

Oncology: Prostate/Testis/Penis/Urethra

INITIAL EXPERIENCES WITH REAL-TIME ELASTOGRAPHY GUIDED BIOPSIES OF THE PROSTATE

KATHARINA KÖNIG, ULRICH SCHEIPERS,* ANDREAS PESAVENTO, ANDREAS LORENZ, HELMUT ERMERT AND THEODOR SENGE

From the Klinik für Urologie und Neurourologie, Marienhospital Herne, Universitätsklinik der Ruhr (KK, TS) and Institut für Hochfrequenztechnik der Ruhr (IS, HE), Universität Bochum and LP-IT GmbH (AP, AL), Bochum, Germany

ABSTRACT

Purpose: Based on our first experiences with real-time elastography in the field of prostate diagnostics we evaluate its usefulness for biopsy guidance for prostate cancer detection.

Materials and Methods: After imaging with conventional B-mode ultrasound in conjunction with real-time elastography 404 men underwent systematic sextant biopsy.

Results: Overall prostate cancer was found in 151 of 404 cases (37.4%). In 127 of 151 cases (84.1%), prostate cancer was detected using real-time elastography as an additional diagnostic feature.

Conclusions: The results show that it is possible to detect prostate cancer with a high degree of sensitivity using real-time elastography in conjunction with conventional diagnostic methods for guided prostate biopsies.

KEY WORDS: prostate, prostatic neoplasms, biopsy, ultrasonography

The phenomenon of elastography or strain imaging was first described in 1991 by Ophir et al.¹ The phenomenon is based on the fact that the backscattered ultrasound signal changes its local characteristic pattern only to a comparably small extent if the insonified tissue is slightly compressed and decompressed (ie approximately up to 2%) during the examination. A high internal correlation is maintained within local regions of interest. However, time or space differences between local regions of interest under different compression ratios change with differences in compressibility of the insonified tissue. Time differences between 2 local regions of interest within 2 subsequent images recorded under different compression ratios can be calculated for each pixel of the images (see figure). Time differences are not absolute but relative values since the compressibility of local tissue regions always depends on the surrounding tissue and the applied compression force.

Calculated derivations of the time differences, which are qualitative estimations of tissue elasticity, are shown side by side with conventional B-mode images on the screen of the ultrasound system. Using real-time elastography the investigator is able to discriminate hard from soft tissue regions.

To visualize tissue compressibility different compressibility values are marked with different colors and the so-called elastograms or strain images are shown in real time on the video screen of the ultrasound system. It was decided to mark hard tissue regions with black, medium hard tissue areas with red, medium soft tissue regions with yellow and soft tissue areas with blue.

The time-consuming calculation of the huge data sets ap-

parent in ultrasound elastography has been one of the main unsolved problems to date. In the past calculations took several hours. Improved computer hardware and sophisticated estimation algorithms now allow real-time examinations with up to 30 frames per second at a resolution of 100 × 100 image pixels of the elastograms.^{2–6}

In a pilot study patients with clinically localized prostate cancer who underwent radical prostatectomy were examined prospectively (unpublished data). Prior to surgery these patients were examined with conventional B-mode ultrasound as well as with real-time elastography. Areas suspicious for prostate cancer were depicted. After surgery the histological specimens were compared with the transverse ultrasound images and with elastography findings. In 78.3% of cases elastography findings correlated with histological findings (fig. 1).

After the first elastography studies for prostate cancer detection a new ultrasound probe was developed that allows the acquisition of a sufficient number of images in the transverse plane as well as in the longitudinal plane. The probe used in the study is a conventional biplanar transducer with the possibility of attaching biopsy equipment. No special hardware is required for the application of elastography. This improvement led to stable image series in elastography in the 2 planes, which finally allows the performance of elastography guided prostate biopsies, as described in this study.

MATERIALS AND METHODS

Between August 2001 and May 2003, 404 men with suspicious digital rectal examination (DRE) findings and/or increased prostate specific antigen (PSA) underwent prostate biopsy. Mean patient age was 65.9 years (range 45 to 81). PSA was 0.8 to 123 ng/ml with most patients (209 of 404 or 51.7%) presenting with values between 4 and 10 ng/ml. Table

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* Correspondence: Ruhr-University Bochum HFT, IC 6/140 Universitätsstrasse 150 44780, Bochum, Germany (telephone: +49 234 32 23 05 6; FAX: +49 234 32 14 16 7; e-mail: Ulrich@Scheipers.org).