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Atypical radiographic features of multiple myeloma in a dog: a case report

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ABSTRACT: A 12-year-old castrated male miniature pinscher dog presented with right forelimb lameness. An expansile osteolytic lesion of the right humerus was conspicuous on right forelimb radiographs. Thoracic and abdominal radiographs showed multiple lytic bone lesions on the right scapula, ribs, vertebrae, femurs and pelvis. Additionally, an expansile osteolytic lesion was observed in two thoracic vertebrae and two ribs. Many plasma cells were identified on fine-needle aspiration of the right humerus expansile osteolytic lesion, and monoclonal gammopathy consistent with multiple myeloma was confirmed on serum protein electrophoresis. The expansile osteolytic lesion, an extraordinary radiographic feature of multiple myeloma in dogs, should be considered as a possible radiographic finding of multiple myeloma.

Keywords: plasma cell myeloma; radiography; bone; expansile lesion

Multiple myeloma is a systemic proliferation of malignant plasma cells or their precursors that arises in multiple bone marrow sites (Withrow and Vail 2007). Neoplastic cells produce osteoclast-activating factor (Matus et al. 1986), and, therefore, multiple myeloma may manifest as bone lysis or diffuse osteoporosis on radiography, especially in vertebrae, ribs, pelvis, skull and long bones, which are engaged in active haematopoiesis (Osborne et al. 1968). Thus, multiple osteolytic lesions are a typical finding in multiple myeloma. Increased numbers of plasma cells in the bone marrow, monoclonal gammopathy, light chain proteinuria, hypercalcaemia, hyperglobulinaemia and cytopaenia are also observed in multiple myeloma. Diagnosis of multiple myeloma is based on the presence of two or three of these abnormalities (Zachary and McGavin 2012).

Case description

A 12-year-old castrated male miniature pinscher dog with anorexia, lethargy and weight loss presented to Chonbuk Animal Medical Center with a seven-week history of right forelimb lameness. On palpation, pain in the right forelimb and reduced muscle mass compared to the left forelimb were detected. There were no clinically significant findings on complete blood count, serum chemistry, blood gas analysis or C-reactive protein testing.

Radiographic examination (HF-525VET, EcoRay, Seoul, Korea) was performed. On right forelimb radiographs, an expansile lesion with moth-eaten lysis on the greater tubercle and the head of the humerus, humeral neck and the region from the proximal metaphysis to the mid-diaphysis of the humerus was seen on the two orthogonal views (Figure 1). Focal osteoproliferative change on the proximal humeral metaphysis was observed on the mediolateral view (Figure 1A), and lateral displacement below this region was also seen on the caudocranial view (Figure 1B). This displacement and osteoproliferative change on this region were considered to be the result of a pathological fracture. In the scapula, 'punched-out' lytic lesions were found on the middle and caudal parts of the

