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Transrectal Ultrasonic Planimetry of the Prostate in Relation to Age and Lower Urinary Tract Symptoms among Elderly Men in Japan

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Taneike, R., Kojima, M. and Saitoh, M. *Transrectal Ultrasonic Planimetry of the Prostate in Relation to Age and Lower Urinary Tract Symptoms among Elderly Men in Japan.* Tohoku J. Exp. Med., 1997, **183** (2), 135-150 —— The aim of the present study is to correlate transrectal ultrasonic planimetric parameters of the prostate in relation to age and urinary symptoms as evaluated by the American Urological Association (AUA) symptom index score for benign prostatic hyperplasia (BPH). In 647 examinees on a mass screening program for prostatic diseases using transrectal sonography (TRS) in Japan, prostatic volume, transition zone volume, transition zone index (transition zone volume/prostatic volume) and presumed circle area ratio (PCAR) were determined using transrectal ultrasonic planimetry and compared with age and AUA symptom score. Increase in age, prostatic volume, transition zone volume and PCAR were significantly correlated with AUA symptom score. However, multiple regression analysis demonstrated that age and PCAR were the only significant independent determinants of symptom score. In particular, PCAR was the only significant determinant of symptom score in men with an intermediately enlarged prostate (20-30 ml in volume). The most significant difference in AUA symptom score was found between subgroups divided by PCAR with a cutoff point of 0.8. Among the planimetric parameters obtained by TRS, PCAR was the most powerful for evaluating BPH in terms of the severity of lower urinary tract symptoms. —— AUA symptom index; benign prostatic hyperplasia; aging; presumed circle area ratio; transrectal sonography

Transrectal sonography (TRS) has been credited as the most reliable method for the planimetry of the prostate, providing invaluable data for the diagnosis and treatment of prostatic diseases (Watanabe et al. 1968, 1975; Watanabe and Kojima 1997). In particular, based upon our experience to date, TRS is an

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inevitable tool for the diagnosis of benign prostatic hyperplasia (BPH) (Watanabe 1993). In our previous reports, it has been demonstrated that presumed circle area ratio (PCAR), which is a planimetric parameter showing how the horizontal sonogram of the prostate approaches a circle, represents the severity of BPH very well (Watanabe 1979, 1993).

On the other hand, enlargement of the prostate (or increased prostatic volume) is traditionally related with the development of BPH (Garraway et al. 1991). Recently, Kaplan et al. (1996) measured transition zone volume as a more sensitive prostate size marker for BPH and reported the clinical usefulness of transition zone index (transition zone volume/prostatic volume) in evaluating BPH. Thus, the lack of consensus concerning a definitive diagnosis of BPH makes it difficult to assess the severity of the disease objectively and quantitatively with sufficient reliability.

In this study, we calculated the distribution of transrectal ultrasonic planimetric parameters of the prostate among elderly men enrolled in community-based mass screening in Japan and correlated them with lower urinary tract symptoms as well as age with the aim of advancing our knowledge of BPH.

Materials and Methods

Since 1975 we have been conducting a mass screening program for prostatic diseases using TRS in community-based populations aged 55 years or more in Japan (Watanabe et al. 1977). In 1994, a total number of 672 men in 6 rural towns in Kyoto, Shiga and Hokkaido Prefectures underwent mass screening examinations under the program, of whom 10 (1.5%), 9 (1.3%) and 6 (0.9%) were diagnosed as having prostatic stone, prostatic cancer and prostatitis, respectively. The remaining 647 men (55–86 years, 66.7 ± 6.4 years), of whom 83 (12.8%), 358 (55.3%), 183 (28.3%) and 23 (3.6%) were 55 to 59, 60 to 69, 70 to 79 and greater than 80 years old, respectively, were enrolled in this study.

The primary study of the mass screening program was comprised of the American Urological Association (AUA) symptom index, digital rectal examination, TRS and serum prostate specific antigen (PSA) determination (Watanabe et al. 1984, 1995; Barry et al. 1992). Examinees completed the questionnaire of the AUA symptom index which had been translated into Japanese (Kawabe and Watanabe 1994). The AUA symptom scores for 7 kinds of symptoms (incomplete emptying, frequency, intermittency, urgency, weak stream, hesitancy and nocturia), each of which was graded from 0 to 5 points, were collected for all examinees. A total of symptom scores was obtained by adding the scores for the 7 kinds of symptoms to give a range from 0 to 35 points, and was categorized as mild (scores 7 or less), moderate (scores 8 to 19) or severe (scores 20 or more) (Barry et al. 1992).

TRS was performed using a chair-type scanner in a mobile unit (Watanabe et al. 1984). Horizontal sonograms of the prostate were photographed every 5 mm in depth, and prostatic volume was calculated using step-section volumetry

