Accuracy of Preoperative Estimation of Breast Carcinoma Size Using B-mode Ultrasound and Ultrasound Elastography.

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Aims and objectives

Estimation of breast carcinoma size is important for preoperative planning for patients prior to mastectomy or breast conserving surgery. Accuracy of breast tumour size is also important in planning prior to sentinel node sampling and for follow up tumour response for neoadjuvant chemotheraphy. Without an accurate measurement, the preoperative decisions can be wrong and the rate of operation will be increased (1).

The accuracy of B-mode ultrasound in determining of the tumour size in comparison with histopathological tumour size has been reported and proved valid if to compare to clinical examination and mammogram (1,2).

Sonoelastography, is an area of considerable interest. By using the conventional ultrasound machine with dedicated elastography software, it is able to produce a grey scale images as well as to measure the elasticity of tumours. Comparing the sizes of breast lesions on strain images produced by sonoelastography and conventional B-mode ultrasound has revealed an interesting difference in size between benign and malignant masses (2,3). Carcinomas appears to be wider than benign lesions on the strain image. This is postulated due to the desmoplastic reaction to surrounding breast tissue (4,5,6).

Most of the previous report regarding sonoelastography focused on the specificity and sensitivity of this new imaging technique in differentiating between breast carcinoma and benign lesion there are limited study regarding the accuracy of the breast tumour size measured on elastography.

Therefore, the objective of this study was to determine the accuracy of the preoperative breast carcinoma size using conventional B-mode ultrasound as well as sonoelastography. Thirty confirmed breast carcinoma case was recruited for this study.
Methods and materials

This prospective cross sectional study was conducted in Department of Radiology, Faculty of Medicine, University Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia. Patients with core biopsy or FNAC confirmed to be malignant were included in the study in the period of two years.

B-mode Ultrasound and sonoelastography Tumour Measurement:

Diagnostic ultrasound was performed on all patients by two breast radiologists in Radiology department independently. The same ultrasound machine with an integrated realtime sonoelastography (ACUSON S2000, Siemens Medical Solutions, Inc, Mountain View, CA) was used throughout the study. A probe frequency of 12 MHz was selected for optimal visualization of tumour. In cases where the tumour was identified, the probe was rotated until the largest diameter was displayed and measurement on the frozen image was taken using the integral calipers. Tumour size was recorded initially on B-mode then followed by sonoelastography by two breast radiologists independently. The measurements were taken before performing core biopsy, if the biopsy confirmed the diagnosis of breast carcinoma, the patients were included in the study.

Histologic Tumour Measurement:

This was performed by one individual histopathologist. The operative specimens were sectioned along its longest plane and a single measurement of the tumour diameter was made using a plastic ruler. The measurements were taken, macro and microscopically. Measurements which requiring refinement, were done by using the vernier caliper on the microscope.

The data was tabulated and analyzed using SPSS 13.0 for Windows. The correlation between different tumour size assessments was statistically analyzed using Pearson correlative coefficients.
Results

Thirty breast carcinoma patients were recruited during the mentioned period. The age of the patients ranging from 41-75 years old, with the median of 54 years. Invasive ductal carcinoma was present in 91% (n=29) of the cases (Figure 1 & 2); invasive carcinoma with DCIS component was present in only 6% (n=2), while mucinous with papillary carcinoma was present in 3% (n=1).

Fig. 1: A 57-year-old lady, presented with a palpable mass in the right breast. The image on the left is B-mode ultrasound showing an irregular hypoechoic lesion with posterior acoustic shadow. The image on the right is the corresponding elastography image which is showing the width of the lesion is wider on elastography than on B-mode. Histopathology confirmed lesion was infiltrating ductal carcinoma and the maximum width of the lesion is more accurate on elastography than B-mode.

References: Radiology, Faculty of Medicine, University Kebangsaan Malaysia - Kuala Lumpur/MY
Fig. 2: A 62-year-old woman with incidental finding of left breast mass on mammogram. The B-mode ultrasound (left) is showing an irregular hypoechoic lesion with heterogenous internal echo measuring 1.6cm. The mass was longer on elastography images measuring 2.4cm in comparison with the width on B mode ultrasound. Histopathology confirmed lesion is infiltrating ductal carcinoma measuring 2.5cm. The accuracy of the mass was more accurate on elastography rather than on B-mode ultrasound.

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Median histological tumour size was 12 mm. The correlation coefficient between histopathological tumour size estimation and B-mode ultrasound as well as real time sonoelastography were significant (p<0.01). Mean value of tumour size on B-mode ultrasound was 7mm lower and 2mm higher on real time elastography in comparison with histopathology size (Figure 3 & 4).

Our result conformed with the findings of this study, where tumour size estimation using B-mode ultrasonography or real-time elastography were both significantly correlated to real tumour size pathologically, reflecting accurate tumour size estimation. The difference between pathologically confirmed real-tumour sizes and measured values using B-mode ultrasonography, on one side, and real time elastography, on the other was also statistically correlated, reflecting the accepted accuracy of tumour size estimation by real time elastography (Figure 3 & 4).
Fig. 3: Assessment of breast cancer tumour size (cm) using B-mode ultrasonography plotted against histopathological assessment. The line of equality is indicated. (r=0.73)

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Fig. 4: Assessment of breast cancer tumour size (cm) using sonoelastography plotted against histopathological assessment. The line of equality is indicated (r=0.92)

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Fig. 2: A 62-year-old woman with incidental finding of left breast mass on mammogram. The B-mode ultrasound (left) is showing an irregular hypoechoic lesion with heterogenous internal echo measuring 1.6cm. The mass was longer on elastography images measuring 2.4cm in comparison with the width on B mode ultrasound. Histopathology confirmed lesion is infiltrating ductal carcinoma measuring 2.5cm. The accuracy of the mass was more accurate on elastography rather than on B-mode ultrasound.

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**Fig. 3:** Assessment of breast cancer tumour size (cm) using B-mode ultrasonography plotted against histopathological assessment. The line of equality is indicated. \((r=0.73)\)

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Fig. 4: Assessment of breast cancer tumour size (cm) using sonoelastography plotted against histopathological assessment. The line of equality is indicated \( (r=0.92) \)

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Conclusion

Breast carcinoma tumour size estimation using B-mode ultrasonography has been thoroughly studied and reported, with advancement of the available technique more publications and studies have showed that B-mode ultrasonography is one of the most accurate method for estimating breast carcinoma tumour size (7,8). However, some recently published study have claimed that measurement of breast carcinoma tumour size using conventional B-mode ultrasound imaging lead to underestimated of breast carcinoma tumour size (2).

Breast cancer was one of the first major applications and advances in ultrasound examination technology particularly real time elastography. Combination of real-time elastography and B-mode ultrasound to differentiate malignant from benign breast lesions have been reported to improve in the diagnostic accuracy of breast ultrasound (4,5,6).

Most of the previous published studies on real-time elastography had focused on sensitivity and specificity of real time sonoelastography for differentiating malignant and benign lesion and less attention on measurement of the breast carcinoma detected on elastography (5,6).

Our study have showed that real-time elastography can be more reliable method for preoperative measurement of the breast carcinoma tumour size in comparison with B-mode ultrasound. B-mode ultrasound measurement tend to underestimate breast carcinoma tumour size in comparison with histopathological size. There was also higher corelation coefficient between measurement of breast carcinoma tumour size using real time elastography in comparison with B-mode ultrasound. However, more studies with larger numbers of recruited patients need to be done in order to provide stronger statistical evidence for the above mentioned observations, with greater statistical power.
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