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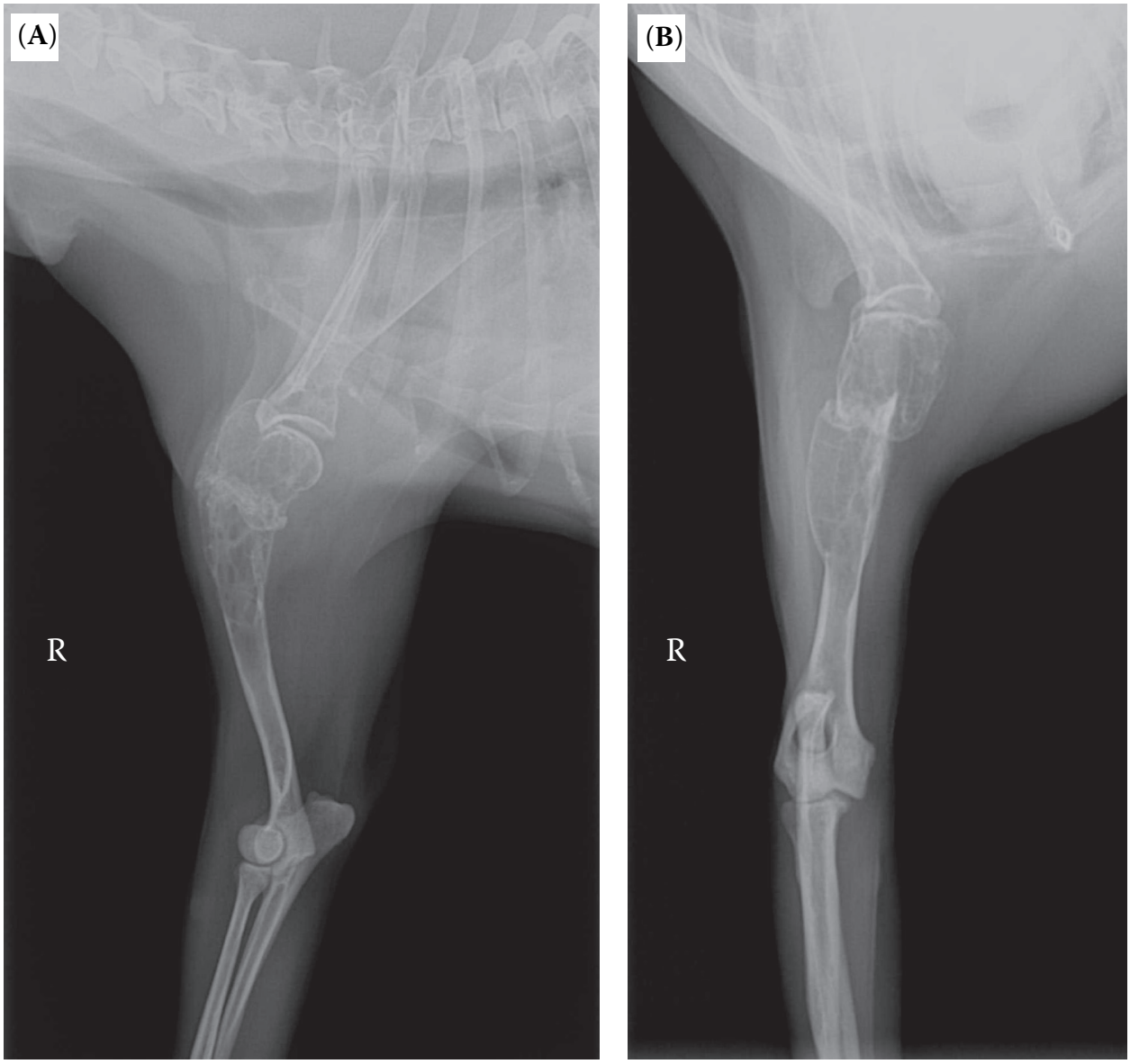

Figure 1. Right forelimb radiograph. (**A**) Mediolateral view. An expansile lesion with moth-eaten lysis on the greater tubercle and head of the humerus, humeral neck and the region from the proximal metaphysis to the mid-diaphysis of the humerus was observed. Focal osteoproliferative change on the proximal humeral metaphysis was also observed. (**B**) Craniocaudal view. Expansile osteolytic lesions that were identified on Figure 1A were also identified on this view. Lateral displacement below the proximal humeral metaphysis was observed, and this displacement as well as the osteoproliferative change (Figure 1A) in this region were considered to result from a pathological fracture

scapular neck. Based on these multiple lytic bone lesions and pathological fractures, the lesion was diagnosed as aggressive. A metastatic malignant tumour and infection were presumed to be the causes of this aggressive lesion.

To investigate the possibility of a bone tumour and related metastasis, thoracic radiographs were taken. On the lateral view of the thorax, geographic lysis of the third and fifth cervical vertebrae and expansile osteolytic lesions were observed on the spinous process of the first thoracic vertebra and vertebral body of the tenth thoracic vertebra (Figure 2). Geographic lysis of the fourth, fifth, and sixth left ribs and expansile osteolytic lesions of the third and eleventh left ribs were seen on the dorsoventral view of the thorax (Figure 3). Neither a generalised increase in opacity nor any nodules in the lung field were observed.