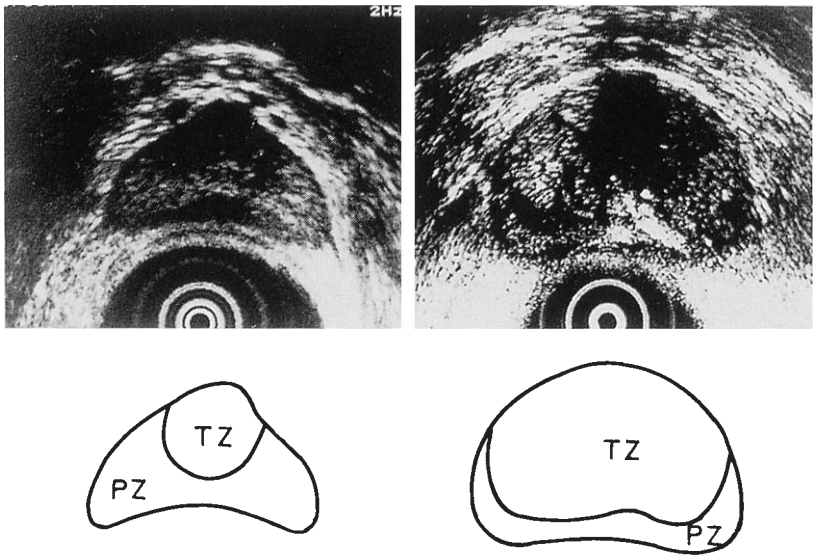

Fig. 1. Transrectal sonograms of the prostate with schematic drawing of the transition zone. TZ, transition zone; PZ, peripheral zone.

(Watanabe 1974). In the same manner, the volume of the transition zone was measured (Fig. 1). A transition zone index was calculated by dividing the transition zone volume by the prostatic volume (Kaplan et al. 1996). PCAR was also calculated on the horizontal sonogram with the maximum area. PCAR is the ratio of the area of the maximum horizontal section of the prostate to the area of the presumed circle of which the circumference is equal to the circumference of the maximum horizontal section (Fig. 2) (Watanabe 1979). All these ultrasonic measurements were obtained using an image measuring system (Finetec, Tokyo) with a personal computer. When PCAR was 0.75 or more, the diagnosis of BPH was made. Out of the 647 examinees, 138 (21.3%) were diagnosed as having BPH.

All values in the text were expressed as the mean plus or minus standard deviation. An unpaired Student's t-test was chosen to compare the numerical variables between the groups. The chi-square for trend was adopted to compare percentages between groups. Simple regression analysis was employed to test the linearity of the relationship between two variables, and multiple regression analysis to test the linear effect of age and ultrasonic parameters in predicting the AUA symptom score. These statistical analyses were performed using commercially-available software (Stat View, Abacus Concepts, Inc., Berkeley, CA, USA). For all statistical tests, a p-value less than 0.05 was considered significant.

Results

Distribution of the total AUA symptom score is shown in Fig. 3. Out of the 647 examinees, 471 (72.8%) had slight symptoms and the remaining 176 (27.2%) had either moderate (141) or severe (35) symptoms. Distributions of ultrasonic planimetric parameters of the prostate are also shown in Fig. 4. Out of the 647

