MR imaging guided biopsy of the prostate using a 32-channel phased-array coil at 3 Tesla

T. Hambrock[1], J. J. Fütterer[1], C. Hulsbergen-vandeKaa[2], H. J. Huisman[1], J. A. Witjes[3], A. Winkel[4], and J. O. Barentsz[1]
[1]Radiology, UMC St. Radboud, Nijmegen, Gelderland, Netherlands, [2]Pathology, UMC St. Radboud, Nijmegen, Gelderland, Netherlands, [3]Urology, UMC St. Radboud, Nijmegen, Gelderland, Netherlands, [4]Interventional Instruments, Invivo GMBH, Schwerin, Mecklenburg-Vorpommern, Germany

Purpose: To investigate the feasibility of MR imaging guided biopsy of the prostate at 3T, using a 32-channel phased-array coil and prototype biopsy device, in a) patients with rising prostate specific antigen (PSA) and previous negative biopsies [1] and b) patients with previous radiotherapy treated prostate cancer, with recurrent rising of PSA.

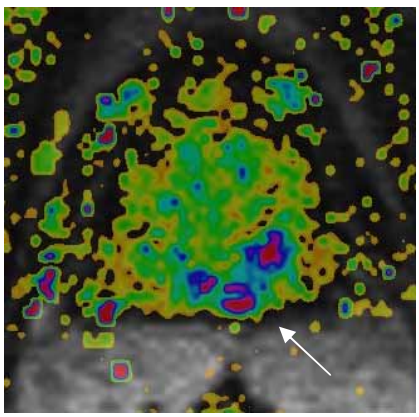
Material and Methods: Ten patients with rising PSA and > 2 previous negative biopsies and four patients with previous radiotherapy treated prostate cancer (> 2 years before) and rising PSA, underwent endorectal coil MR imaging (T2-weighted imaging, Dynamic Contrast-Enhanced MR imaging and Hydrogen Spectroscopic Imaging) for localization of tumor suspicious region(s). Tumor suspicious regions were identified from these three MR imaging modalities by two radiologists [2]. On average, two weeks after the first MR examination, these patients received a 3T (Siemens Trio Tim, Germany), 32-channel phased-array coil MRI. A high-resolution transverse T2-w fast spin echo sequences was made and used to localize the prior determined tumor suspicious area(s), using anatomical landmarks as reference [3]. Parallel imaging (iPAT, factor 3) was used to shorten imaging time. A prototype biopsy device (Invivo, Germany) was used and the attached needle guider inserted in the rectum. Fast T2-w steady-state free-precession (trueFISP) imaging was used to identify the 3D position of the needle guider, and adjustments made to align the needle guider exactly towards tumor suspicious lesions. After correct alignment, biopsies were taken via the needle guider. Correct needle positioning within tumor suspicious lesions was confirmed by additional imaging with the needle left in situ. Image quality, speed and ease of the procedure were also evaluated by two radiologists.

Results: Total imaging and biopsy time was less than 30 min per patient. The procedure was easy to perform and patients tolerated the procedure well. No significant procedure related complications occurred (one patient had mild transurethral hemorrhage, post-biopsy). Image quality of the fast trueFISP T2-w sequences was excellent. Each trueFISP sequence, used to check alignment of the needle guider after adjustments were made, lasted 15 seconds with parallel imaging applied. In total, 40 out of 40 representative prostate core biopsy specimens were successfully obtained. Histological analysis of these specimens revealed prostate cancer in 48% (19/40) of cores, chronic prostatitis in 35% (14/40), necrosis in 2.5% (1/40), atrophy in 2.5% (1/40). In 12.5% (5/40) of cores no pathological changes were noted. In all patients with previous radiotherapy treated prostate cancer, all prior determined tumor suspicious regions proved positive for cancer on biopsy. In patients with previous negative biopsies and rising PSA, tumor was histologically confirmed in 3 patients and in 4, chronic prostatitis was found.

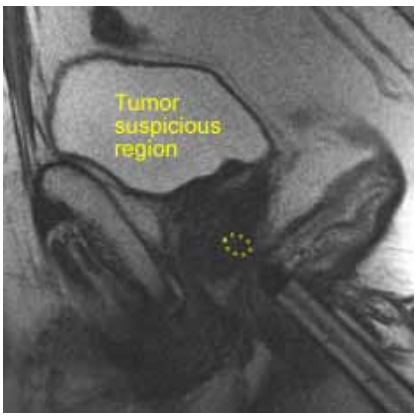
Conclusion: MR-guided biopsy with this prototype biopsy device, at 3T, using parallel imaging with a 32-channel phased-array coil is feasible, easy to perform and can be done in a short time span, yielding excellent image quality. This technique is of great potential in a subset of patients with previous negative biopsies or suspected recurrence after radiotherapy, by improving the cancer detection rate.

References:

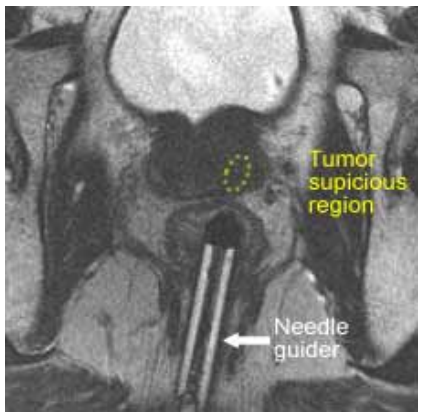
1. Anastasiadis AG, et al. Eur Urol. 2006; 50(4):738-48
2. Futterer JJ, et al. Radiology 2006; 241:449-458
3. Beyersdorff D, et al. Radiology 2005; 234:576-581



Localization of tumor suspicious region with dynamic contrast-enhanced MRI



T2-w trueFISP sagital images with the needle guider aligned towards prior identified tumor suspiciuous region



T2-w trueFISP T2-w transverse images with guider aligned onto the tumor suspicious region