Value of multiparametric MRI in prostate cancer.

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Introduction: Prostate cancer is the most common cancer in men. In the screening process the measurement of the PSA value is the first step. Next, ultrasound-guided biopsy usually is performed which often misses the cancer due to the random sampling technique. Repeated biopsy because of still rising PSA is successful in only about 10% of patients and, for most patients it is a painful procedure. MRI of the prostate is a possibility to localize and stage prostate cancer and maybe to improve screening. Currently, T2-weighted images and spectroscopy are the most common modalities. To evaluate the possible relevance of prostate MRI in the process of diagnosis and screening, we compared all current available MRI modalities with special attention to invasiveness, time needed for the MR examination and for reading as well as for statistical parameters, especially the negative predictive values.

Methods: 16 patients with either biopsy-proven prostate cancer or high suspicion for prostate cancer in spite of negative biopsy were examined with a 1.5 T MR unit (MAGNETOM Avanto, Siemens). All patients underwent the same MR examination protocol, consisting of the following sequences: T2-weighted triplanar TSE (TR 6360, TE 108), echo-planar diffusion-weighted imaging (EPI-DWI) axial (TR 1200, TE 67), 3D chemical-shift imaging spectroscopy (3D CSI) (TR 690, TE 120) and axial dynamic-contrast-enhanced TurboFLASH (dce MRI) (TR 217, TE 1.09) following power-injector supported administration of bw adapted Gd-DOTA (Dotarem®, Guerbet). In all patients an endorectal coil was used for spectroscopy. N-Butylscoplamin (Buscopan®, Bayer) was administered intravenously if the patient had no contraindications.
Two experienced readers blinded to histology and clinical features evaluated all images independently. Additionally, a consensus reading of the two readers was performed. First, T2-weighted images were evaluated, followed by EPI-DWI after fusion of the ADC-maps with T2-weighted axial images, dce MRI and 3D CSI spectroscopy. The level of suspicion for malignancy was subclassified into 5 steps, definite benign till definite malignant. A level of suspicion of 4 and 5 was determined as positive. The results of the reading were compared with the biopsy findings.

Results: The results of the blinded readers as well as for consensus reading were as follows. For the T2 weighted images a sensitivity of 50.0-85.7%, a specificity of 44.4-72.2% and a negative predictive value of 65.0-81.8% could be obtained. For the DWI a sensitivity of 78.6-100.0%, a specificity of 38.9-55.6% and a negative predictive value of 70-100% were calculated. The results of the DCE showed a sensitivity of 71.4-85.7%, a specificity of 44.4-55.6% and a negative predictive value of 66.7-81.8%. The spectroscopy showed a sensitivity of 64.3-78.6%, a specificity of 50.0-77.8% and a negative predictive value of 69.2-82.4%. The descriptive statistic is shown in table 1. The average time needed for reading were 1:54 (minutes:seconds) for T2, 3:17 for DWI, 2:12 for DCE and 3:47 for spectroscopy. The average examination times needed for the sequences were 8:46 for T2, 1:28 for DWI, 8:41 for DCE and 11:36 for spectroscopy. For planning of spectroscopy an additional time of about 5-10 minutes was needed. A schedule of the examination times is shown in table 2 and for reading in table 3.

Discussion: MRI in prostate cancer is reasonable for two approaches in the diagnostic work-up. The currently most used application is therapy monitoring in patients with biopsy-proven prostate cancer. A different approach is the detection of cancer foci in patients with a high suspicion for prostate cancer due to clinical examination or extremely high PSA values. In the second group a MRI is performed to better localize the dominant intraprostatic lesion (DIL) which can lead to a higher certainty for a positive biopsy. For these indications the complete MRI protocol is essential, especially in patients during or after hormonal and radiation therapy.
To avoid unnecessary and unsuccessful biopsies and a delayed therapy, an adapted concept at an earlier point of diagnostic work-up is needed. For initializing a screening of patients it is crucial to implement a short, widely-available and non invasive examination. In the presented study it could be shown, that T2-weighted images in fusion with ADC-maps derived from EPI-DWI lead to an acceptable negative predictive value, while there is only moderate additional value of performing dce-MRI and spectroscopy. In a screening setting the exigency of an endorectal coil needed for the spectroscopy as well as the application of contrast-agent needed for dce-MRI might be abandoned. Furthermore, these two modalities have been the most time consuming sequences during the MRI. In conclusion, it seems to be possible to offer a MRI for screening for prostate cancer in a short and non-invasive way, which may lead to an earlier detection and higher biopsy success rate.

Table 1: Results in comparison to biopsy.

	T2			DWI			DCE			CSI		
	R1	*R2*	*C*	*R1*	*R2*	*C*	*R1*	*R2*	*C*	*R1*	*R2*	*C*
Sensitivity	50.0	85.7	71.4	92.9	100.0	78.6	85.7	71.4	78.6	71.4	64.3	78.6
Specificity	72.2	50.0	44.4	55.6	38.9	38.9	50.0	44.4	55.6	50.0	61.1	77.8
NPV	65.0	81.8	66.7	90.9	100.0	70.0	81.8	66.7	76.9	69.2	68.8	82.4

Table 2: Time needed for performance.

	T2	DWI	DCE	CSI
time	8:46	1:28	8:41	11:36

Figure 1: Patient with an area suspicious for PCA in the peripheral zone.

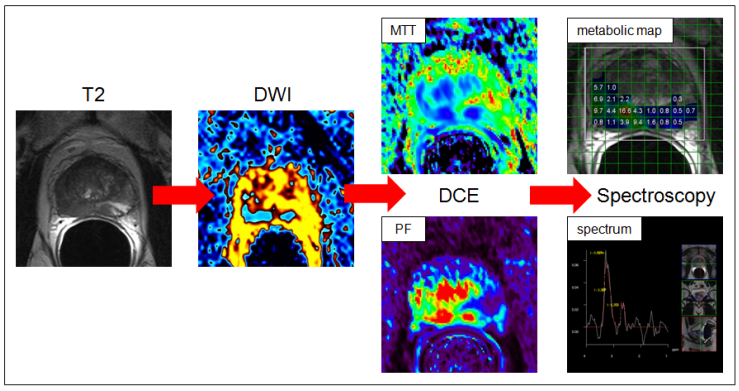

Table 3: Time needed for reading.

	T2	DWI	DCE	CSI	total
R1	02:19	03:00	02:15	04:21	11:55
R2	01:22	03:08	02:09	03:30	10:09
C	01:22	03:45	02:10	03:31	11:26
Ø	01:54	03:17	02:12	03:47	11:10