Musculoskeletal X-Ray And MRI Evaluation of Bone Tumour With its Histopathological Correlation

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ABSTRACT *Introduction- Bone tumours are uncommon malignancy but having significant cancer morbidity and mortality which can only reduce by early and accurate diagnosis .Our study is carried out to measure the strength of agreement in Clinical, Radiological and Histopathological diagnosis of all Bone Tumours from September 2014 to November 2015 using 1.5 Tesla Philips Achieva magnetic resonance imaging machine, at the Radiology Department of GOVT. MEDICAL COLLEGE AND ASSOCIATED GROUP OF HOSPITALS, KOTA.*

Result: In our study total no of 30 cases of bone tumour and tumour like lesion is carried out within one year duration in hadoti region. Malignant tumours were more commonly encountered constituting 46.6 % of the total lesions, 20-29 year age group predominantly affected. Male: Female ratio – 1.30:1.Chondrogenic (29.97%) and Osteogenic tumours (13.3%) and giant cell tumour (13.3%) were commonest lesions. MRI shows excellent sensitivity and specificity in soft tissue involvement, neurovascular involvement and joint involvement.

Introduction-

Bone lesions are diverse in size, gross and histologic feature. This diversity makes it critical to diagnose bone tumours correctly, stage them accurately and treat them appropriate[1]. A systematic approach to clinical history, radiographic evaluation and histopathology is necessary for accurate diagnosis[2].Radiography is the optimal initial imaging modality for evaluating undiagnosed bone tumours[3]

Although traditionally Magnetic resonance Imaging is used in evaluation of musculoskeletal tumours and extent of disease prior to treatment, its role continues to evolve as new techniques emerge[4].A combination of the signal intensity characteristics, site, and morphology of the tumour on MRI images and the presence or absence of abnormal signal intensity adjacent to the tumour can allow the radiologist to categorize many tumours as benign or malignant.[5]MRI is very helpful in local staging and surgical planning by assessing the degree of intramedullary extension and invasion of the adjacent physeal plates,bone marrow lesion, joints, muscle compartments and neurovascular bundles involvement as well as in assessing response to neoadjuvant therapy and post-therapeutic follow-up.[6]

Subject and methods-

X-Ray and MRI studies along with histopathological analysis is studied of 30 patient from September 2014 to November 2015, using 1.5 Tesla Philips achieva magnetic resonance imaging machine, at the Radiology Department of GOVT. MEDICAL COLLEGE AND ASSOCIATED GROUP OF HOSPITALS, KOTA .However sample size is small in our study but it can make an excellent contribution even in that particular small sample size.

All patient was examined using 1.5 tesla Philips machine pulse sequence used are T1w, T2w, in coronal plane using body coil followed by T1w and T2w sequences in axial plane supplemented by sagittal and coronal plane using surface coil, second plane of imaging included STIR sequence and post contrast fat sat T1w images.

T1W-often thought of as making an anatomical image, as it produces excellent contrast between cortical bones, bone marrow and surrounding soft tissues. (TR/TE-500-760/15-30ms)

T2- considered to produce a pathological scan which show high signal within the most tumour due to their increased water content, fast modification of standard se pulse sequence is preferred because it often shorter imaging times.(TR/TE-2200-2700/80-100ms)

GADOLINIUM ENHANCED SE-important for characterization of bone tumour as well as for assessment of response to therapy and recurrence of tumour. (TR/TE-3000-3500/96-102ms) performed if required.

STIR-short tau inversion recovery frequently used. Specific T1 is proportional to the magnetic field strength at 1.5 tesla T1 is 140-160 ms.

Contrast used: Magnevist - Dimeglumine gadopentetate (469 mg/ml)

Dose of contrast – 0.1 ml/Kg body weight. No contrast reactions were encountered.

Scan time varied from 17 mins to 25 mins.

Interpretation of Imaging –Studies are observed by senior radiologists in our department having 10 to 20 year of experience.

