Skeletal Radiol (1990) 19:535–537

Skeletal Radiology

Case report 634*

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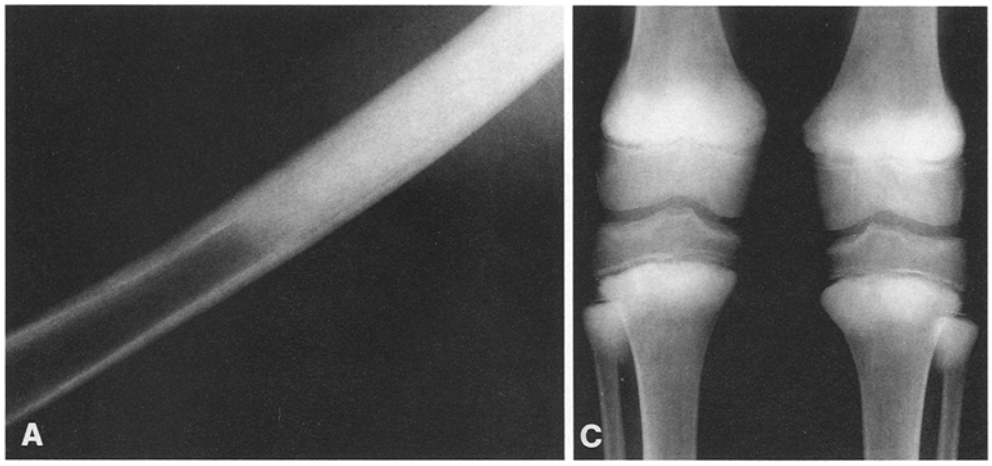
Radiological studies



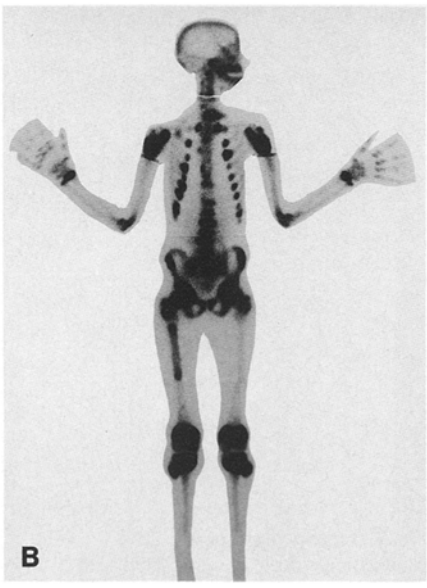


Fig. 1. A An AP radiograph of the right femur demonstrates a dominant sclerotic lesion in its proximal half.
B A 99mTcMDP bone scintigram shows increased radionuclide activity in the metasphyses of multiple long bones, ribs, vertebrae, mandible, and pelvis, in addition to the right femoral diaphysis.
C Corresponding radiographs of the knees demonstrate metaphyseal osteosclerosis in the metaphyses of the distal ends of the femora and proximal ends of the tibiae and fibulae

Clinical information

This 14-year-old white male presented with pain in the right leg of several weeks' duration. Initial radiographs were unremarkable, and the symptoms were attributed to subacute trauma resulting from contact sports. Six weeks later, the patient returned with worsening pain in the proximal segment of the right leg and new onset of aching at the ends of most long bones. Radiographs of the right femur demonstrated a long, ill-defined sclerotic lesion in the proximal end of the diaphysis (Fig. 1A). No evidence of lytic destruction, aggressive periosteal reaction, or soft tissue mass was evident. A bone scintigram demonstrated diffuse, abnormal radionuclide accumulation in the metaphyses of most long bones (Fig. 1B) and in numerous flat bones and vertebrae. Corresponding radiographs (Fig. 1C) revealed multiple sclerotic lesions as described.

Biopsy of the proximal left tibial metaphyseal lesion was performed.

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Diagnosis: Osteosarcomatosis

The histopathology of a secondary tumor focus showed typical osteosarcoma according to commonly accepted histological criteria (Fig. 2). Chemotherapy was administered and the patient did well initially. Six months later, radiographs demonstrated interim enlargement of the osteosclerotic metaphyseal lesions, with a peculiar "caking" of the sclerosis (Fig. 3). Eighteen months following diagnosis, the patient's clinical condition deteriorated, pulmonary metastases were noted in a chest radiograph at 22 months and death rapidly ensued.

Discussion

"Multifocal osteosarcoma" or "osteosarcomatosis" is a rare form of osteosarcoma manifested by multiple symmetrical metaphyseal lesions. Several authors [1–3] have proposed that osteosarcomatosis represents multiple simultaneous or synchronous primary skeletal osteosarcomas. In several reported cases, pulmonary metastases have been delayed or even absent. These authors claim that a multicellular origin of osteosarcoma exists, although the malignancy is usually limited by the body's immune system to a single site (e.g., metaphysis of long bone). It is believed that defects in the patient's immunological defenses and/or exposure to an unknown antigen unleash this multicellular tumor.

