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Bone scintigraphic and CT evaluation of chondrosarcoma of the rib: Correlation with histological grade in 6 cases

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Objective: The objective of this study is to assess the value of CT and bone scintigraphic findings for grading of rib chondrosarcoma. ***Methods:*** Included in this study were six cases of histologically proven chondrosarcoma of the rib, in which bone scintigraphy and/or CT was performed. Correlation of histologic grade (I–III), tumor size on CT, CT grading (modified Brown's system), the pattern (nodular or peripheral, presence or absence of extended uptake pattern) and the intensity (Simon and Kirchner's grade, 0–4) of scintigraphic uptake were assessed. ***Results:*** CT grade was III, except for one case of dedifferentiated chondrosarcoma. Scintigraphic grade was 3 or 4 in all the cases. ***Conclusion:*** The patterns of CT and bone scintigraphic findings more likely reflect the size of the mass and ossification, and are not well correlated with the histological grading.

Key words: chondrosarcoma, rib, CT, bone scintigraphy, histological grading, preoperative assessment

INTRODUCTION

RIBS are flat and curved tubular bones having the characteristics of both tubular and flat bones. For evaluation of rib lesions, CT is a modality of choice because of its high spatial and reasonably good contrast resolutions. CT is useful for assessing the grade of chondrosarcoma,[1] but its value has not been established for the rib lesions. Bone scintigraphy, on the other hand, is a good screening method for rib pathology, but its role in the evaluation of chondrosarcoma is not well investigated. The objective of this study is to assess the value of CT and bone scintigraphic findings for grading of rib chondrosarcoma.

MATERIALS AND METHODS

Included in this study were histologically proven cases of chondrosarcoma of the rib, for which bone scintigraphy and/or CT was performed. Six cases were obtained from three hospitals during an 8-year period.

Bone scintigraphy using Tc-99m methylene diphosphonate (MDP) or hydroxymethylene diphosphonate (HMDP) was performed in all patients. Two to three hours after intravenous injection of Tc-99m MDP or HMDP (555 to 740 MBq), whole body and chest images were obtained in 5 cases. In one case, only chest images were available. CT scan with or without intravenous contrast medium was available in 5 cases. The slice thickness was 10 or 5 mm. In the one case in which CT was not available, the tumor size was measured by MR imaging.

Histological grading was classified into grades I–III. Correlation of histologic grade, tumor size on CT (or MR imaging if CT was unavailable), CT grading, the pattern and the grade of scintigraphic uptake, and the presence or absence of an extended scintigraphic uptake pattern were assessed.

CT grading was based on the system reported by Brown et al. (Fig. 1).[2]

Grade I: tumor limited to inside the ossified rim, with no extension into the extraosseous soft tissue.

Grade II: expansive tumor with partial disruption of peripheral ossified rim.

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Grade III: infiltrating growth through the ossified rim.

Bone scintigraphic grading was based on Simon and Kirchner's system,[3] in which, the scintigraphic uptake is classified into 5 grades: 4+ (greater than the sacroiliac joint), 3+ (equal to the sacroiliac joint), 2+ (greater than normal contralateral or adjacent bones), 1+ (equivocal increase), and 0 (normal). The pattern of the tumor uptake was classified as ether nodular (nodular uptake in the center of the mass with or without uptake in the periphery), or peripheral (only in the periphery of the tumor). Presence or absence of extended pattern (uptake extending beyond the known disease limits) described by Thrall was also assessed.[4]

The grading was performed by the consensus of two of the authors experienced in the diagnosis of musculoskeletal tumors.

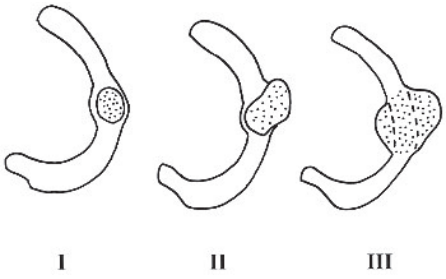


Fig. 1 CT grading of rib tumors.

