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Diagnostic efficacy of ultrasound, ultrasound elastography and magnetic resonance imaging for breast lesions: A comparative study

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***Abstract*---**Background: The present study was conducted for comparing the diagnostic efficacy of ultrasound, ultrasound elastography and magnetic resonance imaging for breast lesions. Materials & methods: A total of 100 subjects were enrolled. Complete demographic details and clinical details of all the subjects were enrolled. All the patients were subjected to B-mode USG assessment. US Elastography was also done. The two-dimensional USG was followed by Real Time ultrasound elastography. The stiffness of the lesion was evaluated. All patients were placed prone on a 0.5 Tesla MRI scanner equipped with a dedicated breast surface coil. The lesion was categorized as benign, probably benign, malignant and probably malignant. Fine needle aspiration cytology (FNAC) or biopsy was performed and the specimen was evaluated cytologically/histopathologically to confirm the diagnosis. All the results were recorded and analysed by SPSS software. Results: Sensitivity and specificity of USG was 78.6 percent and 86.2 percent respectively. Sensitivity and specificity of Elastography was 89.5 percent and 92.6 percent respectively. Sensitivity and specificity of MRI was 96.2 percent and 93.1 percent respectively. Conclusion: MRI was most sensitive and most specific followed by USG elastography. Hence, it can be concluded that in low-resource settings like ours, USG elastography can emerge as a suitable alternative.

***Keywords*---**ultrasound, elastography, magnetic resonance imaging.

Introduction

Ultrasound (US) elastography provides information regarding tissue hardness and is expected to become a novel diagnostic tool for assessing breast diseases. Generally, breast carcinoma lesions are harder than the adjacent normal mammary tissue, and the degree of tissue hardness is closely related to various pathologic architectural features. Many investigations of imaging tissue elasticity using ultrasound have been performed since the 1990s.[1- 3] In an initial study, the image strain distribution was investigated with respect to the degree of static tissue compression. However, the advantages of US, such as real-time operation and freehand manipulation, should be preserved in elasticity imaging. Itoh et al developed a new method (combined autocorrelation method) that satisfies these conditions. In contrast, MR imaging (MRI) reflects tissue characteristics, including fibrotic changes. Fibrotic changes of the stroma are observed in many breast diseases and affect the hardness of the tissue.[4- 6] Currently, there are various imaging methods for non-invasive diagnosis of breast masses, including conventional ultrasonography, X-ray mammography, multi-slice spiral computed tomography, magnetic resonance imaging (MRI) and Doppler ultrasound color flow imaging. However, each single method has various advantages and disadvantages, and the results obtained from different methods are often conflicting. Therefore, the combination of two or three diagnostic methods is commonly adopted in determining the properties of breast masses and for the clinical diagnosis of breast cancer.[6- 9] Hence; the present study was conducted for comparing the diagnostic efficacy of ultrasound, ultrasound elastography and magnetic resonance imaging for breast lesions.

Materials and Methods

The present study was conducted for comparing the diagnostic efficacy of ultrasound, ultrasound elastography and magnetic resonance imaging for breast lesions. A total of 100 subjects were enrolled. Complete demographic details and clinical details of all the subjects were enrolled. All the patients were subjected to B-mode USG assessment. Side of involvement, area of involvement, size of lesion, shape of lesion, type of margins, echo pattern, echotexture, post-acoustic enhancement, type of architecture, vascularity and its pattern, duct extension, height/width ratio was calculated and diagnosis was prepared using BIRADS criteria. US Elastography was also done. The two-dimensional USG was followed by Real Time ultrasound elastography. The stiffness of the lesion was evaluated. All patients were placed prone on a 0.5 Tesla MRI scanner equipped with a dedicated breast surface coil. The lesion was categorized as benign, probably benign, malignant and probably malignant. Fine needle aspiration cytology (FNAC) or biopsy was performed and the specimen was evaluated cytologically/histopathologically to confirm the diagnosis. All the results were recorded and analysed by SPSS software.

Results

Mean age of the subjects was 49.5 years. Confirmed diagnosis of malignancy was seen in 31 percent of the patients while confirmed diagnosis of benign pathologies was seen in 69 percent of the patients. Sensitivity and specificity of USG was 78.6

percent and 86.2 percent respectively. Sensitivity and specificity of Elastography was 89.5 percent and 92.6 percent respectively. Sensitivity and specificity of MRI was 96.2 percent and 93.1 percent respectively.

