

Efficiency of the biparametric MRI in detection of prostate cancer: preliminary experience

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Abstract

Prostate cancer (PCa) is the most widely spread malignant tumor in men. The value of the biparametric MRI (biMRI), the MRI modality without usage of dynamic contrast enhancement (DCE), in detection of the clinically significant PCa still remains unclear. **Objectives.** The aim of the work was to estimate the diagnostic effectiveness of the application of biMRI in the detection of clinically significant PCa. **Materials and methods.** The study included 26 men suspected of having the PC. In all patients, a comprehensive clinical examination was performed, which included biMRI. The evaluation of MRI data was carried out in accordance with the PI-RADS system version 2 and improved by us sectoral map. **Results.** The distribution of patients according to the PI-RADS was as follows: 1 point – 2 (7.69%) patients, 2 points – 5 (19.23%) patients, 3 points – 8 (30.77%) patients, 4 points – 6 (23.08%)

Key words:

prostate cancer, multiparametric MRI, biparametric MRI, diagnostics, Gleason, diffusion weighted imaging, PI-RADS

patients and 5 points – 5 (19.23%) persons. In the subgroup of patients with the 5 points, clinically significant PC was detected in 100% of cases. In the subgroup of patients with tumors of 4 points, clinically significant PC was diagnosed in 5 (83.33%) cases, and in 1 (16.67%) patient – clinically insignificant tumor. In the subgroup of patients with 3 points, clinically significant PC was diagnosed in 4 (66.67%) cases, 1 (16.67%) patient – clinically insignificant tumor and in 1 (16.67%) patient – benign prostatic hyperplasia. PCs' with Gleason score ≥ 7 demonstrated significantly lower mean values of apparent diffusion coefficient (ADC) of diffusion-weighted images of MRI in comparison with tumors with Gleason score < 7 : $0.85 \pm 0.08 \times 10^{-3} \text{ mm}^2/\text{s}$ vs $1.09 \pm 0.03 \times 10^{-3} \text{ mm}^2/\text{s}$ ($p < 0.05$). **Conclusions.** The obtained results testify to the high informativeness of biparametric MRT in the diagnostics of cancer of prostate. Application of the PI-RADS system allowed in 100% cases to detect a clinically significant variant of PCa and avoid unnecessary puncture biopsy. At the same time, the usage of DCR gave an additional diagnostic information only in a limited quantity of cases.

Introduction

Prostate cancer (PCa) is the most widely spread malignant tumor in men. As the morbidity on this pathology for the last thirty years has increased by four times, the lethality is about ten per cent. Such situation could be explained by the possibilities of the early diagnostics of PCa by means of a wide application of the prostate-specific antigen (PSA) measurement in the blood of the patients [1]. At the same time, many substantial researches prove that modern diagnostic and treatment approaches to PCa should be fundamentally revised and improved. Researchers had not obtained a significant difference in the indices of mortality in the patients with localized PCa and fulfilled radical prostatectomy in the comparison with the patients who were only on the observation [2]. As in the case of radical prostatectomy, application of the radiation therapy for the treatment of PCa is also associated with the development of serious complications: a loss of erection being observed in nearly 50% of patients. In case of early stage of the PCa, radical surgical treatment of this pathology could be highly effective; however, such approach is not always optimal and justified (especially low risk tumors) [3]. Thus, such alternative clinical strategies have been introduced, as active observation, watchful waiting

and organ-preserving focal therapy [4,5]. The above mentioned, in the first turn, may be recommended to the patients with the so called “clinically insignificant” PCa with a tumor ≤ 6 according to the scale of Gleason and a level of PSA in the blood $< 10 \text{ ng/ml}$ [6,7]. However, often a choice of optimal method of treatment during an individual approach to the patient creates a considerable clinical problem. Such a situation has been caused by relatively low diagnostic value of USG in detection of PCa, and a considerable quantity of pseudonegative results of puncture biopsy of prostate which is equal to 45% [8,9]. Recently the data appeared that multiparametric MRI (mpMRI) is capable to provide a valuable information for the diagnostics of PCa and allow more exactly stratify the patients for the active surveillance avoiding unnecessary biopsies of prostate. Albeit, the value of the biparametric MRI (biMRI), the MRI modality without usage of dynamic contrast enhancement (DCE), in detection of the clinically significant prostate cancer still remains unclear.

