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ORIGINAL ARTICLE

Malignant Breast Lesion Detection with MRI and its Accuracy

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ABSTRACT

Objective: Using histology as the gold standard, this study aims to determine whether or not magnetic resonance spectroscopy can reliably diagnose malignant breast lesions.
Study Design: Cross-sectional
Place and Duration: Conducted at department of Radiology Central Park Medical College, Lahore. Duration was 6 months from October 2021 to March 2022.
Methods: This research included 75 females. Malignancy-suspicious palpable lesions were included. Patients completed a consent form admitting the hazards before any data was gathered. The kinematics and morphology of dynamically enhanced magnetic resonance (MRS) images were studied. MRS's choline peak (Cho) was utilized to detect cancer. Single-voxel technique was employed to evaluate MRS' diagnostic accuracy in cancer. MRS and biopsies were compared. Data was analyzed using SPSS 24.0.
Results: Malignant lesions were found in 65 (86.7%) of the patients by MRS, and in 58 (77.3%) of the cases according to the histological findings. Malignant lesions by MRS most frequently showed a ductal enhancement or a peripheral enhancement morphology. The results of MRS showed a 78% specificity, 85% accuracy, 90% sensitivity, 75% NPV, and 91% PPV.
Conclusion: MRS must be employed because of its better specificity, sensitivity, and accuracy in characterizing breast lumps. MRS is a specific, sensitive, and effective diagnostic technique for breast cancer.
Keywords: Accuracy, Magnetic resonance spectroscopy (MRS), Malignant breast lesion, Histopathology,

INTRODUCTION

To put it simply, breast cancer is a leading killer of women [1]. A sonomammogram (SMG) is the most accurate method currently available for diagnosing breast cancer. Evaluation of breast disease may be more effective if additional non-invasive modalities are included in the process.

In order to determine whether or not a lesion is cancerous without causing any damage to the patient, ultrasonography (US) has developed a technique called elastography (shear wave or stain) [2, 3]. When an acoustic radiation force is excited, shear elastography (SWE) records the shear wave's velocity to create an elastography color-coded image and a quantification of tissue stiffness [3].

Using the microscopic motion of water molecules, diffusion-weighted magnetic resonance imaging (DW-MRI) creates an image and is said to be capable of distinguishing malignant from benign tissue, either qualitatively (by visually sensing the signal of a lesion) or quantitatively (by measuring apparent diffusion coefficient-ADC) [4].

Breast USG, however, is still the go-to for characterising masses seen on the MMG or as a supplementary screening tool [5]. It has already been established [6] that USG can detect tiny tumours that are not visible on clinical examination or mammography in women who have thick breasts. Since the amount or thickness of fibroglandular tissue, fibrous scarring, radiation, breast implants, or other forms of breast reconstruction do not affect MRI's sensitivity for the identification of invasive breast cancer, it is the most accurate of the currently available breast imaging modalities. However, there are controversies over its low specificity and high rate of false positive results, as well as the increased cost, lack of uniformity in acquisition techniques, and interpreting guidelines that prevent its frequent usage. [7].

Scientists led by Baltzer PA et al. discovered that breast lesions were present in 65% of women and often indicated the presence of breast cancer. [8] Clinically, noninvasive breast cancer screening remains a pressing issue. If a lump in the breast is suspected to be cancerous, imaging exams can help find any others, even if they are not palpable or on the other side of the body. These findings may have far-reaching implications for treatment, particularly with regards to the choice of local therapy. [9] When it comes to screening for breast cancer, mammography and sonograms are by far the most common tools used. [10] Since it is important not to overlook a malignant tumour in its early stages of sickness, aggressive biopsy is commonly used even if mammography and sonograms have limitations. This means that between seventy and ninety percent of breast biopsies are performed for noncancerous reasons, causing the patient unnecessary suffering and money. [11] Compared to mammography and ultrasounds, electromagnetic resonance imaging (MRI) is more accurate and uses less radiation for the diagnosis of breast cancer. Additionally, MRI has a higher sensitivity than mammography. Proton magnetic resonance spectroscopy (1H MRS) of the breast, in addition to MRI tests, has been proposed to boost the specificity of detecting malignant from benign tumours in the area.[12,13]