RESULTS

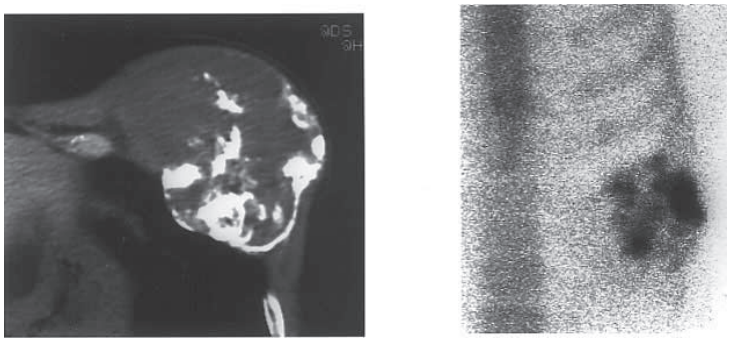
The results were summarized in the table (Table 1). Among the six cases of chondrosarcoma, the age ranged from 21 to 77 years and four were men and two were women. Histological grading was I (n = 2), II (n = 2), III (n = 1) and dedifferentiated (n = 1). The dedifferentiated chondrosarcoma contained an area of malignant fibrous histiocytoma. The size of the mass on axial CT images was 2.5 × 1.5 to 8 × 7 cm.

The grading of bone scintigraphy by Simon and Kirchner's system was either 3 or 4 (Figs. 2–4). In one case with no sacroiliac joint included in the study, the grades of 3 and 4 were not determined. The pattern of the uptake was nodular (prominent in the center of the mass, n = 3) or peripheral (prominent in the margin of the mass, n = 3) (Figs. 2–4). The uptake on bone scintigraphy corresponded to the tumor mineralization and periosteal new bone formation. The extended pattern was probably present in one case with infiltrating growth through the periosteal reaction, and its histological grade was II.

CT grading was III in 4 cases, and in a case of dedifferentiated chondrosarcoma, the smallest tumor, it was I (Fig. 5).

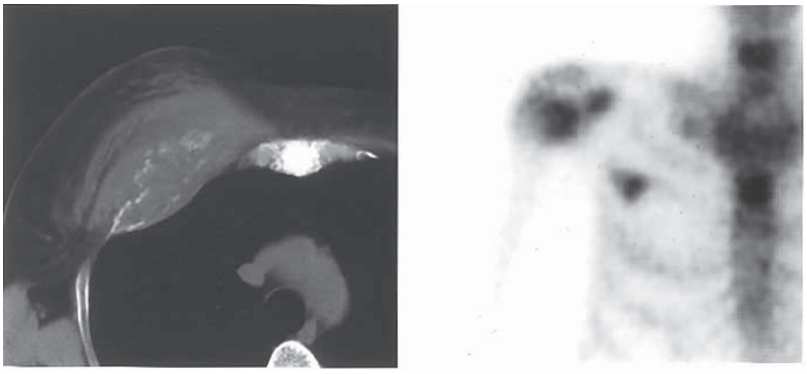
Table 1

age/gender	histology	size (cm)	uptake	pattern	extension	CT
21M	dedifferentiated	2.5 × 1.5	3/4	nodular	(–)	I
49M	III	6.5 × 5	4	nodular	(–)	III
62M	II	6.5 × 5	3	peripheral	(–)	III
72F	II	8 × 4	3	peripheral	(+)	III
45M	I	8 × 7	4	nodular	(–)	III
77F	I	4.5 × 4	3	peripheral	(–)	NA



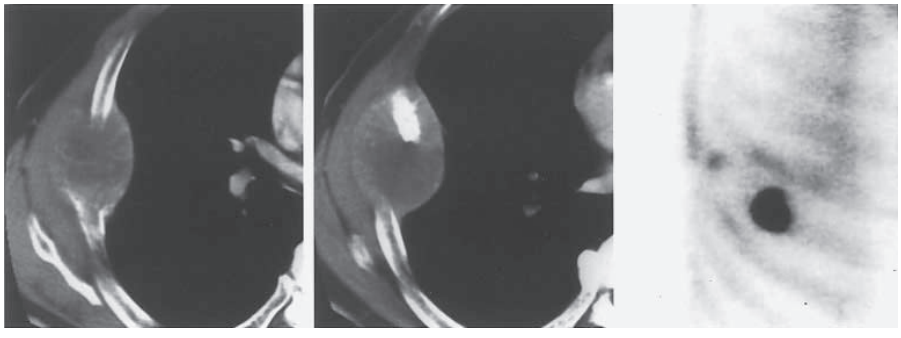
A **B**

Fig. 2 Chondrosarcoma of the rib, histological grade I (45-year-old man). A: CT. Nodular ossification is prominent in the posterior aspect of the tumor. Peripheral ossification is seen on the posterior aspect. B: Bone scintigraphy. Uptake in the ossified portion is prominent.