Results-

In present study we have 30 cases of bone tumour and tumour like lesion. In the present study malignant tumours were more commonly encountered constituting 46.6 % of the total lesions. Most affected age distribution in present study is 20-29 year i.e. 29.97% and least affected age group is 50-59 year i.e.3.33% . Out of 30 patients included in this study 17 are males and 13 are females i.e. 56.61 % male and 43.29% female.so male: female is 1.3:1. Male preponderance was seen in benign, malignant and with male: female ratio of 2.6:1, 1.3:1 respectively. Thus indicating males are predominant involves compare to females and in metastasis its 1:2 indicating females are more affected. In the present study, osteosarcoma is the most common tumour (16.65%) (FIGURE 1).Most common region involved is Epi-metaphysis i.e.19.98% cases in long bone overall flat bone is more common affected. Most common tumour group affected are cartilaginous tumour i.e.29.97% ,4 cases of enchondroma(FIGURE 5) and 3 cases of chondrosarcoma(FIGURE 2).In our study one case of Chordoma (FIGURE 4) ,Osteoid osteoma , Two cases of Fibrous dysplasia, Case of metastasis from breast tumour , metastasis from thyroid carcinoma (FIGURE 6) and two cases of osteochondroma seen .

We have four cases of osteosarcoma out of which one case diagnosed as GCT on histopathy. Another case having swelling and pain around knee showing variable signal intensity on T2 and STIR imaging and variable contrast enhancement, possibility of osteosarcoma and GCT is given on MRI but histopathology shows plumps fusiform cells are arranged whorls, fascicles and criss cross pattern with hyper chromatic pleomorphic atypical nuclei suggestive of fibrosarcoma.

Three cases of plasmacytoma are seen (FIGURE 3) out of which one case proven as high grade lymphoma. Patient having swelling and pain in right iliac fossa on conventional radiological findings shows expansile lytic lesion with involvement of sacrum and iliac bone, on MRI its associated with soft tissue component a differential diagnosis of plasma cell disorder, MFH, lymphoma and chondrosarcoma (FIGURE 2) is given with high possibility of plasma cell disorder is given but on histology its proven as high grade lymphoma.

We have four case of enchondroma(FIGURE 5) out of which one case having thick sclerotic rim and variable chondroid calcification diagnosed as chondromyxoid fibroma as more possibility as compare to enchondroma but proven as enchondroma on histopathology.

We have four cases of GCT out of which one case which is previously diagnosed as Dermoid on ultrasonography, having large expansile lytic lesion involving right iliac bone with multiple thin septations and cortical destruction possibility of malignant aetiology is given on conventional x ray, but on MRI it shows variable hyperintensity on T2 and STIR imaging with free fluid level so possibility of GCT with ABC changes is given on MRI, its proven as GCT on histopathology. Most common clinical presentation of patient is pain and swelling. Out of 30 patients included in this study 11 cases was benign, 14 malignant, 3 metastasis and 2 tumour like lesion. Most common malignant tumour was Osteosarcoma based on radiological data and most common benign was GCT.

X ray findings-

On plain film margin are well defined in 14 cases, out of which 9 cases are benign and 3 cases are malignant. Ill-defined margin seen in 16 cases out of which 13 were malignant and 1 case was benign. Cortical break seen in 18 cases out of which 14 were malignant and two cases was benign. Periosteal reaction was present in 7 malignant cases out of 14 cases; in benign case no periosteal reaction observed. Calcification seen in 10 cases out of 30 patients; out of which 6 cases was malignant and 4 cases was benign. Soft tissue density seen in 12 cases and all of these cases are malignant.

Radiological histopathological correlation - moderate association seen based on kappa value which is .56 in our study.