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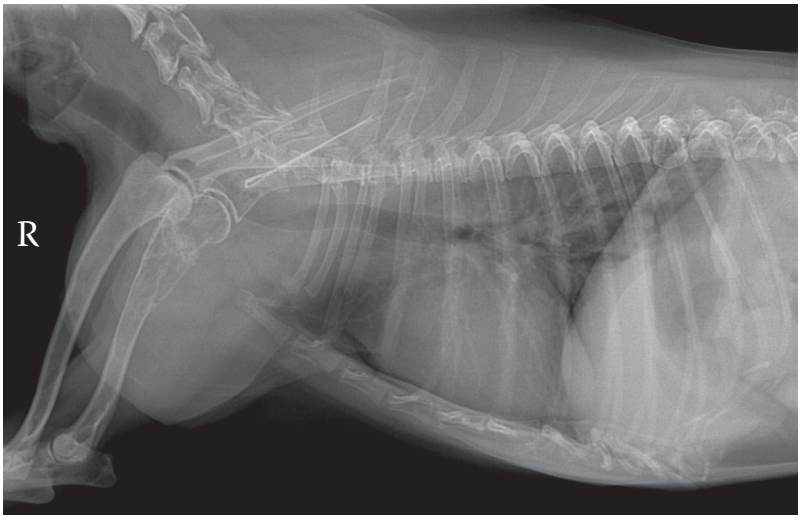

Figure 2. Thoracic radiograph – right lateral view. Geographic lyses of the third and fifth cervical vertebrae were observed. Expansile osteolytic lesions were seen on the spinous process of the first thoracic vertebra and vertebral body of the tenth thoracic vertebra

Abdominal radiographs were performed to identify other lesions. On the lateral view of the abdomen, geographic to moth-eaten lytic lesions were present in the third, fifth and sixth lumbar vertebrae, ilium and sacrum (Figure 4). The same lesions were identified in the fifth and seventh lumbar vertebrae, both iliac wings, both femoral heads and necks and in the medial aspect of the left ischiatic table on the vendrodorsal view of the abdomen (Figure 5).

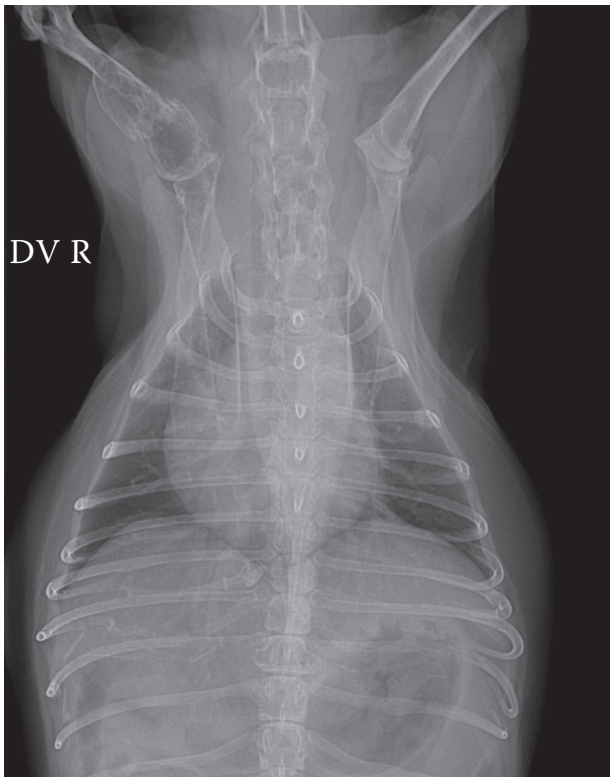

Figure 3. Thoracic radiograph – dorsoventral view. Geographic lyses of the fourth, fifth and sixth left ribs were observed. Expansile osteolytic lesions were found on the third and eleventh left ribs. The opacity of the lung field was normal, and no nodules were found

Based on the multiple osteolytic lesions with some expansile osteolytic lesions, multiple myeloma was considered likely, while metastasis of a primary tumour was also included in differential diagnosis. In rare cases, enchondroma and fibrous dysplasia can give rise to expansile osteolytic lesions, so these could also not be excluded from differential diagnosis.

