

## Extensive Rib Osteosarcoma with Intraperitoneal Invasion in a Small Breed Dog: Clinical and Histopathologic Findings

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**Abstract :** An 11-year-old mixed breed male dog was presented with a thoracoabdominal wall mass of 3-year duration. Initial tentative diagnosis of osteosarcoma was made. Despite chemotherapy treatment, 72 days following the date of presentation, the dog was euthanized. Based upon necropsy and histopathologic findings, the tumor was definitely diagnosed as a combined type osteosarcoma of the rib. At necropsy examination, the tumor extended the left kidney and diaphragm, but distant metastasis was not found. The tumor's weight was 2.3 kg and that was 38.3% of the dog's weight. This case report describes the clinicopathological, computed tomographic, histopathologic and immunohistochemical findings of extensive rib osteosarcoma in a small breed dog.

**Key words :** dog, osteosarcoma, rib

### Introduction

Tumors originating from the chest wall are uncommon in the dog. Of these, osteosarcoma and chondrosarcoma are the most common malignant bone tumors of mesenchymal origin (2,8,13,16). Canine osteosarcoma is more commonly observed in appendicular bones than axial bones or extraskeletal systems (7,17). According to previous reports, canine osteosarcoma has highly invasive and metastatic behavior with poor prognosis (2,8,13,14,16).