MRI findings

Most of tumour appear hypointense on T1w imaging, replace the marrow and typical produce low signal similar to muscle ((Fig. 3.1a; Vanel et al. 1998; Hwang and Panicek 2007a,b). STIR is a sensitive sequence in detecting pathology, but because high signal intensity at STIR can be seen in any tissue having a T1 time similar to that of water, its ability to characterize lesions is diminished, and tumour extent is often overestimated (Fig. 3.1b; Shuman et al. 1991; Delfaut et al. 1999). Also, it has been reported that the greater the extent of marrow oedema around a bone lesion, the more likely it is to be benign (James et al. 2006). In our study Marrow involvement: are seen in 26 cases out of 30 patients; 13 cases was malignant, 8 benign, 3 metastasis and 2 was tumour like lesion. The extent of marrow involvement was best shown by T1W images and STIR coronal or sagittal sequence.

Soft tissue component: was seen in 10 cases. Four cases showing soft tissue density on x- ray does not show soft tissue extension on MRI. Two cases show soft tissue extension on MRI which does not show any opacity on x ray. Extra osseous involvement was best shown by T2 weighted axial images.

Joint involvement: Out of total 30 cases 11 cases showed evidence of joint involvement. Thus 36.6% cases show joint involvement. Out of which 8 cases were malignant. Rest of cases does not show joint involvement. Out of 11 patients in whom surgery was performed .The sensitivity was 100%, specificity 87.5%, positive predictive value 72.5% and negative predictive value 100%.

Neurovascular bundle involvement: Out of a total of 30 cases, MRI showed neurovascular bundle involvement in 7 cases (all of which were malignant). It was not involved in 23 cases. Thus 23.3% cases demonstrated involvement of neurovascular bundle and 76.6% cases did not show involvement of Neuro-vascular bundle on MRI. Surgery could be performed in 25 of these patients. MRI and surgical/pathological correlation; Out of 25 cases who were operated. The sensitivity in our study is 100%, specificity 90 %, positive predictive value 71.42% and negative predictive value 100%.

Cortical break: Out of a total 30 cases; cortical break was detected on MRI in 10 cases. It is best demonstrated on T1 W images. Out of 25 cases operated cortical involve-

ment was seen in 8 cases and it was absent in 2 cases. The sensitivity, specificity, positive predictive value and negative predictive value of MRI in detecting cortical involvement in our study are 100%, 89%, 83% and 100% respectively.

Regarding the staging of cases based on AJR grading in 2003, 6 cases are of IIB stage, 5 cases of IVB stage, 3 cases of distant metastasis III stage; so most common bone tumour are appear in II B stage.

Discussion-
Radiographs are initial imaging modality for the evaluation of bone pain and standard radiographic techniques are typically adequate for tumour imaging[8].

Radiological diagnosis of bone tumour takes includes clinical history, site of lesion, borders of the lesion, type of matrix, type of bone destruction, type of periosteal reaction, nature and extent of soft tissue involvement and number of lesions[9] .On radiograph wide zone of transition, cortical expansion, soft tissue density, multilaminated periosteal Reaction are suggestive of malignancy. It provides critical information regarding lesion location, margin, matrix mineralization, cortical involvement and adjacent periosteal reaction. But MRI is the best modality for focal extent, local staging, invasion of muscle, neurovascular structures and adjacent fat planes and degree of marrow involvement. MRI is excellent role in assessing intra articular extension and the presence of intratumoral necrosis[3].

·X ray findings-
In our study; on plain film margin are well defined in 14 cases, of which narrow zone of transition seen in 13 case; so benign Aetiology suggested on radiologically in 13 cases however 9 cases are benign and 3 cases are malignant. In our study 12 cases showing cortical expansion out of which 6 cases were benign, 4 were malignant and 2 were metastasis. Periosteal reaction was present in 7 malignant cases out of 14 cases; in benign case no periosteal reaction observed. Calcification seen in 10 cases out of 30 patients; out of which 6 cases was malignant and 4 cases was benign. Soft tissue density seen in 12 cases and all of these cases are malignant. The most common age distribution from the present study is 20-29 year. The incidence of malignant bone tumours shows a striking age-specific distribution: in the age group 0–40 years, there is an incidence peak between 10 and 20 years (primarily osteosarcoma and Ewing's sarcoma) and for the age group above 40 years there is a steady increase in incidence up to 80 years (primarily chondrosarcoma and to a lesser degree Paget's related osteosarcoma) (Dorfman and Czerniak 1995, 1998; Unni et al. 2005)[10].

