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THE ROLE OF MR SPECTROSCOPY AND CONTRAST ENHANCED MRI IN PROSTATE CANCER DIAGNOSIS

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Abstract

In patients with increased prostate-specific antigen, the next diagnostics tool is transrectal ultrasound-guided biopsy. The biopsy can cause pain, bleeding and infection. Multiparametric magnetic resonance imaging (mp MRI) as non-invasive diagnostics tool is used as a triage test to avoid biopsy, as well as to improve the diagnostics. The aim of this study was to examine the value of MR spectroscopy and dynamic post-contrast series in the diagnosis of prostate cancer.

This cohort prospective study included 100 patients from CGH "September 8th" with increased levels of PSA. The MRI equipment used was Siemens Essenza 1,5T with body coil.

The results obtained by MR spectroscopy analysis were correlated with the post-contrast series, whereby by mapping suspicious areas, patients underwent biopsy according to the PIRADS (prostate imaging and reporting data system) classification.

Of the 100 patients, 96 were biopsied according to the PIRADS (prostate imaging and reporting data system) classification. The MRI results and pathohistological findings were then compared.

On MR postcontrast series, a malignant lesion was detected in 52% of patients, in 33% of patients the lesion was suspicious for malignancy. On MR spectroscopy, a choline+creatinine/citrate ratio of 0.8 to 2 indicating a possible malignant lesion was confirmed in 33% of patients, this ratio was greater than 2 in 33% of patients, indicating a lesion highly suspicious for malignancy.

MR spectroscopy combined with contrast enhanced MRI is a powerful tool for non-invasive differentiation of benign prostatic hyperplastic nodule and prostatitis from a malignant nodule.

keywords: prostate, carcinoma, spectroscopy, IV contrast

Introduction

Prostate carcinoma is the second most common carcinoma in the male population [1]. The diagnosis of prostate carcinoma includes prostate-specific antigen (PSA) and digital rectal imaging. The diagnosis of prostate problems is based on the fact that swelling is harmful to PSA, carcinoma, prostate inflammation and benign prostatic hyperplasia (BPH) [2].

Also, prostatitis, hemorrhage, atrophy and postirradiation changes can be directed to the radiologist as carcinomas in the peripheral zone on T2 pulse sequence [3, 4].

Magnetic resonance is a non-invasive diagnostics tool for evaluating the cause of PSA growth. Mostly, the magnetic resonance is focused on the changes in the lateral zone, which is often the predilection site for carcinoma, but about 20-30% of prostatic carcinomas PCs also appear in the transitory zone [55] lowering the degree of biological aggressiveness.

The transitory zone is the part around the proximal urethra and it's a zone of hypertrophy during the lifetime with consecutive appearance of BPH. BPH, stromal hypertrophy and PC have similar appearance on MR, they present themselves with a hyposignal on T2 pulse sequence and as a consequence there are diagnostic problems for differentiation of BPH nodule of carcinoma [6].

More studies have shown a high degree of diagnostic accuracy in the detection of malignancies in the prostate with a combination of MR spectroscopy and postcontrast series.

The main advantage of spectroscopy is that it is possible to give data for the presence of metabolites in small volumes of interest (voxels). Metabolites were analyzed by prostate spectroscopy for citrate (Ci 2.6 ppm), creatinine (Cr 3.0 ppm) and choline (Cho 3.2 ppm).

In practice, the PC can be detected in the peripheral zone with a ratio of choline + creatine/citrate, which in normal tissue and on the periphery is 0.8, and every change with a ratio of more than 0.8 is considered to be a suspected cancer [7, 8].

On the other hand, the elevated values of choline are estimated to be indicative of the presence of cancer, although there are also benign cases where elevated choline can be found, and that is prostatitis [9].

Post contrast series are T1 pulse sequence with applied paramagnetic contrast medium (gadolinium diethylenetriamine pentaacetic acid).

