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FEATURES OF MULTIPARAMETRIC MRI STUDY IN PROSTATE CANCER

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Abstract

This study investigates the magnetic resonance (MR) imaging features associated with prostate cancer (PCa) using multiparametric MRI (mpMRI). Data from 114 patients undergoing mpMRI of the prostate were analyzed to identify correlations between MR signs, apparent diffusion coefficient (ADC) values, and the presence of organ deformation. The study reveals statistically significant differences in DWI b-values and the presence of organ deformation between patients with and without MR signs of prostate tumor. These findings contribute to a better understanding of MR imaging characteristics in PCa diagnosis and management.

Keywords: Prostate Cancer (PCa), Multiparametric MRI (mpMRI), Magnetic Resonance Imaging (MRI), Diffusion-Weighted Imaging (DWI), Apparent Diffusion Coefficient (ADC), Organ Deformation, Diagnosis, Screening, T2-weighted imaging (T2w)

Relevance

Prostate cancer (PCa) is the most common cancer among the male population of the world, accounting for 22.7% of all diagnosed malignant diseases (excluding non-melanoma skin cancer), and is the second leading cause of death among cancer patients (Robert-Koch-Institut und die Gesellschaft der epidemiologischen Krebsregister in Deutschland e. V. Hrsg. 2019). MRI is included in the list of mandatory diagnostic studies of PCa (Wei J. T., Barocas D., Carlsson S., Coakley F., Eggener S., Etzioni R., Fine S. W., Han M., Kim S. K., Kirkby E., Konety B. R., Miner M., Moses K., Nissenberg M. G., Pinto P. A., Salami S. S., Souter L., Thompson I. M., Lin D. W. 2023). In recent years, a trend has been iden-

tified that demonstrates a certain value of traditional diffusion-weighted imaging (DWI) with T2 – weighted imaging (T2 w) in magnetic resonance imaging (MRI), which is a key component of multiparametric MRI (mpMRI) in screening for prostate diseases, including PCa (Abreu-Gomez J., Lim C., Haider M. A., 2024; Spilseth B., Margolis D. J. A., Gupta R. T., Chang S. D. 2024).

The aim of the study: To determine the features of MR signs of MRI in prostate cancer.

Relevance

Prostate cancer (PC) is the most common cancer among the male population of the world, accounting for 22.7% of all

diagnosed malignant diseases (excluding non-melanoma skin cancer), and is the second leading cause of death among cancer patients (Robert-Koch-Institut und die Gesellschaft der epidemiologischen Krebsregister in Deutschland e. V. Hrsg. 2019). MRI is included in the list of mandatory diagnostic studies of PC (Wei J. T., Barocas D., Carlsson S., Coakley F., Eggener S., Etzioni R., Fine S. W., Han M., Kim S. K., Kirkby E., Konety B. R., Miner M., Moses K., Nissenberg M. G., Pinto P. A., Salami S. S., Souter L., Thompson I. M., Lin D. W. 2023). In recent years, a trend has been identified that demonstrates a certain value of traditional diffusion-weighted imaging (DWI) with T2-weighted imaging (T2w) in magnetic resonance imaging (MRI), which is a key component of multiparametric MRI (mpMRI) in screening for prostate diseases, in-

cluding PC (Abreu-Gomez J., Lim C., Haidler M. A. 2023; Spilseth B., Margolis D. J. A., Gupta R. T., Chang S. D., 2024).

Purpose of the study: To determine the features of MR signs of MRI in PC.

Materials and methods of the study. The study was conducted at the Fedorovich Clinic and included 114 patients who underwent multiparametric MRI of the prostate gland. The age of the participants ranged from 40 to 87 years. The multiparametric MRI (mpMRI) procedure is a comprehensive study that includes several imaging modes that allow obtaining detailed information about the structure and function of the pelvic organs, including the prostate gland. The study data are divided into 2 groups depending on the presence/absence of a multiparametric feature (Table 1).

Table 1. Descriptive statistics of quantitative variables depending on the multivariable MRI feature among study participants

Indicators	MRI MP sign		p
	Availability	Absence	
Age of participants, M (SD)	66.88 (10.01)	68.63 (10.53)	0.364
MR dimensions of the PG (mm ²), Me [IQR]	43.5 [34.0; 60.0]	39.0 [32.0; 62.0]	0.486
Prostate tumor size (mm ²), Me [IQR]	13.1 [8.0; 23.0]	12.0 [8.5; 18.0]	0.775
DWI b (s/mm ²), Me [IQR]	2000.0 [2000.0; 2000.0]	1100.0 [1000.0; 1600.0]	< 0.001*
IDC values (mm ² /s), Me [IQR]	0.68 [0.59; 0.80]	0.63 [0.42; 0.81]	0.096

Results: An analysis of the presence of signs of organ deformation depending on the multiparametric MRI feature was performed among the study participants.