The occurrence of primary osteosarcoma in small breed dogs is much more uncommon than in large breed dogs (2,5,8,16), although secondary bone tumors are reported to occur more commonly in small breed dogs (<10 kg) than in large breed dogs (5).

This report describes the clinical and histopathological characteristics of combined type osteosarcoma of the rib in a small breed dog with extension of the left kidney and diaphragm.

### Case Report

An 11-year-old mixed breed male dog weighing 6 kg was presented for a precise evaluation of a thoracoabdominal wall

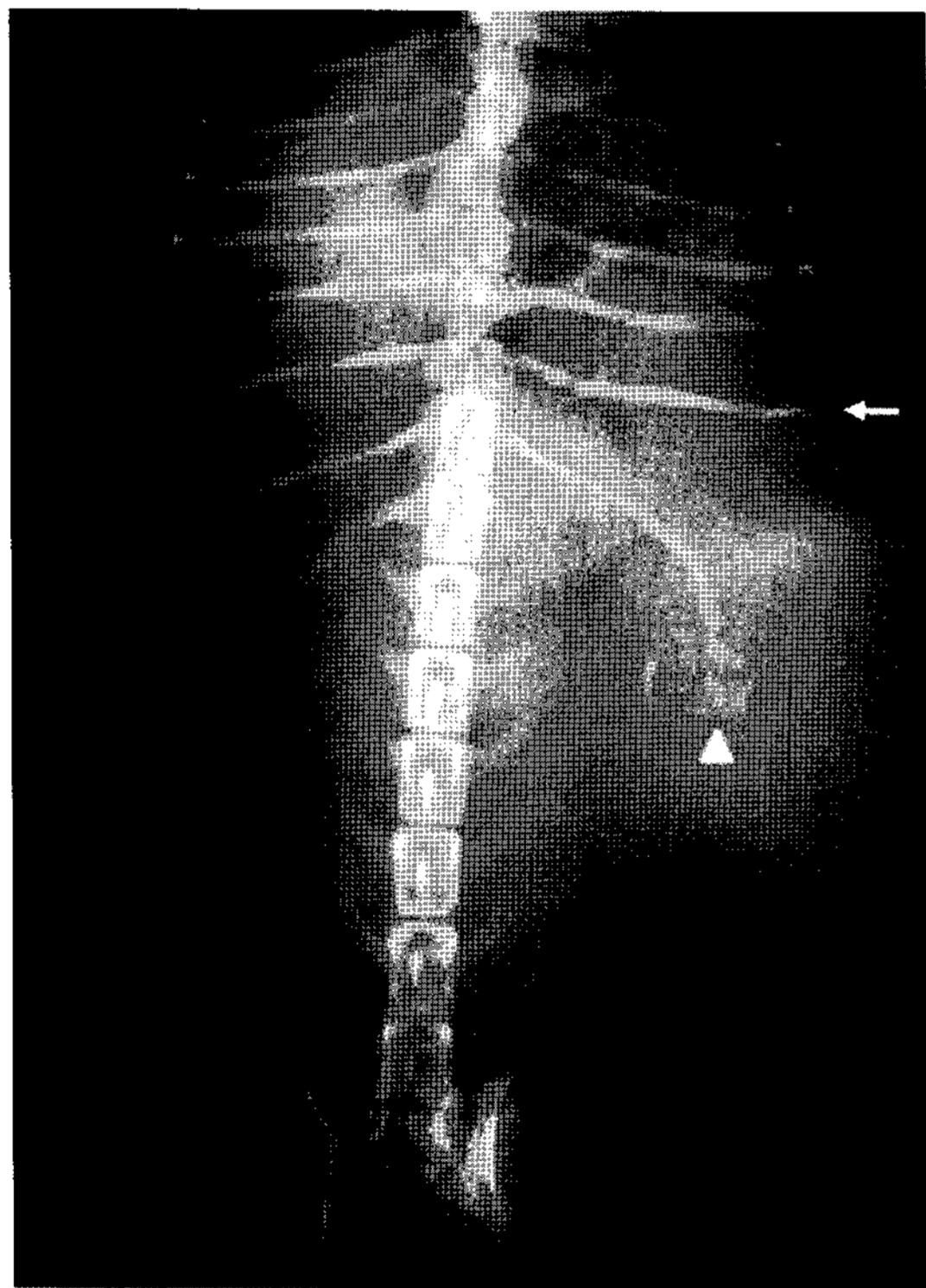
mass of 3-year duration. The mass was firm, irregular, and measured 15 × 10 × 10 cm (Fig 1). A firm and irregular mass was palpated in the left caudodorsal pelvic cavity on rectal examination. It was unknown whether palpated mass was an extension of thoracoabdominal mass or another mass. A complete blood count showed no remarkable findings. Serum biochemical profiles revealed elevated alkaline phosphatase (ALP) (370 U/L; reference range, 0-142 U/L), and mild proteinuria (less than 30 mg/dl) was noted on urinalysis.