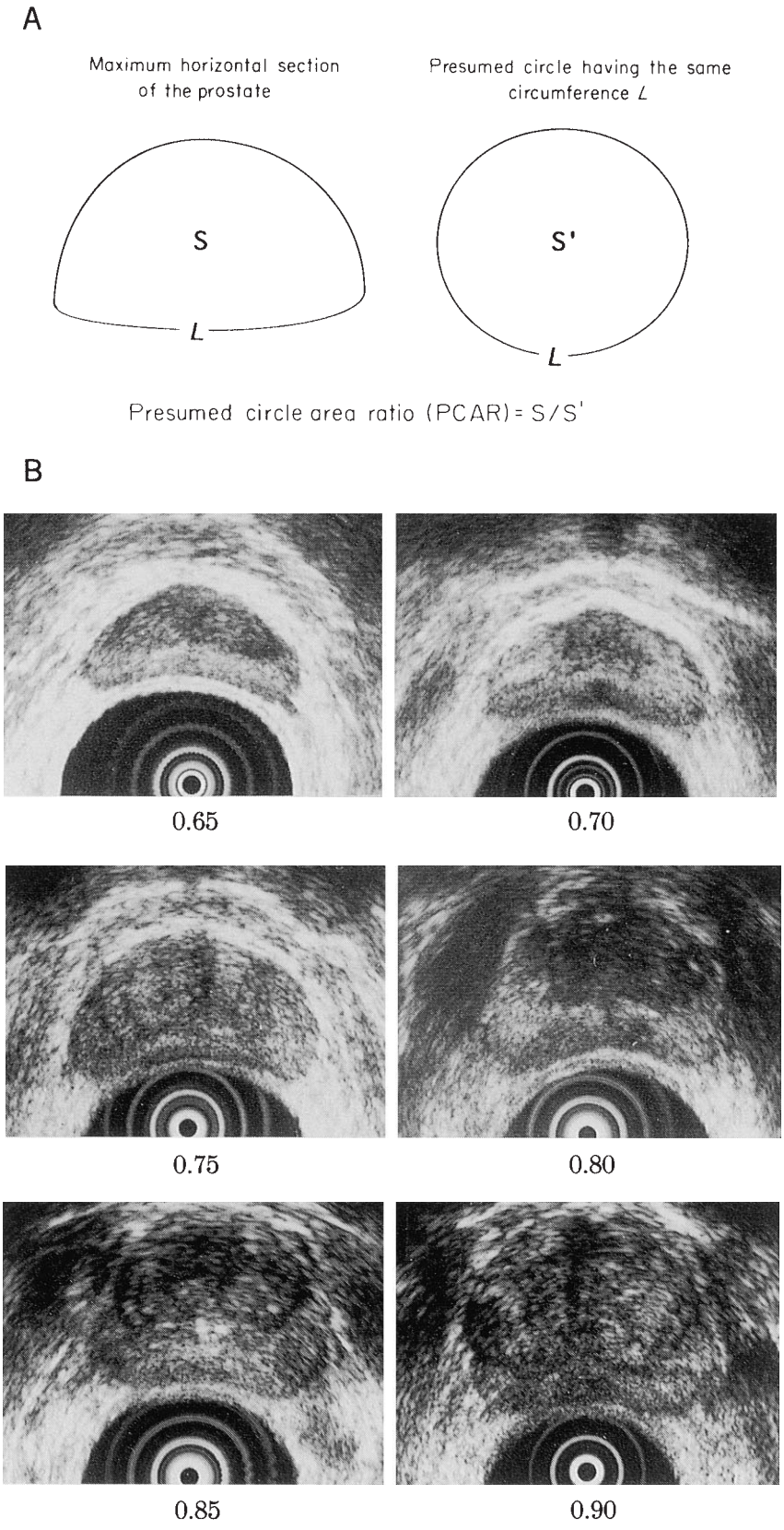

Fig. 2. Schematic drawing of PCAR (A) and representative transrectal sonograms of the prostate with various PCAR (B).

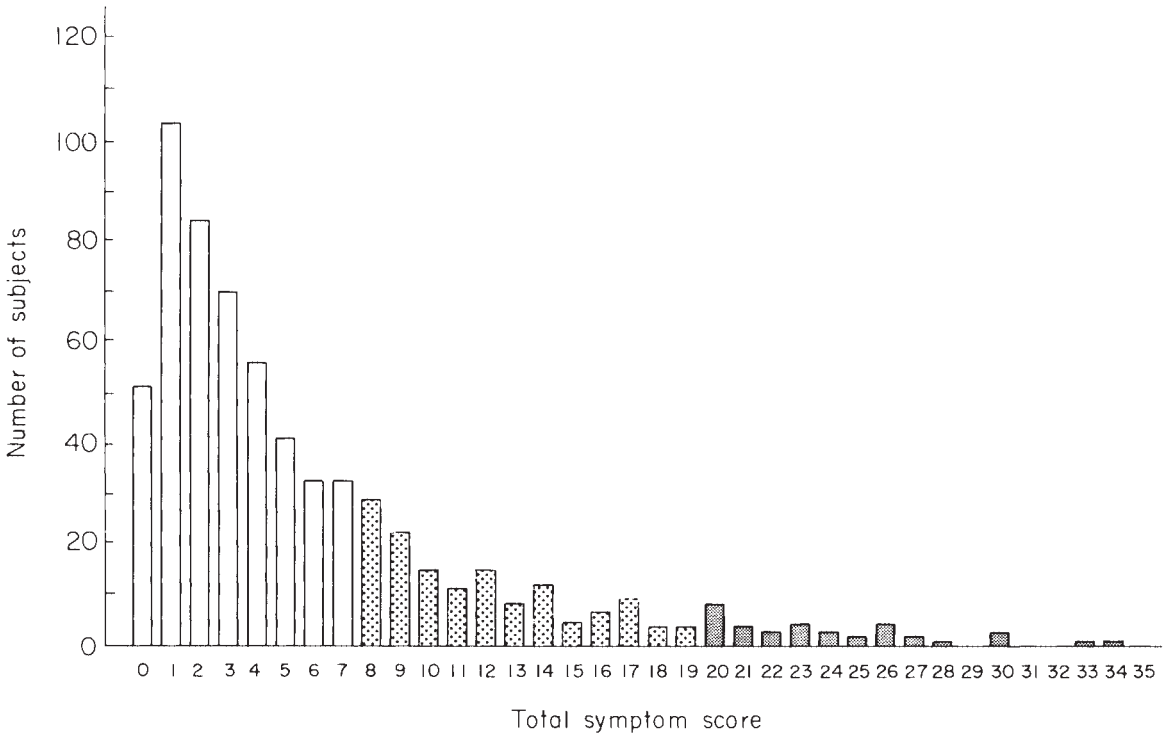

Fig. 3. Distribution of AUA symptom scores in 647 men.
Mild symptom (scores 7 or less, □): 471 cases (72.8%), Moderate symptom (scores 8 to 19, ▦): 141 cases (21.8%), Severe symptom (scores 20 or more, ■): 35 cases (5.4%).