Table 2. Analysis of the presence of signs of organ deformation depending on the multiparametric MRI sign among study participants

Indicators	Categories	MRI MP sign		p
		Availability	Absence	
Deformation of the right ventricle	Availability	47 (82.5)	36 (63.2)	0.021*
	Absence	10 (17.5)	21 (36.8)	

* – differences in indicators are statistically significant ($p < 0.05$)

According to the data obtained when comparing the presence of signs of organ deformation depending on the multiparametric MRI sign among the study participants, we

established statistically significant differences ($p = 0.021$) (method used: Pearson Chi-square).

The odds of absence of organ deformation in the group without MR signs of prostate tumor were 2.742 times higher than in the group with MR signs of prostate tumor; the differences in odds were statistically significant (95% CI: 1.150–6.539).

An analysis of the parameters of the MR signal of tumor localization was performed depending on the multiparametric MRI feature among the study participants.

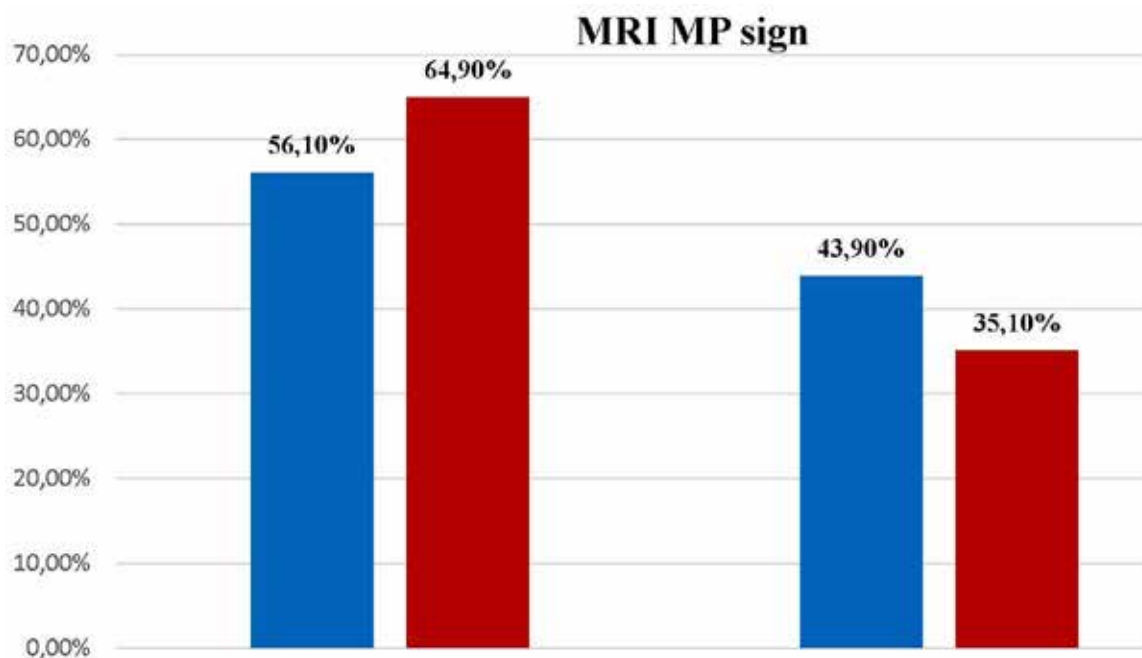
When assessing the parameters of the MR signal of tumor localization depending on the multiparametric MRI feature among the study

participants, it was not possible to identify statistically significant differences ($p = 0.338$) (*method used: Pearson Chi-square*).

The odds of indicator 2 in the group without MR signs of prostate tumor were 1.445 times lower compared to the group with MR signs of prostate tumor; the differences in odds were not statistically significant ($OR = 0.692$; 95% CI: 0.325–1.472).

We performed an analysis of the values of the parameters of the apparent diffusion coefficient depending on the multiparametric MRI feature among the study participants.

Figure 1. Analysis of MR signal parameters of tumor localization depending on the multiparametric MRI feature among study participants



According to the presented table, when assessing the values of the parameters of the apparent diffusion coefficient depending on the multiparametric MRI feature among the study participants, we identified statistically significant differences ($p < 0.001$) (method used: Pearson Chi-square).

