MR Imaging Findings of Malignant Fibrous Histiocytoma of Bone

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Purpose: The purpose of this study is to assess magnetic resonance (MR) imaging findings of malignant fibrous histiocytoma (MFH) of bone and to evaluate the role of contrast-enhanced MR imaging in the diagnosis of bone MFH.

Materials and Methods: MR imagings of pathologically proven bone MFH in ten patients were reviewed. Enhanced study was also performed with Gd-DTPA. The MR images were evaluated for signal intensity, homogeneity, marginal definition, presence of internal septation, cortical destruction, soft tissue extension, joint involvement and contrast enhancement.

Results: Tumors showed iso- or slightly high signal intensity to muscle on T1-weighted images and heterogeneously high signal intensity on T2-weighted images. Four cases showed poor-marginated border on T2-weighted images and four cases had internal septa. Eight of nine patients with intravenous administration of Gd-DTPA showed contrast enhancement, five were heterogeneous and three were homogeneous. All cases showed cortical destruction and soft tissue extension. Five cases showed joint involvement.

Conclusion: Bone MFH showed similar MR imaging findings of soft tissue MFH or other malignant bone tumors, but joint involvement was suggestive finding of bone MFH.

Index Words: Bone neoplasms, MR Histiocytoma

Malignant fibrous histiocytoma (MFH) is the commonest soft tissue sarcoma in late adult life. In contrast, MFH primarily arising in the bone is a rare entity (1-3). Although analysis of the magnetic resonance (MR) appearances of soft tissue MFH has been published (4, 5), and MFH of bone has been included in large general series of MR imaging of bone tumors (2, 3, 6), an analysis of this tumor has not been made. We reviewed the MR images of ten cases of bone MFH retrospectively in attempt to define a characteristic appearance and evaluate the role of gadolinium diethylene triaminopentaacetic acid (DTPA) in the diagnosis of bone MFH.

MATERIALS and METHODS

Six males and four females with pathologically proven bone MFH were included in this study. Patient's age ranged from 16 to 53 years (mean 32 years). Tumors were located in femur, tibia, fibula, calcaneus, humerus, ilium, rib, pedicle of lumbar spine, and maxilla. In long tubular bones, tumors were in metaphysis or metaepiphysis. One case arose from pre-existing multiple osteochondroma (Fig. 1).

MR images were obtained on a 1.0T unit (SMT-100X; Shimadzu, Japan) with the following sequences: spin-echo T1-weighted sequences of 500/20 TR/TE and T2-weighted sequences of 2000/80 TR/TE in axial and longitudinal (sagittal or coronal) planes. The slice thickness/gap was 8-20 mm/2 mm. Acquisition matrix was 256 x 256 with a field of view of 15-20 cm. Additional T1-weighted scans were obtained in nine patients after intravenous administration of Gd-DTPA (0.1 mmol/kg body weight).

The MR images were reviewed retrospectively for signal intensity, homogeneity, marginal definition, presence of internal septation, pattern of contrast enhancement, cortical destruction, soft tissue mass formation, and joint involvement. In case of heterogeneous mass, the lesion was characterized by its pre-
dominant signal intensity. Marginal definition was categorized into three degrees: poorly, moderately, or well marginated. Pattern of contrast enhancement was denoted as either homogeneous or heterogeneous. All tumors were surgically resected and pathologically proved to be MFH of storiform-pleomorphic type.

RESULTS

On plain films, all tumors presented pure osteolytic lesion with adjacent soft tissue mass (Fig. 2a) except a case of secondary MFH (Fig. 1). There were lack of sclerotic margin or periosteal reaction.

On T1-weighted MR images, the masses were slightly hyperintense to adjacent muscle (Fig. 2b) in six patients and isointense in four. On T2-weighted image, all showed predominantly high signal intensity to muscle (equal to or higher than subcutaneous fat, Fig. 2c). Seven of ten cases showed homogeneous pattern on T1-weighted image and all were heterogeneous on T2-weighted image. Eight of nine cases with Gd-DTPA administration showed contrast enhancement (Fig. 2d); five were heterogeneous and three were homogeneous. Tumor margin was poorly defined in eight, and moderately defined in two on T1-weighted image. On T2-weighted image, the tumor margin was well defined in three, moderately defined in three, and poorly defined in four cases. On contrast-enhanced MR, the definition of tumor margin was well defined in two, moderate in three, and poor in four cases. Internal septations were visible in four cases on all pulse sequences, especially on T2-weighted and contrast-enhanced images. All cases showed cortical destruction and adjacent soft tissue mass formation. Five cases showed extension of the mass into adjacent joint space indicating joint involvement (shoulder, hip, ankle, facet joint of lumbar spine, and talocalcaneal joint)(Fig. 3). Two cases showed intratumoral hemorrhage and seven cases showed necrosis.