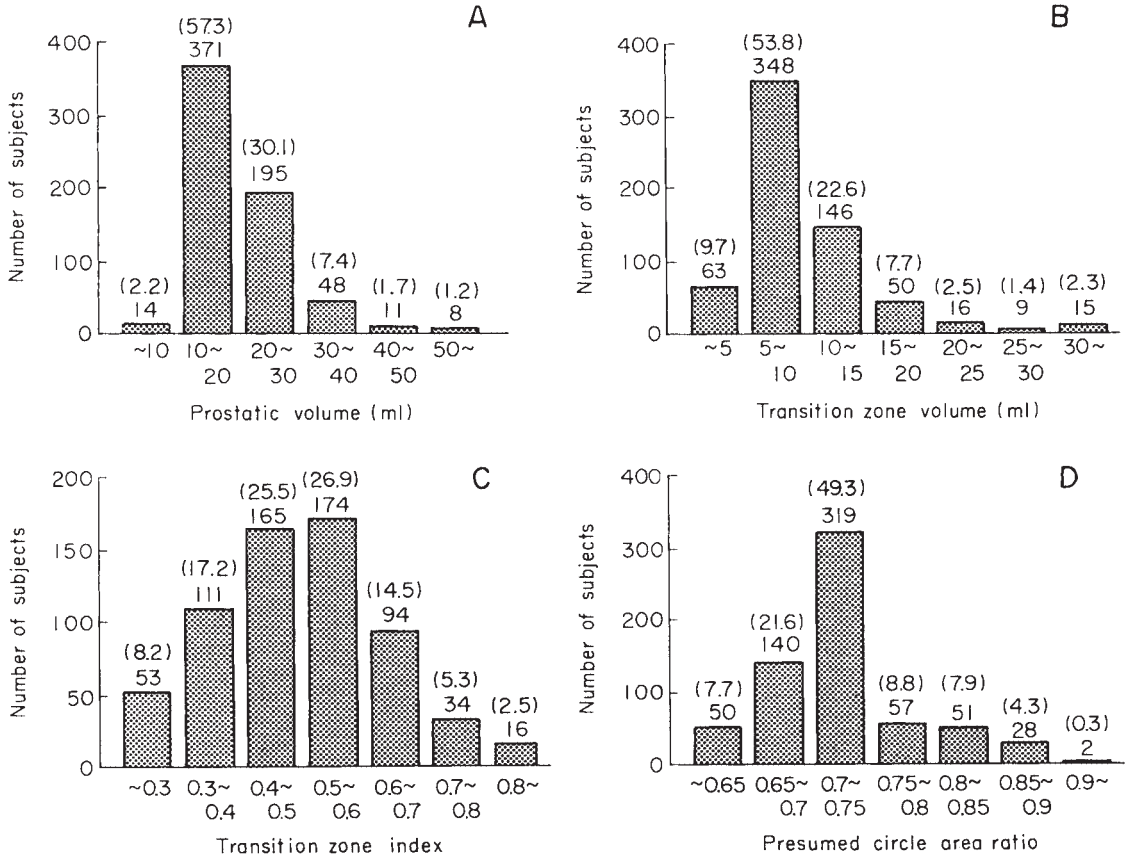

Fig. 4. Distribution of prostatic volume (A), transition zone volume (B), transition zone index (C) and presumed circle area ratio (D).
Frequency (%) is shown as a parenthesized number.

TABLE 1. *Interrelationships between age, prostatic volume, TZ volume, TZ index and PCAR*

	Age	Prostatic volume	TZ volume	TZ index
Prostatic volume	$r=0.063$			
TZ volume	$r=0.179^{***}$	$r=0.846^{***}$		
TZ index	$r=0.231^{***}$	$r=0.180^{***}$	$r=0.631^{***}$	
PCAR	$r=0.145^{***}$	$r=0.685^{***}$	$r=0.695^{***}$	$r=0.322^{***}$

TZ, transition zone; PCAR, presumed circle area ratio.
r, Correlation coefficient.
$^{***}p<0.001$

examinees, 262 (40.5%), 67 (10.4) and 19 (2.9%) had a prostate greater than 20, 30 and 40 ml in volume, respectively. The prevalence of a transition zone volume greater than 15 ml and a transition zone index greater than 0.6 was 13.9% (90/647) and 22.3% (144/647), respectively. PCAR ranged from 0.57 to 0.96, with an average of 0.73 ± 0.06. Out of the 647 examinees, 138 (21.3%) had a PCAR of 0.75 or more and were diagnosed as having BPH.

Interrelationship between ultrasonic parameters. There were significant interrelationships between ultrasonic parameters (Table 1). The most remarkable correlation was that between prostatic volume and transition zone volume ($r=0.846$, Fig. 5A), followed by that between transition zone volume and PCAR ($r=0.695$, Fig. 5B) and that between prostatic volume and PCAR ($r=0.685$, Fig. 5C).

Relationship between age and ultrasonic parameters. Age correlated significantly with all the ultrasonic parameters of the prostate except prostatic volume (Table 1), showing the most remarkable correlation with transition zone index ($r=0.231$, $p<0.001$). The mean value of transition zone volume, transition zone index and PCAR increased with age (Table 2).

Relationship between symptom scores and ultrasonic parameters. Simple regression analyses demonstrated the strongest linear relationship between total symptom scores and PCAR ($r=0.169$, $p<0.001$, Fig. 6A), followed by age ($r=0.139$, $p<0.001$, Fig. 6B), transition zone volume ($r=0.105$, $p<0.01$) and prostatic volume ($r=0.077$, $p<0.05$, Fig. 6C) when analyzed together over the 647 examinees (Table 3). In those with a prostatic volume of less than 20 ml, age and PCAR correlated significantly with symptom score (Table 4). In contrast, PCAR was the only parameter correlating significantly with symptom scores in examinees with an intermediately enlarged prostate (20–30 ml of prostatic volume) (Table 5). In those with an enlarged prostate of 30 ml or more in volume, PCAR showed the strongest linear relationship ($r=0.427$, $p<0.001$) with symptom scores, followed by transition zone volume ($r=0.297$, $p<0.05$) and transition zone index ($r=0.283$, $p<0.05$) (Table 6).