Purpose

The aim of the work was to estimate the diagnostic effectiveness of the application of biMRI in the detection of clinically significant PCa.

Materials and Methods

The research was allowed by the ethic commission and was carried on the basis of the clinics of the department of urology and the department of radiology of Lviv National Medical University named after Danylo Halytsky and on the basis of medical centre “Euroclinic” during 2018, 26 men took part in the research in age 56-70 (the average age – 67.6 ± 4.5) with the suspicion on PCa according to the data of clinical observation. All the patients took part in complex clinical observation which included MRT and generally accepted methods. One (or more) factors were the criteria of the observation: the level of general PSA in the blood above 4 ng/ml, the symptoms of PCa according to the data of digital rectal examination, the features of PCa according to the results of USG. In all cases, before MRI, puncture biopsy or treatment of the PCa were not carried out. MRT was performed using 1.5 T scanner (Signa HDxt, General Electric, the USA) with the eight-channel coil. In all the cases the identical standardized protocol of scanning was used, which included axial diffusion-weighted images (DWI) with $b\text{-value} = 1000 \text{ mm}^2/\text{s}$. DWI were carried on before the using of contrast substances. Maps of the

apparent diffusion coefficient (ADC) were generated automatically on the working station on the basis of DWI and were used as the measure of diffusion. The estimation of the obtained results of MRI scanning was executed according to the Recommendations of American College of Radiology – Prostate Imaging – Reporting and Data System (PI-RADS) version 2.1. The assessment of each of the zones of prostate – central, transitional and peripheral was executed. According to the PI-RADS system, the obtained point was interpreted as the follows: 1 – a very low probability of clinically significant PCa; 2 – a low probability of clinically significant PCa; 3 – an intermediate result; 4 – a high probability of clinically significant PCa; 5 – a very high probability of clinically significant PCa. For the marking of the area of affection the elaborated sector maps of prostate were used on which each of the third part of prostate (basal, medium and apical) was virtually distributed into twelve sectors (Fig. 1).

The obtained MRI data was analyzed in concordance with the results of clinical data (the level of serum PSA) and with results puncture biopsy of the prostate. For the statistical processing of the obtained data Microsoft Excel 2016 and SPSS v.22 software packages were used.

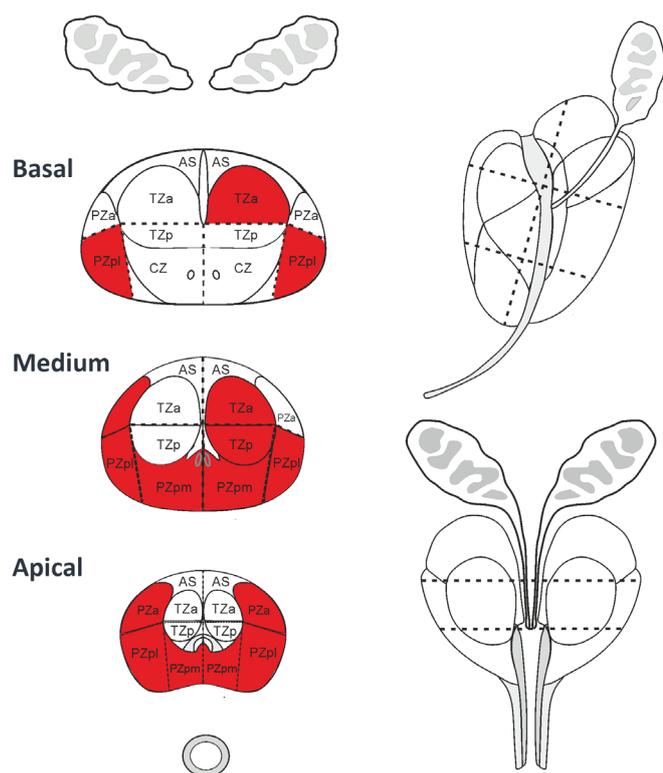


Fig. 1.

Sector map of prostate. Patient T., 65 years of age, PSA – 23 ng/ml, affection of prostate – 5 points according to the system PI-RADS (red color).

