INTRODUCTION

Carcinoma Breast is regarded as one of the most common malignancies, accounting for 22% of all the cancers in the female population worldwide. Ultrasound guided (USG) core biopsy is considered superior to surgical biopsy of suspicious breast lesion in terms of convenience, cost, and being less invasive. Most patients are reluctant to be subjected to biopsy as it is a painful and invasive procedure; and it has been concluded that 75% of these biopsies are proven to be benign in pathologic reports.\(^1\)-\(^4\) Therefore, combining reliability and minimally invasive approach is the need of the hour for such suspicious breast lesions.\(^5\) It has been observed that imaging features on ultrasonography may be useful in differentiating benign from malignant lesion. Consultant histopathologist’s report upon the biopsy specimens was obtained. Results of sonoelastography were compared with histopathology reports.

ABSTRACT

Objective: To observe the diagnostic accuracy of elastography in detecting malignant breast lesion taking strain ratio of 4.8 and histopathology as gold standard.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Department of Diagnostic Radiology, from March to September 2015.

Methodology: A total of 137 patients aged 20 to 60 years with clinically palpable breast lump of any size for at least one month duration were included in this study. Patients with purely cystic lesions and those on chemotherapy or hormonal therapy were excluded. Each patient was subjected to sonoelastography followed by ultrasound guided trucut biopsy. The strain ratio cut off value of 4.8 was used to differentiate benign from malignant lesion. Consultant histopathologist’s report upon the biopsy specimens was obtained. Results of sonoelastography were compared with histopathology reports.

Results: Mean age was 38.20 ±10.63 years. The size of the lesion ranged from 2.0 to 6.0 cm, a mean = 3.97 ±1.26 cm. The duration since the lump was noticed ranged from 12 weeks (3 months) to 20 weeks (5 months) with a mean of 15.09 ±2.56 weeks. Forty-one (29.9%) lesions were labelled malignant on sonoelastography while the actual number of malignant lesions was 35 (25.5%) on histopathology. When the results of sonoelastography were cross-tabulated with histopathology results, the number of TP (true positive), FN (false negative), FP (false positive) and TN (True negative) were 31, 4, 10 and 92 cases, respectively. It yielded 88.57% sensitivity, 90.20% specificity, 75.61% positive predictive value, 95.83% negative predictive value, 89.78% accuracy for sonoelastography in the diagnosis of malignant breast lesion taking histopathology as gold standard with an observed prevalence of malignant breast mass to be 25.55%.

Conclusion: Using a strain ratio of 4.8, sonoelastography was found to be 88.57% sensitive, 90.20% specific, and 89.78% accurate in the diagnosis of malignant breast masses.

and 5 are considered malignant. However, at times there is considerable overlap in the ultrasound features of a lesion and BI-RADS category remains a query.\textsuperscript{7, 8}

Tissue elasticity is the spatial rate of change in displacement secondary to the tensile stress generated by pressure and is measured by sonoelastography, which is based on displacement produced by tissue compression. The measured value of tissue elasticity is lesser for harder tissue and vice versa. Therefore, sonoelastography can be used to differentiate between benign and malignant breast lesions.\textsuperscript{8, 9} Strain pattern images show the relative degree of stiffness of region of interest (ROI) in comparison to the stiffness of surrounding tissue and, therefore, it can determine the tissue hardness and diagnose malignant breast masses. Mean elasticity score for malignant lesions is considered to be 4.1, while for benign lesions it is 2.1 (p<0.001). The sensitivity and specificity of elastography is 87.2\% and 90.6\%, respectively for cut off value for strain ratio 4.8 and cut off value between 3 and 4, respectively for Itoh color scoring system.\textsuperscript{10}

The rationale of this study was to determine the accuracy of strain ratio cut off value of 4.8 on elastography compared to biopsy in the non-invasive diagnosis of breast malignancy.

**METHODOLOGY**

This cross-sectional study was conducted in the department of Diagnostic Radiology, CMH Rawalpindi from March to September 2015. After approval by the Ethical Committee, informed written consent was obtained from all the patients for further inclusion in the study. Patients were assessed for eligibility. Inclusion criteria comprised of patients aged between 20-60 years having palpable breast lump of any size for at least one month duration. Patients with purely cystic breast lesions and patients on chemotherapy or hormonal therapy were excluded from the study. Those fulfilling the inclusion criteria were subjected to stress/stretch elastography. In order to assess the correlation of age with malignancy, participants were stratified in four groups 1-4 (20-29 years, 30-39 years, 40-49 years and 50-60 years, respectively).