Radiographic findings included a pathologic fracture of 11th rib, osteolysis of the left 12th rib, absence of the left 13th rib, increased radiodensity of the left abdomen, and cranioventral and right displacement of abdominal organs (Fig 2). Abdominal ultrasonography revealed heterogeneous large mass including multiple anechoic regions and involvement of the medial region of the left kidney by the mass. To evaluate the thoracoabdominal wall mass, we initially performed a fine needle aspiration biopsy (FNAB), which retrieved large number of atypical mesenchymal cells (Fig 3). An amorphous eosinophilic extracellular matrix suggestive of osteoid was also observed. Computed tomography (CT) was performed to determine the degree of tumor invasion and/or the presence of metastases more accurately (Fig 4). CT scan showed that the abdominal cavity was filled with a heterogeneous mass, displacing the abdominal organs to the right cranial side, involvement of the left kidney and diaphragm and,

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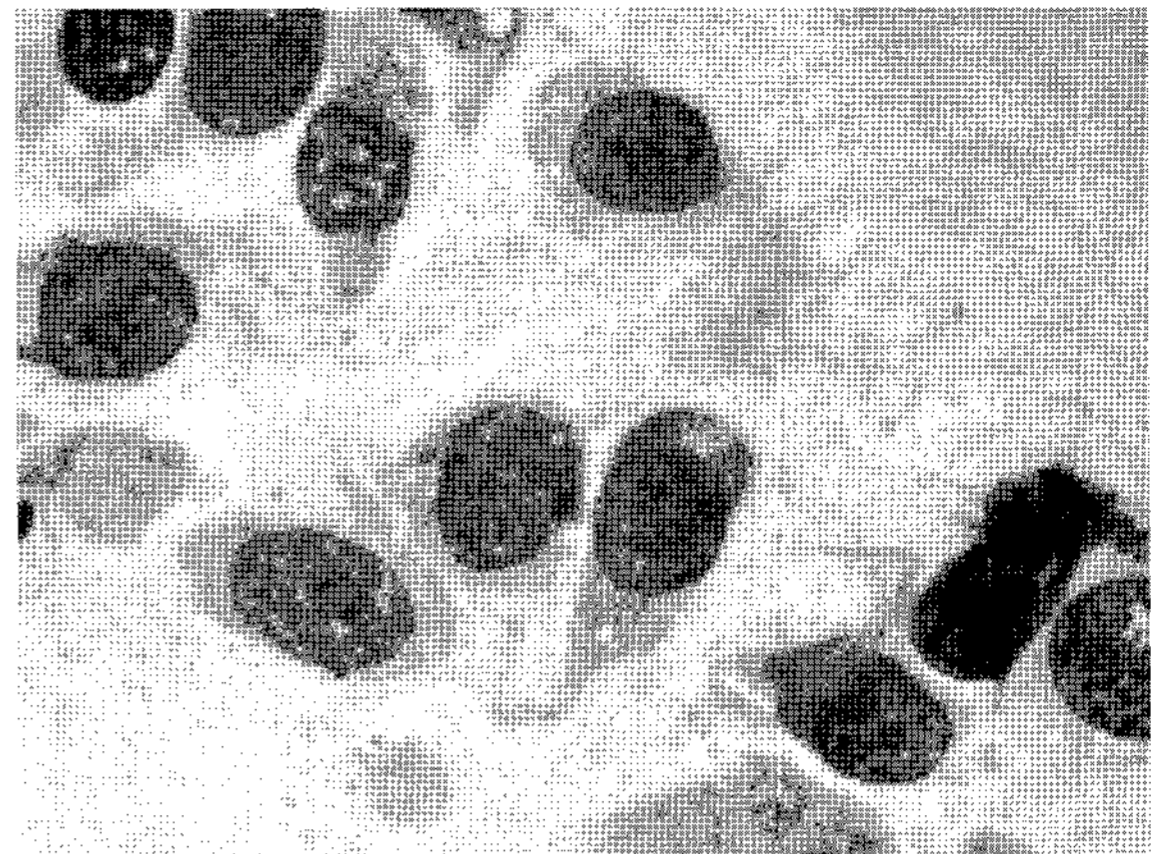
**Fig 1.** Photograph of combined type osteosarcoma. Large tumor mass on the left thoracoabdominal wall was observed. Its size was approximately 15 × 10 cm.



**Fig 2.** Radiograph of combined type osteosarcoma. A pathologic fracture of 11th rib (arrow) and osteolysis of the left 12th rib (arrowhead) were observed.

possible splenic involvement. An incisional biopsy was performed, and based upon histopathological examination, a diagnosis of osteosarcoma was made.

The mass was not resectable because of its large size, renal and diaphragmatic involvement, and suspected splenic involvement. Thus, chemotherapy was initiated with doxorubicin (1 mg/kg, IV, q 3 weeks; Korea United Pharm, Seoul, Korea), carboplatin (10 mg/kg, IV, q 3 weeks; Korea United Pharm, Seoul, Korea) and celecoxib (2 mg/kg, PO, q 12 h; Pfizer,



**Fig 3.** Cytologic findings of combined type osteosarcoma. Pleomorphic mesenchymal cells predominate. Multiple, variable size nucleoli were observed and pink extracellular matrix was also detected. Diff-Quik stain. Original magnification × 1,000.

Seoul, Korea) for palliative purposes. Ultimately, due to compression of chest wall by the mass, this dog suffered from respiratory distress and was euthanized 72 days following first presentation.

