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ROLE OF MRI IN EVALUATION OF PRIMARY BONE TUMORS

Radio-Diagnosis

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ABSTRACT

Magnetic Resonance Imaging (MRI) is maximally sensitive to the presence of musculoskeletal soft-tissue lesions and also provides exquisite definition of their features. The purpose of this study is to evaluate the role of MRI in cases of bone tumors, to determine the MRI characteristics of different primary bone tumors and to evaluate the role of magnetic resonance imaging in prediction of malignancy and delineation of anatomic extent of primary bone tumors.

KEYWORDS

AP- Anteroposterior, FNAC- Fine needle aspiration Cytology, MRI -Magnetic resonance imaging, STIR-Short Tau inversion Recovery

INTRODUCTION :

Primary neoplasms of the skeleton are rare, amounting to only 0.2% of the overall human tumor burden. Evaluation of bone tumors involves a multimodality approach and whereas cross sectional imaging has extraordinarily improved the ability to characterize tumors, differential diagnosis of primary osseous neoplasm remains based on their radiographic appearances. 1Radiography offers more information than any other imaging modality in the study of bone lesions and remains the cornerstone for the differential diagnosis of skeletal tumors and tumor like lesions due to its higher specificity in detecting tumor morphologic hallmarks. The radiographic features that help the radiologist make the diagnosis of a bone tumor or tumor-like Lesion, or at least narrow the diagnostic possibilities, include patterns of bone destruction, lesion margins, internal characteristics of the lesion, type of host bone response (medullary or periosteal), location, site and position of the lesion in the skeletal system and in the individual bone, soft tissue involvement, and single or multiple lesion nature. These radiographic features coupled with clinical information helps define whether the lesion is neoplastic or non-neoplastic, primary or metastatic, and will help further direct the subsequent work-up.

Magnetic Resonance Imaging (MRI) is maximally sensitive to the presence of musculoskeletal soft-tissue lesions and also provides exquisite definition of their features. Categorization of the many distinct attributes of the lesions is the key to2 differentiation of benign from malignant processes. Combining the observations concerning the architectural details with the location and pattern of growth, and finally with the specific MR signal characteristics and contrast enhancement patterns, will produce the most limited differential diagnosis possible.

MRI is the best modality for focal extent and local staging.4 This is particularly true with regards to invasion of muscle, neurovascular structures and adjacent fat planes and the degree of marrow involvement. MRI has also been shown to be superior in assessing intra-articular extension and the presence of intra-tumoral necrosis and hemorrhage. MRI is particularly appropriate if it is necessary to show soft tissue changes within an area of sclerosis, which may be responsible for the new bone formation and which may be masked on radiographs and CT by the surrounding sclerosis.5

In the follow-up, MRI is the best single method to assess the response to therapy and to detect tumor persistence.7 Biopsy is the definitive diagnostic procedure and should be carried out only after the appropriate diagnostic and staging tests. Whenever a bone lesion is suspected, clinic-radiological and pathologic correlation is essential to make a more accurate diagnosis and to improve patient care.8

Case Study:

AIM & OBJECTIVES:

Magnetic Resonance Imaging (MRI) is maximally sensitive to the presence of musculoskeletal soft-tissue lesions and also provides exquisite definition of their features. The purpose of this study is to evaluate the role of MRI in cases of bone tumors, to determine the MRI characteristics of different primary bone tumors and to evaluate the role of magnetic resonance imaging in prediction of malignancy and delineation of anatomic extent of primary bone tumors.

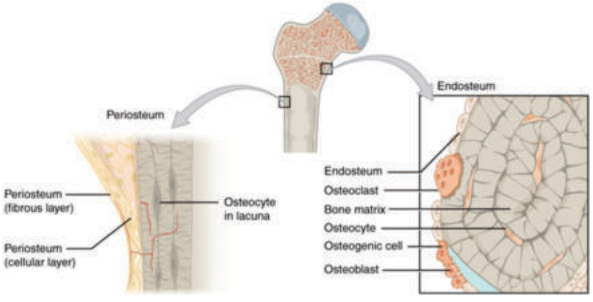

Fig 1: Structure of the bone

MATERIALS AND METHODS

Source Of Data :

The main source of data for the study is patients from the following teaching hospital attached to Govt Medical college, suryapet.

1. Janani Diagnostic Centre.

Appropriate MR sequences and multiplanar imaging will be performed for every patient.