In a study, magnetic resonance spectroscopic (MRS) was found to accurately differentiate between benign and malignant breast tumours 89.5% of the time and 92.3% of the time, respectively. [14] In this study, we tested magnetic resonance spectroscopy's (MRS) ability to accurately identify malignant breast lesions in a population-based sample to fill in the gaps left by earlier research. If it were established that a noninvasive pre diagnostic technique for correct diagnosis existed, practitioners would be able to better manage these patients and reduce their morbidity and mortality. This would help the sufferers and the community as a whole. [15] It would also aid in reducing the number of unnecessary pure diagnostic biopsies performed on breast lesions, which would lower not only the negative outcomes of this intrusive procedure but also the patient's suffering, anxiety, and rising medical costs.

MATERIAL AND METHODS

This cross-sectional study was conducted at department of Radiology Central Park Medical College, Lahore. Duration was 6 months from October 2021 to March 2022 and comprised of 75 females. All patients provided written informed permission before their demographic information was collected. Patients with a history of chemo or surgery were also excluded from this trial, as were those younger than 20 years of age.

Dynamically enhanced images from 1.5 Tesla MRI scanners were used to study the dynamics and structure of magnetic resonance spectroscopy (MRS). The malignancy biomarker, choline peak (Cho), was found and measured using MRS. The

effectiveness of MRS as a diagnostic tool for detecting cancerous breast lesions was analysed using a single-voxel technique.

To reduce the effects of patient movement while prone, a double breast coil was used for all scans. Mild compression was administered to both breasts during the scan. The 20-22 cannula gauges used to secure the intervention line may be adjusted with a three-way stopcock for the most precise contrast injection. Multi-planar reconstruction using thin slices for fat suppression and subtraction in three-dimensional MIP (maximum intensity projection). After the initial 20-second contrast injection, a second saline flush of 20 millilitres was provided intravenously at a dose of 0.2 millilitres per kilogramme to facilitate contrast-enhanced images using MRS. The total time for the dynamic process, including four post-contrast scans, was 7 minutes and 35 seconds. Types II and III kinetic curves, with their spiculated borders and ductal patterns or peripheral rims, were employed for cancer diagnosis using MRS.

SPSS version 24 was utilised for data analysis, and the kinetic features and morphology of malignant breast lesions were used to calculate frequency and percentage. Diagnostic parameters for MRS were calculated, including sensitivity, accuracy, specificity, NPV, and PPV, and compared to those obtained from histopathology.

RESULTS

Mean age of the patients was 50.2±10.96 years and mean BMI 25.1±3.30 kg/m^2.Majority were from urban areas and were non-educated. (Table 1)

Table-1: Characteristics of enrolled cases

Variables	Frequency	Percentage
Mean age (years)	50.2±10.96	
Mean BMI (kg/m^2)	25.1±3.30	
Area of Living		
Rural	33	44
Urban	42	56
Education Status		
Educated	30	40
Non-educated	45	60

Malignant lesions were found in 65 (86.7%) of the patients by MRS, and in 58 (77.3%) of the cases according to the histological findings. (Figure 1)

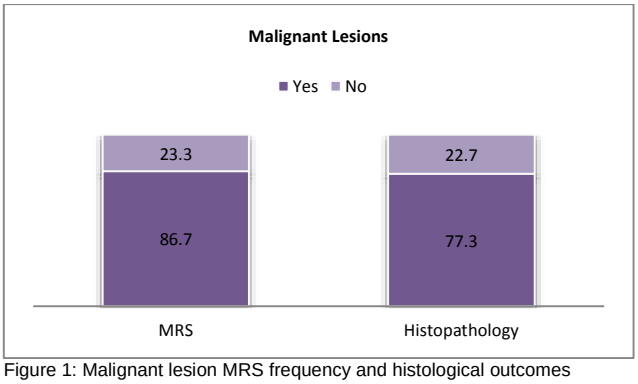

Figure 1: Malignant lesion MRS frequency and histological outcomes

Ductal enhancement and peripheral enhancement were the most common morphology among patients of malignant lesion by MRS.(Table 2)

Table-2: Morphology features of MRS

Variables	Frequency	Percentage
Morphology of MRS		
No-enhancement	7	9.3
Homogeneous Enhancement	12	16
Peripheral Enhancement	20	26.7
Ductal Enhancement	36	48

