ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 11 | November - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF MRI IN PRIMARY BONE TUMORS AND ASSESSING THEIR LOCAL SPREAD

Radiodiagnosis

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ABSTRACT

Background: Radiographs are the most valuable modality for diagnosis of bone tumors, however MRI is emerging as the modality of choice for assessing local spread of tumor.

Objective: To assess role of MRI in local spread of tumor and comparison to surgical & histo-pathological results.

Results: 47 patients (age 10-73 years with mean age of 38 years) were studied from May 2018 to November 2019. There were 26 males and 21 females, 9 patients were excluded as no operative results were available. Out of the 38 total cases, 11 were osteosarcoma, 7 were Ewing's sarcoma, 7 were GCT, 6 were Chondrosarcoma, 2 Osteochondroma, 1 PNET, 1 ABC, 1 Hemangioma, 1 Chordoma and 1 Multiple myeloma. Cortical break was detected in 29 patients on MRI with 2 false positive cases showing 93% accuracy. Medulla involvement was detected in 34/35 patients (97%). Neuro-vascular involvement was detected in 9 patients on MRI with 1 false positive cases showing 88.9% accuracy. Joint involvement was detected in 13 patients on MRI with 2 false positive cases showing 84.6% accuracy. All 4 cases of skip lesion (100%) were detected on MRI.

Conclusion: MRI is the modality of choice to assess for local spread of bone tumors.

KEYWORDS

MRI, Bone tumour, Local spread

INTRODUCTION

Radiographs remain the first line and most valuable investigations for determining the diagnosis and aggressiveness of bone tumors. However significant limitations arise in assessing local spread, neurovascular and medulla involvement. [1]

MRI with its enhanced contrast resolution, multiplanar capabilities and excellent soft tissue characterization has emerged as a indispensable pre-operative imaging for local spread of bone tumors. MRI is excellent in assessment of skip lesions, neurovascular, marrow, articular and joint involvement.[2]

Apart from typical (very high T2) signal characteristic of chondroid tumors, MRI does not have any advantage over plain radiographs in diagnosing bone tumors. [3]

AIM

To study the signal characteristics of primary bone tumors and assess the role of MRI in local spread of bone tumors and compare with surgical and histopathological results.

METHODS AND METHODOLOGY

Patients presenting with clinical suspicion of bone tumors from a period of May 2018 to November 2019 were evaluated. Patients demographic details, sex, age and clinical history were taken. Plain radiographs were taken in minimum 2 views (AP and lateral) of the affected bone/joint with additional views (Oblique) taken if needed. Once a radiological diagnosis has been made, pre-operative MRI was performed to assess local spread. MRI was done on a 3T Siemens Magnetom Skyra with dedicated joint coils (shoulder, knee, elbow etc) as applicable.

T1 SE & STIR sagittal & coronal images, T1 SE & T2SE axial images, GRE images in case hemorrhage was suspected, DWI and tri-planar post contrast images were taken. Both the proximal and distal joint were included in the imaging to look for involvement and to confirm presence or absence of skip lesions.

The following points were documented on MRI – Location, Signal characteristic, margins, cortical break, contrast enhancement, intramedullary involvement, skip lesions, neurovascular involvement, muscle, articular and joint involvement.

Patients operative findings and histopathological reports were acquired and comparison with MRI findings was performed.

RESULT

47 patients were enrolled in the study from May 2018 to November 2019 with age ranging from 10 to 73 years (mean 38 years). There were 26 males and 21 females. 9 patients were excluded as these were not operated due to metastasis.

Out of the 38 total cases, 11 were Osteosarcoma, 7 were Ewing's sarcoma, 7 were GCT, 6 were Chondrosarcoma, 2 Osteochondroma, 1 PNET, 1 ABC, 1 Hemangioma, 1 Chordoma and 1 Multiple myeloma.

Table 1 Describes the efficacy of MRI in assessing local spread of bone tumors.

FINDING	PRESENT/ ABSENT	MRI	SURGICAL/PATHOLOGICAL
Cortical Break			
	Present	29/38	27/38
	Absent	9/38	11/38
Intra-Medullary Involvement			
	Present	34/38	35/38
	Absent	4/38	3/28
Neuro-Vascular Involvement			
	Present	9/38	8/38
	Absent	29/38	30/38
Skip Lesion			
	Present	4/38	4/38
	Absent	34/38	34/38
Joint Involvement			
	Present	13/38	11/38
	Absent	25/38	27/38

DISCUSSION

Staging malignant primary tumours required the evaluation of intramedullary involvement with assessment of longitudinal extent,

epiphyseal involvement and skip metastasis which determines the site of resection. Extramedullary spread includes assessment of muscle compartment and joint involvement along with the relationship of neurovascular bundle. These factors determined the type of limb salvage performed and gave valuable road map to the surgeon.

