ORIGINAL ARTICLE

Diagnostic Accuracy of Magnetic Resonance Imaging in Predicting Malignancy in Musculoskeletal Tumours Taking Histopathology as Gold Standard

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ABSTRACT

Objective: To determine theediagnostica accuracy of magnetic resonance imaging in detection of musculoskeletal tumor taking histopathology as gold standard.

Methods: This retrospective cross-sectional study was conducted at the Diagnostic Radiology Department, Lahore General Hospital, Lahore. The current study involved 132 patients of both genders aged between 25-60 years referred to department of diagnostic radiology with suspicion of musculoskeletal tumor. Contrast MRI was performed followed by histopathology of the surgically excised lesion.

Results: The mean age of the patients was 37.3±9.8 years. The mean duration of disease was 7.3±3.3 months. There were 82 (62%) male and 50 (38%) female patients with a male to female ratio of 1.6:1. Musculoskeletal tumor was diagnosed in 65 (49%) patients on contrast MRI while histopathology confirmed musculoskeletal tumor in 60 (46%) patients. There were 60 trueppositive, 5 falseppositive, 0 falsepnegative and 67 truepnegative cases which yielded 100% sensitivity, 93 % specificity, 96% accuracy, 92% positive predictive value and 100% negativeppredictive value for contrast MRI in detecting musculoskeletal tumor.

Conclusion: It can be concluded that contrast MRI was found to be 100% sensitive, 93% specific and 96% accurate in diagnosing musculoskeletal tumors which owing to its non-invasive and radiation free nature and widespread availability advocates its preferred use in future practice.

Keywords: Musculoskeletal Tumor, Contrast MRI, Histopathology, Diagnostic Accuracy.

INTRODUCTION

Tumours involving musculoskeletal system can evolve either from bone or soft tissues such as muscle and cartilage. Malignant tumours are considered sarcomas (e.g., osteosarcoma, chondrosarcoma). Although tumours of the musculoskeletal system are not common, pathological fractures are the major concerns associated with bone tumors. In many cases, when the tumour is peripherally located in limbs, complete tumour resection is necessary via either limb-sparing techniques or amputation.[1]

Osteosarcomas were most common malignant tumours (estimatedpincidence: 1.68 per million/year), chondrosarcoma (0.79 per million/year) and Ewingpsarcoma (0.76 per million/year). Benign tumours and tumour-like lesionspwere foundpinp79.3% of patients, with slight higher prevalence in females. Mostpcommon benignpbone lesionspwereposteochondroma (5.81 per million/year), simple bone cyst (2.13/million/year) and enchondroma (2.05 per million/year).[2]

Magnetic ResonancepImaging (MRI) is the principal imaging modality for the assessment of musculoskeletal tumours due to its exceptional soft tissue contrast, its sensitivity to detect oedema involving bone and soft tissue and its quality of multiplanar imaging. MRI of musculoskeletal system has few demerits due to similar MRI signals of few different tumours and technical expertise required in certain instances. Therefore,application of correct protocols for tumour evaluation, both in diagnosis and in pre-operative assessment are required.[3]

Correct estimation of extent of tumour is necessary for pre-surgical evaluation using MRI. Conventional MRI sequences provide adequate estimation of tumour extent and its relation to surrounding nerves, vessels or joint spaces.[4] MR imaging is also helpful in detection of post-operative recurrent or residual mass or response to chemotherapy or radiotherapy.[5]

Tumours arising primarily from musculoskeletal system are a broad range of tumours which have different signal intensity characteristics on T1-weighted and T2-weighted images.[6] The T1 and T2 relaxation time in a tumour is not a fixed feature, as they depict the variations in the tumour microenvironment as a result of many processes which are occuring in a growing tumour, like variations in water contents as a result of necrosis and haemorrhage or myxoid change or changes in tumour oxygenation. Hence, post treatment variations in the T1 and T2 relaxation times as compared with pre-treatment levels in a tumour are certainly expected.[7]

Recent studieshave claimed that contrast MRI is extremely sensitive and specific tool for diagnosing musculoskeletal malignancies which along with its non-invasive and radiation free nature make it ideal to solve this dilemma.[8,9]The rationale of the present study was to define the actual sensitivity and specificity of MRI as there lays a gap between studies performed internationally.

