Elastography and early breast cancer detection

It has taken almost 20 years for the development of the technology of ultrasound-elastography to reach its current level, where it is a modality that plays a vital role in modern breast imaging.

The technique is founded on the basic principle that there is a difference in the elasticity of benign and malignant lesions. In the early days of elastography much effort was expended in trying to establish correlations of elasticity measurements with various types of breast tissue. However the use of elastography information to predict malignancy was not reliable enough for example to be able to decide that interventional procedures were unnecessary.

As a result, the so-called “Tsukuba Score” — published in 2006 and named after the Japanese clinic where the work was carried out — for the characterisation of elastograms did not refer directly to the possibility of predicting malignancy but was limited to the quantification of stiff tissue in relation to lesions that could be seen in the conventional ultrasound image [1].

The Tsukuba Score is shown below:

Score 1: The entire lesion is soft.
Score 2: There is a mosaic-like irregular distribution of soft and stiff tissue distributed over the whole lesion.
Score 3: The center off the lesion is stiff, but its periphery is soft.
Score 4: The whole lesion is stiff.
Score 5: Not only the whole lesion but also its surrounding is stiff.

Technical advances in recent years have resulted in elastography being able to detect even small, clinically occult lesions having a size of only 3 to 4 mm. Such developments have consequently made modern elastography-based procedures interesting for the detection of early breast cancer.

As a result of the introduction of mammography screening in Germany, the technique of ultrasound has become one of the most frequently used methods for initial assessment. Since the cancers generally looked for in screening mammography are small, it was however a significant challenge for ultrasound to be able to identify such lesions. There was much to learn about the echographic characteristics of small lesions, which sometimes could not be found at all in a routine scan, but only by means of a “second-look” ultrasound.

To ensure the success of ultrasound in the finding of such small lesions and eventual interventional examinations, the role of additional techniques became more and more important.

For example, three dimensional ultrasound data can increase the confidence that a lesion is real even if initially it was only able to be seen in one plane.

Likewise, a positive Doppler ultrasound increases the probability that a structure which shows neovascularization might also correlate with a breast-lesion detected by MRI.

A positive elastographic finding, however, does not only support the results of the initial ultrasound examinations described above, but also provides much more information about the interaction between the lesion and its surrounding tissue.

The technique can delineate the borders of a tumor more precisely than conventional ultrasound. This latter suffers from a well-known underestimation of the tumor-size, especially in case of malignancy [Figure 1]. Even intraductal cancers, ductal components of an invasive breast cancer, and satellites in the neighbourhood of a malignant finding can show as positive elastographically. On the other hand a layer of soft tissue in the surroundings of a proven breast cancer could help in deciding to reduce the extent of any surgical intervention. Of course all clinical decisions indicated by elastography should be confirmed histologically.

PRACTICAL EXPERIENCE

In our Interdisciplinary Unit for Senologic Diagnostics at the University Hospital in Marburg, Germany we have gathered a clinical experience of strain and shear-wave elastography techniques. The current work was carried out using the A30 ultrasound system from Samsung Electronics using the Elastoscan function, which is based on strain technology. The system needs only weak compression-decompression movements to generate sufficient elastograms of a region of interest. In fact, when we examined tumors

The Author:
Dr Volker F Duda is
Head of the interdisciplinary unit for “Senologic Diagnostics”
Marburg University Hospital,
Marburg, Germany
email: duda@med.uni-marburg.de
of the nipple and those located in or close to the skin we even realized that compression by the transducer was indeed not necessary at all. Another somewhat surprising observation was that small cysts lying deep in the breast near to the fascia pectoralis appeared soft elastographically, whereas small breast cancers at the same depth clearly showed stiffness.

In general, small lesions were easier to analyze by elastography because of the direct comparability with the surrounding tissue, whereas elastograms of bigger lesions were sometimes more difficult to interpret.

An essential argument for the increasingly widespread use of elastography in breast imaging is the fact that it is quick and easy to use. All that is needed is to position a lesion detected by conventional ultrasound in the center of the field of view, activate the elastography function, wait a few seconds, freeze the image, and then scroll back using the ciné loop until an optimal picture is found.

Recently two papers were published by the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) presenting “Guidelines and Recommendations on the Clinical Use of Ultrasound Elastography” [2, 3]. The recommended standards described in the publications include elastography of the breast as well and demonstrate the clinical importance of this special ultrasound technology.

**CONCLUSION**

By itself elastography is not a screening modality and is unable to remove the need for histological characterisation of suspicious lesions. However, elastography can significantly reduce uncertainties in ultrasound findings, especially in the field of second-look ultrasound. Furthermore the technique can make the prediction of tumor size more precise and can greatly improve the chances of success of otherwise difficult interventional procedures.

**REFERENCES:**


**STATE-OF-THE-ART ULTRASOUND IMAGING AND ELASTOGRAPHY**

Samsung’s Accuvix A30 Ultrasound System establishes a new benchmark for state-of-the-art imaging. Offering features such as the proprietary EZ Exam and ElastoScan, this system facilitates clinical decision-making and boosts diagnostic confidence. Its 21.5-inch LED monitor is a world first and the larger screen combines with enriched 3D performance to deliver uncompromising image quality for increased detection rates. This is complemented by advanced automation and newly designed imaging tools which transform separate exams into a single streamlined procedure for faster, more relevant results.

**ELASTOSCAN**

This enables the imaging of malignant tumors and other diseases that would normally be undetectable through conventional studies. The system detects the presence of a solid mass in tissue using ultrasound, and subsequently converts the stiffness into images. Since many tumors have tissue characteristics that are harder than the surrounding tissues, they appear less elastic than the surrounding tissue, and so the difference in tissue elasticity provides clearer contrast and can be used to verify the presence of a lesion. ElastoScan is normally used as an additional method to verify the state of the region. For instance, in breast or prostate applications, ElastoScan is used after applying palpation, blood tests and 2D exam methods, to confirm the state of the region.

SAMSUNG MEDISON
SEOUL, KOREA

www.samsungmedison.com