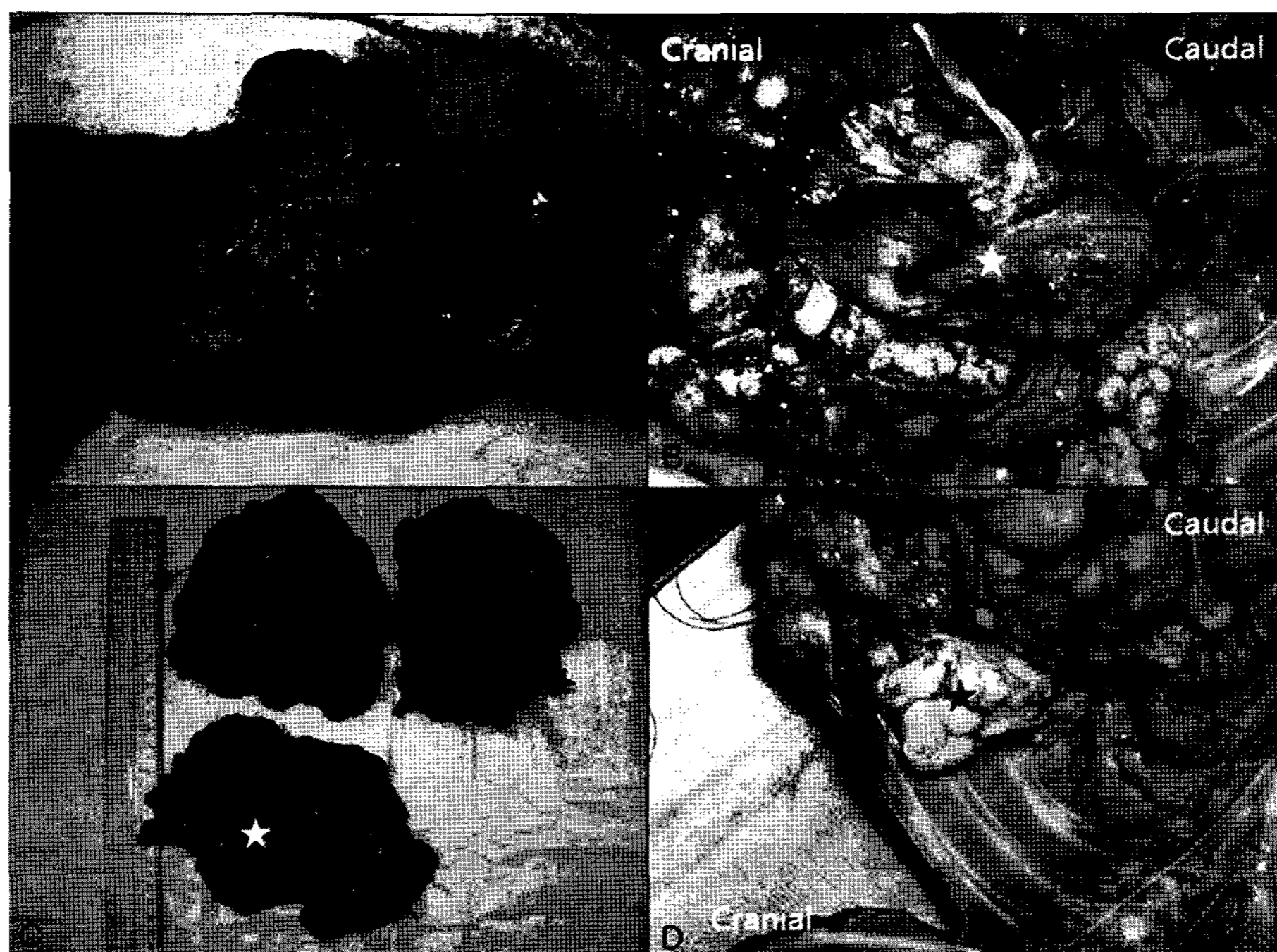
On postmortem examination, the mass measured approximately 25 × 20 × 15 cm, weighed 2.3 kg, and was composed of pale, glistening tissues with a necrotic center (Fig 5). The mass involved the left kidney and diaphragm, but the other organs were not involved. Hemorrhagic effusion was observed in the thoracic cavity. For histopathologic examinations, all tissues were fixed in 10% neutral buffered formalin, routinely embedded in paraffin and cut at 4 μm. All sections were stained with hematoxylin and eosin (H & E). On histopathologic examination, the mass was composed of multifocal to coalescing streams and bundles of poorly differentiated spindle to stellate shaped mesenchymal cells within a faintly eosinophilic amorphous matrix (osteoid) interspersed with foci of cartilaginous differentiation composed of multinucleated lacunae embedded within a basophilic amorphous matrix. Extension of cartilaginous proliferation was seen in the kidney and diaphragm (Fig 6).

Immunohistochemistry using S100 protein was performed on sections of tumor to definitively identify area of cartilaginous differentiation (15). 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 using a two-step Envision system-HRP® (DakoCytomation, Inc., Glostrup, Denmark). On immunohistochemical examination, neoplastic chondrocytes in the kidney and diaphragm were immunoreactive for S-100 protein, but neoplastic osteocytes within the rib were negative.

From these histopathologic and immunohistochemical results, the present case was diagnosed as a combined type of osteosarcoma composed of osteoblastic and chondroblastic components, involving the left kidney and diaphragm.