MRI images were evaluated for local spread with the below mentioned features -

Intramedullary/Marrow Involvement –T1 SE pre & post contrast and STIR images in sagittal or coronal plane are used to assess for marrow involvement. In T1 SE images, normal fatty marrow appears hyperintense which is in sharp contrast to the hypointense tumor. On STIR images, the normal fat in marrow is suppressed giving low signal to normal marrow and the tumor appears hyperintense. While assessing for marrow involvement it is important to differentiate true tumour margins from peritumoural bone marrow edema. Both sequences show similar efficacy in detecting intra-medullary involvement as evaluated by Tateishi U, et al [4] and Iagaru A, et al[5]. In our study 34/38 (89%) of patients showed intra-medullary involvement and on surgical histopathological correlation 35/38 (92%) patients showed intra-medullary involvement.

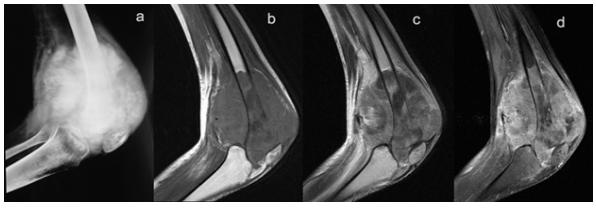

Figure 1 Osteogenic sarcoma distal femur a) X ray knee lateral- large mass involving distal femur. b) T1 W shows medullary involvement. c) Post Gad T1W shows extra-osseous soft tissue component. d) T2W demonstrates involvement of joint with sparing of tibia.

Cortical Break – Is an important characteristic to determine extracompartmental disease and is best established on T1 SE (axial and coronal/sagittal) images [6, 7]. In our study there were 2 false positive cases, which on review were due to marked cortical thinning simulating cortical break.

Joint involvement - Is critical in determining surgical approach (Intra-articular or Extra-articular resection). T1 SE & post contrast T1 WI imaging is better than STIR images for delineating joint involvement by tumor as it is difficult to differentiate tumor/edema interface on STIR images [2]. In our study, joint involvement was established by direct extension of tumor tissue into joint space with involvement of articular surface, nodular enhancing synovial deposits and in knee joint involvement of cruciate ligaments was also considered as joint invasion [8]. Joint effusion is not a specific marker of joint invasion with low positive predictive values, however absence of joint effusion has a high negative predictive value for joint involvement [2]. In our study, 13/38 patients showed joint involvement on MRI with 2 false positive results.

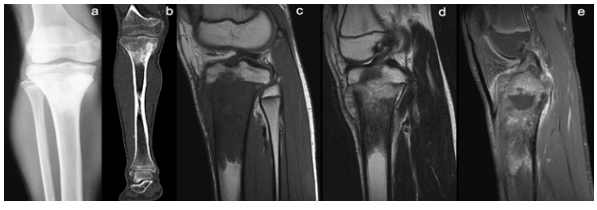

Figure 2 Osteogenic Sarcoma proximal tibia a) X ray knee AP and lateral showing osteosclerotic lesion b) CT scan shows hyperdense lesion in tibia c) MRI T1W sagittal shows marrow involvement reaching articular surface with cortical break anteriorly d) and e) T2W and Post Gad T1 shows lifting of periosteum anteriorly with involvement of anterior cruciate ligament suggestive of joint involvement.

Neuro-vascular Involvement – Assessment of neurovascular involvement is critical for presurgical planning & T2 WI and post contrast FS T1 WI axial images are best to assess for neurovascular involvement. On MRI, loss of fat planes with angle of contact more than 180 degree is taken as invasion [3]. In our study, 9/38 patients had neurovascular invasion on MRI with one false positive case where the angle of contact was approximately 180 degree and was given positive on MRI, however on surgery plane between tumor and neurovascular bundle was established.