The goal is to distinguish the tissue with abnormal vascularization from neoangiogenesis, one of the main characteristics of cancer [10]. Increased vascularization in normal tissue is well defined, and in cancer the vascularization is poorly defined. On the other hand, the interstitial area is bigger in cancer compared to the normal tissue, and because of that there is a bigger difference between the concentration of contrast in plasma and the interstitium [10].

Our goal here is to test the value of MR spectroscopy and dynamic post contrast series in prostate carcinoma diagnostics.

Materials and methods

In this study, 96 patients of both sexes aged 45 to 80 years with PSA levels of 4ng/ml were analyzed. They were all beforehand observed by an urologist. In some of the patients was implemented rectal touche. The examination is implemented on a magnetic resonance device Siemens Essenza 1.5T with standard body coil. 96 of these patients were referred for biopsy.

MR was implemented on the small pelvis area according to the protocol for evaluation of the prostate in which were included T2, MR spectroscopy and series with IV contrast.

The results of the postcontrast series are correlated with MR spectroscopy with analysis of the metabolites citrate, choline and creatine as well as their ratio, whereupon with mapping of the suspected zones (Figure 1) the patient is subjected to a biopsy according to the PIRADS (prostate imaging and reporting data system) classifications shown in Table 1.

Table 1. Tumor formation grading through PI RADS classification.

PI RADS classification	Definition	Total score T2W, diffusion with ADC, postcontrast series, MR spectroscopy
1	Surely benign	4,5
2	Most probably benign	6-8
3	Undetermined	9-12
4	Most probably malignant	13-16
5	Certain malignant	17-20

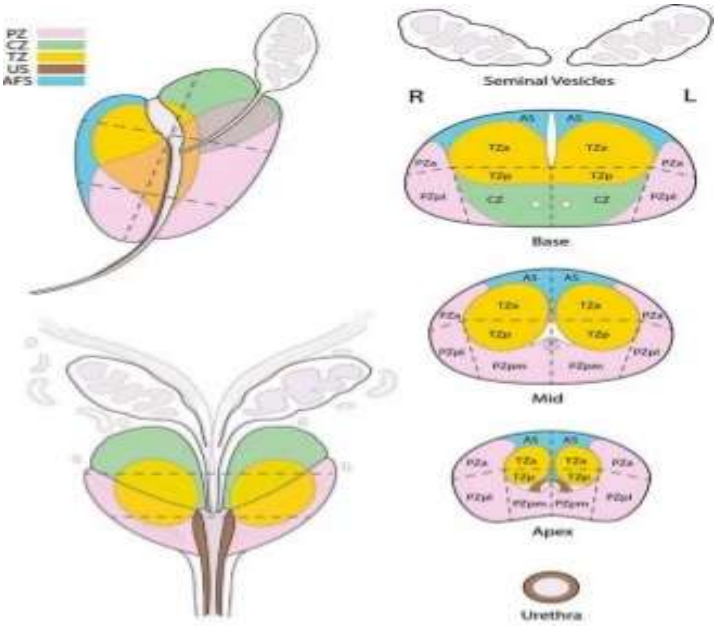

Fig 1. Prostate model and marcation of changes based on the location

The T2 pulse sequence (Figure 2) is used to characterize regions suspected of cancer. Peripheral zones are normally characterized by hypersignal. Prostatic cancer presents as hyposignal, and in rare cases as isosignal [11, 12, 13].

The parameters for the standard protocol for the T2 pulse sequence for the sagittal and transverse planes are TP/TE 5000/80-149 ms, FOV (field of view) 14-20 cm, slice thickness or thickness of one slice 3 mm and imaging matrix 256x256. Prostate tumors in the central zone present as hyposignal, which makes them more difficult to differentiate from changes in the context of BPH and reduces the sensitivity of the T2 sequence by 60-70% [14].