Duration Of Study: 2 years

Data Analysis: Prospective study

All patients referred to the department of Radio-Diagnosis with either suspected or diagnosed primary bone tumors in a period of 2 years from September 2021 to September 2022 will be subjected for the study. A detailed history will be taken followed by clinical examination. All patients will be first evaluated with plain film examination followed by MRI evaluation. The patients will then be followed up with regard to histopathological correlation where ever possible. Initially a minimum of 30 cases are intended to be taken up, however it may be extended up to 50 cases depending upon the availability of cases within the study period.

Inclusion Criteria:

- Patients with either clinically suspected or diagnosed primary bone tumors.
- Patients of all age groups.

Exclusion Criteria:

The study will exclude

- Patients having history of claustrophobia.
- Patient having history of metallic implants insertion, cardiac pacemakers and
- metallic foreign body in situ.
- Undiagnosed suspected cases of primary bone tumors which were

diagnosed as metastasis or inflammatory or infective etiology on histopathological examination were excluded from the study.

METHODOLOGY :

Technique :

Imaging will be done with 1.5 Tesla Philips Achieva Machine using Sense body /surface coils. The following sequences will be selected as required.

1. Localizer sequence conventional spin echo.
2. Sagittal and coronal T1 images.
3. Axial and sagittal T2 images.
4. Sagittal STIR images.
5. Post contrast fat sat T1W images.
6. Coronal STIR images

Optional Sequences

Axial T2W GRE images.

Recommended protocol for MR imaging:

MR imaging was performed on a 1.5 Tesla MRI system. (Fig.6) Patient's position (prone or supine) was determined by the area of abnormality.Body or surface coils were used according to the site of involvement. The smallest local coil that adequately covers the anatomic area was used for imaging. The closest joint was included in the field of view in at least one plane to provide a landmark for surgical localization. [Fig.2, 7(a) , 7(b)and 7(c)]

The region of abnormality was positioned as close to the centre of the coil as possible. Prior to imaging the region of interest, a large field of view localizer using an increased diameter surface coil or body coil was used to accurately determine the proximal and distal extension of a large lesion, wherever required. Slice Thickness was 4-5 mm. T1-weighted images were obtained in coronal and sagittal plane. T2-weighted images were obtained in axial and sagittal planes. Post contrast fat sat T1W images were obtained with IV gadolinium . These were supplemented by STIR sequences in sagittal plane. Wherever required, a second plane of imaging included STIR sequence in coronal and T2 W-GRE in axial planes.

Fig.2 : 1.5 Tesla Philips Achieva Machine

Fig2a

Fig2b

Fig2c

Fig. 2: Radiofrequency coils, (a) Body coil (b) Surface coil (c) Head coil

RESULTS AGE DISTRIBUTION :

In our study, 21 cases (39.62%) were in the age group of 11 -20 years followed by 9 cases (16.98%) in 21-30 age groups. The age-wise distribution of the patients in our study is shown in Chart - 1.

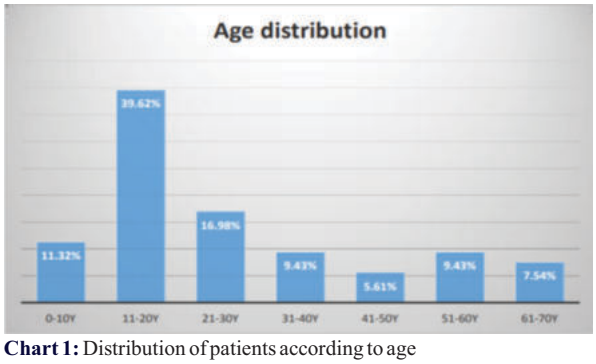

Chart 1: Distribution of patients according to age

Gender Distribution:

In our study, primary bone tumours were more common in males (60.37%) than in females (39.62 %). This is demonstrated in the Chart -2.

