TOSHIBA
Leading Innovation

Transcutaneous real-time elastography of the abdomen: initial experiences

Horst Kinkel

Ultrasound Research Laboratory, Department of Gastroenterology
Akademisches Lehrkrankenhaus Düren, Germany

Modern ultrasound offers several options to visualize and characterize lesions in organs, for example B mode, Doppler imaging, contrast-enhanced sonography or 3D sonography. In addition, real-time elastography allows the assessment of the relative stiffness of organs and tissue changes, thus providing a different kind of information which promises to support differential diagnosis. Transcutaneous elastography has already proven its worth in breast and thyroid examinations. As far as abdominal organs are concerned, however, insufficient penetration severely limited the value of the procedure. Toshiba's new application for transcutaneous real-time elastography icludes a convex transducer which seems to overcome this obstacle. Below, initial experiences with transcutaneous elastography for focal liver lesions are presented.

The sonographer uses the transducer to apply extrinsic pressure on the patients body resulting in compression of the organ of interest.

Simultaneous display of the B mode image and the elastography image in so-called twin mode allow the sonographer to observe both compression and decompression of the lesion of interest (Fig. 1). With some experience, uniform compression and decompression of the organ can be achieved without significantly moving the lesion itself. The change of shape caused by compression and decompression of the organ depends on the elasticity of the organ or the focal lesion in the organ. Stiff structures cannot be as easily compressed compared to soft structures. The elasticity of the focal lesions and of the normal parenchyma surrounding the lesions can be compared and quantified with real-time elastography. In short, it is possible to determine whether for example a focal liver lesion is harder (less elastic) or softer (more elastic) than the surrounding liver tissue.

Actual measurement of elasticity is performed offline after compression and decompression.

Again, compression and decompression can be observed and controlled. On the measurement/quantification screen the pressure wave is displayed along the time axis (Fig. 2, red box). The curve should have a sinus shape.

Elasticity itself is displayed in colour codes: stiff tissue areas in blue, softer ones in green to red (Fig. 2, green box). Moreover, a numerical code is assigned to the elasticity of a freely defined region of interest (ROI) over time (Fig. 2, blue box). Several ROIs can be defined in the lesion and in the surrounding liver tissue. Thus, elasticity of the focal lesion and the normal surrounding liver tissue can be captured numerically.

By calculating a coefficient (elasticity of normal tissue/elasticity of focal lesion) the numerical characterization of focal lesions independent of the pressure applied by the sonographer is possible. The ultimate objective should be the ability to differentiate benign and malignant lesions.

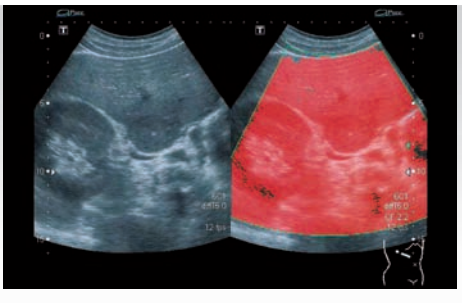

Fig. 1: B mode image and elastography in twin mode.

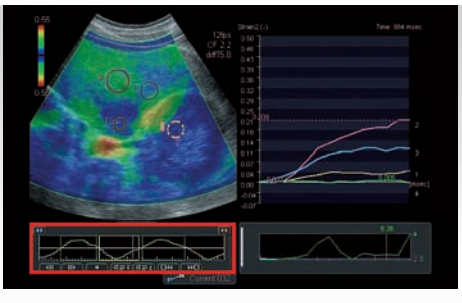

Fig. 2: Elastography of a liver metastasis at CUP.

Figures 2 to 6 illustrate the initial results of the elasticity measurements of liver lesions.
Figures 7 and 8 show the elasticity measurements of eight different lesions as graphs compared to the surrounding liver tissue. Figure 8 shows the average elasticity coefficient of the malignant and benign lesions.

