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Research Article

A Symptomatologic Perspective to Sonoelastography: Correlation of Compressive Sonoelastography Findings with VAS Score for Breast Cysts

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Abstract

Objective: To investigate threshold values for the diameter, elasticity score and strain ratio for symptomatic breast cysts.

Patients and Methods: Sonoelastography was performed prospectively to breast cysts determined by ultrasonography for consecutive patients evaluated in our breast ultrasonography unit. Just after the ultrasonography, the patients were asked to specify the severity of the pain, if any, associated with the lesion on the visual analogue scale (VAS). The longest and shortest diameters of the cyst, short/long diameter ratio, strain ratio and elasticity score obtained by ultrasonography and sonoelastography were compared with VAS scores. For symptomatic cysts (VAS≥1) to obtain the threshold values, the long and short diameter, short/long diameter ratio, elasticity score and strain ratio were analysed by receiver-operating characteristic (ROC) tests.

Results: The area under the curve (AUC) values obtained by ROC analysis were 0.835, 0.857, 0.729, 0.780 and 0.680 for long and short diameters, short/long diameter ratio, elasticity score and strain ratio, respectively. The short diameter is considered the most valuable parameter according to the AUC values. A threshold of 8.5-mm for short diameter had a sensitivity of 80% and specificity of 86% for symptomatic cysts. A threshold value of 2 for elasticity score had a sensitivity of 70% and a specificity of 86%, while a threshold of 1.2 for the strain ratio had a sensitivity of 51% and a specificity of 72%.

Conclusion: This study concluded that expanded and relatively hard cysts (are likely to be symptomatic.

Keywords

Breast cyst; Elasticity score; Long diameter; Short diameter; Sonoelastography; Strain ratio; Visual analogue scale

Introduction

In the Western world, 7% of women are estimated to have a palpable breast cyst [1,2]. Breast cysts are generally accepted to be benign processes with an incidence of carcinoma between 0.1 and 1.2%; each case should therefore be carefully evaluated [3-6]. Histopathologically, a terminal duct or acini turns in on itself and forms a cyst by expansion [7]. Breast cysts may cause symptoms such as pain or a palpable mass.

Compressive sonoelastography determines the stiffness of a lesion compared to surrounding tissues [8]. By this way the lesion is can be characterized as benign or malignant [9]. Benign lesions are softer than or have the same stiffness as the surrounding fat tissue in the breast [10-12]. Elasticity scores of benign lesions have been found to be significantly lower than in malignant lesions [13,14].

The visual analogue scale (VAS) is used to transform values that cannot be measured in quantitative values. Two ends of a 10-cm line indicate the two margins of a parameter. For example, the left end represents no pain and the right end represents severe pain. The patient is asked to indicate where his or her symptoms fall on this scale. The distance from the patient's mark to the end where there is no pain can be used to quantify the severity of the patient's pain. This test has been widely proven to be accurate, safe and easy to apply.

In this study, ultrasonography and sonoelastography findings for breast cysts were evaluated and threshold values for diameter, elasticity score and strain ratio of symptomatic cysts were investigated to assess which parameters had the highest sensitivity and specificity.

Patients and Methods

This prospective study was approved by the local ethics committee and informed consent was obtained from the patients enrolled.

Breast cysts determined by ultrasonography for consecutive patients evaluated in our breast ultrasonography unit was evaluated by sonoelastography. The elasticity scores and strain ratios of the lesions were recorded. Just after the procedure, the patients were asked to specify the severity of the pain, if any, associated with the cyst on the visual analogue scale.

Sonoelastography

The patient was examined in supine position with the ipsilateral arm under the head. The breast was scanned in a ductal radial-direction. On sonography, the long and short diameter, and short/long diameter ratio of the cysts were recorded.

The patients were assessed by a radiologist experienced in compressive sonoelastography (ADK). Each patient was asked not to move and to avoid deep breathing during the examination. The largest cyst detected was studied by compressive sonoelastography (EUB-6500; Hitachi® Medical, Tokyo, Japan) and elasticity scores and strain ratios were measured.

Elasticity score was calculated according to the scale proposed by Itoh et al. [15]. According to this scale, 1=the entire lesion is deformable; 2=a mostly deformable lesion with small peripheral hard areas; 3=the lesion has a hard centre and deformable peripheral areas; 4=the entire lesion is hard; 5=the lesion and all of the tissues around it are hard.

Strain ratio is the ratio of the average strain measured from the lesion and surrounding fat of similar depth. The first region of interest

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(A) is placed in the nearby fatty tissue and the second (B) was in the lesion itself. It is important that both regions of interest are at a similar depth because the pressure decreases with increasing depth. Green coded fields in the fat tissue that had medium hardness were preferred. The system automatically measured the strain ratio (the value of B/A).

Visual analogue scale

The patient was asked to rate her pain related to the cyst on the visual analogue scale, with 10 representing the worst pain and 1 being only slight pain; 0 represented no pain.

Statistical analysis

The longest and shortest diameters of the cyst, short/long diameter ratios, the strain ratio and elasticity scores were compared with the VAS score using the Pearson correlation. For symptomatic cysts (VAS≥1) the long and short diameter, short/long diameter ratio, elasticity scores and strain ratio were analysed by receiver-operating characteristic (ROC) test. P value less than 0.05 was considered statistically significant.

