Accuracy of MRI/3D-MRSI based TRUS-biopsy in peripheral zone (PZ) and transition zone (TZ) of prostate gland in patients suspected for cancer with prior negative biopsy

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Introduction

The purpose of this study was to evaluate the accuracy of transrectal ultrasound biopsy (TRUS-biopsy) performed on regions with abnormal MRI and/or 3D-MRSI for both transition (TZ) and peripheral (PZ) zones in patients suspected for prostate cancer with prior negative biopsy and to analyze the relationship between 3D-MRSI and histopathological findings.

Materials and Methods

The ability of MRI/MRSI directed TRUS-biopsy was evaluated in 54 patients (mean age: 63.9 years, range: 52-76 years), with mean PSA value= 11.4 ng/mL (3.0–42.0 ng/mL). All patients presented almost one or more prior (extended or sextant) TRUS-biopsies negative for cancer. A 3-point score system was used for both imaging techniques to distinguish healthy from malignant regions. On MRI, the presence of cancer was identified as areas of nodular low T_2 signal intensity within the PZ, and as homogeneous or lenticular shape T_2 hypointensity within TZ. On 3D-MRSI, voxels were regarded as malignant when Choline-plus-Creatine-to-Citrate ratio was at least 3 standard deviations (SD) over and above the mean healthy value (mean±S.D.= 0.22±0.13) for the PZ and at least 4 SD for the TZ[1]. At biopsy each prostate was divided into 12-regions: left and right of lateral base, parasagittal base, lateral mid zone, parasagittal mid zone, apex and TZ. TRUS-biopsies following 3D-MRSI were performed on each region by visually overlapping 3D-MRSI voxels and MR images on TRUS images by using internal anatomical landmarks. Descriptive statistics was used to calculate sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and ROC analyses were performed to evaluate the accuracy (AUC) and the best cutoff in the 3-point score system. The hierarchical log-linear model was used to analyze the data.

Results

Twenty-two of 54 patients (39.6%) had prostate cancer. Table 1 shows results of TRUS-biopsies performed on regions with abnormal MRI, 3D-MRSI, and "combined" MRI/3D-MRSI on a patient-by-patient analysis for prostate cancer detection. Table 2 shows results on a region-by-region analysis distinguishing PZ from TZ.

Table1

Technique	Sensitivity	Specificity	PPV	NPV	AUC
MRI	72.2%	62.5%	57.1%	76.9%	0.676
3D-MRSI	90.9%	43.8%	52.6%	87.5%	0.673
MRI **and** 3D-MRSI	72.7%	71.9%	64.0%	79.3%	0.723
MRI **or** 3D-MRSI	90.09%	34.4%	48.8%	84.6%	0.626

Table2

Technique		Sensitivity	Specificity	PPV	NPV	AUC
MRI	PZ	27.0%	95.8%	32.3%	94.7%	0.614
	TZ	61.1%	98.8%	91.7%	92.7%	0.800
3D-MRSI	PZ	64.9%	85.8%	25.8%	97.0%	0.753
	TZ	72.2%	93.3%	68.4%	94.4%	0.828
MRI **and** 3D-MRSI	PZ	21.6%	98.6%	53.3%	94.5%	0.601
	TZ	61.1%	100.0%	100.0%	92.8%	0.806
MRI **or** 3D-MRSI	PZ	70.3%	83.3%	23.6%	97.4%	0.768
	TZ	72.2%	92.2%	65.0%	94.3%	0.822

Table3: percentage of positive findings of 3D-MRSI according to the histological analysis. * indicates a significant test.

Positive histological findings		Negative histological findings	
Cancer G1	0/1 (0%)	HGPIN (high-grade prostatic intraepithelial neoplasia)	7/23 (30.4%)
Cancer G2	0/1 (0%)	ASAP (atypical small acinar proliferation)	1/2 (50%)
Cancer G3	28/41 (68.3%)	BPH (benign prostatic hyperplasia)	7/260 (2.7%) *
Cancer G4	7/10 (70.0%)	Flogosis	55/191 (28.8%)
Cancer G5	2/2 (100.0%)	Post-inflammatory atrophy	5/99 (5.1%) *

Low Gleason grade are not detected by 3D-MRSI; within the negative histological findings a significantly lower frequency of positive 3D-MRSI were found in cores presenting BPH (P<0.001) and post-inflammatory atrophy (P=0.015).

Discussion and Conclusions

The use of metabolic 3D-MRSI information and of the anatomic MRI information to direct TRUS-biopsy in PZ has already shown a detection rate of prostate cancer of 40.4% and 35.7% [2,3]. Our study, which includes the TZ in the MR guided biopsy scheme, showed a detection rate of 39.6%. The accuracy of MRI/MRSI directed-biopsies in localization of prostate cancer is good in a patient and, in particular, in a region analysis. The combination of the two imaging modalities gives to TRUS-biopsy an higher accuracy also in the TZ for patients with prior negative biopsies. The high specificity and NPV showed in the per region analysis represents an important added value to the high per patient detection rate of MRI/MRSI directed-Bx, as it provides additional information that predicts the extent and aggressiveness of prostate cancer. As demonstrated by the histopathological analysis the main limitation of 3D-MRSI is the percentage of false positive findings due to flogosis.

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