Multiple regression analysis demonstrated age ($p<0.01$) and PCAR ($p<$

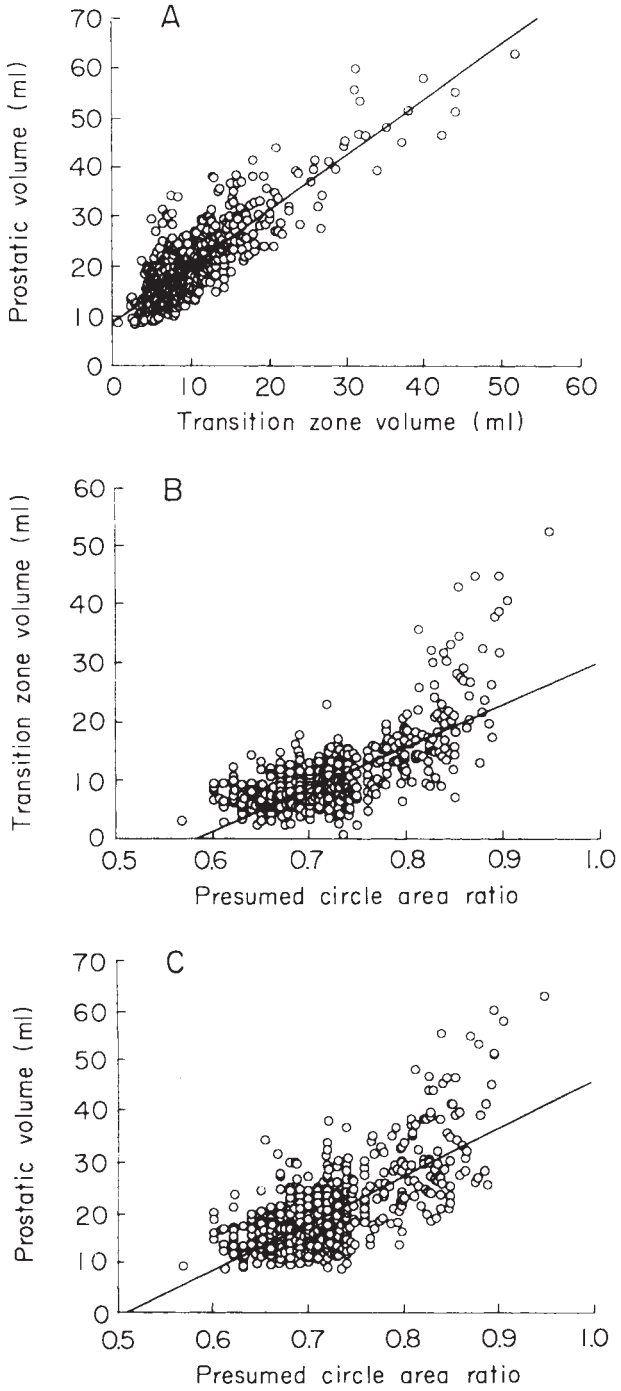

Fig. 5. Relationships between prostatic volume and transition zone volume (A: $r=0.846$, $p<0.001$), between transition zone volume and presumed circle area ratio (B: $r=0.695$, $p<0.001$) and between prostatic volume and presumed circle area ratio (C: $r=0.685$, $p<0.001$).

0.001) to be significant independent determinants of total symptom score. The addition of PCAR improved the correlation coefficient to 0.210 from 0.139 when age alone was taken as an independent variable (Table 3). When similar regression analyses were performed in subgroups divided by prostatic volume, PCAR was always a significant determinant of symptom scores (Tables 4–6). In particular, in examinees with an intermediately enlarged prostate, PCAR was the only

TABLE 2. *Total symptom score, prostatic volume, TZ volume, TZ index and PCAR by age*

Age (years)	Total symptom score	Prostatic volume (ml)	TZ volume (ml)	TZ index	PCAR
55–59	4.9±6.2	19.4±7.4	8.8±4.4	0.46±0.12	0.71±0.05
60–69	5.6±5.8	20.1±7.7	9.7±5.3	0.48±0.13	0.72±0.06[g]
70–79	6.6±6.3[a]	20.9±9.1	11.8±7.6[d]	0.55±0.15[f]	0.74±0.07[h]
80–	8.5±8.5[b]	19.9±11.1	12.2±10.1[c]	0.56±0.17[e]	0.73±0.07

TZ, transition zone; PCAR, presumed circle area ratio.
[a] $p<0.05$ vs. 55–59; [b] $p<0.05$ vs. 55–59, 60–69
[c] $p<0.05$ vs. 55–59, 60–69; [d] $p<0.01$ vs. 55–59, $p<0.001$ vs. 60–69
[e] $p<0.001$vs. 55–59; $p<0.01$ vs. 60–69; [f] $p<0.001$ vs. 55–59, 60–69
[g] $p<0.05$ vs. 55–59; [h] $p<0.001$ vs. 55–59, $p<0.05$ vs. 60–69

significant independent determinant of symptom score.

Total AUA symptom score was compared between subgroups divided by a cutoff point for each ultrasonic parameter. The most significant difference in the symptom score was noted between subgroups divided by a PCAR cutoff point of 0.80 ($p<0.001$) (Table 7).

Relationship between age, ultrasonic parameters and BPH. Comparing examinees with a normal prostate (509, 78.7%) with BPH cases, there were significant differences in age and ultrasonic parameters (Table 8). Prostatic volume was significantly greater in examinees with BPH than in those with a normal prostate. The frequency of BPH increased from 4.4% in examinees with a prostate of less than 20 ml in volume to 85.1% in those with one of 30 ml or more (Fig. 7). Total symptom scores were also significantly greater in examinees with BPH than those with a normal prostate.

DISCUSSION

In this community based population in Japan, 27.2% of elderly men had substantial lower urinary tract symptoms as evaluated by the AUA symptom score (total score of 8 or more). This prevalence rate is consistent with that reported in Canada (23%) (Norman et al. 1994), the United States (28%) (Chute et al. 1993), the Netherlands (30%) (Bosch et al. 1995) and Spain (30.4%) (Hunter et al. 1996). On the other hand, a lower prevalence of symptoms than this was reported in France (14.2%) (Sagnier et al. 1994) and Singapore (11%) (Tan et al. 1997). Although the reason for the low prevalence of lower urinary tract symptoms in these countries remains unexplained, differences in racial constitution, dietary habit or sampling design could be pointed out.