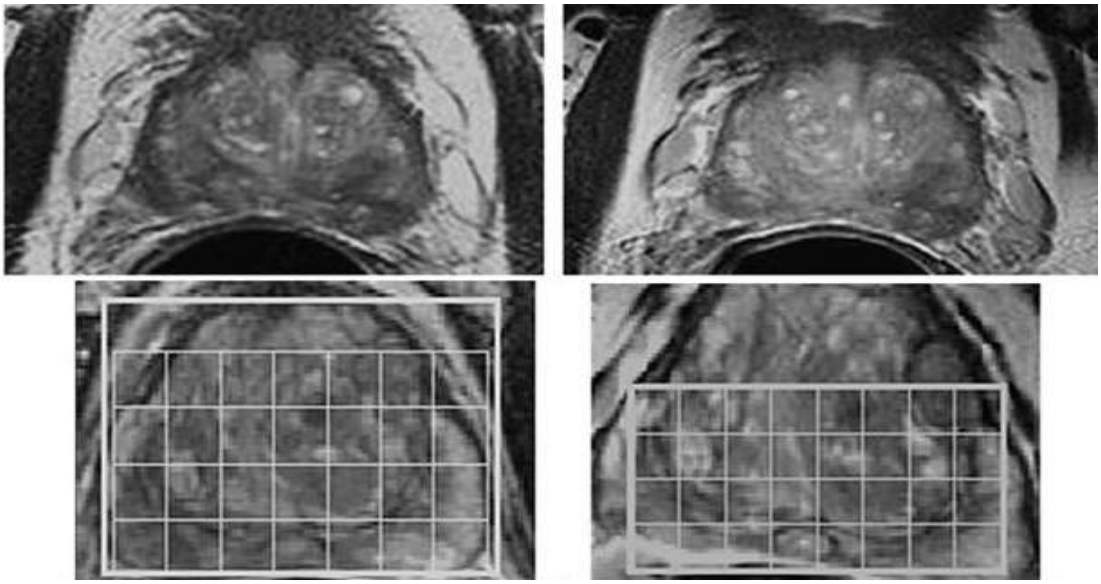

Fig. 2. Image of the prostate in a T2 pulse sequence

The T2 pulse sequence provides us with information about the morphology of the tissues, but for cancer diagnostics we need data on vascularization and the presence of certain metabolites, their ratio, as well as the possible detection of reduced concentrations of metabolites normally present in the tissues.

MR spectroscopy was performed using a multivoxel chemical shifting sequence with a spectral pulse optimized for quantitative detection of choline, creatine and citrate (FOV 50x50x50 mm, TR 700 ms, TE 120 ms TA 11.50 min) (Figure 3).

The analysis, i.e, the sub processing, takes about 20-25 minutes. In this process, the suspicious zones that we previously detected on the T2 pulse sequence are analyzed and the absolute values of choline, creatine and citrate in ppm are taken, as well as the ratio Ho+Cre/Ci. A value less than 0.8 is taken as a normal ratio [15].

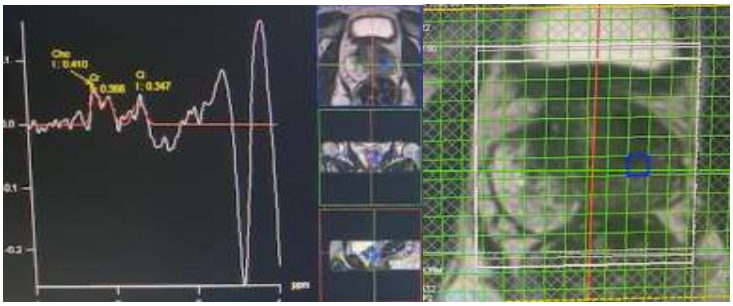

Fig. 3. Image of prostate spectroscopy

Post-contrast series are performed so that after intravenous application of paramagnetic contrast agent, scans are performed every 8 seconds for 5 minutes. Then follows the subtraction of a part of the obtained images based on the regions with maximum and minimum postcontrast enhancement. ROI (region of interest) is placed in the zones that are hyposignal on the T2 pulse sequence and higher post-contrast enhancement.