In our study male: female ratio is 1.3:1. Male preponderance was seen in benign, malignant and with male: female ratio of 2.6:1, 1.3:1 respectively.

In the present study, osteosarcoma was the most common tumour (16.65%). This is similar to the observation of Rao VS (45.7%) and Dorfman HD (35.9%) most common primary bone malignancies[10].

MRI findings –
Marrow involvement-

T1WI is very important in the evaluation of bone marrow. Most bone tumours will be evident as lesions with low signal against a background of surrounding fatty marrow.

T1WI also provides excellent contrast among the cortical, marrow and surrounding tissues[7].For bone tumors, as discussed by Vogler and Murphy in 1988, a true T1weighted sequence is one of the most important sequences needed to help evaluate the bone marrow[4].In our study marrow involvement seen in 26 cases out of 30 patient.13 cases was malignant, 8 benign, 3 metastasis and 2 was tumour like lesion. .The extent of marrow involvement was best shown by T1W images and STIR coronal or sagittal sequence.it was confirmed by pathological findings. T1 weighted spin echo pulse sequence in a longitudinal (coronal or sagittal plane) was used for intramedullary staging.

Soft tissue component-
Orest B Boyko and David A cory in 1986 evaluated 25 patients with Osteogenic sarcoma and Ewing's sarcoma with MRI and found that tumour involvement of the soft tissue is best shown by T2 weighted sequence[9]

In MRI showing Soft tissue component is seen in 10 cases; all are malignant. Four cases showing soft tissue density on x- ray does not show soft tissue extension on MRI. Extra osseous involvement was best shown by T2 weighted axial images.

Joint involvement-
Joint involvement- In our study, MRI showed joint involvement in 11 cases .It was uninvolved in 21 cases; after surgery out of which 8 cases are malignant. The sensitivity of joint involvement was 100%, specificity 87.5%, positive predictive value 72.5% and negative predictive value 100%.Suggesting MRI is highly sensitive for detecting joint involvement in malignant tumours.

Neurovascular bundle involvement-
Out of a total of 30 cases, MRI showed neurovascular bundle involvement in 7 cases (all of which were malignant). Thus sensitivity in our study is 100%, specificity 90 %, positive predictive value 71.42% and negative predictive value 100%. Suzanne and William Kaufman in 1997 found that it is easier to evaluate neurovascular bundle proximity to tumour with Fat sat T1 W post contrast images than with T2W for 64% of cases[9].

OSTEOSARCOMA
20 yrs., male patient presented with complaint of long standing large swelling in right lower knee region with gait impairment and significant pain.

Figure 1-
A.AP and lateral view x ray knee joint pesence of densly scerotic lesionnoted distal to epimetaphysis region in right lower femur with periosteal reaction.presence of similar lesion noted in proximal epiphysis of right tibia s/o metastasis joint space seen normla.

B.Large, fairly defined, lobulated, multi-compartmental mass lesion is seen involving the lower portion of right femur which appear isointense to hyperintense (to normal muscle) on T1W images.C.Lesion is appear heterogenous hyperintense on T2 weighted imaging with extension of lesion in medulla proximally.D.Post contrast GAD T1 weighted coronal image showing heterogenousenhancement with multiple necrotic area within it.

CHONDROSARCOMA

28 YR female patient presented with weakness of left lower limb since 3 month followed by weakness in right lower limb also having backache, radiating pain in back.
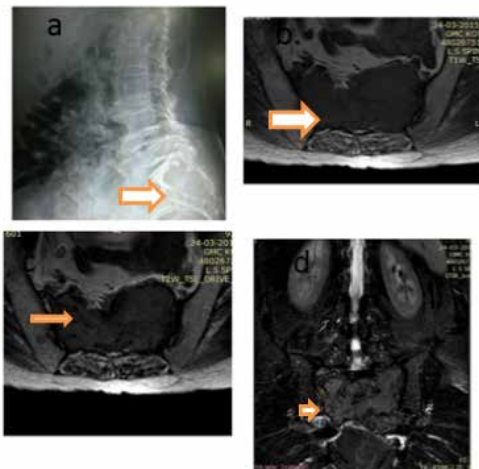
Figure 2