Prostatic planimetry using TRS has contributed much to the better understanding not only of the physiology of the prostate but also of pathological changes in prostatic diseases (Watanabe and Kojima 1997). Among planimetric approaches to the prostate, size measurement is the most common. The present

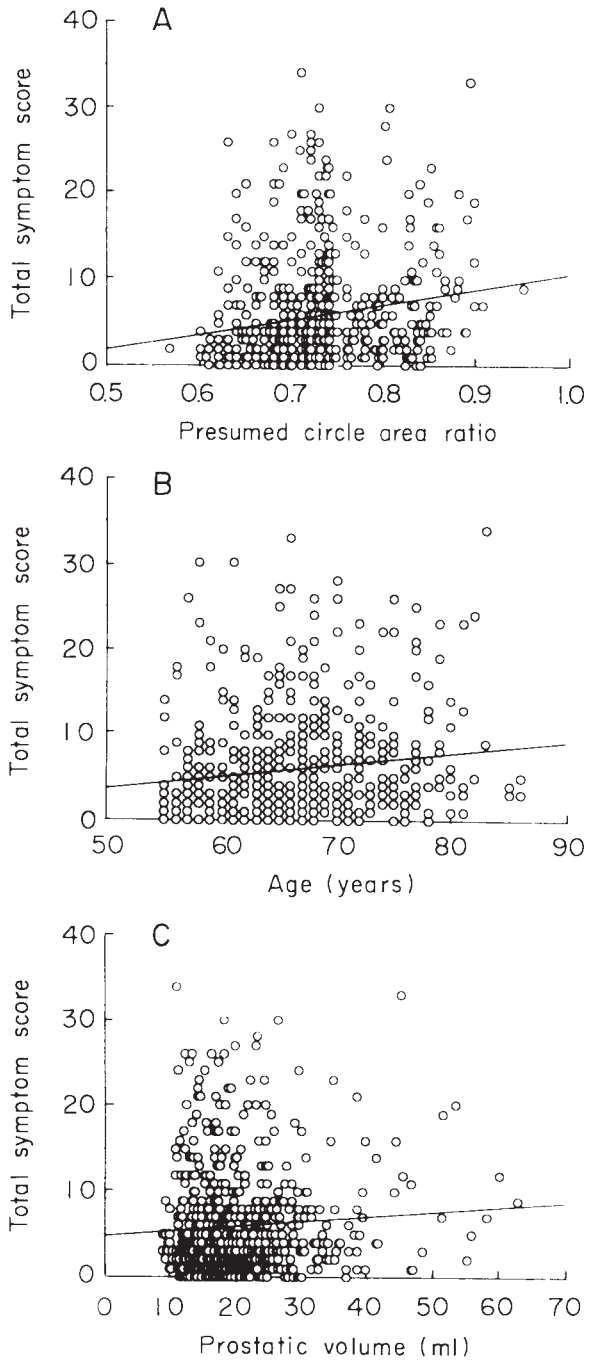

Fig. 6. Relationships between AUA symptom score and presumed circle area ratio (A: $r=0.169$, $p<0.001$), age (B: $r=0.139$, $p<0.001$) and prostatic volume (C: $r=0.077$, $p<0.05$)

study calculated the distribution of prostatic volume in elderly men in a community based population in Japan. As a result, 40.5% of our samples had a prostate of 20 ml or more in volume and only 2.9% had one more than 40 ml. These prevalence rates were significantly lower than those obtained in a community based random sample of white men 40 to 79 years old in the United States (Girman et al. 1995). Similarly, Simpson et al. (1996) studied the distribution of prostatic volume using TRS in a community based population aged 40–79 years in Scot-

TABLE 3. *Simple and multiple regression analyses of AUA symptom score as a function of age, prostatic volume, TZ volume, TZ index and PCAR in 647 examinees*

Variable	Simple regression			Multiple regression		
	p-Value	*r*	Adjusted R^2	*p*-Value	*r*	Adjusted R^2
Age	<0.001	0.139	0.018	<0.01		
Prostatic volume	<0.05	0.077	0.004	n.s.		
TZ volume	<0.01	0.105	0.009	n.s.	0.210	0.038
TZ index	n.s.	0.052	0.001	—		
PCAR	<0.001	0.169	0.026	0.001		

AUA, American Urological Association; TZ, transition zone; PCAR, presumed circle area ratio.
n.s., Statistically not significant.
r, Correlation coefficient.

TABLE 4. *Simple and multiple regression analyses of AUA symptom score as a function of age, prostatic volume, TZ volume, TZ index and PCAR in examinees with a prostate less than 20 ml in volume (n=385)*

Variable	Simple regression			Multiple regression		
	p-Value	*r*	Adjusted R^2	*p*-Value	*r*	Adjusted R^2
Age	<0.001	0.193	0.035	<0.001		
Prostatic volume	n.s.	0.006	—	n.s.		
TZ volume	n.s.	0.021	—	n.s.	0.232	0.044
TZ index	n.s.	0.028	—	—		
PCAR	<0.05	0.113	0.010	<0.05		

AUA, American Urological Association; TZ, transition zone; PCAR, presumed circle area ratio.
n.s., Statistically not significant.
r, Correlation coefficient.

land. The overall prevalence rate of men with a prostate more than 20 ml or 40 ml in volume was significantly higher than ours, being 76.5% and 7.1%, respectively. These results indicate the necessity to take the difference in prostatic volume across countries into account, particularly when evaluating comparatively the clinical impact of prostatic enlargement between different cohorts of elderly men.