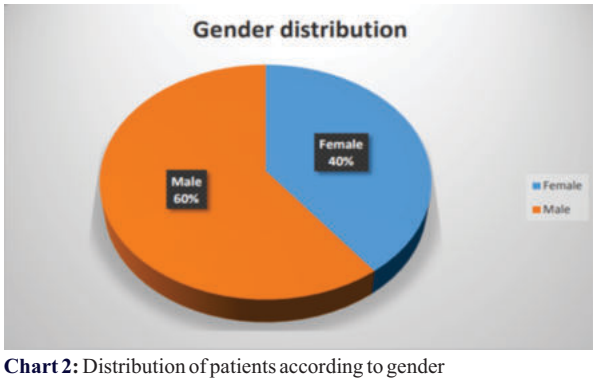

Chart 2: Distribution of patients according to gender

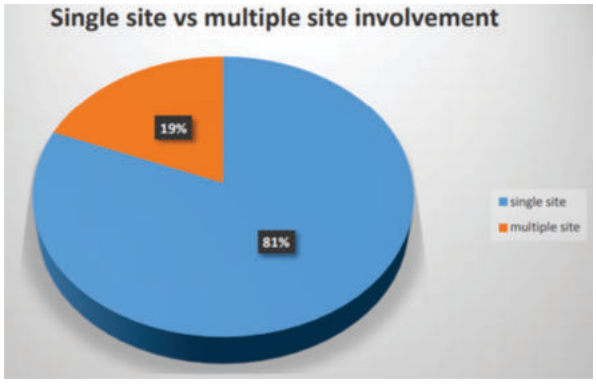

Chart 3: Distribution of cases based on number of sites involved

In our study, multiple bones were involved in 10 cases (18.86%). These patients were of 3 multiple myeloma (5.7%), 3 multiple osteochondroma/diaphyseal aclasis (5.7%), 1 lymphoma (1.8%), 1 multiple enchondromatosis/Ollier's disease (1.8%),1 chordoma (1.8%) 1 non-ossifying fibroma (NOF) (1.8%). Chart - 3 shown above demonstrates the distribution of case based on the number of bones involved.

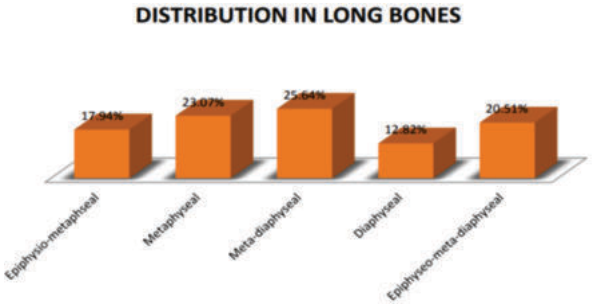

Chart 4: Distribution of cases based on the site of involvement in long bone Lesions

Out of 39 cases of long bone involvement, most bone tumors were observed in the meta-diaphyseal region, comprising of 10 cases (25.6 %). Second most common site was metaphyseal (9 cases) and third most common site was epiphysiometaphysio-diaphyseal (8 cases). The distribution of bone tumors in long bones is as shown in Chart-4 above.

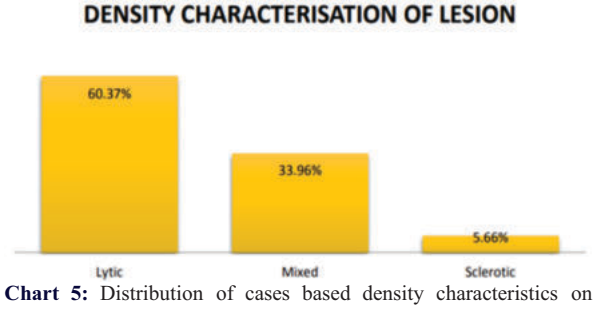

Chart 5: Distribution of cases based density characteristics on radiographs

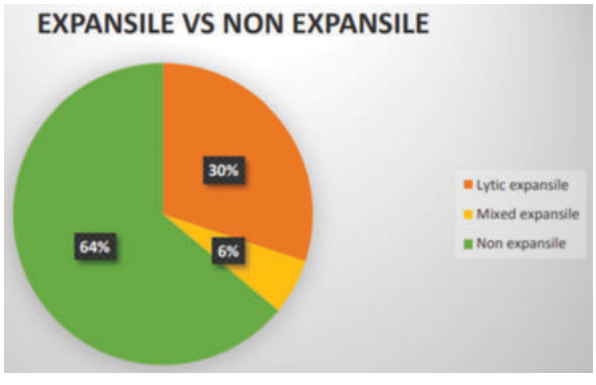

Chart 6: Distribution based on the expansile character on radiographs

In our study of primary bone tumours, 32 cases (60.4 %) were lytic lesions. Out of these 32 cases, 25 cases (47.16 %) were purely lytic and 7 cases (13.2 %) were lytic destructive in nature. Distribution of cases is as shown in Chart 5. In our study. 22 cases were expansile lesions. Out of these,15 cases (28.3 %) were lytic-expansile lesions while 3 cases (5.6 %) were mixed density- expansile lesions. (Chart - 6)

Table 1: Comparison of the margin of bone tumour with its benign and malignant characteristics

MARGIN OF BONE LESION	BENIGN	MALIGNANT	TOTAL
Well defined	29	6	35
Ill defined	0	18	18
TOTAL	29	24	53

In our study, 35 cases (66%) had well-defined margins, of which 29 cases (54.7 %) were benign and 6 cases (10 %) were malignant lesions. The 6 cases of malignant lesions with well-defined margins were chondrosarcoma (n=2),multiple myeloma (n=2), sclerotic osteosarcoma (n=l)and parosteal osteosarcoma (n=1). (Table -1). 18 cases (33.9 %) had irregular/ ill-defined borders of which 18 cases (33.9%) were malignant.

