ORIGINAL RESEARCH ARTICLE

Diagnostic Efficacy of MRI in Distinguishing Benign and Malignant Lesions: A Comparative Study

Chandan Kakkar[1], Sinewraz P M[2], Vikram Narang[3]

[1]Assitant Professor, Department of Radiology, Dayanand Medical College and Hospital, Ludhiana, Punjab, [2]Clinical Head, Cloudex Radiology, Cloudex scans, 3rd Floor' Emad Tower, Fort Road, Kannur, Kerala, [3]Assistant Professor, Department of Pathology, Dayanand Medical College and Hospital, Ludhiana, Punjab, India

Corresponding author: Dr Sinewraz PM, Kasturba Medical College and Hospital, Manipal, Karnataka, India

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A B S T R A C T

Introduction: Soft tissue tumors in the extremities are not very common, however, they do occur with sufficient frequency to present a regular diagnostic challenge. Role of imaging in evaluation of soft tissue masses is to determine the pathology, stage of the disease and the resectabilty of a particular lesion. This study was planned to evaluate the efficacy of MR Imaging in predicting the pathological diagnosis of soft tissue masses and distinguishing benign from malignant masses.

Material and methods: The present study was designed to adopt a retrospective methodology to meet the objectives. Based on inclusion and exclusion criteria, total 56 participants from Department of Radio diagnosis, Kasturba hospital between January 2002 and August 2008 were recruited for this study after obtaining the written informed consent. The study protocol included a Proforma for each patient which included patient's name, age, sex and hospital ID No. A detailed history of the patient regarding the nature and duration of clinical symptoms was evaluated.

Results: MRI was accurate in providing a diagnosis in 78.6% of cases based on the MR morphology, location and extent of the lesion with high sensitivity, specificity and negative predictive value for diagnosing malignancy.

Conclusion: Benign and Malignant soft tissue masses can be correctly and confidently recognized based on MR imaging. Contrast enhanced MR imaging when added with non-enhanced MR imaging improves the differentiation between benign and malignant lesion.

Key words: Tumors, MR Imaging, Benign, Malignant.

INTRODUCTION

Soft tissue tumors in the extremities are not very common, however, they do occur with sufficient frequency to present a regular diagnostic challenge**.** Role of imaging in evaluation of soft tissue masses is to determine the pathology, stage of the disease and the resectabilty of a particular lesion. MR imaging, because of its superior contrast resolution and lack of ionizing radiation, it is considered over the rest of the imaging options.[1] This study was planned to evaluate the efficacy of MR Imaging in predicting the pathological diagnosis of soft tissue masses and distinguishing benign from malignant masses.

MATERIAL AND METHODS

The present study was designed to adopt a retrospective methodology to meet the objectives. Based on inclusion and exclusion criteria, total 56 participants from Department of Radio diagnosis, Kasturba hospital between January 2002 and August 2008 were recruited for this study. Individuals who underwent MR imaging for evaluation of soft tissue masses with histopathological confirmation or who underwent correlative confirmative imaging evaluation (colour doppler / Angiography) and with adequate clinical or surgical follow up were selected as a eligible participant for the study after obtaining the written informed consent. The study protocol included a Proforma for each patient which included patient's name, age, sex and hospital ID No. A detailed history of the patient regarding the nature and duration of clinical symptoms was evaluated. MRI scan performed using 0.5 T "SIGNA CONTOUR" of GE scanner. Examination for suspected pathology accomplished by using specific coils.

Image evaluation: The evaluation of the MR images was done using the above mentioned criteria and available clinical details of the patients. Plain radiographs were used in conjunction with MR images wherever available. Based on the imaging details and other relevant data a possible diagnosis of either benign or malignant lesions was given. Specific diagnosis was given for a particular case wherever possible. The radiological diagnosis was done based on determining the plane in which the lesion is residing, the morphology of the lesion with respect to its location, extent, character and signal intensity on pre-contrast scans and pattern of contrast enhancement, the effect of the mass on the surrounding structures, whether displaced or infiltrated,

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presence or absence of adjacent bone destruction.

Features which were identified as to suggest malignancy were, larger and deep seated lesions, infiltrative ill-defined lesions, heterogeneous signal intensity, hemorrhage, perilesional edema, neurovascular involvement, bony destruction and liquefaction. Features which were identified as to suggest Benignity were, Smaller and superficial lesions, well defined lesions, homogeneous signal intensity, absent or homogeneous contrast enhancement.