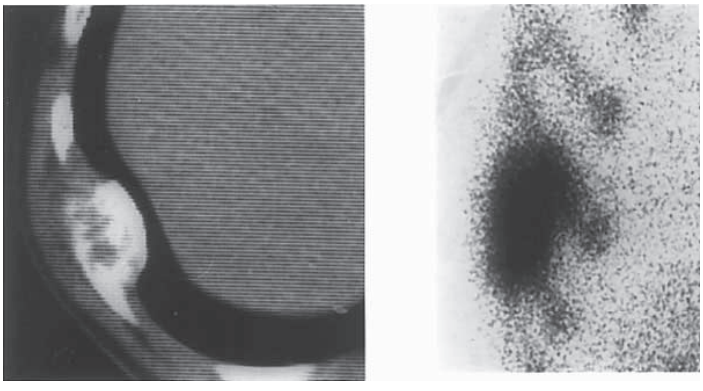
A B

Fig. 3 Chondrosarcoma of the rib, histological grade II (72-year-old woman). A: CT. Infiltrating process in the soft tissue is significant. Periosteal reaction is only noted partially. B: Bone scintigraphy. No uptake is seen in the tumor itself. Prominent uptake is noted only at the margin. Uptake in the lateral aspect of the rib probably reflects the extended uptake pattern.



A B C

Fig. 4 Chondrosarcoma of the rib, histological grade III (49-year-old man). A: CT. Expansive tumor growth with bone destruction is evident. No mineralization in the lytic lesion itself. B: CT, just caudal aspect of Figure 4A. Sclerotic reaction is prominent in the rib involved by the mass. B: Bone scintigraphy. Increased uptake only in the anterior and posterior aspect of the rib. Increased uptake in the margins of the upper and lower ribs.



A B

Fig. 5 Dedifferentiated chondrosarcoma (21-year-old man). A: CT. There is a densely ossified mass. No significant soft tissue density component is noted. B: Bone scintigraphy. Tumor uptake is significant.

DISCUSSION

Chondrosarcoma is the most common malignant neoplasm of the rib. Twelve percent of chondrosarcomas of bone arise in the rib.[5] Most such condrosarcomas are of low histological grade, I and II. Chondroid tumors measuring more than 2–3 cm are suspicious for malignancy.

The detection of rib chondrosarcoma is not difficult because of its large size and typical ossification pattern. CT is usually adequate for evaluation, and it is generally useful in detecting active tumor growth. However, there is still a limitation in estimating disease activity. In our series, the CT growth pattern most likely reflects tumor size, not histological grade. The smallest tumor in our series, high grade dedifferentiated chondrosarcoma, had a low-grade margin.

Bone scintigraphy has been reported not to be useful for bone tumor grading in general,[3] and this is also true in the evaluation of chondrosarcomas.[6,7] The pattern of uptake more likely corresponds to tumor ossification, rather than tumor vascularity.[8] When the tumor completely replaces the bone, uptake of the radionuclide is not significant except for macroscopically detectable tumor ossification. Extended uptake pattern is typically uncommon in chondrosarcoma, and was suspected only in one grade II tumor in our series. This study confirms the results of Hudson et al. in the rib cases.[6,7] Radionuclide bone imaging may contribute to the detection of occult tumor growth, but such a growth is uncommon in chondrosarcoma.

There are limitations in our study. This is a retrospective analysis, and the number of cases is small. Scintigraphic images are only planar, and SPECT images are not available for analysis to better correlate with CT findings.

In summary, nodular and peripheral uptake patterns on bone scintigraphy are both seen in chondrosarcomas of the rib. The tumor uptake is well correlated with the distribution of ossification in the tumor. The patterns of CT and bone scintigraphic findings more likely reflect the size of the mass and ossification, and they are not well correlated with the histological grading.

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