THE ROLE OF MULTIPARAMETRIC MRI IN DETECTION OF PROSTATE CANCER IN PATIENTS WITH TOTAL SERUM PROSTATE SPECIFIC ANTIGEN LEVELS OF 4-10 NG/ML: A PROSPECTIVE COHORT STUDY

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Target audience

Radiologist and urologist who focus on the detection of prostate cancer (PCa) in men with total serum prostate specific antigen (PSA) levels of 4–10 ng/mL, which is referred to as the "gray zone."

Purpose

To evaluate the role of multiparametric MRI (mp-MRI) in detection of PCa and to explore the role of mp-MRI in prediction of PCa incidence in patients with total PSA levels of 4–10 ng/mL by a prospective cohort study.

Methods

We prospectively collected 345 consecutive patients with total PSA levels of 4–10 ng/mL undergoing prebiopsy mp-MRI from July 2002 to December 2009. The age and PSA level (total PSA, free PSA and free-to-total PSA ratio) within 3 months of the prostate MRI were recorded. Mp-MRI was done including a combination of high-resolution T2-weighted image (T2WI), and at least two functional MRI techniques (diffusion weighted imaging (DWI), dynamic contrast enhanced MRI (DCE-MRI) and MR spectroscopy imaging (MRSI)). A five-point subjective suspicion score was assigned to all focal abnormalities (Score: 1, definitely benign; 2, likely benign; 3, indeterminate; 4, likely malignant; 5, definitely malignant), as prostate imaging reporting and data system (PI-RADS) recommended by European Society of Urogenital Radiology (ESUR).[1] The results of biopsy guided by transrectal ultrasonography within 3 months were recorded. Individual patients were followed with intervals of 1 or 2 years till December 2013 and censored at the occurrence of death or emigration. At the end of follow-up, the final diagnosis was obtained according to pathology (biopsy, transurethral resection of the prostate (TURP) or surgical pathology) or clinical comprehensive analysis. Receiver operating characteristic (ROC) curve was used to analyze diagnostic efficacy of mp-MRI, under results of biopsy within 3 months. To calculate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of mp-MRI, score 3, 4 and 5 were considered positive findings and score 1 and 2 were considered negative findings. To analyze the role of mp-MRI in prediction of PCa incidence, patients were divided into 3 groups according to mp-MRI results: score 1-2, score 3 and score 4-5. Cumulative detection rate of PCa was derived using Kaplan-Meier method, and differences between curves were analyzed by log-rank test. A cox proportional hazards model was used to identify independent variables for the prediction of PCa incidence. Mp-MRI result was defined as a categorical variable. Multivariate models were adjusted for age and baseline PSA level. Both age and baseline PSA level were defined as continuous variables.

Results

Of 345 patients (mean age: 68.6 yr, range: 26-91), 142 patients had biopsy within 3 months. Fifty-five of 142 patients were pathologically diagnosed with PCa. During 132 months of follow-up (median follow-up: 74 mo), 102 of 345 patients were diagnosed with PCa. The mean total PSA value was 7.1 ng/mL. For results of biopsy within 3 months as the standard of reference, the sensitivity, specificity, PPV, NPV and the area under the ROC curve (AUC) for the detection of PCa with mp-MRI were 0.91 (95% confidence interval [CI], 0.80-0.97), 0.77(95% CI, 0.67-0.85), 0.71 (95% CI, 0.59-0.82), 0.93 (95% CI, 0.85-0.98) and 0.90 (95% CI, 0.84-0.95), respectively. The detection rate of PCa at the first, third and tenth year were 3.1%, 4.0% and 8.9% in group score 1-2; 27.8%, 38.9% and 55.6% in group score 3; 58.3%, 63.1% and 73.8% in group score 4-5 (Fig. 1). Unadjusted and multivariable adjusted hazard ratios are presented in Table 1. In univariate analyses, older age, greater baseline total PSA level and higher score of PI-RADS were all significantly associated with an increased risk of detection rate of PCa, while free PSA and free-to-total PSA ratio were not. In adjusted analysis with age and baseline PSA, higher score of mp-MRI was independently associated with a greater risk of detection rate of PCa: compared with score 1-2 (reference), the hazard ratio (HR) was 7.53 (95% CI 4.04-14.05) for score 3, 14.89 (95% CI 8.84-25.10) for score 4-5 (P<0.001). However, age was not significantly associated after adjustment in the multivariate model (P=0.55).

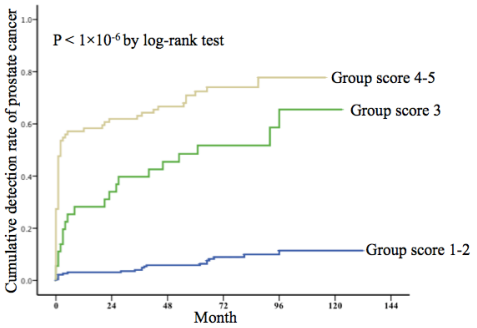

Figure 1: Kaplan-meier curve of cumulative detection rate of prostate cancer with mp-MRI stratified by PI-RADS scores

Table 1: Hazard ratios for the detection rate of prostate cancer analyzed by cox proportional hazard model.

		Unadjusted model		Adjusted model	
Variable	Events. No	HR (95% CI)	P value	HR (95% CI)	P value
Age	102/345	1.03 (1.01-1.06)	0.009	1.01 (0.99-1.03)	0.553*
Baseline PSA level (ng/mL)					
Total PSA	102/345	1.20 (1.07-1.35)	0.001	1.15 (1.03-1.29)	0.016
Free PSA	98/308	0.71 (0.49-1.04)	0.077*		
Free-to-total PSA ratio	98/308	0.09 (0.01-1.30)	0.077*		
Score of PI-RADS	102/345				
1-2	20/225	1 (reference)		1 (reference)	
3	20/36	7.93 (4.26-14.76)	<0.001	7.53 (4.04-14.05)	<0.001
4-5	64/84	15.69 (9.38-26.25)	<0.001	14.89 (8.84-25.10)	<0.001

* P value > 0.05

Discussion

It is well-known that PSA level has high sensitivity for PCa detection. However, in patients with PSA levels in the 4 to 10 ng/mL range, it is difficult to distinguish PCa from prostatitis and only 30% to 35% of men will be found to have cancer.[2] This situation leads to a clinical dilemma. Our study showed mp-MRI represented an excellent NPV (93.1%). The ability to predict with high confidence the absence of clinically significant prostate cancer (NPV) would control the number of unnecessary biopsy times. Also, mp-MRI showed excellent AUC (0.90), suggesting obviously clinically relevant predictive characteristics. Furthermore, higher score of mp-MRI was significantly associated with a greater risk of detection rate of PCa.

Conclusion

In the challenging field of PCa diagnosis in patients with total PSA levels of 4-10 ng/ml, mp-MRI with PI-RADS was shown to be a valuable tool for the detection of PCa and prediction of the incidence of PCa.

References

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