Ethical clearance for the study was obtained from KMC and KH Institution Ethics Committee before the commencement of the study.

STATISTICAL ANALYSIS

The sensitivity, specificity, positive predictive value and negative predictive value was calculated**.** For the purpose of statistical analysis, malignant disease was considered a positive diagnosis and benign disease a negative diagnosis. Thus, sensitivity represents the percentage of malignant lesions correctly diagnosed, and specificity represents the percentage of benign lesions correctly diagnosed. The false-negative rate represents the percentage of malignant lesions erroneously categorized as benign, whereas the false-positive rate reflects the percentage of benign lesions erroneously categorized as malignant. The chi-square test and Fisher exact test were used for categorized variables. A p value of < 0.05 was considered to be significant.

RESULTS

Table I shows the distribution of study subjects based on age with respect to benign and malignant lesions. Study included 56 Participates, out of which 40(71.4%) were male and 16 (28.6%) were female subjects. The mean age in the study was 31.4 years with the age ranging from 2 to 76 years. The most common clinical presentation of patients was swelling 51(89. 3%) followed by associated pain in 23(41.1%) patients. Other clinical presentations included associated skin changes and 2 patients with clinical evidence of neurovascular deficit.

Age distribution (years)	No. of cases (n=56)	Benign lesions	Malignant lesions
<10	3(5.4%)	2(5.4%)	1(5. 3%)
10-20	19(33.9%)	14(37.8%)	5(26.3%)
21-30	9(16.1%)	4(10.8%)	5(26.3%)
31-40	11(19.6%)	8(21.6%)	3(15.8%)
41-50	6(10.7%)	5(13.5%)	1(5. 3%)
51-60	2(3.6%)	0(0.0%)	2(10.5%)
>60	6(10.7%)	4(10.8%)	2(10.5%)
Total	56	37(100%)	19(10 0%)

Table-I: Distribution of study subjects based on age with respect to benign and malignant lesions.

Type	Frequency	Percentage
Haemangioma	16	28.6%
Synovial sarcoma	5	8.9%
Neurofibroma	4	7.1%
Fibromatosis	3	5.4%
Abscess	3	5.4%
Lipoma	3	5.4%
Liposarcoma	3	5.4%
Schwannoma	2	3.6%
Leiomyosarcoma	2	3.6%
Ganglion cyst	2	3.6%
MPNST	1	1.8%
MH	1	1.8%
Leiomyoma	1	1.8%
Sebaceous cyst	1	1.8%
Extraosseous ewing's	1	1.8%
Rhabdomyosarcoma	1	1.8%
Myxoid chondrosarcoma	1	1.8%
Fibromyxoid sarcoma	1	1.8%
Alveolar soft part	1	1.8%
Angiosarcoma	1	1.8%
MFH	1	1.8%
Lymphangioma	1	1.8%
AV malformation	1	1.8%
Total	56	100%

Table-2: Spectrum of lesions among the study subjects.

MRI features		Benign	Malignant	Chi square	Fischer exact
Size	<5cm	11(29.7%)	4(21.1%)	0.488	0.482
	>5cm	26(70.3%)	15(78.9%)		
Margins	Sharp	26(70.3%)	15(79%)	0.488	0.543
	Ill defined	11(29.7%)	4(21%)		
Plane	Subcutaneous	6(16.2%)	3(15.8%)	0.967	1.000
	Deep	3183.8%)	16(84.2%)		
Signal Intensity T2	Homogeneous	28(75.7%)	4(21.1%)	0.000	81.1
	Heterogeneous	9(24.3%)	15(78.9%)		
Signal intensity T1	Homogeneous	34(91.9%)	14(73.7%)	0.065	0.105
	Heterogeneous	3(8.1%)	5(26.3%)		
Signal intensity T1	Low	30(81.1%)	12(63.2%)		
	Intermediate	4(10.8%)	7(36.8%)		
	High	3(8.1%)	0(0.0%)		
Signal intensity T2	Low	0(0.0%)	0(0.0%)		
	Intermediate	9(24.3%)	8(42.1%)		
	High	28(75.7%)	11(57.9%)		
Edema	Present	4(10.8%)	4(21.1%)	0.300	0.423
	Absent	33(89.2%)	15(78.9%)		
Haemorrhage	Present	0(0%)	5(26.3%)	0.01	0.03
	Absent	37(100%)	14(73.7%)		
Neurovascular involvement	Present	13(35.1%)	13(68.4%)	0.018	0.025
	Absent	24(64.9%)	6(31.6%)		
Bone involvement	Present	7(16.2%)	4(36.8%)	0.694	0.745
	Absent	30(83.8%)	15(63.2%)		
Joint involvement	Present	1(2.7%)	1(5.3%)	0.625	1.000
	Absent	36(97.3%)	18(94.7%)		
Contrast administered	Yes	31	19		
	No	6	0		
Contrast enhancement	Yes	26(83.9%)	18(94.7%)		
	No	5(16.1%)	1(5.3%)		
Pattern of contrast enhancement	Diffuse	11(44%)	4(22.2%)	0.093	0.145
	Peripheral	3(12%)	2(11.1%)		
	Inhomogeneous	11(44%)	12(66.7%)		
Liquefaction	Present	5(14.3%)	14(73.7%)	0.000	0.000
	Absent	20(85.6%)	5(22.3%)		