Results

The study included a total of 49 female patients between 19 and 50 years of age (mean age and SD was 33 ± 9 years). Cysts had an average long diameter of 17 ± 6 mm (range, 9-47 mm), an average short diameter of 9 ± 4 mm (range, 5-18 mm), and an average short/long diameter ratio of 0.4 ± 0.1 (range, 0.3-1.0). The average elasticity score was 1.6 ± 0.6 (range, 1-3) and the average strain ratio was 1.3 ± 0.8 (range, 0.07 to 3.63) (Figure 1). Of the 35 patients with symptomatic (painful) cysts, patients gave their pain an average VAS score ± SD of 1.9 ± 0.8 (ranging from 1-4). 14 patients had cysts with no pain (VAS score of 0).

Among the evaluated parameters, VAS scores showed the strongest correlation with strain ratio (R=0.605, P<0.0001). The short diameter had the second strongest correlation with VAS scores (R=0.430, P=0.005). Elasticity score (R=0.399, P=0.009) and short/long diameter ratio (R=0.381, P=0.01) had weaker correlations to VAS but were still statistically significant. There was a weak correlation between the long diameter (R=0.250) and VAS scores and this correlation was not statistically significant (P=0.110).

The area under the curve (AUC) values obtained by ROC analysis were 0.835, 0.857, 0.729, 0.780 and 0.680 for long and short diameters, the short/long diameter ratio, elasticity score and strain ratio, respectively (Figure 2). The short diameter is considered the most valuable parameter according to the AUC values. A threshold value of 8.5 mm for the short diameter had a sensitivity of 80% and specificity of 86% for determination of symptomatic cysts. A threshold value of 2 for elasticity score had a sensitivity of 70% and a specificity of 86%, while a threshold of 1.2 for the strain ratio had a sensitivity of 51% and a specificity of 72%.

Discussion

This study showed that wider and relatively hard cysts (with high elasticity scores and strain ratios) are likely to be symptomatic.

Sonoelastography evaluates the hardness of a lesion. It is reported to be less subjective and have more sensitive, specific and reproducible results than clinical examination [8,16,17]. It is used to typify a lesion discovered in B mode and is a particularly important

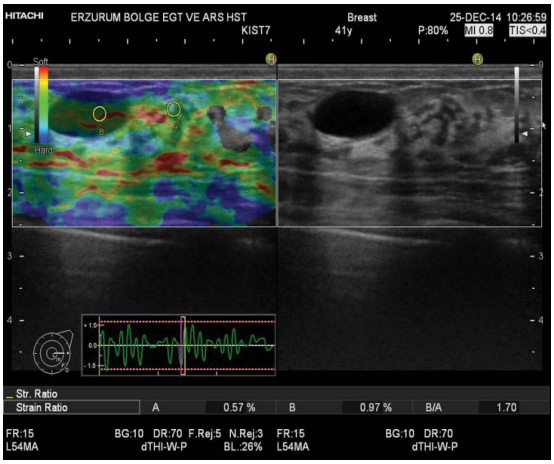

Figure 1: Sonoelastography findings for a symptomatic cyst. This cyst has an elasticity score of 2 and a strain ratio of 1.70.

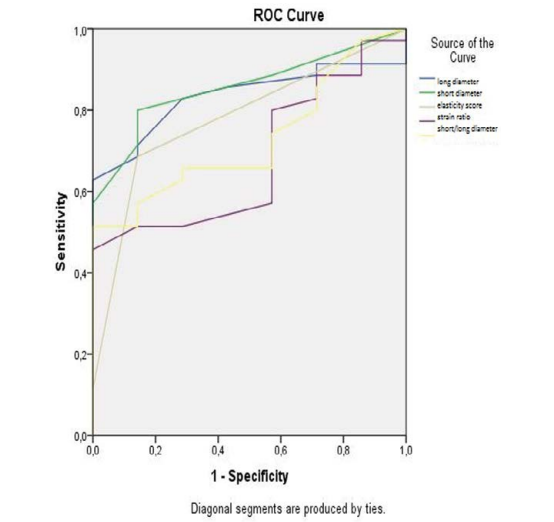

Figure 2: ROC analysis.

technique for discrimination of BI-RADS 3 and 4 lesions, improving the ultrasonographer's confidence in their diagnosis [18]. Although these benefits of sonoelastography are known in the literature, aside from distinguishing between benign and malignant lesions, there have been no studies on the use of sonoelastography in asymptomatic/symptomatic discrimination. Patients who attend routine checks are concerned about painful hard masses, which could be symptomatic cysts.

This study investigated an alternative use of sonoelastography: discrimination of symptomatic and asymptomatic breast cysts. Elasticity scores and strain ratio parameters of symptomatic cysts seem to be higher than those of asymptomatic ones. This study shows that compressive sonoelastography parameters are specific enough to be used as a diagnostic tool. Additionally, this study brings a functional-clinical perspective to the practice of sonoelastography rather than it being a purely anatomical-structural assessment method. However, a drawback of the study may be the relatively small number of patients with asymptomatic cysts. It would also be helpful to analyse parameters such as cyst contents (clear, purulent, haemorrhagic)

or cytological data, in addition to pain scores. We conclude that sonoelastography can be used not only for discriminating between benign and malignant lesions but also for supplying information about the symptomatology of breast cysts.

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