The odds of indicator 2 in the group without MR signs of prostate tumor were 4.886 times higher than in the group with MR signs of prostate tumor; the differences in odds were statistically significant (95% CI: 2.185–10.930).

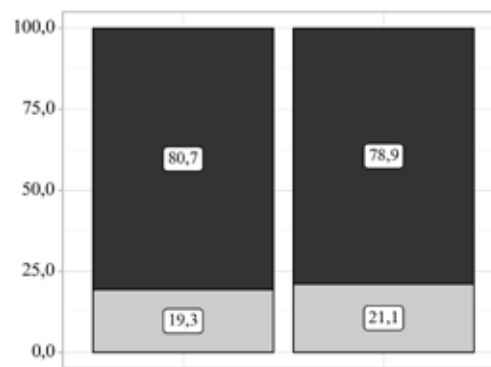
We conducted an analysis of MR differentiation of the pancreatic tumor focus depending on the multiparametric MRI feature among the study participants.

When comparing the MR differentiation of the pancreatic tumor focus depending on the multiparametric MRI feature among the study participants, we were unable to identify significant differences ($p = 0.815$) (method used: Pearson Chi-square).

The odds of indicator 2 in the group without MR signs of prostate tumor were 1.115 times higher than in the group with MR signs of prostate tumor; the differences in odds were not statistically significant (95% CI: 0.446–2.786).

We conducted an analysis of the parameters of the measured diffusion coefficient depending on the multiparametric MRI feature among the study participants.

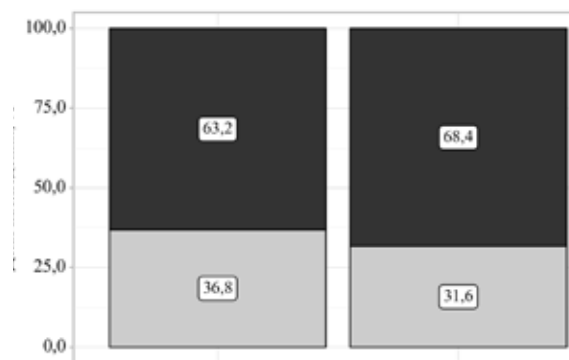
Figure 2. Analysis of MR differentiation of pancreatic tumor focus depending on the multiparametric MRI feature among study participants



When analyzing the parameter of the measured diffusion coefficient depending on the multiparametric MRI feature among the

study participants, it was not possible to establish statistically significant differences ($p = 0.554$) (method used: Pearson Chi-square).

Figure 3. Analysis of the parameters of the measured diffusion coefficient depending on the multiparametric MRI feature among study participants



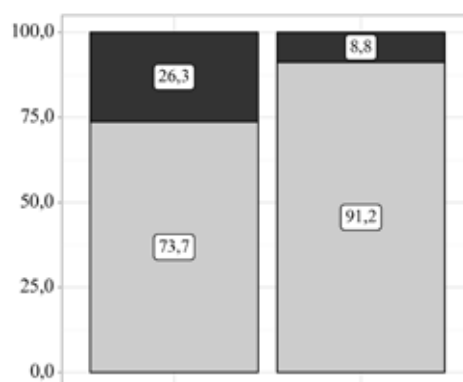
The odds of indicator 2 in the group without MR signs of prostate tumor were 1.264 times lower compared to the group with MR signs of prostate tumor; the differences in odds were not statistically significant ($OR = 0.791$; 95% CI: 0.364–1.718).

An analysis of possible signs of pancreatic tumor metastasis depending on the multi-

parametric MRI sign was performed among the study participants.

When comparing possible signs of pancreatic tumor metastasis depending on the multiparametric MRI sign among the study participants, statistically significant differences were found ($p = 0.014$) (method used: Pearson Chi-square).

Figure 4. Analysis of possible signs of pancreatic tumor metastasis depending on the multiparametric MRI sign among study participants



The odds of indicator 2 in the group without MR signs of prostate tumor were 3.714 times higher than in the group with MR signs of prostate tumor; the differences in odds were statistically significant (95% CI: 1.248–11.056).

Conclusion

Comparative analysis of our study depending on the multiparametric MRI feature

shows significant differences and presents MRI examination as a determining factor in the diagnosis of prostate cancer. In addition, multiparametric MRI examination has a great advantage over other clinical and radiation diagnostic methods in determining the localization, deformation of the prostate gland and the degree of its diffusion coefficient.

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