Table-3: Distribution of MRI features according to Benign and Malignant tumors.

Out of the total 56 patients 9 patients had recurrent lesions at same site. There was a period ranging from 2-10 years interval between the primary lesion and recurrent lesion.

There was a significant difference between the affected sexual groups with male and female ratio of 2.5:1. The malignant as well as benign lesions were more common in the male population. The affected population was predominantly in the adolescent age group and third decade in case of benign as well as malignant lesions. The spectrum lesions among the study subjects was shown in table II.

A majority of the soft tissue masses were seen in the lower extremity (7 5%) followed by upper extremity with s ingle case each in the head and neck region and the back. A uniform distribution of the benign and malignant lesions was noticed in all three size ranges with majority of lesions in both groups noticed in size range >5cm. Majority of the lesions in both benign and malignant gr up were seen in deeper locations involving the fascial and intramuscular compartments.

The study found that MR Imaging showed a sensitivity of 73.7% for detecting malignancy and a specificity of 84.1% for diagnosing malignancy. The positive predictive value was 66.67% and the negative predictive value was 88.1%. Distribution of MRI features according to Benign and Malignant tumors where shown in table III.

DISCUSSION

The present study did a retrospective analysis of fifty six patients, who had presented with soft tissue masses and underwent MR imaging evaluation. The radiological diagnosis, based on the imaging morphology of the lesions, was correlated with histopathological findings or correlative confirmative imaging and clinical follow up.

Moulton et al[2] in their study of 222 patients had female predominance with male to female ratiolls of 1:1.58, where the mean age in their study was 34 years and the study by Totty et al[3] tells the male to female ratio was 1:1.53 which was comparable to our sample population.

The study found that the benign mass was constituted about 66% of malignant lesions. This was comparable to the study done by Berquist et al[3] where the ratio was 1.11:1 between

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benign and malignant lesions. Totty et al[4] and Crim et al[5] also observed benign lesion predominance in their studies.

Efficacy in our study was comparable with available literature except for Kransdorf et al.[6] The study by the Kransdorf et al was early in the course of MR emergence as imaging modality for the soft tissue masses and hence the lack of experience in the field could have accounted for the less accuracy. The other probable reason for the difference can be the kind of referral population for tumor evaluation with significant overlap of features in both groups. Wetzel and Levine24 had a small number of cases in their study with assessment of lesions in one location only which could have accounted for high sensitivity and specificity in their study. Berquist et al[3] in their study had a significant number of lesions for image specific diagnosis was possible which probably accounted for higher accuracy. Recent studies by Rijswijk et al[7] and Gielen et al[8] have found high rates of accuracy of MR imaging in differentiating benign from malignant lesions. Gielen et al[8] in a large multi institutional review of 548 cases of soft tissue masses found very high accuracy along with imaging based specific diagnosis in 38% malignant lesions which has not been reported in previous studies. In conclusion, the changing results in current studies can be attributed to the emergence of technology, better methodologies and experience in the field.

Limitations

Due to the limitations on our scanner, we have had no experience with the currently used contrast administration techniques.

CONCLUSION

The study concludes that MRI was accurate in providing a diagnosis in 78.6% of cases based on the MR morphology, location and extent of the lesion with a high sensitivity, specificity and negative predictive value for diagnosing malignancy. MR imaging can predict the nature of lesion in majority of the cases. T2 heterogeneity, neurovascular involvement, hemorrhage and liquefaction were more often encountered in malignant lesions than their benign counterparts. Many benign soft tissue masses can be correctly and confidently recognized based on MR imaging. Contrast enhanced MR imaging when added with non-enhanced MR imaging improves the differentiation between benign and malignant lesion.

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