To determine the cause of the expansile osteolytic lesion in the right humerus, fine-needle aspiration was performed. Numerous plasma cells were observed (Figure 6). The serum sample was sent to a specialised lab for the electrophoretic examination of serum proteins (Samkwang Medical Laboratories, Seoul, Korea), and monoclonal gammopathy was identified. Based on these results and the multiple lytic bone lesions, the patient was diagnosed with multiple myeloma.

After clinical diagnosis in our hospital, the patient was prescribed melphalan (an alkylating agent) and prednisone for seven months. Blood tests and radiographs revealed no significant changes, but lameness and pain in the right forelimb were alleviated. The patient's appetite also improved.

DISCUSSION AND CONCLUSIONS

Expansile osteolytic lesions arise within bones, and cause progressive outward displacement of the bone cortex (Dennis et al. 2010). Cortex thinning also occurs, and subsequent pathological

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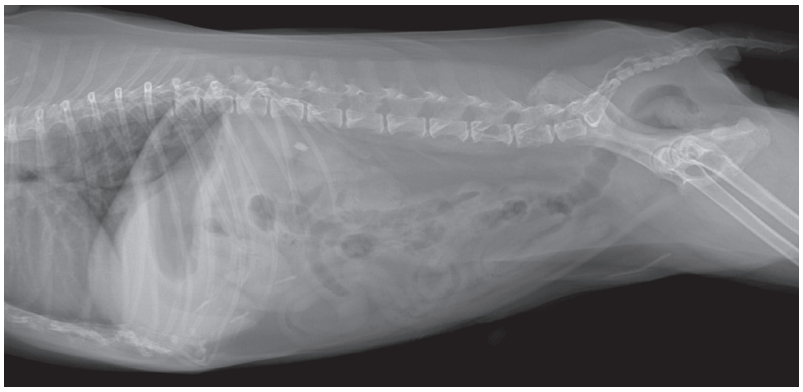

Figure 4. Abdominal radiograph – right lateral view. Geographic to moth-eaten lyses were observed in the third, fifth and sixth lumbar vertebrae, ilium and sacrum

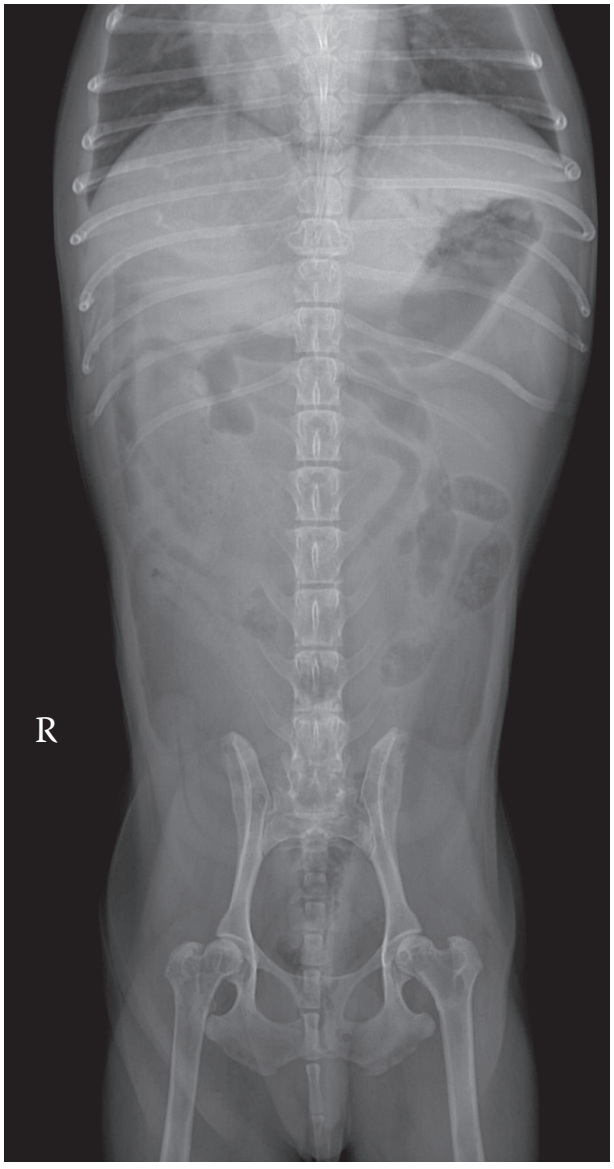

Figure 5. Abdominal radiograph – ventrodorsal view. The same regions of lysis were identified in the fifth and seventh lumbar vertebrae, both iliac wings, both femoral heads and necks, and the medial aspect of the left ischiatic table