The conflicting school of thought [4–6] maintains that osteosarcomatosis is a metastatic disease, since, in addition to the multiple smaller metaphyseal sclerotic lesions, most patients have a large symptomatic, asymmetrical, dominant tumor. On imaging studies, this latter lesion typically demonstrates destructive changes, aggressive periosteal reaction, and an accompanying soft tissue mass. These features are consistent with a primary osteosarcoma, but are not encountered in the smaller sclerotic metaphyseal lesions. The synchronous appearance of multiple tumor foci in tubular and flat bones also favors a metastatic hypothesis. Furthermore, these authors emphasize that the majority of the cases in the literature do demonstrate pulmonary metastases either at initial diagnosis or shortly thereafter. One possible explanation of tumor dissemination in the absence of radiographically demonstrable pulmonary metastases is the route of the system of the vertebral veins, thereby bypassing the portal, caval, and pulmonary venous systems [7–8]. Batson [7] hypothesized that, regardless of the primary malignancy, "it is possible to explain most cases of aberrant malignant metastases ... by the demonstrated role of the vertebral vein system."

Although solitary ostersarcoma is the most common malignant primary bone tumor in the adolescent and young adult, the incidence of osteo-

Further radiological study

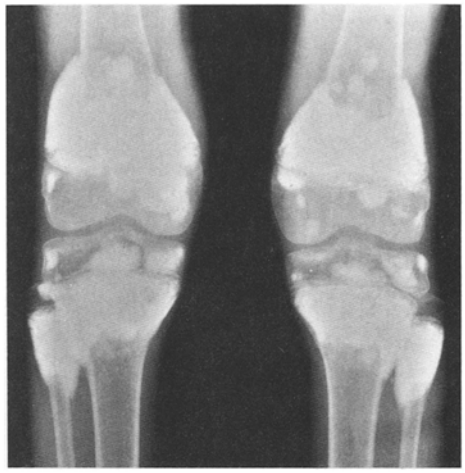

Fig. 3. A follow-up AP radiograph of the knees 6 months later demonstrates marked interim progression of the metaphyseal sclerosis

Histological specimen

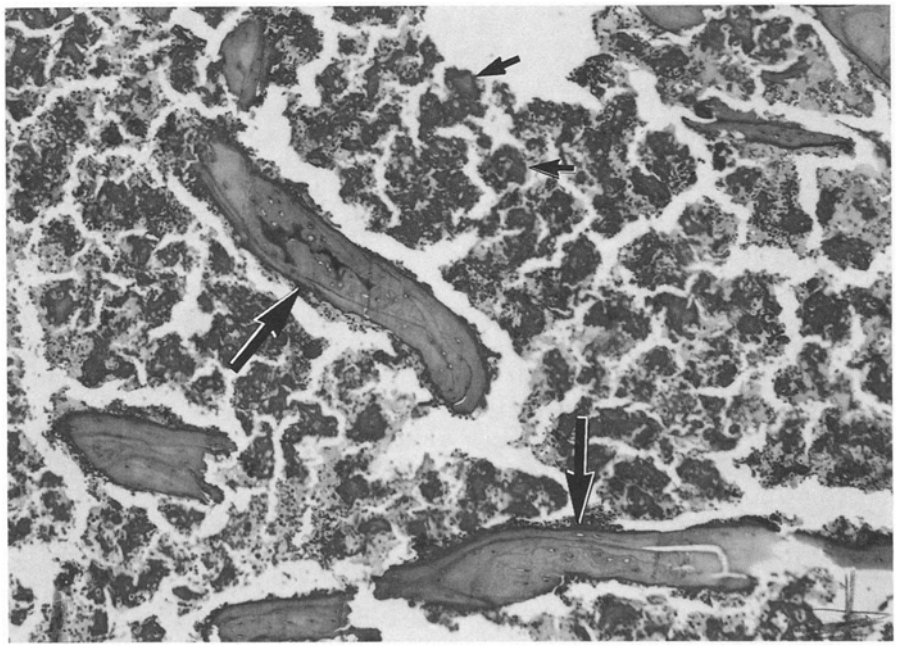

Fig. 2. Intermediate power photomicrograph (hematoxylin and eosin) shows typical osteosarcoma, with numerous islands (*small arrows*) of malignant osteoid interspersed between residual trabecular seams (*large arrows*)

sarcomatosis is low. In a review of 600 cases of osteosarcoma, Dahlin encountered only 16 patients (2.7%) with multicentric involvement [9]. However, the significance of this uncommon entity is great, as surgery is generally precluded. As with the case presented here, it is recommended that nuclear bone scanning be performed as part of the initial evaluation of all patients with suspected osteosarcoma.

The etiology and clinical significance of this patient's progressive metaphyseal sclerosis are uncertain. During the first 18 months, aggressive chemotherapy halted the symptomatic progression of disease. Except for chemotherapeutic side effects, the patient felt well, participated in most everyday activities, and had resolution of his diffuse skeletal pain. As a result, sequential biopsies of the metaphyseal sclerotic foci were not performed. In addition, no new sites of disease were detected. The secondary bony metastatic sites, however, continued to demonstrate increasingly "caked" sclerosis. In light of the long clinical response during this period, the progressive sclerosis of the secondary bony tumors may in part be secondary to a reparative response.

In *summary*, a patient was encountered with a clinically and radiographically dominant osteosarcoma in the femoral diaphysis and coexistent multiple blastic metaphyseal tumors distributed widely throughout the skeleton. Despite chemotherapy, the growth of these secondary tumor foci was unrelenting and they became increasingly sclerotic. The osteosclerosis resulted from a combination of malignant matrix mineralization within the affected bone and peculiar, peripheral multilayered "caked" calcifications. The latter appearance may have resulted, at least in part, from attempted reparative response. To the best of our knowledge, this "caked" sclerotic appearance of the secondary foci in osteosarcomatosis has not been previously described.

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