With a quantitative analysis of the images in post-processing we obtain three types of postcontrast enhancement curves. Type 1 - mild, gradual enhancement which is most often benign and is characterized

by 1 in the PIRADS score; Type 2 - so-called plateau type of enhancement which is characterized by 2 in the PIRADS score and is suspicious for malignancy; Type 3 contrast washout, highly suspicious for malignancy [16, 17].

The curves are formed based on three parameters:

- Onset time (OT), the time between injection and the appearance of the curve expressed in seconds.
- Time to peak (TTP), the time it takes for the curve to reach its maximum in seconds.
- Peak enhancement, expressed in mmol/kg, the highest level of contrast concentration in the ROI.

The vascularity of the tumor is greater than the rest of the tissue due to neoangiogenesis and this is objectively shown in the curves.

Early OT in the arterial phase, due to increased arterial vascularity due to neoangiogenesis; high PE values and early peak enhancement with rapid washout are shown by a rapid fall of the curve. Postprocessing takes about 10 min.

Results

In this study, a correlation was made between MR spectroscopy, i.e. the ratio of choline+creatine/citrate, and the pH finding from the biopsy. It is taken into account that a ratio below 0.8 is a benign lesion, a ratio of 0.8 - 2 is a suspicious malignant lesion, and a ratio greater than 2 is highly suspicious for a malignant lesion.

In this study, a correlation was shown between MR postcontrast series and pathohistological findings from the biopsy. Changes with a Type 1 curve are considered to be definitely benign, a Type 2 curve is considered to be probably benign, and a Type 3 curve is highly suspicious for malignant changes.

The study showed a correlation between the diagnostic value of MR spectroscopy and MR postcontrast series.

The study included 100 patients, of whom 96 patients who underwent biopsy were analyzed, with malignant change, i.e. histological diagnosis of PC, being found in 55 (57.29%) patients.

According to the findings of the MR postcontrast series, a malignant lesion was detected in 52% of patients, in 33% of patients the lesion was suspicious for malignancy.

According to the findings of the MR spectroscopy, a choline+creatinine/citrate ratio of 0.8 to 2, indicating a possible malignant lesion, was confirmed in 33% of patients, this ratio was greater than 2 in 33% of patients, and indicates a lesion highly suspicious for malignancy.

Table 2. Correlation of the pathohistological findings with MR postcontrast series and MR spectroscopy

variable	n (%)
pathohistology	
benign	41 (42.71)
malignant	55 (57.29)
MR postcontrast series	
benign lesion	48 (48)
malignant lesion	52 (52)
MR spectroscopy (choline+creatinine/citrate ratio)	
< 0.8 benign lesion	34 (34)
> 0.8 possible malignant lesion	66 (66)

Table 3. Table of summed up frequency. The marked zones have a number > 10 (the border values are not taken into account).

Table of summed up frequency. The marked zones have a number > 10 (the border values are not taken into account)			
Postcontrast curves 1 and 2= b Curve 3=3 is m	pathohistology 1=b 2=m 1	pathohistology 1=b 2=m 2	Total
1 neg	35	9	44
3 pos	6	46	52
All groups	41	55	96

The proportion of malignant changes on postcontrast MR series was 52/96=0.5417 or 54.17%, while the proportion of malignant changes confirmed pathologically was 55/96=0.5729 or 57.29%. The difference in the proportion of malignant lesions detected by postcontrast MR series and by biopsy was not statistically significant (p=0.61). The sensitivity and specificity of postcontrast MR series in diagnosing malignant changes in the prostate were 83.64% and 85.37%, respectively.

