Improved accuracy of biopsy needle guidance in Real-Time-Elastography by combination with a 3D-navigation system (Navigo™)

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Introduction

Over the last years Real-Time-Elastography (RTE) has emerged as an upcoming ultrasound-based imaging technique improving prostate cancer (PC) detection rates. However, in standard RTE accurate needle guidance into suspicious areas is difficult as compression and decompression is required during free-hand guidance. The novel Navigo™ system (UC-Care, Israel) has been developed to generate a 3D prostate model in which the exact location of each core taken can be registered using regular TRUS video recording combined with electromagnetic spatial monitoring. In a first step the Navigo™ system was adapted to merge standard RTE-images with the generated 3D prostate model. This enables the user to mark suspicious areas during standard RTE and subsequently guide the needle towards these areas only using the 3D-navigation system without the artifacts caused by manual compression and decompression. The present study aimed to investigate if the combination of RTE with a 3D-navigation system can further improve accuracy and efficacy in biopsy needle guidance into suspicious RTE-areas compared to standard RTE.

Material and Methods

The Navigo™ system allows the transformation of regular TRUS bi-planar images into a 3D prostate model. Two CIRS-066 prostate phantoms containing 3 isoechogenic but RTE-positive and MRI-visible lesions (0.5cc) were used for the present study. RTE was performed using a Hitachi ultrasound device (Preirus + EUP V53W). Following the ultrasound-based scan, a 3D model of the phantom was generated. In one phantom the center of each RTE-positive lesion was marked with the Navigo™ system. Afterwards three targeted biopsies per lesion were done using only the Navigo™ system (without the ultrasound or RTE-image). In the other phantom biopsies were performed under free-hand RTE guidance. Each biopsy tract was injected with gadolinium based magnetic resonance contrast. Phantoms were then subjected to 1mm slice magnetic resonance imaging to assess the accuracy of targeted biopsies.

Results

A total of 18 (9 Navigo™-guided + 9 standard RTE-guided) biopsies were targeted into 6 lesions of two phantoms. All 18 (100%) biopsies successfully hit the target lesion. The procedural targeting error (mean ± SD) was 1.97 ± 1.09 mm using free-hand RTE guidance and 0.92 ± 1.03 mm using the Navigo™ system ($p=0.181$).

Conclusions

The combination of the Navigo™ system and RTE achieved satisfying accuracy for targeting suspicious RTE-lesions, exceeding the results of free-hand RTE. Improved accuracy in hitting RTE-suspicious lesions might help to further improve prostate cancer detection rates. In addition the location of each core taken is registered within the Navigo™ system opening new ways for RTE-based re-biopsies under active surveillance as well as focal therapy planning in prostate cancer.