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IMPACT OF MORPHOMETRIC ANALYSIS OF PROSTATE ZONAL ANATOMY ON LOWER URINARY TRACT SYMPTOM: COOPERATIVE ANALYSIS OF MRI-PROSTATE IN USA AND JAPAN

Hypothesis / aims of study

Magnetic resonance imaging (MRI) has been recognized as a reliable imaging to evaluate the prostate, and potentially enhance the morphometric analysis of prostate zonal anatomy. Objective of this study is to evaluate impact of the morphometric analysis of the prostate zonal anatomy on lower urinary tract symptom (LUTS) in cooperative analysis of MRI-prostate between USA and Japan.

Study design, materials and methods

A total of 307 men, average age 68 years, including Japanese men (n=156) and non-Asian American men (n=151), who had elevated PSA and underwent MRI with slice-thickness of 3-mm prior to prostate biopsy. Associated LUTS was assessed using International Prostate Symptom Score (IPSS). Using computer software of Synapse Vincent version 2 (Fujifilm, Japan), the boundary of prostate zonal anatomy was segmented in each axial step section of T2-weighted image of MRI, to reconstruct 3D-model of the prostate zonal anatomy to calculate following variables; (1) volume of whole gland prostate [Pr-vol.] (ml), (2) volume of transition zone [TZ-vol.] (ml), (3) volume of peripheral zone [PZ-vol.] (ml), which includes both the peripheral zone and central zone of McNeal's zonal anatomy[1)], (4) Presumed Circle Area Ratio [PCAR], which is defined as the *ratio of the area* in the maximum axial section of the prostate *to the area* of a presumed circle with the equal circumference of the section[2)]. (PCAR evaluates how closely the shape of the section approaches a circle, and represents "increase of intra-prostatic pressure"[3)].), and (5) PZ-thickness (mm), defined as PZ-volume divided by the maximum coronal section-area of prostate, by computerized-calculation from the reconstructed 3D-prostate volume (Figure 1). The relation between these morphometric variables and LUTS were evaluated with total IPSS, sum of obstructive symptom scores (incomplete emptying, intermittency, slow stream, and hesitancy) and sum of irritative symptom scores (frequency, urgency, and nocturia).

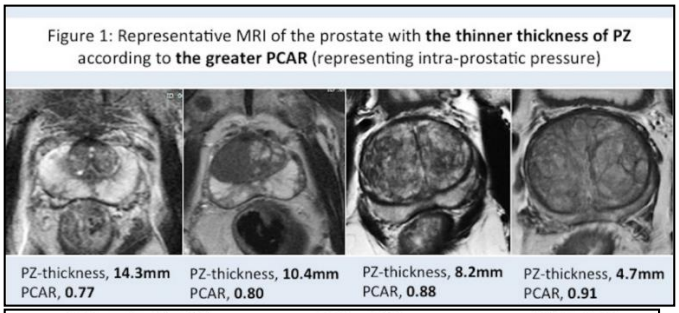

Figure 1: Representative MRI of the prostate with **the thinner thickness of PZ** according to **the greater PCAR** (representing intra-prostatic pressure)

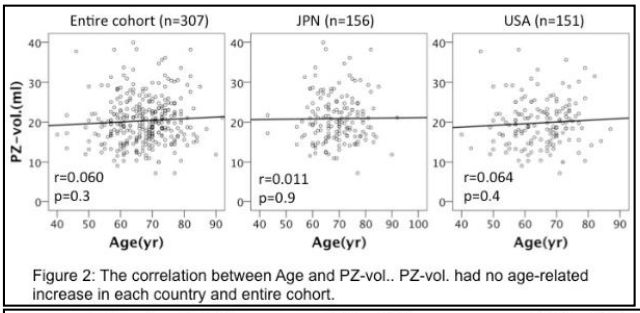

Figure 2: The correlation between Age and PZ-vol.. PZ-vol. had no age-related increase in each country and entire cohort.

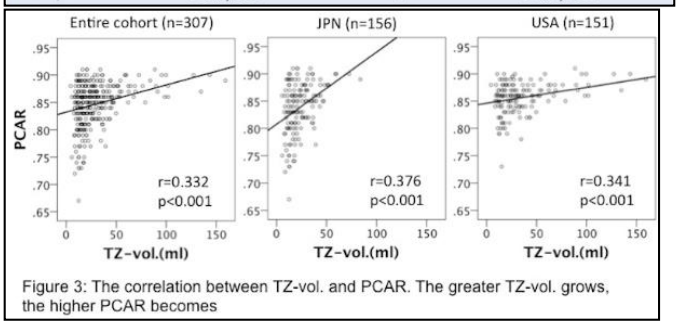

Figure 3: The correlation between TZ-vol. and PCAR. The greater TZ-vol. grows, the higher PCAR becomes