A.AP view right upper thigh showing mixed lytic lesion with significant   chondroid calcification and cortical breach on x ray.B. Lesion appear hypointense on coronal T2 weighted imaging C.   Lesion appear hypointense on T1 weighted imaging D.Lesion appear hyperintense on STIR imaging with significant soft tissue   compo-nent and cortical destruction.
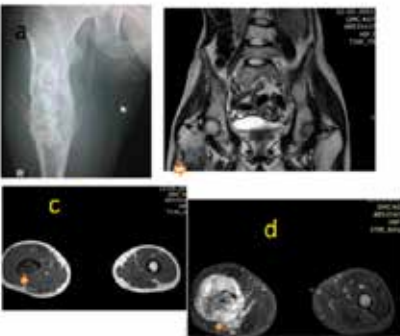
PLASMACYTOMA

75 yrs. old female presented with complaints of back pain, constipation, numbness, or dysesthecia in the extremities, generalized malaise, sluggish mentation, and sensory loss**.**

FIGURE 3

CHORDOMA

31yr female patient having lower back pain referred to lower limb coming for usg guided FNAC. On usg bone destruction seen in sacral region .

Figure 4-

A. Axial T1 weighted image showing large hypointense lesion. B. AP Radiograph pelvis showing ill-defined osteolytic lesion involving sacral vertebra with large soft tissue density. C. Axial T2weighted imaging lesion appears significantly hyperintense. D. Axial view STIR imaging lesion appears heterogeneous hyperintese. E. Coronal T2 weighted gradient images showing heterogenous hyperintense lesion with soft tissue component


ENCHONDROMA

28yr.Female presented in our department with complaint of pain in right hand. On examination, there is swelling in right hand in ring finger which is quite hard on palpation**.**

Figure 5-

A and B.PA and anterior oblique view of right hand showing well defined expansile lytic lesion with chondroid calcification in distal 4th metacarpel.

C.Lesion appear hypointense on T1weighted D.Lesion appears hyperintense on T2weighted imaging E.Lesion appear hyperintense on STIR imaging s/o of high water content within lesion
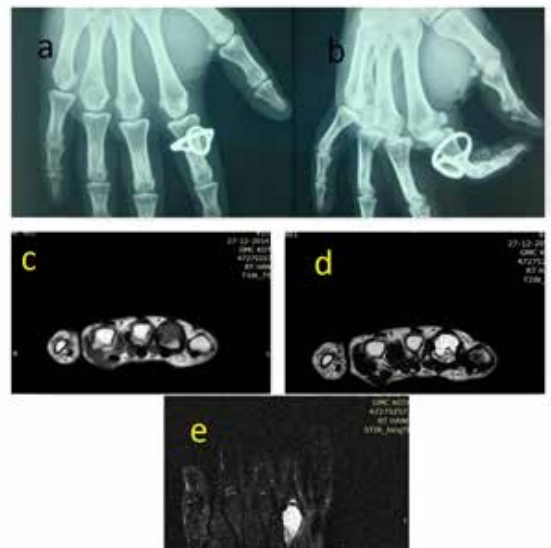
BONY METASTASIS IN THYROID CARCINOMA (follicular variant)

Figure 6

A.Lateral xray skull showing large Lytic expansile lesion in frontal region B.AP view x ray knee showing large osteolytic lesion with pathological fracture and metallic fixation in left lower femur. C.AP and Lateral view of LS spine showing collapse of L3 vertebra. D.AP view xray of left shoulder showing large osteolytic lesion with cortical breach involving head and neck of humerus. E.T1 weighted axial images of shoulder showing large hypointense lesion. F.T2 weighted axial images showing lesion appear significant hyperintense in center and isointense at periphery

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