In the clinical evaluation of BPH, many urologists employ prostatic volume (weight) as an indicator of the severity of the disease. Garraway et al. (1991) adopted prostatic weight (more than 20 g) measured using TRS as the criterion for BPH according to findings obtained in necropsy studies. These indicated that

TABLE 5. *Simple and multiple regression analyses of AUA symptom score as a function of age, prostatic volume, TZ volume, TZ index and PCAR in examinees with a prostate of 20 ml or more and less than 30 ml in volume (n = 195)*

Variable	Simple regression			Multiple regression		
	p-Value	*r*	Adjusted R^2	*p*-Value	*r*	Adjusted R^2
Age	n.s.	0.009	—	n.s.		
Prostatic volume	n.s.	0.099	0.003	n.s.		
TZ volume	n.s.	0.109	0.007	n.s.	0.208	0.023
TZ index	n.s.	0.073	—	—		
PCAR	<0.01	0.195	0.033	<0.05		

AUA, American Urological Association; TZ, transition zone; PCAR, presumed circle area ratio.

n.s., Statistically not significant.

r, Correlation coefficient.

TABLE 6. *Simple and multiple regression analyses of AUA symptom score as a function of age, prostatic volume, TZ volume, TZ index and PCAR in examinees with a prostate of 30 ml or more in volume (n = 67)*

Variable	Simple regression			Multiple regression		
	p-Value	*r*	Adjusted R^2	*p*-Value	*r*	Adjusted R^2
Age	n.s.	0.120	—	n.s.		
Prostatic volume	n.s.	0.226	0.037	n.s.		
TZ volume	<0.05	0.297	0.074	n.s.	0.430	0.133
TZ index	<0.05	0.283	0.066	—		
PCAR	<0.001	0.427	0.170	<0.01		

AUA, American Urological Association; TZ, transition zone; PCAR, presumed circle area ratio.

n.s., Statistically not significant.

r, Correlation coefficient.

mean prostatic weight reached 20 g in men between the ages of 21 and 30 years and remained essentially constant with increasing age unless BPH developed (Berry et al. 1984). Despite these epidemiological studies correlating prostatic volume with BPH, it has been well known that prostatic volume correlates with neither symptoms (Christiansen and Bruskewitz 1990) nor urodynamic measures of infravesical obstruction (Hald 1989).

Since the nodular enlargement of the transition zone of the prostate is the primary pathological change in BPH (McNeal 1978), the volume of the transition zone could be used as a planimetric parameter for the evaluation of BPH. Based upon this assumption, Greene et al. (1990) noted that transition zone volume was

TABLE 7. *Total AUA symptom score according to prostatic volume, TZ volume, TZ index and PCAR*

Cutoff point	No. subjects[a]	Total AUA symptom score	Statistics
Prostatic volume (ml)			
15	180/467	5.8±6.2/5.9±6.1	n.s.
20	385/262	5.9±6.2/5.9±6.0	n.s.
25	522/125	5.7±6.1/6.7±6.2	n.s.
30	580/ 67	5.7±6.1/7.2±6.4	n.s.
TZ volume (ml)			
5	63/584	6.1±5.8/5.9±6.2	n.s.
10	411/236	5.8±6.3/6.0±5.9	n.s.
15	557/ 90	5.6±6.0/7.5±6.7	$p<0.01$
20	607/ 40	5.9±6.1/9.0±6.8	$p<0.01$
TZ index			
0.4	164/483	6.0±6.1/5.8±6.2	n.s.
0.5	329/318	5.8±6.0/6.0±6.3	n.s.
0.6	503/144	5.7±5.9/6.6±6.9	n.s.
0.7	597/ 50	5.7±5.9/8.2±8.5	$p<0.01$
PCAR			
0.65	50/597	4.6±5.6/6.0±6.2	n.s.
0.70	190/457	5.0±5.4/6.3±6.4	$p<0.05$
0.75	509/138	5.5±6.0/7.2±6.6	$p<0.01$
0.80	566/ 81	5.5±5.9/8.5±7.3	$p<0.001$

AUA, American Urological Association; TZ, transition zone; PCAR, pressured circle area ratio.

[a]Values at less/greater than cutoff point.

significantly larger in clinical BPH patients than those without the condition. Recently, Kaplan et al. (1996) proposed the clinical utility of the measurement of transition zone volume in assessing BPH and proposed a transition zone index. The authors reported that a transition zone index of 0.5 was a useful cutoff point and highly significant for delineating patients with severe abnormalities of symptoms and urodynamic measures.

In previous studies, we investigated ultrasonic planimetric parameters of the prostate versus obstructive measures obtained by pressure flow studies in men with lower urinary tract symptoms, resulting in failure to find any utility in the measurement of transition zone volume in predicting infravesical obsrtruction (Kojima et al. 1997b). In the present study, too, neither transition zone volume nor transition zone index played a significant role in relation to symptoms. Accordingly, it is likely that planimetric measurement of the transition zone has little clinical significance in the evaluation of BPH.