MATERIALS AND METHODS

A retrospective cross sectional study was done at the department of Diagnostic Radiology, Lahore General Hospital, Lahore for a period of six months dated 05-01-2019 to 04-07-2019. Patients were selected by non-probability and consecutive sampling technique. The sampling selection was done on the basis of following criteria. Patients of both genders (male and female) with the age of 25 to 60 years were selected for the study. Patients who were suspected for musculoskeletal tumor (presence of fever, pain and swelling) on clinical evaluation from last one year were selected. Patients having previous history of chemotherapy, history of any orthopedic procedure in last 6 months were excluded from the study.

A total 132 suspected cases of musculoskeletal tumor were enrolled. After taking the informed written consent, a detailed phistory and examination was carried out. All the patients presenting to the radiology department, through emergency, OPD and referral from other hospital underwent contrast induced MRI by consultant radiologist routinely. The MRI was performed routinely on 1.5 Tesla and 3 Tesla. Patients were considered as the confirmed cases of tumors on MRI and histopathology as per operational definition. Confirmation of all malignancies was done by surgical histology and histopathological correlation.

Analysis of collected data was done through SPSS version 11.0. 2×2 table was formulated to calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy of the MRI.

RESULTS

Mean patient`s age was 37.3±9.8 years. There were 82 (62%) male and 50 (38%) femaleppatients with a maleptofemalepratio of 1.6:1. The duration of disease was 7.3±3.3 months as shown in Table 1.

Musculoskeletal tumor waspdiagnosed in 65 (49%) patients on contrast MRI while histopathology confirmed musculoskeletal tumor in 60 (46%) patients as shown in Table 2.

There was nopstatistically significant difference in the frequency of histopathological confirmed musculoskeletal tumor across various subgroups based on patient's age (p-value=0.872), gender (p-value=0.793) and duration of disease (p-value=0.974) as shown in Table 3.

Table 1. Baseline Characteristics of Study Sample.

Characteristics	Participants
Age (years)	37.3±9.8
Gender	
• Male	82 (62.1%)
• Female	50 (37.9%)
Duration of Disease (months)	7.3±3.3

Table 2:Diagnosis of Musculoskeletal Tumor on Contrast MRI and Histopathology.

Musculoskeletal Tumor	Contrast MRI	Histopathology
Yes	65 (49.2%)	60 (45.5%)
No	67 (50.8%)	72 (54.5%)

When cross-tabulated diagnosis of musculoskeletal tumor on contrast MRI with that of histopathology was done, there were 60 true positive, 5 false positive, 0 false negative and 67 true negative cases which yielded 100% sensitivity, 93% specificity, 96% accuracy, 92% positive predictive p value and 100% negative p predictive p value for contrast MRI in detecting musculoskeletal tumor keeping histopathology as gold standard as p shown in Table 4.

Table 3.Stratification of Musculoskeletal Tumor confirmed on Histopathology across various Subgroups.

Subgroups	N	Musculoskeletal Tumor(n=60)	P-value
Age			
• 25-42 years	78	35 (44.9%)	0.872
• 43-60 years	54	25 (46.3%)	
Gender			
• Male	82	38 (46.3%)	0.793
• Female	50	22 (44.0%)	
Duration of Disease			
• 1-6 months	53	24 (45.3%)	0.974
• 7-12 months	79	36 (45.6%)	

Chi-square test, observed difference was statistically insignificant

Table 4.Contingency Table (2×2) to Determine Diagnostic Performance of Contrast MRI in Diagnosing Musculoskeletal Tumors.