**Fig 4.** CT images of combined type osteosarcoma. CT scan was performed for metastasis or invasion of the tumor. (A) A coronal CT image showed that heterogeneous mass filled with abdominal cavity. (B) Contrast enhanced transverse CT image revealed that tumor mass invaded to the left kidney (arrow).

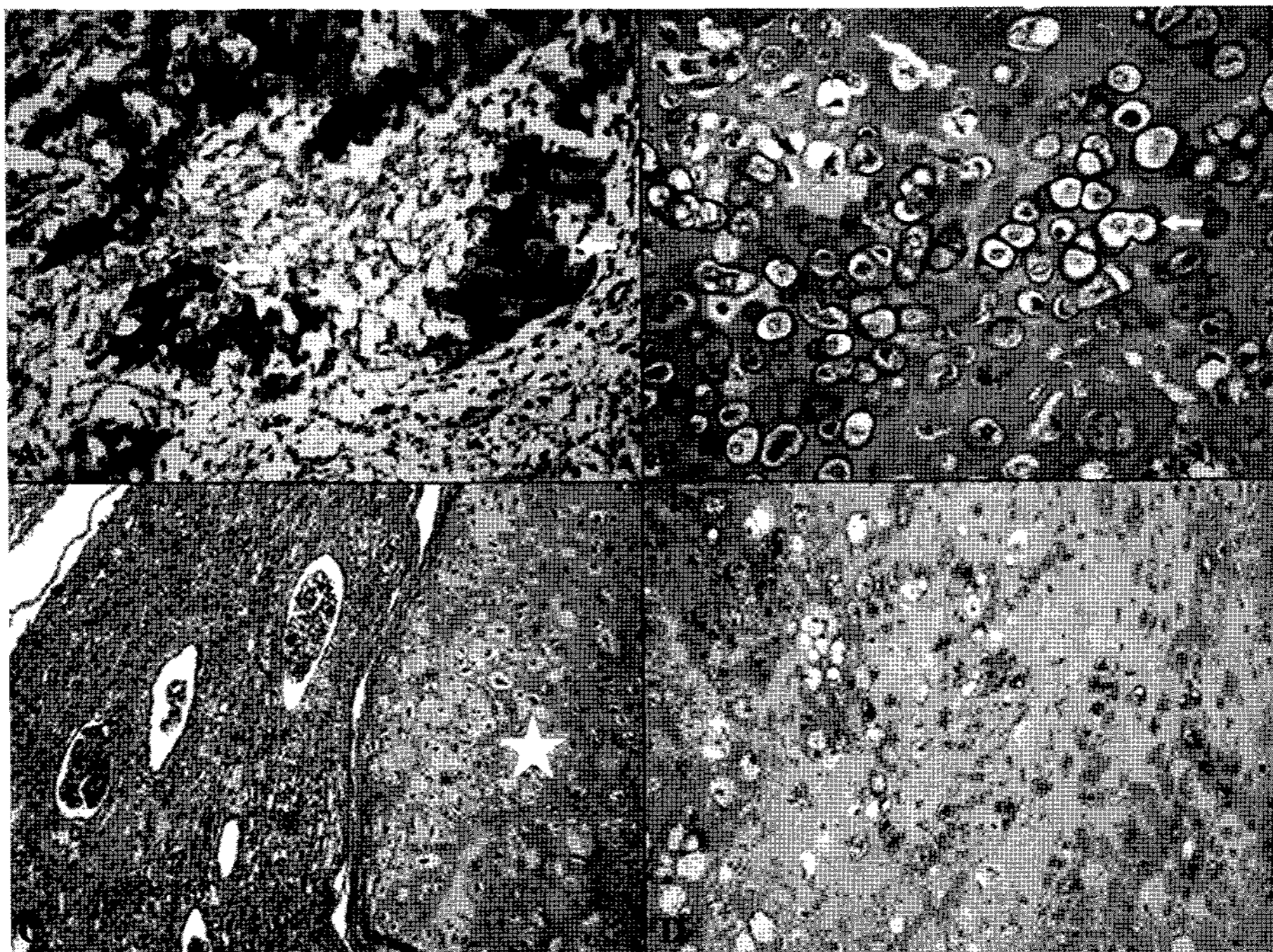


**Fig 5.** Necropsy findings of combined type osteosarcoma. (A) Cartilaginous large mass weighing 2.3 kg was observed in the abdominal cavity. Its size was approximately  $25 \times 20 \times 15$  cm. (B) The left kidney (asterisk) was invaded by the tumor and (C) necrotic center (asterisk) was observed. (D) Diaphragm was also invaded by the tumor (asterisk).

