed mass in the ribs 4th through 8th (approximately 20 × 20 × 15 cm in diameter). The distal ribs including the costochondral junctions were completely involved in the tumor mass, and the border between the bones and the tumor was obscured. The tumor was dissected easily from the skin, but the demarcation from the skeletal muscles of the thoracic wall was not clear. The cut surface of the tumor was fragile with scattered calcified foci, and the center of the tumor was filled with blood, fibrin, and necrotic tissue. At autopsy, other gross pathological findings included suppurative pleuritis of the left thorax and splenic infarct, but no metastasis was found out.

Microscopically, the costochondral junctions of the ribs 4th through 8th were involved in the tumor mass. Much of the tumor grew extraskeletal, however, the medullary cavities of the ribs were also replaced by the proliferated tumor cells (Fig. 2). The tumor mass was hemorrhagic and necrotic, and it had irregularly anastomosing vessels with severe thrombi.

The tumor cells were characterized by a biphasic morphological pattern: coexistence of the sharply demarcated cartilaginous islands of varied maturity and the surrounding undifferentiated mesenchymal cells. Additionally, the mesenchymal cells had condensed around blood vessels, and the compressed and deformed blood vessels exhibited stag-horn appearance (Fig. 3).

The cartilaginous components of the tumor were scattered throughout the lesion. The tumor cells set in a basophilic extracellular cartilaginous matrix tended to have vacuolated cytoplasm, round or ovoid vesicular nuclei, and few mitotic figures. The pleomorphisms of the nuclei were not prominent (Fig. 4).

The undifferentiated mesenchymal cells mainly consisted of round, oval, or spindle shaped cells with scanty pale or faintly eosinophilic cytoplasm, and indistinct cell borders. The nucleus varied in size, shape, chromatin pattern, location, and exhibited considerable mitotic activity (Fig. 5).

Immunohistochemically, most tumor cells enclosed by multinodular mature or immature cartilaginous islands were immunoreactive for S-100 protein. S-100 protein distributed uniformly throughout the cytoplasm and nucleus. On the other hand, noncartilaginous undifferentiated mesenchymal cells were not immunoreactive for S-100 protein.

In dogs, skeletal neoplasms are common; osteosarcomas and chondrosarcomas are the most common: osteosarcomas are more common (80%), and chondrosarcomas are the less common of the two (10%) with fibrosarcomas and hemangiosarcomas occurring about equally (7%) [10, 11]. Chondrosarcoma tends to arise from any site where normal cartilage exists [14], however, there are anatomical

![Fig. 2. Low-power view of mesenchymal chondrosarcoma. Nodules of well-developed cartilage and vessels with typical proliferating pattern. H.E. × 23.5](image)
predisposing locations. Less than 28% of chondrosarcomas 
involve the appendicular skeleton, and even fewer 
chondrosarcomas involve the long bones (7 to 20% of the 
dogs reported) [1]. Chondrosarcomas occur more commonly 
on flat bones of large breed dogs [5, 11]. Fifteen out of 54 
canine primary tumors of the rib were identified as 
chondrosarcomas [9].

Canine mesenchymal chondrosarcomas also have 
particular primary sites; they are more common than 
ordinary chondrosarcomas in sinonasal skeletal tumors [8]. 
Additionally, mesenchymal chondrosarcoma of the 
extraskeletal origin has also been reported [7]. On the other 
hand, it has not yet been described in the long bones [7], 
and to our knowledge, it has also not yet been described in 
the ribs.

In comparison with other species, the incidence of
mesenchymal chondrosarcomas in human beings is low, a study of a total of 11,087 cases of bone tumors revealed only 37 mesenchymal chondrosarcomas (in 34 patients) in the Mayo Clinic series [13]. Mesenchymal chondrosarcomas are very rare in domestic and experimental animals; only one case was reported in a cow [12], and another one case was in a Chinese hamster [2].

There is a convincing histopathological criterion for the diagnosis of mesenchymal chondrosarcoma: the coexistence of nests of well-defined cartilaginous tissue within a proliferation of primitive mesenchymal cells [8, 13]. Additionally, in the pattern analysis of human pathology, vascular proliferation with a hemangiopericytomatosus pattern or stag-horn appearance of the deformed blood vessels was very typical for mesenchymal chondrosarcoma [13]. In veterinary pathology, typical growth or vascular patterns for differential diagnosis of mesenchymal chondrosarcoma have not yet been generally accepted, but “hemangiopericytoma-like appearance” has been observed in a cow [12] and “pericytoma-like vascular spaces containing thick, spindle cell stroma” has been observed in five neoplasms out of 24 canine mesenchymal chondrosarcomas [8].

It is inappropriate to introduce “hemangiopericytomatosus pattern” directly from human pathological nomenclature into the description for the characteristic histological patterns of canine mesenchymal chondrosarcoma. Because canine hemangiopericytoma has very variable histopathologic appearance and several histological patterns have already been recognized in canine hemangiopericytoma [4]. Therefore, in our present case, we used “stag-horn appearance” to express the characteristic histological pattern, but we did not use “hemangiopericytomatosus pattern” for the description of histopathological findings.

The immunohistochemical method is also an important clue for the differential diagnosis of chondrosarcoma from other mesenchymal origins: the cells delivered from the cartilage have a positive reaction for the immunohistochemistry of S-100 protein [6]. However, the immunohistochemistry of S-100 protein is not a further clue to differentiate mesenchymal chondrosarcoma from an ordinary chondrosarcoma [6].

Biologically the behavior of mesenchymal chondrosarcoma is highly malignant [14], but no distant metastasis has been observed in canine sinonasal and extraskeletal cases [7, 8]. In our present case, the clinical symptoms also demonstrated rapid deterioration. The tumor mass grew quickly and extended directly into the thoracic cavities, but no distant metastasis was observed. It also demonstrated an eccentric manner of growth with costal tumor masses tending to spread into body cavities, as in chondrosarcoma of the flat bones [10].

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REFERENCES