Conventional US and sonoelastography were performed on Toshiba Xario 200 US machine with probes frequency of 7.5-13 MHz. The lesion was analyzed in B-mode in all possible planes to study the lesion characteristics including the size of the lesion. Subsequently, the elastography mode was used to obtain elasticity images slight to fro motion of the probe (represented by graph formation at the bottom of the screen). Elastography acquisition was considered correct when a uniform graph pattern formed over the time of examination indicating a good technical approach. Multiple frames of elasticity images were generated followed by automatic construction of color coded images with red color for softest and blue for hardest components. Green color indicated average strain in the ROI. Color score was given according to Itoh color scoring system.\textsuperscript{3} Strain ratio (fat/lesion ratio) which depicts the stiffness of lesion, was calculated by software in the machine. The cut off value for strain ratio was set as 4.8. All of the lesions were followed by biopsy with 18 G Trucut needle. Three cores were obtained and fixed in formalin. The labelled specimen was examined and reported by a consultant histopathologist.

Data collected was recorded on a specially designed proforma and entered into SPSS version 16. Continuous variables, such as age, duration and size of lesion were calculated as mean ± standard deviation while categorical variables such as conclusion of sonoelastography and histopathology were presented as frequencies and percentages. Chi-square test was applied taking p ≤ 0.05 as significant to compare the percentage of malignancy with strata of age, duration and size of lesion. A 2×2 table was generated to calculate sensitivity, specificity, positive and negative predictive values, and accuracy of ultrasound elastography in the diagnosis of malignant breast lesion taking histopathology as gold standard.

**RESULTS**

A total of 137 female patients with age ranging from 20 years to 60 years were studied. The mean age, size of lesion, and duration of breast lump is given in Table I. Out of the total, 41 (29.9\%) lesions were labelled malignant on sonoelastography while the actual number of malignant lesions on histopathology were presented as frequencies and percentages. Chi-square test was applied taking p ≤ 0.05 as significant to compare the percentage of malignancy with strata of age, duration and size of lesion. A 2×2 table was generated to calculate sensitivity, specificity, positive and negative predictive values, and accuracy of ultrasound elastography in the diagnosis of malignant breast lesion taking histopathology as gold standard.

### Table I: Mean ± standard deviation of continuous variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=137)</td>
<td>(n=137)</td>
<td>(n=137)</td>
<td>(n=137)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>20</td>
<td>60</td>
<td>38.2±10.63</td>
</tr>
<tr>
<td>Size of lesion (cm)</td>
<td>2</td>
<td>6</td>
<td>3.97±1.26</td>
</tr>
<tr>
<td>Duration of lump (weeks)</td>
<td>12</td>
<td>20</td>
<td>15.09±2.56</td>
</tr>
</tbody>
</table>

### Table II: Frequency of malignant lesion in relation to age, duration and size of lesion on sonoelastography.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroups</th>
<th>Frequency of Malignancy</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(P &lt; 0.05)</td>
</tr>
<tr>
<td>Age</td>
<td>20-29 years</td>
<td>1 (2.4%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td></td>
<td>30-39 years</td>
<td>5 (12.1%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40-49 years</td>
<td>12 (29.2%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50-60 years</td>
<td>17 (41.4%)</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>12-14 weeks</td>
<td>11 (26.8%)</td>
<td>P = 0.08</td>
</tr>
<tr>
<td></td>
<td>15-17 weeks</td>
<td>12 (29.3%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18-20 weeks</td>
<td>12 (29.3%)</td>
<td></td>
</tr>
<tr>
<td>Size of lesion</td>
<td>2-3 cm</td>
<td>2 (4.9%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td></td>
<td>3.1-4 cm</td>
<td>6 (14.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1-5 cm</td>
<td>6 (14.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.1-6 cm</td>
<td>21 (51.2%)</td>
<td></td>
</tr>
</tbody>
</table>
The results of sonoelastography and histopathology were cross-tabulated in order to assess sensitivity, specificity. There were 31 true positive, 4 false negative, 10 false positive, and 92 true negative cases. It yielded 88.57% sensitivity, 90.20% specificity, 75.61% positive predictive value (PPV), 95.83% negative predictive value (NPV), and 89.78% accuracy for sonoelastography in the diagnosis of malignant breast lesion taking histopathology as gold standard with an observed prevalence of malignant breast mass to be 25.55%.