fractures are possible (Dennis et al. 2010). These lesions represent benign or low-grade malignancy (Dennis et al. 2010). When expansile osteolytic lesions are observed, giant cell tumour (Berg et al. 1990), enchondroma or enchondromatosis (Huff and Brodey 1964), osteochondroma or multiple cartilaginous exostoses (Green et al. 1999), benign bone cyst (Biery et al. 1976), aneurysmal bone cyst (Dowdle et al. 2003), fibrous dysplasia (Fitzgerald et al. 2002), and bone abscess (Biery et al. 1976) are typically considered in differential diagnosis.

Multiple myeloma, which was confirmed in this case, is not included on the lists of conditions considered in differential diagnosis. Three case reports in the veterinary literature have described expansile osteolytic lesions on radiography. One case involved IgM-secreting multiple myeloma (Lautzenhiser et

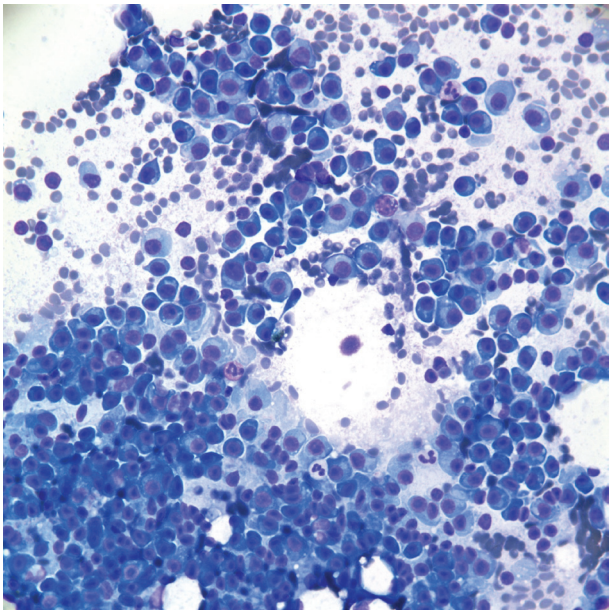

Figure 6. Microscopic view of fine-needle aspirate from the right humerus. Many plasma cells are observed (Diff-Quik; × 400)

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al. 2003), and another concerned non-secretory multiple myeloma (Marks et al. 1995). Because both were unusual types of multiple myeloma, their characteristics differed from the present case, which was of the usual multiple myeloma type, but was unique in terms of the expansile osteolysis observed in the radiographic findings. Another case concerned a cat with multiple myeloma with an expansile lesion on a rib (Patel et al. 2005). This case also differed from the present case because the cat had a single lesion. The above-mentioned three cases are limited by the fact that they did not provide appropriate radiographic figures, and did not focus on the expansile osteolytic lesion. Dogs with multiple myeloma rarely have expansile osteolytic lesions accompanied by multiple osteolytic lesions. However, if expansile osteolytic lesions are present with multiple lytic bone lesions, multiple myeloma should not be totally excluded from differential diagnosis.

Why expansile osteolytic lesions are present in multiple myeloma remains unclear, but the mechanism of cortical expansion has been explored. Cortical expansion results from endosteal resorption due to pressure from an impinging growth or hyperaemia, and is accompanied by new bone formation. Eventually, the whole cortex is destroyed with only a shell of the new bone remaining. In relation to this case, proliferation of the neoplastic cells in the bone marrow could lead to hyperaemia and subsequent processes (Barr et al. 2005). To the best of the authors' knowledge, this is the first case report to use radiographs to describe marked expansile osteolytic changes affecting the proximal humerus, thoracic vertebrae and ribs in a small breed dog. Further studies which focus on the pathophysiology of expansile osteolytic lesions in multiple myeloma and other bone lesions are needed.

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