The results of MRS showed a 78% specificity, 85% accuracy, 90% sensitivity, 75% NPV, and 91% PPV. (Figure 2)

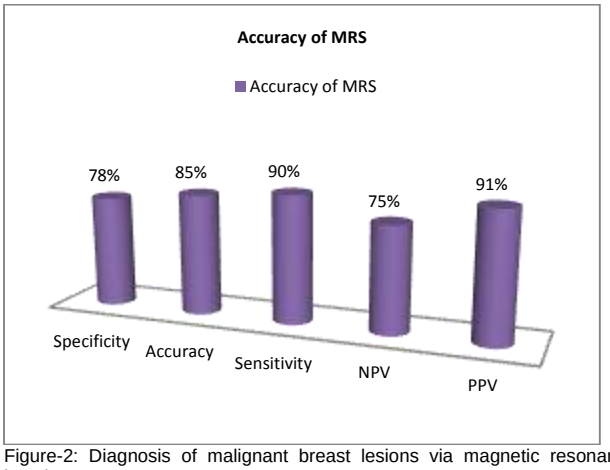

Figure-2: Diagnosis of malignant breast lesions via magnetic resonance imaging

DISCUSSION

There is still a public health concern with breast cancer [16]. Breast cancer treatment centres around conventional SMG and contrast-enhanced magnetic resonance imaging (CE-MRI), with the latter providing relatively high sensitivity for the portrayal of malignancy [17]. It is possible to quantify DW-ability MRI's to distinguish between cancers by measuring its ADC [18], which is based on the fact that it uses the microscopic mobility of water molecules to do so. Elastography's evaluation of tissue stiffness can aid in raising diagnostic certainty for cancer [19].

In current study 75 females were presented. Mean age of the patients was 50.2±10.96 years and mean BMI 25.1±3.30 kg/m^2.Majority were from urban areas and were non-educated. Malignant lesions were found in 65 (86.7%) of the patients by MRS, and in 58 (77.3%) of the cases according to the histological findings. The findings were consistent with those of earlier research. [20,21] Most individuals with a malignant lesions by MRS had either a ductal or peripheral enhancement. [22] Bartellaet al [23] examined the diagnostic efficacy of MRS and MRI in a sample of 56 patients with 57 distinct anomalies (level III-2 diagnostic evidence). Of the 57 lesions biopsied in the study, only 17 were malignant, and an additional 40 were suggested for follow-up. When all 57 lesions were subjected to the gold standard of biopsy, 31 were found to be malignant whereas 26 were found to be benign. More than half of the benign lesions (23 of 26) lacked a choline peak, but all 31 biopsied malignant lesions exhibited a substantial peak (100%) (88 percent specificity).

In current study, the results of MRS showed a 78% specificity, 85% accuracy, 90% sensitivity, 75% NPV, and 91% PPV. According to the literature [24], the sensitivity, specificity, NPV, and PPV of MRS range from 94% to 98%. Researchers used a p-value of 0.001 to indicate statistical significance. There was an estimated diagnostic accuracy of 86.7% when attempting to identify malignant breast lesions. Statistical studies provided the foundation for the MRS guideline for preoperative illness characteristics and reliable diagnosis. Brennan S et al. [25] found that MRS could have prevented the need for biopsy in more than half of the BI-RADS 4 lesions without missing any cancers. When comparing MRS results to those of other methods, it has been found that MRS is 89.5%-92.35% accurate at identifying malignant vs benign breast tumours. [26] The overall performance of quantitative DW-MRI was higher for BIRADS 3 lesions than for BIRDS 4 lesions (100% sensitivity, 86.11 specificity, and 86.49 accuracy vs. 74.07% sensitivity, 50% specificity, and 72.41% accuracy). One limitation of this research is the small sample size, which makes it difficult to draw any firm conclusions about the

subgroups. Previous research has shown that ADC values vary between benign and malignant lesions, and DW-MRI has been shown to improve the diagnostic test of suspicious breast lesions and reduce the number of unneeded samples [27,28].

CONCLUSION

MRS must be employed because of its better specificity, sensitivity, and accuracy in characterizing breast lumps. MRS is a specific, sensitive, and effective diagnostic technique for breast cancer.

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