Table 2 : Comparison of the zone of transition of bone tumour with its benign and malignant characteristics

ZONE OF TRANSITION OF BONE LESION	BENIGN	MALIGNANT	TOTAL
Wide	0	19(35.84%)	19(35.85%)
Narrow	29 (54.71 %)	5(9.43%)	34 (64.15 %)
TOTAL	**29 (54.71 %)**	**24 (45.29 %)**	**53(100%)**

In our study, 19 cases (35.84 %) hade wide zone of transition and all these cases were malignant. While 34 cases (64.15 %) had a narrow zone of transition of which 29 cases (54.71 %) were benign and 5 cases (9.43 %) were malignant. (Table - 2). The five cases with malignant lesions with narrow zone of transition were of multiple myeloma (n=3), chondrosarcoma (n=1) and chordoma (n=1).

Table 3 : Comparison of radiography and MRI in evaluating soft tissue Involvement

RADIOGRAPHY	MRI findings		
	Present	Absent	Total
Present	19 (35.84%)	0	19 (35.84%)
Absent	1 (1.8%)	33 (62.27%)	34 (64.16%)
Total	**20 (37.73%)**	**33 (62.27%)**	**53 (100%)**

In our study, 19 cases (35. 84%) revealed soft tissue involvement on radiographs and MRI. In 1 cases (4%), soft tissue involvement was not identified on the radiographs, while MRI revealed the soft tissue involvement and assisted the diagnosis and hence the management of the patient. The lesion was a case of Ewing□s sarcoma. (Table -3) Out of 53 patients of bone tumors, 14 cases(26%) revealed calcification/ matrix mineralisation within the lesion . Out of these 14 cases with calcification,8 cases (15%)were benign and 6 cases(11%) were malignant. Benign bone tumors with matrix mineralisation were osteochondroma (n=4),chondroblastoma (n=3), and enchondroma (n=1). Malignant primary bone tumors with calcification were chondrosarcoma (n=4), chordoma (n=1), telangectatic osteosarcoma (n=1).

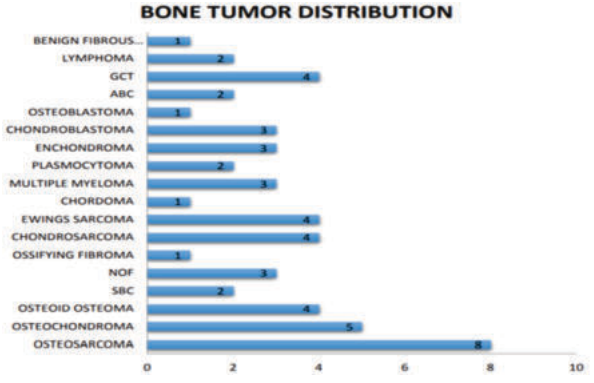

Chart 4 : Distribution of pathologies

CONCLUSION:

In our study of 53 cases of suspected or diagnosed cases of bone tumors, benign lesions were more common than malignant lesions (55%). Most common lesion in our study was osteosarcoma (15%).

Lesions were more common in males (60.37%) than females (39.63%) with amaximum number of patients in the age group of 11-20 years (39.62 %). Most of the lesions involved the appendicular skeleton (n=39).Most bone tumors on radiographs presented as predominantly lytic lesions(60.37%), 33.96 % cases were mixed (lytic-sclerotic) and 75.7% cases were predominantly sclerotic lesions.

Also presence of wide zone of transition favors malignancy in a case of bone tumor. Calcification was identified in 26 % cases and trabeculations or internal septations were identified in 15 % cases. These characteristics of the lesions assisted in narrowing the differential diagnosis of the lesions.

Presence or absence of joint involvement is particularly important in preoperative evaluation of tumor extent which will subsequently decide the line of management (intra or extra-articular resection). MR imaging detected joint involvement in 23% cases. Although MRI could demonstrate different components of the tumor, there was no significant difference in patterns of different histological types of tumors.

Most bone tumors show non specific signal characteristics, most are hypointense on T1-weighted images and hyperintense on T2-weighted images and STIR sequences. 43 cases were subjected to pathological examination. Histopathological correlation was obtained in 98 % cases (n = 42). Limitations of this study were lack of control group, smaller sample size and unavailability of contrast evaluation in few cases due to economic constraints. However, despite these limitations, MR imaging is an excellent modality to delineate the extent of tumor and soft tissue and joint involvement.

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