Original Research Article

Assessment of the accuracy of MRI in differentiating benign and malignant lesion by different intralesional tissue signal characteristics

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Abstract

Background: Despite the diversity associated with soft tissue tumour development, all diagnosis carry similar symptoms and treatment options. By systematically using clinical history, lesion localisation, mineralisation on radiographs and signal intensity characteristics on MR images, one can determine the diagnosis for the subset of determinate lesion that have characteristic clinical and imaging features and narrow the differential diagnosis for lesions that demonstrate indeterminate characteristics. **Material & Methods:**The present retrospective study was conducted at department of Department of Radiology at MRI Centre, M.B. Govt. Hospital, Udaipur. The study duration was September 2012 to March, 2015. The study group of 50 patients, consisted of mainly patients from different parts of Rajasthan and also some from the states like Gujarat and Madhya Pradesh. **Results:** In the present study, in demographic study youngest age was 6 months female with angiofibroma and oldest was 79 years male with Leiomyosarcoma. Most common age group over all was 31 to 40 years [24%]. Amongst malignant and benign most common age group was again 31- 40 years, 8% in benign and 16% in malignant. Benign lesions were more common in females and malignant were more common in males.Out of total study participants 50 patients, 32 cases were malignant and 18 cases were benign.Most tumors were hypointense on T1W study[58%] and hyperintense on T2W images[86%]. Heterogenous hyperintensity on T2W images was more common in malignant lesions than in benign. Sensitivity and specificity of this characteristic predicting malignancy is as follows. Statistics show that heterogenous hyperintensity has higher sensitivity, specificity, PPV and NPV in predicting malignancy and p value suggests that there is significant difference among the malignant and benign lesions. [Chi = 20.91; p = 0.0001].**Conclusion:**We concluded from the present study that MRI is the modality of choice for evaluation of soft tissue tumors along with highly sensitive in detection of soft tissue tumors almost 100%. MRI has an important role in determining the origin of these lesions and in defining their extent and relation to adjacent structures. However, it must be emphasized that MRI cannot completely distinguish benign from malignant lesions when radiologic evaluation is non-specific.

Key words:MRI, Soft tissue tumors, malignant lesions.

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Introduction

A soft tissue mass, also known as a soft tissue tumour is a neoplastic growth that forms in the non epithelialextraskeletal connective tissue and soft tissues of the body such as the muscle, tendon and blood vessels which are usually mesodermal in origin [1]. Despite the diversity associated with soft tissue tumour development, all diagnosis carry similar symptoms and treatment options. By systematically using clinical history, lesion localisation, mineralisation on radiographs and signal intensity characteristics on MR images, one can determine the diagnosis for the subset of determinate lesion that have characteristic clinical and imaging features and narrow the differential diagnosis for lesions that demonstrate indeterminate characteristics [2]. Soft tissue sarcomas make up less than 1% of malignant tumours. They arise most commonly in the extremities, chest wall and retroperitoneum and are more common in older people and male, although age and gender vary for the various histological types [3]. Patients are commonly referred for imaging to evaluate a soft tissue mass in the trunk or extremities. These lesions range from non neoplastic conditions to benign and malignant tumors. Presently imaging provides a limited ability to reliably distinguish between benign and malignant soft tissue lesions [4]. Thus, the primary goal for the imaging referral is to confirm the presence of a mass and to assess its extent for management plan. In an important subset of cases, characteristic clinical and imaging information can help to narrow the differential diagnosis. These characteristics include clinical history, lesion localisation, mineralisation on radiographs and signal intensity [SI] characteristics on Magnetic Resonance (MR) images. Presently examination of bone and soft tissue are the most commonly requested MRI examinations [5]. The pixel intensity in MRI reflects the density of hydrogen, generally as water or fat. To be more exact, MR signal intensity reflects the density of mobile hydrogen nuclei modified by the chemical environment i.e. by the magnetic relaxation times (T1 and T2) and by motion[6]. Hence, present study was conducted to assess the accuracy of MRI in differentiating benign and malignant lesion by different intralesional tissue signal characteristics.

Materials & methods

The present retrospective study was conducted at department of Department of Radiologyat MRI Centre, M.B. Govt. Hospital, Udaipur. The study duration was September 2012 to March, 2015. The study group of 50 patients, consisted of mainly patients from different parts of Rajasthan and also some from the states like Gujarat and Madhya Pradesh.All patients were seen by appointment, except for the emergency cases of trauma. They were advised and consulted by their physicians. Significant clinical findings of all patients were recorded. Most of the patients were taken for examination without any pre-medication. In case of uncooperative patients and younger children sedative was used under the supervision of anaesthetist. Relevant history regarding allergies and fitness for contrast study were obtained, the renal function tests were evaluated. Previous investigations (USG, CT scans etc.) were reviewed. Patients were explained about the procedure and the risks involved. All patients were subjected to sign on consent form. All studies were done in the presence of a radiologist with standby anaesthetic support.MRI of soft tissue tumours was done on Phillips (MR ACHIEVA) machine with field strength of 1.5 Tesla. The contrast used in the study was Gadolinium-DTPA with dose of 0.1 ml mol/kg. In paediatric patients non ionicMR contrast agent omniscan (gadodiamide injection)was used as intravenous injection at a dose of 0.2 mL/kg.