Table 4. Correlation of pathohistology with MR postcontrast series

MR postcontrast series	**Pathohistological findings**		Total
	malignant	benign	
Malignant lesion	46	6	52
Benign lesion	9	35	44
Total	55	41	96

McNemar Chi=0.27 p=0.61

Table 5. Sensitivity and specificity of MR postcontrast series

Statistic	**Value**	**95% CI**
Sensitivity	83.64%	71.20% to 92.23%
Specificity	85.37%	70.83% to 94.43%
Positive Likelihood Ratio	5.72	2.70 to 12.08
Negative Likelihood Ratio	0.19	0.10 to 0.35
Positive Predictive Value	88.46%	78.39% to 94.19%
Negative Predictive Value	79.55%	67.86% to 87.75%
Accuracy	84.38%	75.54% to 90.98%

The proportion of malignant changes on MR spectroscopy was 66/96=0.6875 or 68.75%, while the proportion of malignant changes confirmed by pathohistology was 55/96=0.5729 or 57.29%. The difference

in the proportion of malignant lesions detected by MR spectroscopy and by biopsy was statistically significant (p=0.015), as a result of a significantly higher percentage of malignant changes seen by MR spectroscopy.

The sensitivity and specificity of MR spectroscopy in diagnosing malignant changes in the prostate were 94.55% and 65.85%, respectively.

Table 6. Correlation of pathohistological findings with MR spectroscopy

MR spectroscopy	**Pathohistological findings**		Total
	malignant	benign	
Malignant lesion	52	14	66
Benign lesion	3	27	30
Total	55	41	96

McNemar Chi=5.9 *p=0.015

Table 7. Sensitivity and specificity of MR spectroscopy

Statistic	**Value**	**95% CI**
Sensitivity	94.55%	84.88% to 98.86%
Specificity	65.85%	49.41% to 79.92%
Positive Likelihood Ratio	2.77	1.80 to 4.26
Negative Likelihood Ratio	0.08	0.03 to 0.25
Positive Predictive Value	78.79%	70.73% to 85.09%
Negative Predictive Value	90.00%	74.56% to 96.51%
Accuracy	82.29%	73.17% to 89.33%

The proportion of malignant changes on postcontrast MR series was 52/100=0.52 or 52%, while the proportion of malignant changes on MR spectroscopy was 66/100=0.66 or 66%. The difference in the proportion of malignant lesions detected by postcontrast MR series and by MR spectroscopy was statistically significant (p=0.011), as a result of a significantly higher percentage of malignant changes seen by MR spectroscopy.

According to the Kappa index value of 0.47326 and 95% confidence interval (CI) of 0.30655-0.63997, there is a moderate level of agreement between the methods of postcontrast MR series and MR spectroscopy in terms of the presentation of malignant changes in the prostate.

Table 8. Correlation of postcontrast MR series and MR spectroscopy in terms of pathohistology

MR postcontrast series	**MR spectroscopy**		Total
	Malignant lesion	Benign lesion	
Malignant lesion	46	6	52
Benign lesion	20	28	48
Total	66	34	100

McNemar Chi=6.5 *p=0.011

Table 9. Table of qualitative categorization

Kappa	0.47326
Standard error	0.08506
95% CI	0.30655 to 0.63997

ROC was performed to determine the discriminatory ability of the two methods, MR postcontrast series, MR spectroscopy and their combination in differentiating malignant from benign changes in the prostate.

According to the area under the ROC curve AUC (Area Under the Curve), both parameters have excellent discriminatory ability for differentiating malignant from benign lesions in the prostate, but their combination presents the highest AUC (0.933).