Conclusion

Real-time elastography with the convex transducer allows transcutaneous assessment of the elasticity of lesions in abdominal organs. It appears to be useful to compare the elasticity of the focal lesion to the elasticity of the surrounding normal parenchyma. Establishing an elastography coefficient (normal parenchyma/focal lesion) may provide a way to quantify and differentiate malignant and benign tissue. Further studies are required.

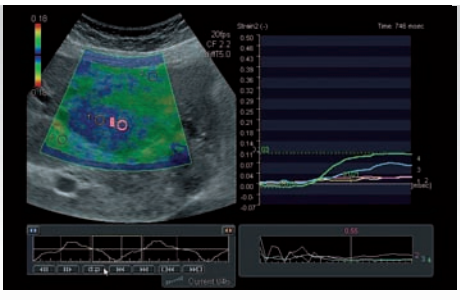

Fig. 3: Metastasis of colon carcinoma.

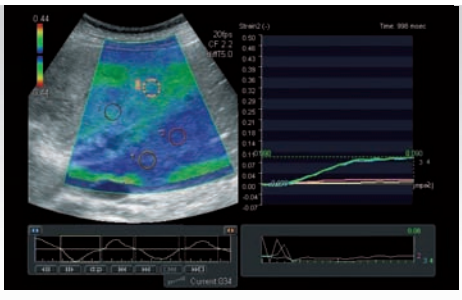

Fig. 4: Metastases of pancreas carcinoma.

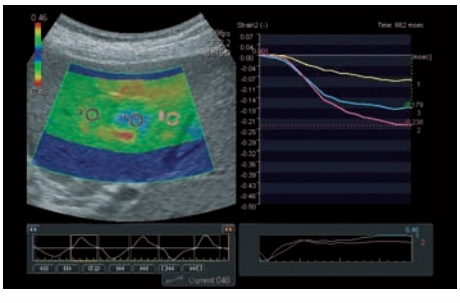

Fig. 5: Liver haemangioma.

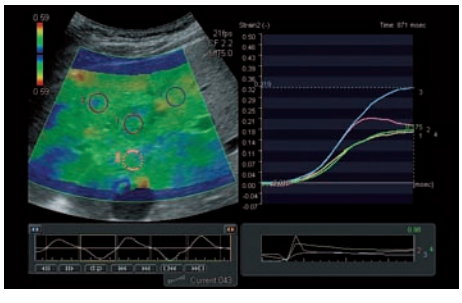

Fig. 6: Focal nodular hyperplasia.

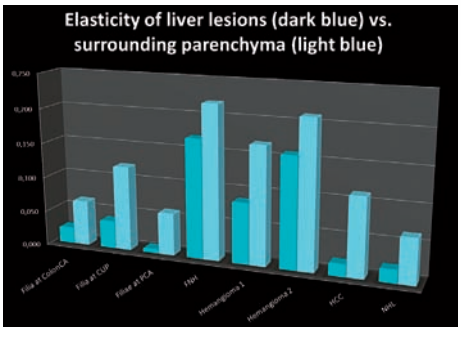

Fig. 7: The individual elastography values of the lesions compared to the surrounding liver tissue.

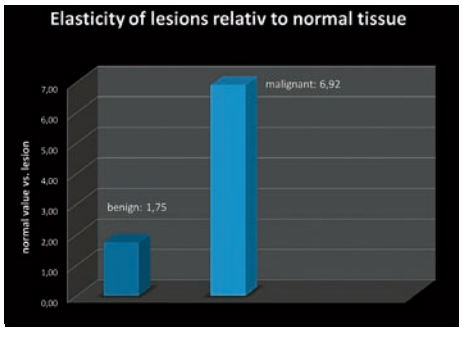

Fig. 8: Average of the elastography coefficient Elasticity of liver tissue/focal lesions (individual lesions, see fig. 7).

TOSHIBA MEDICAL SYSTEMS CORPORATION

11/2009 TWPUS0005EC.EU

Printed in Europe

www.toshiba-medical.eu

Made for Life

ULTRASOUND CT MRI X-RAY SERVICES