### Discussion

The most common clinical sign in cases of malignant rib neoplasms involving the ribs is a progressively enlarging mass (2,8,16). Another common clinical signs included lameness, dyspnea, lethargy and coughing (14, 16). Unfortunately, intrathoracic or intra-abdominal expansion of these tumors, as in this

case, makes early diagnosis difficult. In the present case, the dog initially presented with only a large mass on the thoraco-abdominal rib area, without any other clinical signs. However, compression of the chest wall by the tumor and pleural effusion in this case caused the dog ultimately develop acute dyspnea. The middle to caudal ribs are most common primary site of rib osteosarcoma in dogs (2,8,14,16). In this



**Fig 6.** Histopathologic findings of combined type osteosarcoma in the thoracoabdominal wall, and its infiltrating cartilage in the kidney. H&E stain (A-C), and immunohistochemical detection of S-100 protein, Envision system-HRP, DAB substrate, Mayer's hematoxylin counterstained (D). (A) The stroma contains amorphous deposits of osteoid, as well as well-formed trabecular of mineralized bone (arrow). (B) Chondroblastic osteosarcoma retains cellular groupings in the hyaline cartilage matrix. Nuclei are enlarged, and binuclear clear cells (arrow) are present. (C) Infiltrating cartilage (asterisk) from the thoracoabdominal wall tumor shows compress to the cortex of the kidney. (D) Chondroblastic region of the tumor. Most neoplastic cartilaginous cells are immunoreactive for S-100 protein.

dog, the large mass arose from the area of the 11th and 12th ribs on the left caudal ribcage.

A definitive diagnosis of osteosarcoma is made based on the production of osteoid and/or bone by malignant mesenchymal cells (17). Canine osteosarcomas are subclassified into several groups including poorly differentiated, osteoblastic, chondroblastic, fibroblastic, telangiectatic, giant cell type and combined type of osteosarcoma. Among them, chondroblastic and osteoblastic osteosarcoma consist of 10.2% of primary canine osteosarcomas. However, the prevalence of this subtype of osteosarcoma in small breed dogs is only 3.5% of the entire canine population, and detailed data regarding this tumor in small breed dogs is lacking (11,17).

In cases of osteosarcoma, the lung is the most common site of metastasis. Additionally, the pleura, bone, liver, triceps muscle, heart valve, spleen, and kidney are other metastatic sites of osteosarcomas (2,8,11,14). Survey radiography may not be able to define the extent of invasion or metastasis in some cases. Therefore, advanced imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI) or nuclear scintigraphy may provide more accurate data regarding tumor invasion or metastasis (3,6,12,18). Interestingly, the tumor in this case did not have distant metastasis on diagnostic imaging or microscopic examination despite its malignant histologic feature. Instead, it showed locally aggressive behavior to adjacent organs. In addition, this invasive

behavior made complete surgical resection more difficult.

The median survival time for primary canine rib osteosarcoma is reported to be 3 to 8 months with rib resection alone or in combination with adjunctive chemotherapy or radiotherapy (2,14,16). If complete surgical margins are obtained, there is a significant increase in survival time and disease free interval (16). Various chemotherapeutic agents have been used for the treatment of canine osteosarcoma (1,2,4, 10,16). However, most of these modalities are successful only in combination with radical surgery and/or radiation. Previous report suggests that the number of tumor cells resistance to chemotherapy increases with the size of the tumor (9). In addition, in a recent report, canine osteosarcoma has a significantly high intratumoral interstitial pressure and low blood flow, thus decreasing tissue oxygenation and drug delivery (19). These factors make medical treatment of osteosarcoma unrewarding until recently. In this case, the tumor was extremely large, and only palliative chemotherapy was performed. This treatment neither decreased tumor size, nor did it improve clinical signs, which stresses the critical role of surgical therapy in treatment of osteosarcoma.

In conclusion, this case demonstrates that a primary osteosarcoma of the rib with involvement of the left kidney and diaphragm in a small breed dog and early diagnostic approaches are crucial for the management of rib osteosarcoma in dogs.

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