VOLUME - 11, ISSUE - 08, AUGUST - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Radiology

MULTIMODALITY APPROACH TO BONE TUMORS

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ABSTRACT

Aim-To study the merits and demerits of various imaging modalities while diagnosing and characterizing bone tumors. **Method**-Prospective study of 40 cases of primary bone tumors as per inclusion criteria were included in study.Plain radiograph and MRI were done in all cases but CT was done in only selected patients considering radiation hazards. **Results**-Out of 40 patients in the study, 37.5% were benign and 62.5% were malignant. The most common malignant bone tumor in the study group was osteosarcoma(25%) followed by metastases and Ewing's sarcoma. Most common benign tumor was giant cell tumor. 25 patients (62.5%) had adjacent soft tissue involvement detected on MRI, X-ray could detect soft tissue component only in 9 patients.10 patients(40%) had neurovascular involvement diagnosed only on MRI. 1 patient of osteosarcoma and 1 patient of Ewing's sarcoma had skip lesions which were detected only on MRI. CT provides better characterization of location, cortical destruction and soft tissue component as compared to X ray. **Conclusion**-Plain radiograph is sufficient in most of the non-aggressive bone tumors , locally aggressive benign bone tumor like GCT, MRI helps delineating the extension, CT is more useful in demonstration of matrix calcification, cortical destruction and periosteal reaction, MRI provides valuable information regarding the exact anatomical extent such as adjacent marrow involvement, involvement of muscles,joints, neurovascular bundle and also detection of metastatic or skips lesions due to its excellent soft tissue detail. Imaging protocol for bone tumors should be case based, keeping with clinical picture and appropriate modality or modalities should be used accordingly.Multimodality approach is more advised for malignant bone tumors to provide precise roadmapto facilitate management plan.

KEYWORDS :

INTRODUCTION

Radiographs are the primary screening technique used for bone tumours and tumour-like lesions. When a lesion is indeterminate or shows signs of aggressiveness, magnetic resonance imaging (MRI) and CT are indicated for further characterization. The choice of examination depends on the radiologist's ability to characterize the lesion from the radiograph as to its morphology, matrix, and probable histologic nature.

The anatomic location, in turn, frequently influences the ability to characterize the lesion. Lesions in long bones can almost always be successfully characterized by radiography and, in these instances, only the MR examination is required to stage the tumor. MRI can extend the diagnostic evaluation by demonstratingcomponents such as cartilage, vascular tissue, fat, liquid and haemosiderin. Even when a specific diagnosis cannot be made, MRI can help by narrowing the differential diagnosis These are the reasons why MRI has changed from asingle study-based diagnosis (solely based on radiographs) to a multimodal imaging approach (which now includes MRI and CT).

MRI is superior to the other imaging modalities in detecting bone marrow lesions, define extent, neurovascular involvement and joint involvement.

Although plain film remains the most essential diagnostic modality, computed tomography (CT) is considered in many instances as the second most important investigation in bone tumors. It is excellent for determining cortical destruction, involvement of adjacent bones and in evaluating calcified or ossified components of bone tumors.

With benign tumors CT has usually limited importance. Its importance increases with the tumor's aggressiveness and tendency to infiltrate surrounding tissues. This general statement is particularly true if surgery is considered for certain tumors such as malignant neoplasm of the long bones and of specific complex anatomic areas, e.g., pelvis, spine, thorax, and large joints. The high contrast resolution and the axial view of CT gives unique information in these situations, which is many times indispensable for management of the patients. Usually CT adds less assistance compared to the plain film in arriving at a primary diagnosis.

Generally plain film gives a more complete overview and important differential diagnostic features, e.g., the various periosteal reactions are less obvious on CT with tumors of the long bones due to the slice thickness and axial view.

Aims And Objectives

To evaluate imaging features of specific benign and malignant bone tumors on different imaging modalities

METHODS AND MATERIALS

This prospective study was performed at our institution which is a tertiary referral center in our country. Every patient was screened according to inclusion and exclusion criteria mentioned below.

Inclusion Criteria:

Patients referred by Orthopaedic unit with clinically suspected bone tumor of extremities.

Patients presented with vague complaint with low index of clinical suspicion but having suspicious neoplastic lesion on plain radiograph, affecting axial skeleton.

Exclusion Criteria:

Patient with Ferro-magnetic metallic implants, cardiac pacemaker devices, cochlear implants Known claustrophobic patients.

Pregnancy

Clinically suspected bone tumor which turn out to be infective lesions on plain radiograph.

40 cases of primary bone tumors as per inclusion criteria were prospectively included in study.

Plain radiograph and MRI were done in all cases but CT was

done in only selected patients considering radiation hazards.

Multidetector Computed Tomography (MDCT)

Only selected patients underwent MDCT scan, which was performed using 64 & 128 slice somatom CT scanner (Siemens). The scan acquisition parameters were 0.37 sec gantry rotation time, 120-140kV, 70-80 effective mAS and detection collimation of 24x1.2mm.

