

## Surgical treatment of osteosarcoma in the ribs of a dog: a case report

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### Key Words:

Osteosarcoma; rib; dog.

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### Abstract

A five-year-old male Doberman pinscher with an oval-shaped mass in the left side of thorax, respiratory distress, and an impairment of the use of the left forelimb was referred to the Faculty of Veterinary Medicine of Shahid Chamran University in Ahvaz. Radiographs were taken. The abnormal mass was removed by radical surgery. Histopathological examination confirmed the occurrence of a well-differentiated canine osteosarcoma. The case was re-examined after approximately 15 months, which revealed a large mass in the left side and metastases in the right thoracic wall and lung. The decision was taken to euthanize the patient and a necropsy was performed. The recommended treatment for canine osteosarcoma is the removal of the primary tumor followed by adjuvant chemotherapy, but recurrence is common.

### Case Description

A five-year-old male Doberman pinscher with a mass in the left side of thorax, respiratory distress, and trouble with the use of the left paw was referred to the Faculty of Veterinary Medicine of Shahid Chamran University in Ahvaz. Based on the owner's statements, the mass started to grow approximately eight months before referral. The dog started to show respiratory distress and exhibited continuous hair shedding with gradual weight loss. The appetite of the dog was good except for intermittent episodes of anorexia in the two weeks prior to referral. The radiographs showed a radiopaque oval-shaped mass between the second and fourth ribs, which had spread to the thoracic cavity. There was no visible metastasis to the lung.

The dog was surgically prepared and was positioned in right lateral position. Anesthesia was continuous with the use of intermittent positive-pressure ventilation (IPPV). The chest wall excision involved the resection of two-thirds of the left second and third ribs and a smaller portion of the fourth rib. The mass, which included ribs and a rim of surrounding healthy tissues, was resected (Fig. 1 and 2). The animal was kept under close observation in hospital for three days. A continuous suction drain was placed to decrease the volume of dead space and promote contact between the skin and the underlying muscle.

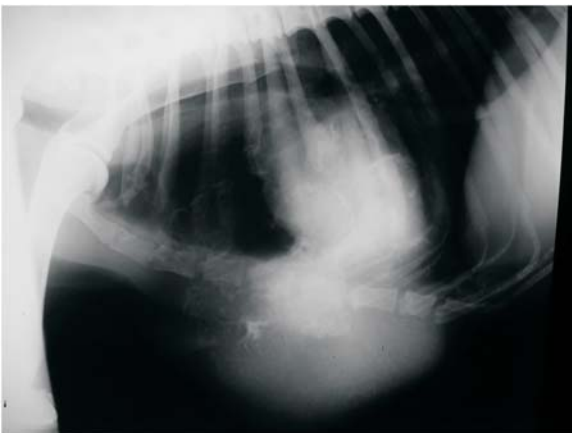
Two months later, the case was followed up and no problems were identified by the owner. The same patient was referred approximately 15 months after the operation. Clinical examination revealed a larger mass on the same side of the thoracic cavity in addition to the

sternal portion of the thorax. Several new masses were determined in the thoracic cavity after radiography (Fig. 3). The patient was cachectic and showed respiratory distress. The prognosis was poor, and the decision was taken to euthanize the patient. A necropsy was performed. Severe adhesions at the site of initial operation were observed. A large mass and several small cauliflower-like masses were observed in the ribs of right thoracic wall, the right lung and the contralateral side of the thorax. Specimens were collected from the regions with adhesions, both lungs, and draining lymph nodes. Histologically, the tumor was composed of pleomorphic cells with oval or round cells, which resembled non-neoplastic osteoblasts (Fig. 4). Between the neoplastic cells, moderate amounts of osteoid were arranged in thin strands or thicker bundles, which were represented by hyaline, eosinophilic material (Fig. 5). A diagnosis of osteosarcoma of the rib was made.

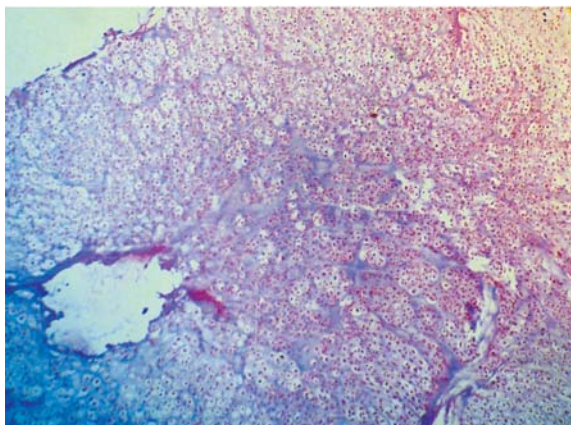
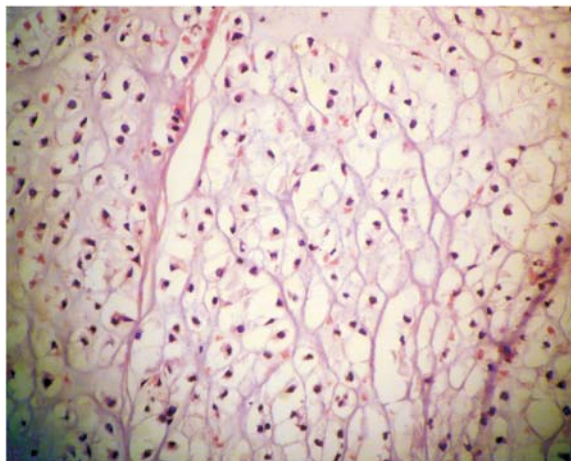
### Discussion

According to the World Health Organization classification of bone and joint tumors, an osteosarcoma is a primary malignant neoplasm of mesenchymal tissue that gives rise to a variety of patterns but always includes the production of bone by malignant osteoblasts (Hoenerhoff *et al.*, 2004). The biological behavior of osteosarcoma in dogs is similar to that in humans and the dog has been suggested as a model for the disease in humans (Hahn *et al.*, 1997).