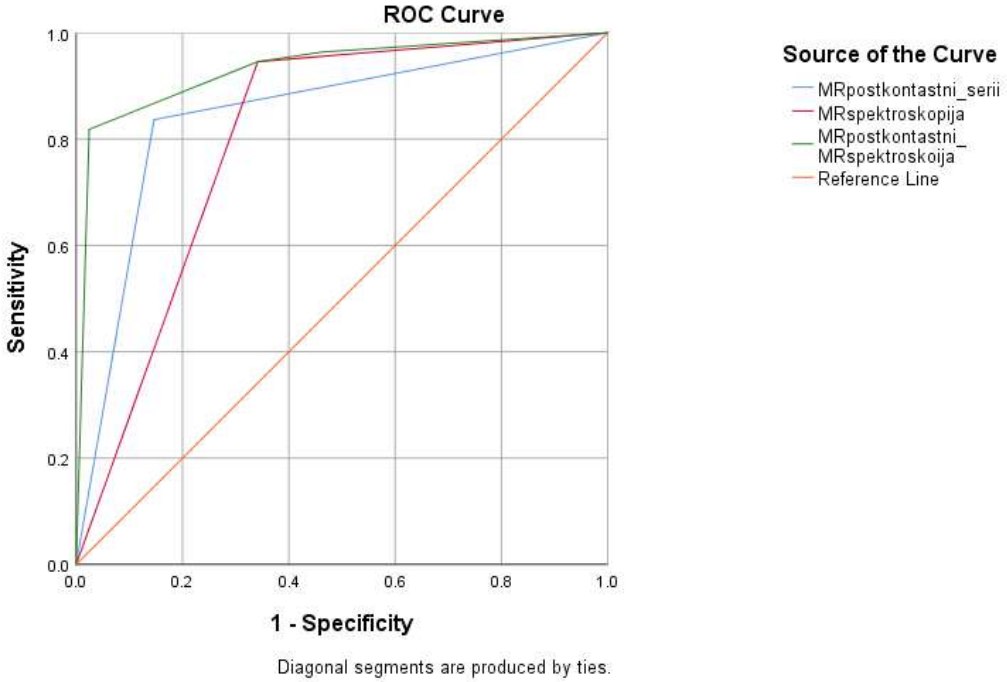

Fig. 4. Sensitivity and specificity of MR postcontrast series, MR spectroscopy and their combination in the detection of prostate carcinoma.

Table 10. Diagnostic value of MR postcontrast series, MR spectroscopy and their combination in the detection of prostate cancer.

	AUC (95% CI)	sensitivity	specificity
MR postcontrast series	0.845(0.760 – 0.930)	83.64%	85.37%
MR spectroscopy	0.802(0.705 – 0.899)	94.55%	65.85%
MR postcontrast series + MR spectroscopy	0.933(0.880 – 0.985)	81.8%	97.6%

Discussion

Prostate cancer is increasing in incidence in patients over 60 years of age, but with a reduced mortality compared to the period 2014-2018 [15]. Timely and accurate detection and evaluation is essential for further treatment planning, as well as monitoring the response to therapy.

For this purpose, we used multiparametric MRI in patients with elevated PSA values as a triage test to avoid unnecessary biopsies, as well as for mapping suspicious lesions to allow increased precision in TRUS biopsies [18].

A pelvic coil was used, not an endorectal one, due to patient intolerance. We evaluated the results obtained based on the PIRADS score from 1 to 5, where 1 is a certain benign lesion, and 5 is a certain malignant lesion. We consider all lesions with a Gleason score of 6 and higher to be malignant lesions.

MR spectroscopy provides functional data about the tissue by showing the absolute and relative concentrations of metabolites in the tissue. In prostate cancer, these are creatine, choline, and citrate. Carcinomas have a significantly higher concentration of choline and a reduced concentration of citrate.

Creatinine is often relatively constant in malignant and benign lesions. Consequently, malignant lesions present with an increased ratio of choline to creatine relative to citrate [19].

Another advantage of MR spectroscopy is the definition of malignant from benign lesions of the transitional zone in BPH [20].

On the other hand, post-contrast series are limited in terms of discrimination of malignant and benign lesions in the transitional zone [21], which to a certain extent limits the diagnostic value of MR spectroscopy.

Previous studies have reported that the sensitivity and specificity of postcontrast MR series in lesions with a Gleason score greater than 6 are 46–96% and 74–96%, respectively, but these results are highly dependent on patient selection, MRI technique, MRI criteria, and tumor size [22, 23, 24].

A similar study of combined postcontrast MR series and MR spectroscopy reported sensitivity, specificity, positive and negative predictive values of 76.5%, 89.5%, 84.5%, and 83.7%, respectively, and these results are improved when the two methods are combined as part of multiparametric MR [25].