Results

In the result of analysis the following distribution of the patients according to the PI-RADS system was obtained: 1 point – 2 (7.69%) patients; 2 points – 5 (19.23%) patients; 3 points – 8 (30.77%) patients, 4 points – 6 (23.08%) patients and 5 points – 5 (19.23%) patients. During one week after MRI, puncture biopsy of prostate under USG control was performed for all the patients whose lesions of prostate were classified as 5 and 4 points according to the PI-RADS system. According to the pathology reports, in the subgroup of the patients with the PI-RADS 5 lesions, clinically significant PCa (≥ 7 Gleason score) was observed in 100% cases. In the subgroup with lesion scored 4 according to the system PI-RADS, clinically significant PCa was diagnosed in 5 (83.33%) cases and in 1 (16.67%) patient – clinically insignificant variant of tumor (6 Gleason score). In 8 patients whose lesion of prostate was classified according to the system PI-RADS as 3 points, puncture biopsy was carried out in 6 (75%) cases due to the level of serum PSA > 4 ng/ml, the rest of the patients were subject to dynamic observation. According to the histological reports in this subgroup of the patients clinically significant PCa was diagnosed in 4 (66.67%) cases and in 1 patient (16.67%) – benign prostatic hyperplasia. For the patients with lesions scored 1 and 2 according to the PI-RADS system a puncture biopsy was not performed, they were subject to dynamic observation during 3 months. During this term only in 1 patient a level of serum PSA remained above 4 ng/ml (and was 5.2 ng/ml), because of this puncture biopsy prostate was executed and a benign hyperplasia was diagnosed. According to retrospective analysis it was found, that in 100% cases of histologically verified clinically significant PCa, on T-2 weighed sequences an area of neoplasm had sufficiently lower intensity of the signal. Thus, in case of localization of tumor in a peripheral zone, in 89% cases a character of neoplasm was focal (distinct contours, a wedge – shaped form) and in case of transitional or central zones tumor involvement, in 75% cases lesion had indistinct margins and an irregular form.

At the same time, DWI of a zone of affection by a tumor had a variable limitation of diffusion (areas of

hyperintensity from smaller to bigger intensity) represented in lower of the ADC values in the comparison with unaffected tissues ($0.94 \pm 0.11 \times 10^{-3}$ mm²/s vs $1.59 \pm 0.09 \times 10^{-3}$ mm²/s, $p < 0.05$). PCs' with Gleason score ≥ 7 demonstrated significantly lower mean values of apparent diffusion coefficient of diffusion-weighted images of MRI in comparison with tumors with Gleason score < 7 : $0.85 \pm 0.08 \times 10^{-3}$ mm²/s vs $1.09 \pm 0.03 \times 10^{-3}$ mm²/s ($p < 0.05$).

We analyzed an added diagnostic value of DCE on PI-RADS classification for each case of histologically verified PCa. Surprisingly, there were no re-classified cases (no change in PI-RADS score) according to PI-RADS system, when biMRI was used for assigning a score for the prostatic lesion. It should be mentioned that only in 19% of patients with ≥ 7 Gleason tumors, on DCE images accumulation of contrast substance during the early contrasting phase was observed in a suspicion area (Fig. 2).

Discussion

We have studied a diagnostic value of the application of biMRT in the detection of clinically significant PCa. There are data of other researchers who had studied effectiveness of MRI in the diagnostics of this pathology. Meng and co-authors had analyzed the link between the MRI data before the biopsy of prostate and a PCa detection rate. On the basis of the obtained data it was proved that MRI in combination with puncture biopsy allowed to detect by 26% more cases of clinically significant PCa (> 7 points according to the scale of Gleason) in the comparison with application of only systematic biopsy: 158 patients and 117 patients correspondingly ($p < 0.001$) [10]. According to our data, biMRI in combination with systematic biopsy allowed to detect 100% of clinically significant PCa. According to the results of Bjurlin and co-authors, MRI allowed to detect more than 70% of cases of clinically significant PCa, which is correlated with our data [11]. In result of the substantial research published in 2017 by Hansen and his colleagues, systematic biopsy of prostate allowed to detect PCa of 7-10 points by the scale of Gleason in 91% cases. In the patients with 5 points according