The axial sections were reconstructed as 3.0mm sections and were viewed in bone and soft tissue windows. The images were also reconstructed in sagittal and coronal plane (multiplanar reformats).

MR Imaging Protocol:

MRI imaging was performed on a 1.5 Tesla MR scanner(either GE HDXT-8 channels,superconducting magnet or PHILIPS AHCIEVA- 16 channels,superconducting magnet).

Patients comfort in the gantry was confirmed before starting the examination. The body and extremity coils were used. The imaging began with 3-plane localizer.

Multiplanar MRI of the bones under evaluation was performed using the following sequences;
- Axial and coronal T1W
- Axial and sagittal T2W
- Coronal and sagittal STIR
- Coronal,axial and sagittal post contrast T1WI if required (in one phase)45.

The examination (CT/MRI) was performed after explaining the procedure in detail and obtaining a valid written consent from the patient / guardian (in case of patient of age less than 18 years).

RESULTS

31Of the total 40 patients in the study, maximum (27.5%) belonged to the age group 10-20 yrs, 55% male and 45% female patients. the most common symptom was pain (92.5%) followed by swelling which was present in 65% patients. Out of 40 patients in the study, 37.5% were benign and 62.5% were malignant. The most common malignant bone tumor in the study group was osteosarcoma(25%) followed by metastases and Ewing's sarcoma. Most common benign tumor was giant cell tumor.

Table1- Frequency Of Benign Tumour

Tumor type (Benign)	No. of patients
OSTEOCHONDROMA	3
GCT	5
ENCHONDROMA	1
NOF	1
OSTEOID OSTEOMA	3
SIMPLE BONE CYST	1
ANEURYSMAL BONE CYST	1
TOTAL	15

Table 2- Frequency Of Malignant Tumour

Tumor type(malignant)	No. of patients
OSTEOSARCOMA	9
EWING'S SARCOMA	4
CHONDROSARCOMA	1
PLASMACYTOMA	1
METASTASES	4
CHORDOMA	1
SPINDLE CELL SARCOMA	1
LYMPHOMA	1
MFH	2
LCH	1
TOTAL	25

In the study patients, 14 patients (35%) had periosteal reaction, all of which were malignant bone tumors with major proportion being osteosarcoma. CT detected 1 additional periosteal reaction which was not detected on X-ray (skull metastasis). In our study MRI detected periosteal reaction in only one patient.All osteosarcoma cases had periosteal reaction.

1 patient of osteosarcoma and 1 patient of Ewing's sarcoma had skip lesions which were detected only on MRI.10 patients (40%) had neurovascular involvement evident only on MRI. In the study, 25 patients (62.5%) had adjacent soft tissue involvement detected on MRI, out of which maximum patients were of malignant bone tumors, with osteosarcoma and Ewing's sarcoma being on top of the list. X-ray could detect soft tissue component only in 9 patients.

One case of Periosteal reaction was detected in all cases on X-ray (100%) and 1 case on MRI(11%).CT was done in 4 cases. Additional 1 case of soft tissue component was detected on CT compared to X-ray. CT provides better characterization of cortical destruction and periosteal reaction compared to X-ray and MRI, 2 cases of pathological fracture were detected in all 3 modalities.

CONCLUSION

In the study, the most common benign tumor was osteochondroma and osteoid osteoma. Most common malignant tumor in younger age group was osteosarcoma and that affecting older age group was metastases. Plain radiograph is essential investigation and is sufficient in most of the non-aggressive bone tumors affecting long bones. In locally aggressive benign bone tumor like GCT, MRI helps delineating the extension but plain radiograph is still valuable for primary diagnosis.

A plain radiograph is not sufficient in detecting the entire anatomical extent, intra- and extra-osseous extent of tumors in complex anatomical regions, aggressive benign and malignant bone tumors.Inspite of CT has radiation hazards, it useful in characterized the bone tumor in more complex anatomical region(pelvic girdle, scapula, chest cage, spine, skull etc).CT also more useful in demonstration of matrix calcification, cortical destruction and periosteal reaction.

MRI is a non-invasive, non-ionising imaging modality that provides the most comprehensive imaging evaluation of primary malignant bone tumors of long bones.MRI provides valuable information regarding the exact anatomical extent such as adjacent marrow involvement, involvement of muscles, joints, neurovascular bundle and also detection of metastatic or skips lesions due to its excellent soft tissue detail, multiplanar imaging ability as well as its extreme sensitivity to marrow changes. Knowledge of these findings is critical for the surgeon to plan the surgical intervention. MRI cannot be used as exclusive modality for primary diagnosis. Certain diagnostic features as calcification, cortical destruction and periosteal reaction are easily overlooked on MRI. Diagnostic morphology on MRI is not as distinct as plain radiograph for primary diagnosis.

Imaging protocol for bone tumors should be case based, keeping with clinical picture and appropriate modality or modalities should be used accordingly. Multimodality approach is more advised for malignant bone tumors to provide precise roadmapto facilitate management plan.

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