In our study, similar results were obtained, namely the combination of the two diagnostic modalities with sensitivities of 81.8% and 97.6%.

In the study by Yuen et al. [26] where MR spectroscopy was evaluated as part of MP, the sensitivity was 70.6%, specificity was 83.5%, and 57.1% of tumors correlated with the localization of MR spectroscopy. In studies involving a smaller number of patients, the sensitivity and specificity were with accuracy of 73.35%, 96.3%, and 88% [27].

The sensitivity and specificity measured in a number of different studies with a larger number of patients ranged from 57% to 100%, while the specificity was 44% to 95%. The accuracy was 67% to 85% [25].

In our study, the sensitivity and specificity of MR spectroscopy were shown to be 94.55 and 65.85, with a diagnostic accuracy of 82.29%.

Conclusion

In our study of 96 patients, MR spectroscopy was shown to be a diagnostic method with higher sensitivity, while postcontrast MR series were more specific for tumor lesions.

The two methods combined together as part of MP MR have a significantly higher sensitivity, specificity and accuracy.

References:

1. Ren J, Yang Y, Zhang J, Xu J, Liu Y, Wei M, et al. T(2)-weighted combined with diffusion-weighted images for evaluating prostatic transition zone tumors at 3 Tesla. Future Oncol. 2013;9(4):585-93.
2. Atan A, Güzel Ö. How should prostate specific antigen be interpreted? Turk J Urol. 2013; 39(3):188-193.
3. Akin O, Sala E, Moskowitz CS, Kuroiwa K, Ishill NM, Pucar D, et al. Transition zone prostate cancers: features, detection, localization, and staging at endorectal MR imaging. Radiology. 2006; 239 (3):784-792.
4. Barentsz JO, Richenberg J, Clements R, Choyke P, Verma S, Villeirs G, et al. European Society of Urogenital Radiology. ESUR prostate MR guidelines 2012. Eur Radiol. 2012;22(4):746-57.
5. Grignon DJ, Sakr WA. Zonal origin of prostatic adenocarcinoma: are there biologic differences between transition zone and peripheral zone adenocarcinomas of the prostate gland? J Cell Biochem Suppl.1994; 19:267-269.
6. Jie C, Rongbo L, Ping T. The value of diffusion-weighted imaging in the detection of prostate cancer: a meta-analysis. Eur Radiol. 2014; 24 (8):1929-1941.
7. Manenti G, Squillaci E, Carlani M, Mancino S, Di Roma M, Simonetti G. Magnetic resonance imaging of the prostate with spectroscopic imaging using a surface coil. Initial clinical experience. Radiol Med. 2006;111(1):22-32.
8. Casciani E, Gualdi GF. Prostate cancer: value of magnetic resonance spectroscopy 3D chemical shift imaging. Abdom Imaging. 2006;31(4):490-499.
9. Shukla-Dave A, Hricak H, Eberhardt SC, Olgac S, Muruganandham M, Scardino PT, et al. Chronic prostatitis: MR imaging and 1H MR spectroscopic imaging findings--initial observations. Radiology. 2004;231(3):717-724.
10. Sciarra A, Salciccia S, Panebianco V. Proton spectroscopic and dynamic contrast-enhanced magnetic resonance: a modern approach in prostate cancer imaging. Eur Urol. 2008;54(3):485-488.
11. Hricak H, Williams RD, Spring DB, Moon KL Jr, Hedgcock MW, Watson RA, et al. Anatomy and pathology of the male pelvis by magnetic resonance imaging. AJR Am J Roentgenol. 1983; 141 (6):1101-1110.
12. Schiebler ML, Schnall MD, Pollack HM, Lenkinski RE, Tomaszewski JE, Wein AJ, et al. Current role of MR imaging in the staging of adenocarcinoma of the prostate. Radiology. 1993;189(2):339-52.
13. Yu KK, Hricak H. Imaging prostate cancer. Radiol Clin North Am. 2000; 38 (1):59-85.
14. Bratan F, Niaf E, Melodelima C, Chesnais AL, Souchon R, Mège-Lechevallier F, et al. Influence of imaging and histological factors on prostate cancer detection and localisation on multiparametric MRI: a prospective study. Eur Radiol. 2013;23(7):2019-29.
15. Kurhanewicz J, Vigneron DB, Hricak H, Narayan P, Carroll P, Nelson SJ. Three-dimensional H-1 MR spectroscopic imaging of the in situ human prostate with high (0.24-0.7-cm3) spatial resolution. Radiology. 1996;198(3):795-805.
16. Kuhl CK, Mielcareck P, Klaschik S, Leutner C, Wardelmann E, Gieseke J, et al. Dynamic breast MR imaging: are signal intensity time course data useful for differential diagnosis of enhancing lesions? Radiology. 1999 Apr;211(1):101-110.
17. van de Ven WJ, Hulsbergen-van de Kaa CA, Hambrock T, Barentsz JO, Huisman HJ. Simulated required accuracy of image registration tools for targeting high-grade cancer components with prostate biopsies. Eur. Radiol. 2013; 23(5): 1401–1407.
18. Toivonen J, Montoya Perez I, Movahedi P, Merisaari H, Pesola M, Taimen P, et al. Radiomics and machine learning of multisequence multiparametric prostate MRI: Towards improved non-invasive prostate cancer characterization. PLoS One. 2019;14(7):e0217702.
19. Magnetic resonance imaging in prostate cancer S D Heenan Prostate Cancer and Prostatic Diseases volume 7, pages282–288 (2004).