All patients diagnosed as having soft tissue tumours were included in this study. These included lesions of primary neoplastic aetiology of soft tissue of whole body.Following subsets were excluded:Soft tissue tumours with inconclusive or inappropriate histological diagnosis, Patient who had recurrent or residual lesion after surgery, Patient who had already taken treatment and Soft tissue lesions not included in WHO classification like ganglion, abscess and neurogenic tumours.The test of significance was utilized to decide the measurable centrality of the information by applying the chi-square test.

Results

In present study, we enrolled50 patients, consisted of mainly patients from different parts of Rajasthan and also some from the states like Gujarat and Madhya Pradesh. Out of total study participants 50 patients, 32 cases were malignant and 18 cases were benign.[Table 1]

Table 1: Distribution of study subjects according to the type of lesion

Type	No. of patient	%
Benign	18	36%
Malignant	32	64%

In demographic study youngest age was 6 months female with angiofibroma and oldest was 79 years male with Leiomyosarcoma. Most common age group over all was 31 to 40 years [24%]. Amongst malignant and benign most common age group was again 31- 40 years, 8% in benign and 16% in malignant. Benign lesions were more common in females and malignant were more common in males.[Table 2]

Table 2: Age and genderwise distribution of study subjects

Age in Years	Malignant		Benign		Total
	Male	Female	Male	Female	
0-1	-	-	-	1	1
1-10	2	-	1	-	3
11-20	3	1	-	-	4
21-30	3	3	-	1	7
31-40	6	2	1	3	12
41-50	3	1	2	1	7
51-60	3	-	2	1	6
61-70	2	-	-	1	3
71-80	2	1	3	1	7

Table 3: Distribution of study subjects according to the MRI findings

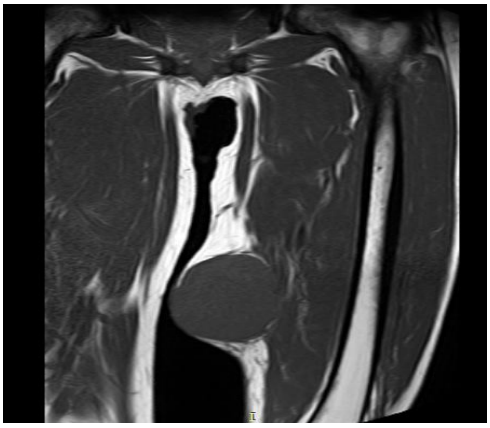
T_2 Heterogeneous Hyperintense	Malignant	Benign	Total		
Yes	27	7	34	79%	PPV
No	5	11	16	69%	NPV
Total	32	18	50		
	84%	61%			
	Sensitivity	Specificity			

Most tumors were hypointense on T1W study(58%) and hyperintense on T2W images(86%). Heterogenous hyperintensity on T2W images was more common in malignant lesions than in benign. Sensitivity and specificity of this characteristic predicting malignancy is as follows. Statistics show that heterogenous hyperintensity has higher sensitivity, specificity, PPV and NPV in predicting malignancy and p value suggests that there is significant difference among the malignant and benign lesions. (Chi = 20.91; p = 0.0001).

Table 4: Distribution of study subjects according to the MRI findings

Margin	Malignant	Benign	Total		
Ill defined	18	2	20	90%	PPV
Well Defined	14	16	30	53%	NPV
Total	32	18	50		
	56.25%	88.9%			
	Sensitivity	Specificity			

Statistics show that ill-defined margins has high sensitivity, specificity, PPV and NPV in predicting malignancy and p value suggests that there is significant difference amongst the malignant and benign lesions [Chi = 7.99; p = 0.0047].



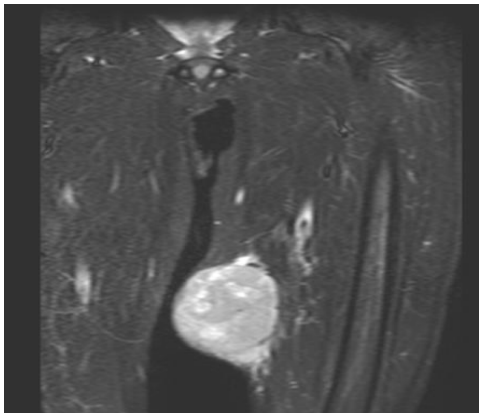


Fig1 and 2: FIBROSARCOMA : Coronal T1 precontrast, post contrast stir coronal and post contrast fat suppressed T1 axial image showing hetrogenous mass involving medial aspect of left thigh with moderate hetrogenous enhancement