DISCUSSION

The objective of minimizing invasive biopsies in diagnosing malignant breast lesions through the use of non-invasive methods is being extensively studied using different sonographic modalities. Among these modalities are the Resistive Index (RI), Colour Doppler, Power Doppler and Sonoelastography (SE). This study focused on sonoelastography as a possible non-invasive diagnostic tool for malignant breast lesions.

These results were comparable to the various studies conducted by Scaperrotta in Italy in 2008, concluding prevalence, sensitivity and specificity of sonoelastography to be 37.5%, 80% and 90%, respectively. Musa et al. and Pardal et al. also conducted study to assess role of sonoelastography in 2012 and 2013, respectively. Similarly, Yerli et al. in Turkey while Alyet et al. and Shakweer et al. in Egypt also conducted similar studies in their population. The average sensitivity of sonoelastography derived from these seven studies is 84.86%, whereas average specificity is 85.27%.

Considering the results of this study, there was a significant association of age and size of lesion with the incidence of malignancy, while duration of the lump was not significantly (P=0.8) associated. The stratified risk of malignancy at the age of 20-30 years is 2.4% compared to 77.3% at 51 to 60 years. A 2.0-3.0 cm lesion carries a risk of 4.9% for malignancy compared to 55.3% for lesions 5.1 - 6.0 cm. All these factors can be used to reasonably estimate the pre-test probability of malignancy such as a 55-year-old woman (risk 77.3%) presenting with a duration of lesion to 20 weeks (risk 37.5%) and having a size of lesion 5.5 cm (risk 55.3%) may be estimated to have a combined average pre-test probability of 56.6%.

Ghajarzadeh et al. in 2014 reported sonoelastography to be 86.0% sensitive and 66.7% specific in the diagnosis of thyroid malignancy. Seo et al. in 2014 reported that SE was 95.6% sensitive and 87.5% specific, with an accuracy of 91.1% in the diagnosis of fatty degeneration of the supraspinatus. There were studies demonstrating SE as a sensitive tool for the diagnosis of malignant breast lesion as well. As regards the frequency of malignancy in the sample population, Yerli et al. in 2013 observed relatively lower frequency (18.3%) of malignant breast lesion in Turkish population. Shakweer et al. on the other hand reported much higher frequency (87.5%) in Egypt. The results are, however, in line with another local study by Mamoon et al. who observed frequency of malignancy among breast masses to be 22% in Pakistani population. These variations can be attributable to population differences among studies.

One important limitation of this study was that all sonoelastograms were performed by a single radiologist with the intention to eliminate bias. However, since it is a skill dependent procedure, inter-observer reliability can be achieved by repeating the study with multiple operators to further confirm its diagnostic accuracy.

This study is first of its kind in local population and advocates the potential of sonoelastography in the diagnosis of malignant breast masses. Based on this study, a sonoelastogram may be considered as an initial investigation in women presenting with breast mass followed by a biopsy, if the sonoelastogram suggests malignancy (i.e. above a cut off of 4.8 and taking pre-test probability into account). Using this technique, the frequency of biopsies done for malignant breast masses may be reduced significantly.

It is recommended that all those lesions with elasticity scores of 3 or higher and strain ratio >4.8 must be examined by means of needle biopsy for histopathological correlation. It was also determined in our study that combined use of conventional US and strain imaging features can remarkably improve the differentiation of malignant from benign breast lesions. Therefore, strain imaging has the potential to further improve the decision-making about performing breast biopsy.

CONCLUSION

Stress/strain sonoelastography is a parameter with sufficient sensitivity and specificity to recommend its use in the diagnosis of breast masses utilizing pre-test probability and likelihood ratios to inform decisions about the need for invasive biopsies.

REFERENCES

2. Marcus PM, Durham DD. Commentary on "Screening for breast cancer" by Peairs et al. Semin Oncol 2017; 44:73

of breast lesions, initial clinical experience. *Cancer Control* 2010; **17**:156-61.