20. Zakian KL, Eberhardt S, Hricak H, Shukla-Dave A, Kleinman S, Muruganandham M, et al. Transition zone prostate cancer: metabolic characteristics at 1H MR spectroscopic imaging--initial results. Radiology. 2003;229(1):241-247.
21. Boesen L. Multiparametric MRI in detection and staging of prostate cancer. Dan Med J. 2017;64(2):B5327.
22. Kim JK, Hong SS, Choi YJ, Park SH, Ahn H, Kim CS, et al. Wash-in rate on the basis of dynamic contrast-enhanced MRI: usefulness for prostate cancer detection and localization. J Magn Reson Imaging. 2005;22(5):639-646.
23. Lemaitre L, Puech P, Poncelet E, Bouyé S, Leroy X, Biserte J, et al. Dynamic contrast-enhanced MRI of anterior prostate cancer: morphometric assessment and correlation with radical prostatectomy findings. Eur Radiol. 2009;19(2):470-80.
24. Verma S, Turkbey B, Muradyan N, Rajesh A, Cornud F, Haider MA, et al. Overview of dynamic contrast-enhanced MRI in prostate cancer diagnosis and management. AJR Am J Roentgenol. 2012;198(6):1277-1288.
25. Panebianco V, Sciarra A, Ciccariello M, Lisi D, Bernardo S, Cattarino S, et al. Role of magnetic resonance spectroscopic imaging ([^{1}H]MRSI) and dynamic contrast-enhanced MRI (DCE-MRI) in identifying prostate cancer foci in patients with negative biopsy and high levels of prostate-specific antigen (PSA). Radiol Med. 2010;115(8):1314-1329.
26. Yuen JS, Thng CH, Tan PH, Khin LW, Phee SJ, Xiao D, et al. Endorectal magnetic resonance imaging and spectroscopy for the detection of tumor foci in men with prior negative transrectal ultrasound prostate biopsy. J Urol. 2004;171(4):1482-1486.
27. Amsellem-Ouazana D, Younes P, Conquy S, Peyromaure M, Flam T, Debré B, et al. Negative prostatic biopsies in patients with a high risk of prostate cancer. Is the combination of endorectal MRI and magnetic resonance spectroscopy imaging (MRSI) a useful tool? A preliminary study. Eur Urol. 2005;47(5):582-586.