3D ^{1}H MRSI Based TRUS Guided Biopsies in Men with Suspected Prostate Cancer

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Introduction: Transrectal Ultrasound (TRUS) guided systematic needle biopsy of the prostate is the standard histopathological procedure used in men suspected to have prostate cancer on the basis of an abnormal digital rectal examination (DRE) or an elevated serum prostate specific antigen (PSA) level. However, the detection rate of TRUS guided biopsies in detecting prostate cancer is low because of its low sensitivity and specificity especially in patient with PSA < 10 ng/mL [1]. Currently no imaging modality can reliably detect tumor within the prostate. 3D ^{1}H MRSI provides distribution of metabolites in the prostate non-invasively which is shown to have the potential in identification of cancer within the prostate gland. The present study was carried out to evaluate the sensitivity and specificity of MRSI directed TRUS guided biopsies in a large cohort of patients.

Methods: Men with raised serum PSA level (> 4 ng/mL) or with an abnormal DRE were investigated (n = 140, age = 65.4 ± 8.8 years) at 1.5 Tesla whole body scanner (Sonata, Siemens) with informed consent and institute ethical committee approved the study. Patients were divided into three categories based on their serum PSA levels (Group I: PSA 0-10 ng/mL, Group II: PSA 10-20 ng/mL, Group III: PSA > 20 ng/mL). MR investigations were carried out using pelvic phased array coil and/or with endorectal coil. T2-weighted images in transverse, sagittal and coronal planes were acquired covering the entire prostate (TR = 5000 ms, TE = 98 ms, slice thickness = 4 or 5 mm, without inter-slice gap. Point resolved spectroscopy localized 3D-MRSI sequence was used with simultaneous suppression of lipid and water. The parameters used for MRSI were: TR = 1300 ms, TE = 120 ms, Average = 3, acquisition time = 17min. MRSI spectral map was overlaid on corresponding T2-weighted image. In each patient voxels in the peripheral zone were analyzed and voxels suspicious of prostate cancer were identified as indicated by increased [(Choline+Creatine)/(Citrate)] ratio. A [(Cho+Cr)/cit] ratio < 0.7 was considered as normal, while the ratio in the range 0.7 – 0.85 was classified as equivocal, and a value > 0.86 was taken as indicative of malignancy [2]. TRUS guided biopsy, in most patients, was performed within 2 days after MRSI by using the MRSI derived x-coordinate (distance from midline of prostate in axial plane) and z-coordinate (distance of transverse plane from the base of prostate) of the suspicious voxel and 2 – 3 cores were taken from the suspected site. MR imaging was also carried out after the biopsy to confirm the site of biopsy.

Results and Discussion: Sensitivity and specificity of MRSI directed TRUS guided biopsies in 140 patients studied was 98% and 40% respectively, with PPV=43%, NPV=97 %. The patients were categorized into three groups since it is clinically challenging for detection of malignancy when the PSA level is from 0 – 10 ng/mL or 10 -20 ng/mL in that order. In these categories (Group I and II) we observed sensitivity and specificity > 92% and > 36% respectively, while NPV was higher than 96%. Group II and Group III had no false negative on MR while Group I had one false negative. The malignancy in this patient was in transition zone and MRSI has limited utility in detecting cancer in this region.

		TRUS guided Biopsy		
MRSI		Positive	Negative	
All patients, n = 140	Positive	43	58	PPV = 43 %
	Negative	1	38	NPV = 97 %
		Sensitivity = 98 %	Specificity = 40 %	
Group I, n = 72 (PSA 0 - 10 ng/mL)	Positive	11	34	PPV = 24 %
	Negative	1	26	NPV = 96 %
		Sensitivity = 92 %	Specificity = 43 %	
Group II, n = 37 (PSA=10 - 20 ng/mL)	Positive	6	20	PPV = 23 %
	Negative	Nil	11	NPV = 100 %
		Sensitivity = 100 %	Specificity = 36 %	
Group III , n = 31 PSA > 20	Positive	26	4	PPV = 87 %
	Negative	Nil	1	NPV = 100 %
		Sensitivity = 100 %	Specificity = 20 %	

PPV = positive predictive value, NPV = negative predictive value

Conclusion: The pick up rate of prostate cancer in men with suspected prostate cancer based on raised PSA or abnormal DRE increased with MRSI focused biopsy as compared to routine historical data. It is also evident from high NPV value that MRSI may have potential to segregate patients which may not need biopsy procedure. Further work is in progress.

References:

1. Tempany CM, Haker S. Magnetic resonance-guided prostate biopsy. In: Antony V-D'Amico, Jay S. Loeffler, Jay R. Harris, editor. Image guided diagnosis and treatment of cancer. New Jersey: Humana Press; 2003. p 35
2. Scheidler J, Hricak H, Vigneron DB et al. Radiology 1999 213:473-80.