Musculoskeletal Tumor on Contrast MRI	Musculoskeletal Tumor on Histopathology		Total
	Yes	No	
Yes	60[a]	5[c]	65
No	0[b]	67[d]	67
Total	60	72	132
Sensitivity 100.00% Specificity 93.06% PositivepPredictivepValue 92.31% NegativepPredictivepValue 100.00% Accuracy 96.21% Diseaseprevalence 45.45%			

[a]True Positive = 60, [c]False Positive = 5, [b]False Negative = 0, [d]True Negative = 6

DISCUSSION

Pathological fractures are the major concerns associated with bone tumors and the difficult choice between limb salvage and amputation which is reliant on timely and accurate diagnosis of the lesion.[1,2]. Imaging of the musculoskeletal system has been revolutionized since the discovery of x-rays. A multimodality approach is necessary for evaluation of musculoskeletal tumors[3]. Each modality offers different diagnostic information. Type of modality is determined by different factors such as patient's history, findings on physical examination and the site of the abnormality.[3,6]. However, a sound knowledge of requesting the most appropriate diagnostic modality for evaluation of presenting complaint is of upmost importance to the physician who wishes to practice proficient and cost-effective medicine[1,3]

MRI can detect soft tissue disorders concerning masses, tendons, ligaments, intervertebral discs and cartilage. In addition, MRI is effective in further characterization of bone injuries, including subtle fractures and contusions[3]. A recent study claimed that contrast MRI is extremely sensitive and specific tool for diagnosing musculoskeletal malignancies which along with its non-invasive and radiation free nature make it ideal to solve the dilemma of timely and non-invasive diagnosis of musculoskeletal tumors[8]. However, the available evidence was limited and contained controversy[8,9] while there was no localppublished material of such kind which necessitatedpthe present study.

Current study was aimed determine the diagnostic accuracy of MRI in detection of musculoskeletal tumor taking histopathologypasgoldpstandard. In the current study, the mean age of the patients was 37.3±9.8 years while the mean duration of disease was 7.3±3.3 months. There were 82 (62.1%) male and 50 (37.9%) female patients with a male topfemaleratiopof 1.6:1. Our results are in line with those of Inuwaet al.[10] who reported similar mean age of 37.8±8.9 years among Nigerian patients with musculoskeletal tumors. They also reported similar male predominance with male to female ratio of 1.7:1. Similar mean age of 39±7.6 years has been reported by Dominic et al.[11]. Qureshi et al.[12] and Bhurgri et al.[13] reported similar male preponderance with male to female ratio of 1.6:1 and 1.9:1 respectively. Similar male preponderance with male to female ratio of 1.6:1 has been reported by Solookiet al.[14]and Jain et al.[15]

In the present study, musculoskeletal tumor was confirmed in 60 (45.5%) patients on histopathology. Our observation is in line with that of Bhurgri et al.[13] who reported similar frequency of musculoskeletal tumor (45.4%). In three similar Indian studies, Vermaet al.[16], Solooki et al.[14] and Jain et al.[15] reported comparable frequency of 45.5%, 45.2% and 42.7% for histopathologically confirmed musculoskeletal tumor respectively. In another Indian study, Guliaet al.[17], however, reported relatively higher frequency of 66.0%. Inuwaet al.[10] and Aina et al.[18] reported slightly higher frequency of 56.9% and 61.6% respectively in Nigerian such patients. Much higher frequency of 86.7% has been reported by Natekaret al.[19] in Indian population.

We observed that contrast MRI was 100% sensitive, 93% specific, and 96% accurate with positive and negative predictive values of 93% and 100% respectively in detecting musculoskeletal tumor keeping histopathology as gold standard. Our results are in line with those of Kumar et al.[20] who reported similar sensitivity (100%) and specificity (96%) of MRI in diagnosing musculoskeletal tumors in Indian population. In another similar Indian study, Bhuyanet al.[21] reported the sensitivity and specificity of MRI to be 100% and 95% respectively in the diagnosis of musculoskeletal tumors. Similar sensitivity of 100% and 94% has been reported by Ma et al.[22] and Berquist et al.[23]

The current study is first of its kind in local population and adds to the limited existing research evidence on the topic. A strong drawback MRI is that it cannot be performed in patients with metallic implants in situ, thus, having an alternative imaging option would be of great help in such cases. Such a study is highly recommended in future research.

CONCLUSION

In the present study, contrast MRI was found to be 100% sensitive, 93% specific and 96% accurate in diagnosing musculoskeletal tumors which owing to its non-invasive and radiation free nature and widespread availability advocate its preferred use in future practice.

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