

MR Spectroscopic Imaging as a tool for guiding prostatic biopsy in patients with prior negative biopsy

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Introduction

The recent development of new approaches for the detection of prostate cancer has aimed the attention to the numerous patients with high risk of prostate cancer, because of the rising PSA level, but with negative prostatic prior biopsies. The purpose of this study was to prospectively evaluate the benefit of "voxel guided" TRUS biopsy on the basis of MRSI results.

Materials and Methods

MR imaging and spectroscopic imaging were performed on 24 patients with persistently elevated PSA level and/or abnormal digital rectal examination (DRE) on a 1.5 T MR imaging system (Signa, GE Medical System, Milwaukee, Wis) with a flexible endorectal coil (Medrad, Pittsburgh, Pa) combined with a pelvic phased-array coil. Proton spectra were collected from the prostate using PRESS volume selection with 3D phase encoding. Choline, creatine, and citrate peak areas were calculated for all voxels and the (Choline+Creatine)/Citrate (CC/Ci) ratio was evaluated. All spectroscopic voxels were classified as malignant if CC/Ci > 3 standard deviations (SD) above the mean healthy value for the peripheral zone, distinguishing those with CC/Ci > 4 SD (examples in Figure 1) and if CC/Ci > 4 SD for the transitional zone [1,2]. All patients presented almost 1 prior negative 10-core prostate biopsy (range of negative biopsies: 1-3), with an average time between 3D-MRSI and prior negative biopsy of 11 months (range 7-13). After MRSI/MRI scans, all patients underwent biopsy: each prostate was divided on the basis of a 12-region scheme (Figure 2). Using internal anatomic landmarks at MRI to overlap 3D-MRSI voxels to the corresponding ultrasound images, "voxel-guided" TRUS-biopsies were performed on the regions with abnormal 3D-MRSI findings, with 3 to 4 cores for each region. Then all patients received extended pattern prostate biopsy, with 1 core in each of the 12 regions.

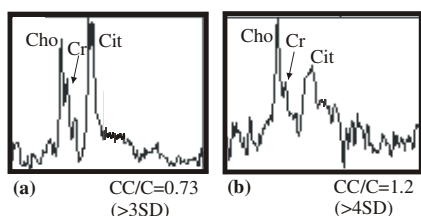


Figure 1: examples of spectra in the peripheral zone with CC/Ci > 3 SD (a) or CC/Ci > 4 SD (b).

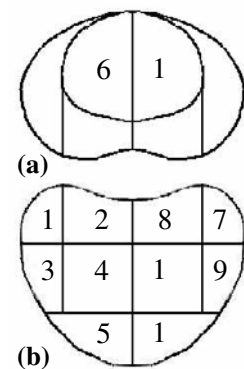


Figure 2: scheme of an extended-pattern biopsy: (a) transversal view showing cores of transitional zone; (b) longitudinal view.

Results

10 of 25 patients (40,0%) had positive biopsy for prostate cancer (in 5 cases only in the transitional zone). Cancer was found in 10 of 17 (58,8%) patients with a positive 3D-MRSI findings, with no false negative case. On a patient-by-patient analysis sensitivity was 100%, specificity 53,3%, positive predictive value (PPV) 58,8%, negative predictive value (NPV) 100% and accuracy 72,0%.

On a region-by-region analysis of the peripheral zone (250 regions), cancer was found in 15 of 33 regions (45%) with a positive 3D-MRSI findings, with a sensitivity of 80,0%, specificity of 91,1%, PPV of 36,4%, NPV of 98,6% and accuracy of 89,6%.

On a region-by-region analysis of the transitional zone (50 regions), cancer was found in 8 of 15 regions with a positive 3D-MRSI findings, with a sensitivity of 87,5%, specificity of 81,0%, PPV of 46,7%, NPV of 97,1 % and accuracy of 82,0%.

If we restrict the analysis of peripheral zone to those voxels with CC/Ci > 4 SD, we obtain a much lower sensitivity (40%), and higher specificity and accuracy (97% and 94 % respectively).

Discussion

MRSI-biopsy detection rate was 40% and 45% on a patients by patients and a core by core analysis in the peripheral zone respectively, which are much higher than detection rate of extended pattern biopsy after prior negative one (values from literature range from 15 to 30%). Moreover 3D-MRSI showed a good diagnostic accuracy and optimal negative predictive value. This means that the use of metabolic findings of 3D-MRSI to perform "voxel guided" TRUS-biopsy can improve the detection of prostate cancer by TRUS-biopsy and hopefully can reduce the number of cores at successive biopsies. By using the more stringent criterion of CC/Ci > 4SD for test positivity for 3D-MRSI, our data show that in the peripheral zone accuracy increases but sensitivity dramatically decreases to 40% making this criterion not adequate from a clinical point of view. On the contrary if we consider voxels corresponding to CC/Ci > 4 SD as positive for the transition zone, our data suggest that 3D-MRSI "voxel-guided" TRUS-biopsy can be extended to the transitional zone with good accuracy.

[1] Males RG et al., Magn Reson Med 2000; 43:17-22.

[2] Testa C et al., Proceedings of ISMRM 13th Meeting May 2005, Miami Florida, USA, p2113.