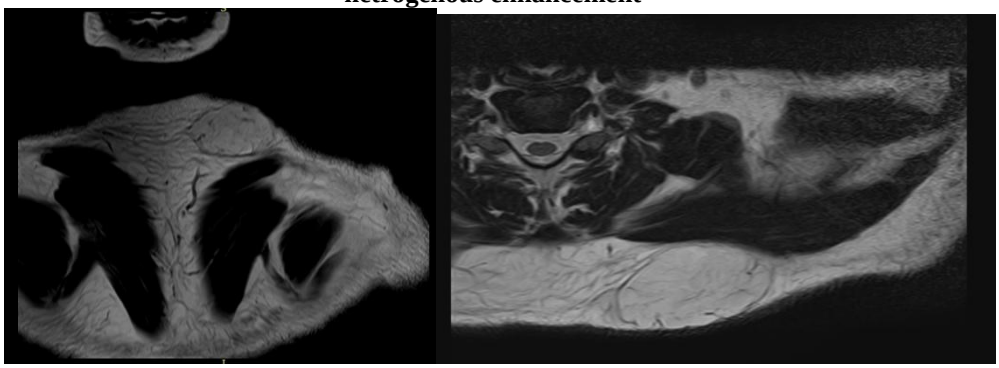


Fig 3 and 4: LIPOMA :Coronal T1, axial T2 and fat suppressed axial T1 sequences show a T1 and T2 hyperintense lesion in back with supression on fat sat sequences

Discussion

The use of MR imaging for the pathological diagnosis of musculoskeletal conditions relies on signal intensity and morphological changes in the tissues being studied. Detecting subtle alterations in these features requires both high contrast resolution (different signal intensities in normal and abnormal tissues) and high spatial resolution. To meet these goals, the signal-to-noise ratio (SNR) of the images must be as high as possible. The best way to increase SNR in musculoskeletal MR imaging is by using local coils. Ideally the coil surrounds the entire limb, which is possible for knee, ankle, wrist and elbow, but not for the hip or shoulder.Imaging artifacts arise from many sources including imperfections in the instrumentation and magnetic fields, inherent properties of mathematics used to reconstruct the images and tissue interfaces and foreign bodies. The most readily preventable sources of artifacts is patient motion. Carefully positioning the patient to ensure comfort prevents motion artifacts [7]. Chen et al in 2009 in a study entitled “Differentiating benign and malignant soft tissue masses by magnetic resonance imaging: Role of tissue component analysis” showed that 118 histologically proven soft tissue masses show T2 low signal matrix, fibrous tissue, calcification, necrosis, septum, fat rim sign. Peritumoral edema and haemorrhage showed statistically significant differences between benign and malignant masses ($p < 0.05$)[8].In the present study most tumors were hypointense on T1W study(58%) and hyperintense on T2W images(86%) Heterogenous hyperintensity on T2W images was more common in malignant lesions than in benign. Sensitivity and specificity of this characteristic predicting malignancy is as follows. Statistics show that heterogenous hyperintensity has higher sensitivity, specificity, PPV and NPV in predicting malignancy and p value

suggests that there is significant difference among the malignant and benign lesions. (Chi = 20.91; p = 0.0001). Similar results were obtained in a study conducted by Kalyanarooj et al found heterogenous signal on T2W; Perilesionaloedema or invasion and necrosis in the masses to be statistically significant for differentiation between benign and malignant soft tissue masses. [9] In the present studystatistics show that ill-defined margins has high sensitivity, specificity, PPV and NPV in predicting malignancy and p value suggests that there is significant difference amongst the malignant and benign lesions (Chi = 7.99; p = 0.0047). Similar results were obtained in a study conducted bySchepper et al reported that although malignant tumors show increased vascularity and have large extracllular spaces, depending on tumoral activity or aggressiveness, there was no correlation between the degree and pattern of enhancement and malignancy grade [10].Similar results were obtained in a study conducted byKransdorf et al stated that in routine clinical practice, synovial sarcoma is frequently misinterpreted as benign at non enhanced MR imaging, perhaps because of its often small size, well defined margins and slow progression. However, these sarcomas will demonstrate early diffuse enhancement at dynamic contrast enhanced MR imaging. Enhancement characteristics may therefore raise a red flag in benign appearing lesions and allow less experienced radiologists to target lesions that need further work up in a referral centre [11].Similar results were obtained in a study conducted by **Bongartz** et al, benign tumors are well delineated and malignant tumors have rather ill-defined margins, however reported that aggressive sarcomas may have a pseudocapsule, whereas benign lesions, such as desmoid tumors may invade neighbouring tissues. They concluded that the margin [well-defined v/s infiltrating] of soft tissue masses on MRI was of no stastical relevance in the prediction of malignancy[12].Similar results were obtained in a study conducted by Datir et al current guidelines suggest that the most important variables for assessing the risk of malignancy in a soft tissue lesion include size, depth in relation to fascia, increasing size and pain[13].

Conclusion

We concluded from the present study thatMRI is the modality of choice for evaluation of soft tissue tumors along with highly sensitive in detection of soft tissue tumors almost 100%.MRI is a well-established imaging tool for the detection and local staging of soft tissue tumors and it is highly accurate in determining the location, nature, and characteristics of the lesion and hence the modality of choice for evaluation of soft tissue tumors.MRI has an important role in determining the origin of these lesions and in defining their extent and relation to adjacent structures. However, it must be emphasized that MRI cannot completely distinguish benign from malignant lesions when radiologic evaluation is non-specific.

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