As is stressed repeatedly in our previous reports, a primary change in develop-

TABLE 8. *Comparison of parameters between men with a normal prostate and BPH*

	Normal prostate ($n=509$)	BPH ($n=138$)	Statistics[a]
Age (years)	66.1±6.3 (55-86)	68.9±6.3 (56-86)	$p<0.001$
Prostatic volume (ml)	17.6±5.0 (8.6-38.0)	30.1±10.0 (13.6-62.8)	$p<0.001$
TZ volume (ml)	8.2±2.9 (0.75-22.7)	18.0±8.6 (4.7-52.2)	$p<0.001$
TZ index	0.47±0.13 (0.09-0.90)	0.59±0.14 (0.23-0.97)	$p<0.001$
PCAR	0.70±0.04 (0.57-0.749)	0.82±0.04 (0.75-0.950)	$p<0.001$
Total symptom score	5.52±5.98 (0-34)	7.23±6.59 (0-33)	$p<0.01$

[a]Student's-t test.
BPH, benign prostatic hyperplasia.

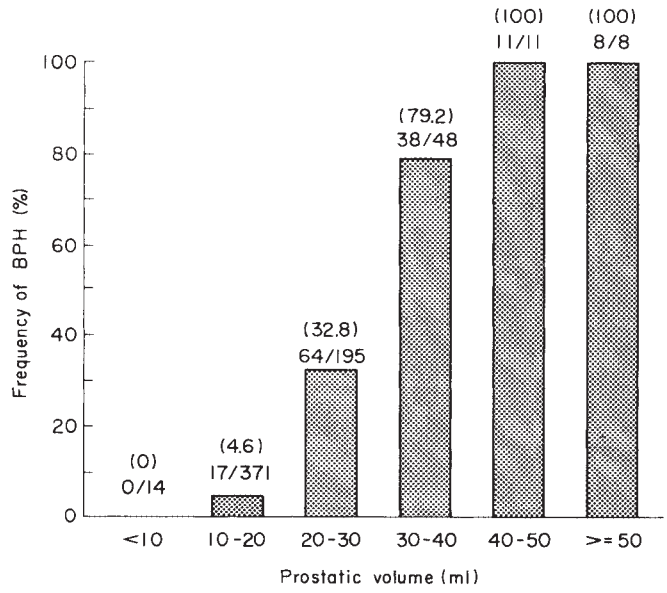

Fig. 7. Frequency of BPH (presumed circle area ratio ≥0.75) by prostatic volume.
Frequency (%) is shown as a parenthesized number.

ing BPH is in the shape, but not in the size of the gland (Watanabe 1979, 1993). Since a hypertrophic prostate can be linked to a closed system in which the inner gland is enclosed by the surgical capsule, the inner gland pushes the capsule out as it grows, resulting in an increase of intraprostatic pressure. Almost the same pressure caused by this expansion may apply to the circumference of the urethra, because it penetrates the center of the inner gland. Accordingly, the degree to which the capsule approximates roundness shows the degree of pressure on the urethra. This concept makes the background of the PCAR theory.

PCAR is a parameter determined by transrectal ultrasonic planimetry of the prostate, which represents the degree how the prostate is round. It aspproaches 1.0, as the prostate becomes round along with the development of BPH. In our previous study, PCAR was shown to be related with post-void residual urine volume in men with lower urinary tract symptoms. Cases with a PCAR of less than 0.75 almost entirely had a residual urine volume below 30 ml. On the contrary, urinary retention was found only in those with a PCAR of more than 0.75 (Watanabe 1993). Our definition of BPH depending on PCAR is based on these results. In our clinic, the diagnosis of BPH is made, when a PCAR is 0.75 or more.

PCAR has been also shown to correlate well with urethral pressure profile (Kojima et al. 1984), lower urinary tract symptoms (Ukimura et al. 1996; Kojima et al. 1997a) and pressure flow study measurements (Kojima et al. 1997b). The present study confirmed again that among prostatic planimetric parametrs PCAR was the most useful for the evaluation of BPH in terms of the severity of lower urinary tract symptoms. Recently, Desai et al. (1996) also demonstrated the possible prediction of prostatic obstruction by PCAR, showing a sensitivity of 75% and a specificity of 92%. They concluded that a PCAR of 0.78 was clearly a distinctive value between the normal and hypertrophic prostate.

It is worth noting that the majority of subjects with a prostatic volume less than 20 ml and that those with one greater than 30 ml were diagnosed as having a normal prostate and BPH, respectively, based upon our definition of BPH, using PCAR. It is of interest that there was a distinctive difference between the prevalence of BPH determined by prostatic volume and that by PCAR in subjects with an intermediately enlarged prostate (20–30 ml in volume), of whom 32.8% were diagnosed as having BPH by PCAR. Provided that a prostatic volume cutoff point of 20 ml was used for the definition of BPH, all these cases were diagnosed as having BPH, while using a cutoff point of 30 ml they were all diagnosed as having a normal prostate. More interestingly, the present study revealed PCAR to be the only significant independent determinant of symptom scores in these examinees. These results suggested that PCAR could represent a planimetric change characteristic to the pathophysiology of developing BPH, particularly in cases with an intermediately enlarged prostate.

In our series of subjects, PCAR showed the most distinct difference in the total AUA symptom score between subgroups divided by a cutoff point of 0.80. These results are of great interest, because our previous study correlating PCAR with obstructive parameters obtained by pressure flow studies demonstrated that 0.8 of PCAR was the most suitable cutoff point for predicting infravesical obstruction based upon a receiver operator characteristic curve analysis of patients with lower urinary tract symptoms (Kojima et al. 1997b). Patients with a PCAR of 0.8 or more have infravesical obstruction with a probability of 86.3%.

In conclusion, of prostatic planimetric parameters obtained by TRS, PCAR

was the most powerful in the evaluation of BPH in terms of the severity of lower urinary tract symptoms as determined by the AUA symptom score. More common use of TRS in clinical settings for the evaluation of the prostate must improve the understanding of BPH.

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