Table 1
Distribution of patients according to final diagnosis

Diagnosis	Number of subjects	Percentage
Malignant	31	31
Benign	69	69
Total	100	100

Table 2
Diagnostic efficacy of different modalities

Modalities	Sensitivity	Specificity
USG	78.6%	86.2%
Elastography	89.5%	92.6%
MRI	96.2%	93.1%

Discussion

The high incidence of breast cancer and its slow evolution before diagnosis have led to research on new diagnostic techniques. The recent introduction of elastography has increased the specificity of USG and enabled earlier diagnosis of breast cancer. The use of quantitative elastography with strain ratio (SR) improves diagnostic accuracy in cases with equivocal Stavros criteria (stages 3 and 4 BI-RADS). USG elastography (SE) differentiates between benign and malignant lesions on the basis of their elasticity: benign lesions have elasticity similar to the surrounding tissue, while malignant lesions are harder than adjacent tissue.[8- 10] Hence; the present study was conducted for comparing the diagnostic efficacy of ultrasound, ultrasound elastography and magnetic resonance imaging for breast lesions.

Sensitivity and specificity of USG was 78.6 percent and 86.2 percent respectively. Sensitivity and specificity of Elastography was 89.5 percent and 92.6 percent respectively. Sensitivity and specificity of MRI was 96.2 percent and 93.1 percent respectively. Roka Namoto Matsubayashi et al investigated the correlation among elasticity score (ES) and signal intensity of short Tau inversion recovery MR images, enhancement ratio, apparent diffusion coefficient (ADC), and the fibrosis in the breast lesions. They reviewed the findings of US elastography and MR imaging from 41 consecutive patients with breast lesions (25 invasive ductal carcinoma, 3 fibroadenoma, 1 phyllodes tumor, 2 ductal hyperplasia, 2 primary malignant lymphoma, 3 mastopathy, 1 metastasis, 1 tubular adenoma, 1 ductal carcinoma in situ, 1 diabetic mastopathy, and 1 intraductal papilloma). In each patient, elastography images were classified based on Tsukuba ES. We calculated the ratio of signal intensity of the lesion to the muscle on short Tau inversion recovery images (L/M ratio), enhancement ratio of early to precontrast and early to delayed images, and ADC for each lesion. The ES and MR findings were correlated with the degree of fibrosis (based on Masson trichrome stain). The ES

significantly correlated with the L/M ratio (P = 0.0306) and the ADC (P = 0.0256). The stromal fibrosis also correlated with ES (P = 0.0023), the L/M ratio (P = 0.0344), and enhancement ratio of the early-to-delayed images (P = 0.049). The ES and L/M ratio are correlated significantly with each other, and they are correlated with the fibrosis.[11]

Cheng R et al compared the efficacy of ultrasound elastography (UE), magnetic resonance imaging (MRI) and the combination of the two methods (UE+MRI) in the differential diagnosis of benign and malignant breast tumors. In total, 86 patients with breast masses were recruited and evaluated by UE, MRI and UE+MRI. Strain ratios of UE were calculated for the breast mass and adjacent normal tissues. In addition, the receiver operating characteristic (ROC) curve was obtained, while the sensitivity and specificity were calculated to determine the optimal cut-off point for the differential diagnosis. The area under the ROC curve (AUC) was also calculated to evaluate the diagnostic performance of these methods. The results indicated that the diagnostic accuracy of UE+MRI was significantly higher compared with the UE or MRI methods in the differential diagnosis of invasive ductal, invasive lobular, intraductal papillary, medullary and mucinous carcinomas (all $P<0.05$). The optimal cut-off points of ROC curve of the Strain Ratio in the diagnosis of breast lesions were 2.81, 3.76 and 3.42 for UE, MRI and UE+MRI, respectively. Furthermore, the AUC values were 86.7, 79.2 and 91.4%, while the diagnostic accuracy rates were 82.5, 75.5 and 95.3%, for UE, MRI and UE+MRI, respectively. Accuracy rate differences between UE and MRI or between UE and UE+MRI were statistically significant ($P<0.05$), whereas no significant difference existed between MRI and UE+MRI ($P>0.05$). Finally, the diagnostic consistency of the UE+MRI method with the pathological diagnosis was higher compared with UE or MRI alone.[12]

Conclusion

From the above results, the authors conclude that MRI was most sensitive and most specific followed by USG elastography. Hence, it can be concluded that in low-resource settings like ours, USG elastography can emerge as a suitable alternative.

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