There are many reports of osteosarcoma in humans (Baghaie and Motahhary, 2003; Mardanpour and

**Fig. 1:** Gross appearance of the tumor after the initial surgical resection.**Fig. 2:** Cross-section of the mass after necropsy.**Fig. 3:** Lateral radiograph showing a large mass in the thoracic wall.

Rahbar, 2008) and dogs (Bundza *et al.*, 1997; Yuen, 2000) around the world, but only a few cases of osteosarcoma in dogs have been reported in Iran (Aldavood *et al.*, 2006). Osteosarcoma is malignant and the most common primary tumor of the appendicular skeleton in dogs and cats. In general, it is

**Fig.4:** Fine strands and bundles of osteoid are deposited between neoplastic cells (H&E, 4×)**Fig. 5:** The tumor is composed of pleomorphic cells that vary from oval to round cells and resemble non-neoplastic osteoblasts (H&E, 20×)

a rapidly progressive tumor that causes lung metastases in the early stages of disease and, in most cases, a swift mortality. In dogs, the mean age of occurrence is between 7.5 and 8 yr, but the range is broad and animals that are less than 2-yr-old are sometimes affected (Maxie, 2007). Approximately 75% of osteosarcomas occur in the long bones, whereas only 25% occur in the axial skeleton. Of the latter, approximately 10% are located in the ribs. Therefore, costal osteosarcomas account for only 3% of all diagnosed osteosarcomas. The treatment options and long-term survival of dogs with osteosarcoma of the ribs are not documented well (Yuen, 2000). The tumor occurs predominantly in large- and medium-sized breeds, such as the Irish Wolfhound, Great Dane, and Saint Bernard.

Osteosarcomas occasionally occur at sites of chronic irritation and repair, such as those associated with osteomyelitis, bone infarcts, or the presence of an internal fixation device. Repeated microtrauma to the metaphyses of long bones produced by weight-bearing



stresses may also play a role in the development of osteosarcomas in large and giant canine breeds (Morris and Dobson, 2001; Maxie, 2007). The familial occurrence of osteosarcoma in dogs suggests the involvement of genetic factors, although this was the tentative conclusion of a single study that was composed of 322 cases (Bundza *et al.*, 1997).

In many cases, the cytological characteristics, together with the clinical history and results of radiographic investigations, will be sufficient to make a definitive diagnosis of osteosarcoma; however, malignancy cannot be excluded on the basis of cytology, as the sample may not be sufficiently representative of the lesion (Maxie, 2007). The differential diagnosis for osteosarcoma includes hemangiosarcoma, chondrosarcoma, fibrosarcoma, coccidioidomycosis, tuberculosis and metastatic mammary osteosarcoma, lymphoma of the ribs, and bacterial osteomyelitis (Bundza *et al.*, 1997; Yuen, 2000). A biopsy is indicated to confirm the diagnosis. Well-differentiated osteosarcomas may consist largely of relatively uniform-sized cells with many features of reactive osteoblasts. A similar population of reactive osteoblasts associated with strands of osteoid may be harvested from an early fracture callus.

As in humans, the common radiographic abnormalities that are suggestive of osteosarcoma include pronounced cortical bone lysis, active, speculated periosteal new bone formation, and pathological fracture (Hahn *et al.*, 1997). Radiographic signs of costal osteosarcoma include an aggressive, granular, osteoproliferative, osteolytic, or mixed lesion that originates at or near the costochondral junction. Thoracic radiographs should be taken to determine the presence of pulmonary metastasis. Evidence of pulmonary metastasis has been associated with a grave prognosis for life expectancy and pursuing radical therapy may not increase survival time. In this case, no metastasis was diagnosed during the initial investigations and surgery, but metastatic masses were observed in the ribs and thoracic wall during the second admission. The median survival time of dogs with osteosarcoma of the ribs has improved from 90 days with surgery alone to 240 days if an adjuvant chemotherapeutic agent was administered within 24 h postoperatively. Survival times may increase with *en bloc* resection of the mass and adjuvant chemotherapy (Yuen, 2000). With amputation alone, the one- and two-year survival rates are estimated to be 11.5% and 2%, respectively, and the mean and median survival times are estimated to be 19.8 and 19.2 weeks, respectively. In humans, the five-year survival rates following amputation or resection alone are between 5% and 20% (Hahn *et al.*, 1997). The case survived for 15 months after radical surgical excision of the tumor and surrounding structures without chemotherapy, and the dog might have survived longer if euthanasia had

not been performed. The prognosis of patients with an osteosarcoma has improved during the last two decades with the use of multi-agent adjuvant chemotherapy, which has led to a five-year disease-free survival of nearly 70%. One of the most powerful prognostic factors in osteosarcoma is the histological response to preoperative chemotherapy that can be evaluated in the resected specimen. The finding of novel molecules that are variably expressed among the osteosarcoma cells might provide insights into the mechanisms of tumor progression and could serve to identify tumors with either a greater or reduced degree of aggressive behavior. These include ezrin, which is a cytoskeleton linker protein that is actively involved in the metastatic process of cancer cells, and some of its partners ( $\alpha$ -smooth muscle actin) that are predictive immunohistochemistry (IHC) prognostic markers for patients with an osteosarcoma (Salas *et al.*, 2007).

Osteosarcoma is an important differential in a dog with a large, firm mass on the thorax. Radiographs are required and histopathological examination is the best method to confirm the diagnosis. *En bloc* resection of the tumor mass can be considered as a temporary treatment for osteosarcoma of the ribs.

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