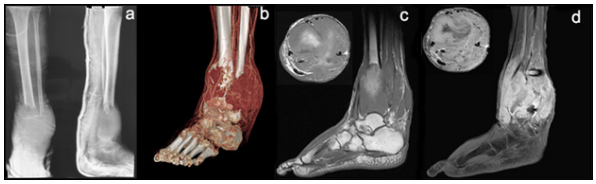

Figure 3 Osteogenic Sarcoma distal tibia and fibula a) X ray leg AP and lateral showing osteolytic mass b) CT scan VRT shows extensive bony destruction c) T1W axial and sagittal shows mass involving tibia and fibula d) Post contrast axial and sagittal image shows extensive marrow infiltration with invasion of neurovascular bundle.

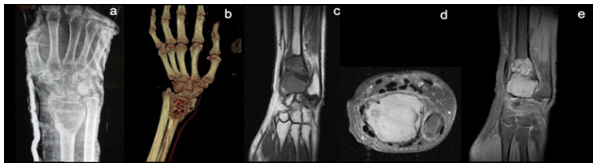

Figure 4 Giant Cell Tumour distal radius a) X ray wrist shows eccentric osteolytic lesion distal radius b) CT scan VRT image Soap bubble appearance c) T1W MRI demonstrates tumour with pathological fracture d) and e) T2W axial and coronal show tumour abutting neurovascular bundle.

Skip Lesions – Skip lesions are simultaneous secondary foci of tumour suggestive of hematogenous spread. There is a higher incidence of local recurrence and distant metastasis with these tumours and hence poorer prognosis.MRI is the best technique to evaluate these lesions [9]. Longitudinal axis T1/STIR images can detect skip lesion with great accuracy. All marrow abnormalities are not skip lesions & signal intensity changes in marrow can be seen with edema, infarction, focal hyperplasia & marrow reconversion. In our study 100% (4/4) of patients with skip lesions were detected on MRI with no false positive/negative.

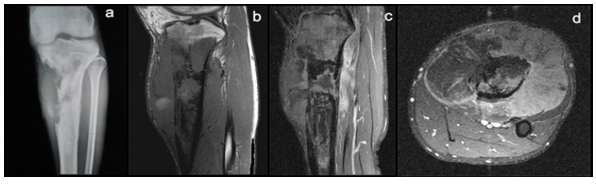

Figure 5 Osteogenic sarcoma proximal tibia a) X ray knee AP eccentric osteolytic lesion b) T1W MRI shows irregular patchy involvement with skip lesion in medullary cavity c) and d) Post Gad images show large extraosseous mass abutting and not involving neurovascular bundle

CONCLUSION

Radiographs remain the most valuable tool for diagnosing bone tumors, with limitations in assessing local spread. MRI is the preferred modality to assess for local staging of bone tumors. Its multiplanar capabilities and excellent soft tissue resolution helps to accurately assess for neurovascular, joint, marrow involvement and local spread. MRI is essential modality for pre-operative assessment of bone tumors.

REFERENCES

1. Miller TT: Bone tumors and tumor-like conditions: analysis with conventional radiography. Radiology 246(3), 662-674(2008)
2. Prem Chand P, Gurivi Reddy C, Aswith Kumar P. Role of MRI in the evaluation of primary bone tumors. International Journal of Contempory Medicine Surgery and Radiology. 2018;3(4):C38-C43
3. Baweja S et al. Evaluation of bone tumors with magnetic resonance imaging and correlation with surgical and gross pathological findings. Indian Journal of Radiology and Imaging. 2006;16(4):611
4. Tateishi U, Yamaguchi U, Seki K, Terauchi T, Arai Y, Kim EE. Bone and soft-tissue sarcoma: preoperative staging with fluorine 18 fluorodeoxyglucose pet/ct and conventional imaging. Radiology, 2007; 245: 839–47
5. Iagaru A, Quon A, McDougall IR, Gambhir SS. F-18 fdg pet/ct evaluation of osseous and soft tissue sarcomas. Clin Nucl Med., 2006; 31: 754–60.
6. Yeslawath ND. Study to evaluate the role of MRI in cases of primary malignant bone tumors. IAIM,2016;3(3):87-94
7. Pustthay Sunil Kumar, P Sree Hari. Role of MRI in primary malignant bone tumors. International Journal of Contemporary Medical Research. 2016;3(7):2144-2148
8. Schima W, et al. Preoperative staging of osteosarcoma: efficacy of MR imaging in detecting joint involvement. American Journal of Roentgenology. 1994;163(5):1171-1175
9. Saifuddin A: The accuracy of imaging in the local staging of appendicular osteosarcoma. Skeletal Radiol. 31, 191–201 (2002).