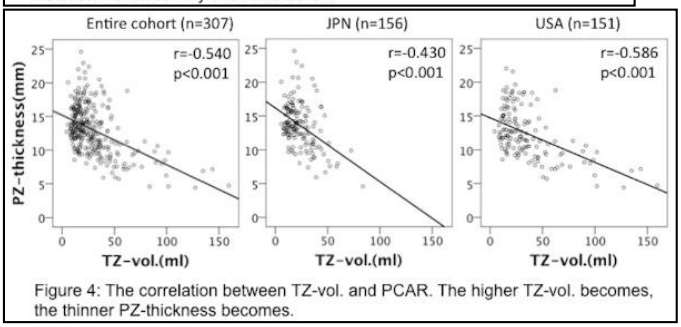

Figure 4: The correlation between TZ-vol. and PCAR. The higher TZ-vol. becomes, the thinner PZ-thickness becomes.

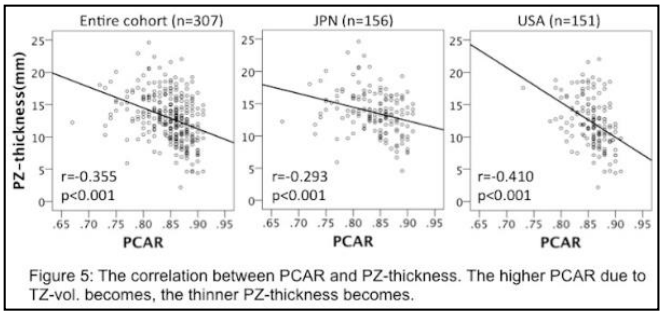

Figure 5: The correlation between PCAR and PZ-thickness. The higher PCAR due to TZ-vol. becomes, the thinner PZ-thickness becomes.

	IPSS	Obstructive Symptom Score	Irritative Symptom Score
PCAR	r=0.271 p=0.006	r=0.251 p=0.011	r=0.234 p=0.018
PZ-thickness	r=-0.241 p=0.015	r=-0.241 p=0.015	r=-0.182 p=0.067
TZ-vol.	r=0.223 p=0.024	r=0.202 p=0.042	r=0.199 p=0.045

r: Peason's coefficient

Table 1: Correlation between morphometric variables and LUTS.

Results

In comparing between Japanese and American men, American men had greater volume in Pr-vol. (41.8 ml vs. 48.9 ml, p=0.004), and TZ-vol. (19.6 ml vs. 26.1 ml, p<0.001), but there were no statistical difference in PZ-vol. (19.9 ml vs. 20.0 ml, p=0.14). PZ-vol. had **no** age-related increase in each country and entire cohort (p=0.9, p=0.4, and p=0.3, respectively) (Figure 2).

PCAR had significant positive correlation with TZ-vol. (r=0.332, p<0.001). PZ-thickness had significant negative correlation with PCAR (r=-0.355, p<0.001) as well as TZ-vol. (r=-0.540, p<0.001). These suggested that the greater the intra-prostatic-pressure increases (represented by the greater PCAR) due to the greater growth of TZ-vol., the thinner the PZ-thickness become (Figure 3, 4, and 5, respectively). Amongst the MRI morphometric variables, PCAR had the most significant relation with LUTS, followed by PZ-thickness and TZ-vol.. PCAR and TZ-vol. had significant positive correlation with all three symptom-scores of IPSS, obstructive symptom, and irritative symptom, while PZ-thickness had significant negative correlation with both IPSS and obstructive symptom but not significant relation with irritative symptom (Table 1).

Interpretation of results

It is well known that the volume of prostate and TZ increase with age, having significant association with the severity of LUTS. However, only a few reports identified the relation between the morphology of PZ and age. This study revealed that PZ-vol. had no age-related increase in the men in both countries. Interestingly, however, PZ-thickness, which is a novel concept in this study, had significant negative correlation with PCAR, and also significant negative correlation with IPSS and obstructive symptom. Since PCAR, which represents the intra-prostatic pressure, significantly increase with TZ-vol., we interpreted these results as that the greater the TZ-volume grows, the higher the intra-prostatic pressure and the thinner the PZ-thickness becomes. The obstructive symptom is most related with intra-prostatic pressure due to the enlarged TZ, with association of the thinner PZ-thickness. MRI would enhance the morphometric analysis of the prostate zonal anatomy for not only TZ but also PZ, and their relationships with LUTS.

Concluding message

MRI has ability to document morphometric analysis of the prostate zonal anatomy. PZ-volume had no age-related increase in both USA and Japan. The greater the TZ-volume grows, the higher the intra-prostatic pressure and the thinner the PZ-thickness become. LUTS, especially obstructive symptom, is significantly associated with the increased PCAR (intra-prostatic pressure) as well as the thinner PZ-thickness amongst the morphometric variables of prostate zonal anatomy.

References

1. Prostate 1981;2:35
2. Prostate 1998; 37;116
3. Urology 1997; 50;548

Disclosures

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