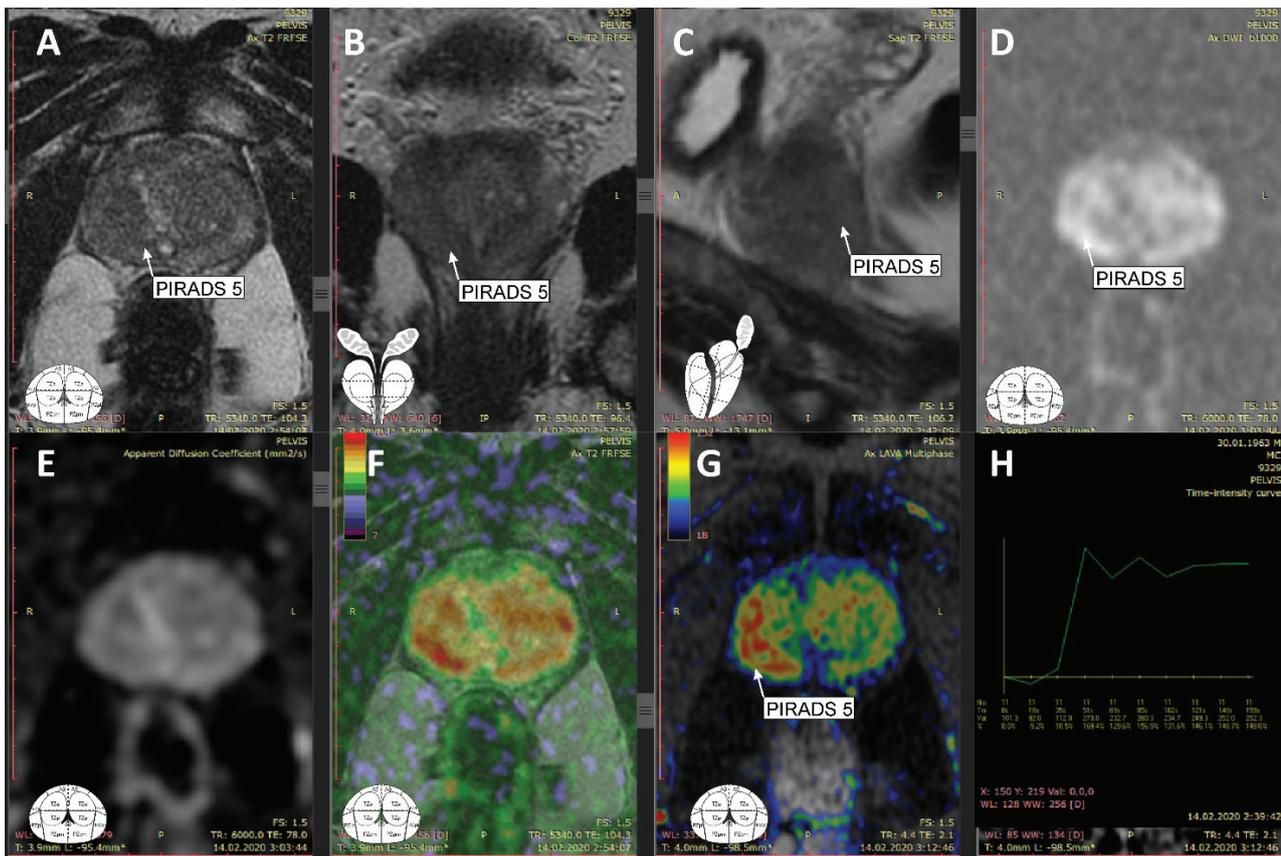


Fig. 2.

Multiparametric and biparametric MRI of the prostate. The same patient, areas of lesion marked by arrows (PI-RADS 5 lesion). A: axial T2 weighed image; B: coronal T2 weighed image; C: sagittal T2 weighed image; D: axial DWI; E: ADC map; F: T2/DWI fusion; G: T1 image with fat suppression, DCE image fused with subtraction map; H: DCE kinetic curve.

to the PI-RADS system, systematic biopsy did not allowed to diagnose 11% of clinically significant PCa, while the image-targeted biopsy on the basis of the results of MRI did not allowed to detect only 9% of the same cases [12]. According to our data, in the subgroup of the patients with PI-RADS 5 lesions, clinically significant CPP (≥ 7 Gleason score) was observed in 100% cases, what in general corresponds to the data of literature.

Conclusions

The obtained results testify to the high informativeness of biparametric MRT in the diagnostics of cancer of prostate. Application of the PI-RADS system allowed in 100% cases to detect a clinically significant variant of PCa and avoid unnecessary puncture biopsy. At the same time, the usage of DCR gave an additional diagnostic information only in a limited quantity of cases.

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