DISCUSSION

MFH as a primary sarcoma of bone was first reported by Feldman and Norman in 1972 (7) and it accounts for 5% of all primary malignant bone tumors (2). MFH may affect persons of any age, but the majority...
of patients were middle-aged or older adults with a peak prevalence in the 4–5th decade and male predominance of 1.5:1 (8–10). The long bones of appendicular skeleton were the most common sites of involvement and femur was the commonest location (8–10). It may arise secondary to pre-existing bony lesions, such as Paget’s disease, bone infarct, fibrous dysplasia, irradiated bone, nonossifying fibroma, enchondroma, or chronic osteomyelitis (2, 9, 10). The most common histologic subtype of MFH is storiform-pleomorphic type, and our cases were all storiform-pleomorphic type.

In our series, location of tumors, age distribution and sex ratio were not different from previously reported cases. Signal intensity and homogeneity of tumors on T1 and T2-weighted images were not significantly different from soft tissue MFH (4, 5). But marginal definition differed from Miller et al. In the series by Miller, only three cases of 13 showed well-defined margin on T2-weighted image. They explained that the margin

![Fig. 2](image_url) 35 year-old woman with MFH of distal fibula.

- a. Plain film shows pure osteolytic lesion in distal fibula.
- b. T1-weighted axial scan shows slightly hyperintense mass in distal fibula.
- c. T2-weighted image shows heterogeneous hyperintense mass with internal septation (arrow).
- d. After Gd-DTPA administration, the mass shows contrast enhancement. Nonenhancing portion represents necrosis.

![Fig. 3](image_url) 26 year old man with MFH of proximal humerus.

- a. T1-weighted axial scan shows large isointense mass with hemorrhagic foci. Tumor invasion into shoulder joint is indicated (arrow).
- b. T2-weighted image shows hyperintense mass with multiple internal septations.
- c. The tumor does not show enhancement on postcontrast MR
was blurred by bright peritumoral signal (edema or tumor invasion). But in our series of bone MFH, there was no significant peritumoral bright signal which obscured the margin. T2-weighted image is better than T1-weighted image in defining tumor margin due to soft tissue contrast between mass and adjacent muscles. In evaluation of marrow involvement, T1-weighted image is superior to T2-weighted image. Though Golfieri suggested multiple thick, curved stripes of low signal intensity as a typical MR feature of bone MFH (6), we could not find such findings in any of the cases. Thus there were no specific findings for bone MFH in point of signal intensity, homogeneity and marginal definition. Other findings such as internal septation, necrosis and hemorrhage were also nonspecific. But, bone MFH shows more aggressive pattern. It is a common belief that skeletal tumors involving the end of bones rarely cross the cartilage space. Abdelwahab documented that transarticular invasion by a tumor is directly related to the mobility of a joint; bone tumors tend to invade joint which lack free mobility (12). Our cases showed invasion not only to the joint without free mobility but also to freely movable joint; shoulder, hip and ankle. We thought joint invasion was related to aggressiveness of tumor and reflects highly aggressive behavior of bone MFH.

Enhanced sequences improved the differentiation of necrotic area from viable tumor tissue and may be helpful in the planning of biopsy, but cannot replace nonenhanced spin-echo sequences, because the contrast between tumor and bone marrow, as well as fatty tissue, is inferior to that seen with nonenhanced T1-weighted spin-echo sequences (13). Our series showed neither specific enhancing pattern nor superiority to T2-weighted image in defining the tumor extent, but differentiation between necrosis and viable tumor tissue was possible. In some series, dynamic Gd-DTPA enhanced MR imaging enabled assessment of the malignant potential of a tumor with some overlap, but there were no advantages for qualitative lesion characterization (13, 14).

In conclusion, bone MFH showed general MR features of malignant bone tumor, but joint involvement was suggestive finding of bone MFH. Gd-DTPA enhanced MR image was not indicated in evaluation of bone MFH.

REFERENCES
골 악성 섬유성 조직구종의 자기공명영상

목적: 골 악성 섬유성 조직구종의 자기공명 (MR) 영상 소견과 그 진단에 있어서 조영증강 MR의 필요성에 대해 알아보았다.

대상 및 방법: 병리학적으로 확진된 10명의 골 악성 섬유성 조직구종 환자의 MR을 종양의 신호강도, 균질도, 종양의 경계, 내부 격막의 존재, 피질골의 파괴, 주위 연부조직 또는 인접 관절로의 침범, 조영증강 여부에 대해 분석하였다.

결과: 종양은 T1 강조영상에서 주위 근육과 같거나 약간 높은 신호강도를, T2 강조영상에서는 높은 신호강도를 보였다. 4예에서는 종양내 격막이 관찰되었다. 조영증강 MR을 시행한 9예중 8예에서 조영증강이 되었고 그 중 5예에서 불균질한 양상을 나타내었다. 전예에서 피질골의 파괴와 주위 연부조직 종괴가 관찰되었고 5예에서는 인접한 관절로의 침범이 있었다.

결론: 골 악성 섬유성 조직구종은 연부조직의 악성 섬유성 조직구종, 또는 다른 악성 골종양과 비슷한 소견을 보였으나 인접한 관절로의 침범이 진단에 다소 도움이 되는 소견으로 생각된다.
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