Is there a correlation between prostate size and bladder-outlet obstruction?

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Summary. This retrospective study was conducted in 521 men with micturition complaints to determine the relationship between prostate size and bladder-outlet obstruction. Analysis showed a statistically significant correlation between bladder-outlet obstruction and prostate size. Urodynamic bladder-outlet obstruction was confirmed in 90% of the patients with a prostate size of more than 80 cm³. In 32% of the patients with a prostate smaller than 40 cm³, no urodynamic evidence of bladder-outlet obstruction was found. We conclude that precise determination of the prostate size and urodynamic investigations are important parameters in the assessment of elderly men with micturition complaints.

The prostate size can be an important parameter in the investigation of patients with micturition complaints and is frequently used to decide between possible treatment modalities: transurethral prostatectomy (TURP) or open prostatectomy [1]. For many years, the gold standard for the evaluation of the size of the prostate was the urologist's fingertip. Unfortunately, the accuracy of this investigation appears to be low [2]. Nowadays the technical possibilities enable us to measure the in vivo volume of the prostate with transrectal ultrasound (TRUS), computerized tomography (CT)-scan imaging, or with magnetic resonance imaging (MRI). Transrectal volumetry has shown a good correlation with the actual prostate size [3–5]. Unfortunately, the accuracy of this investigation appears to be low [2]. Nowadays the technical possibilities enable us to measure the in vivo volume of the prostate with transrectal ultrasound (TRUS) investigation, with computerized tomography (CT)-scan imaging, or with magnetic resonance imaging (MRI). Transrectal volumetry has shown a good correlation with the actual prostate size [3–5]. The most accurate and reliable method to determine the volume of the prostate appears to be the planimetric method [6, 7].

The correlation of prostate size with clinical parameters such as age, duration of symptoms, pattern of symptoms, and uroflow parameters is reported to be low [8–10]. There seems to be agreement in the observation that patients with larger prostates fare better after prostate resection [1, 11–13]. On the other hand, patients with small prostates do not need an extensive resection of prostatic tissue [14, 15]. In the majority of clinical (outcome) studies, the prostate size is estimated by rectal examination or by resected tissue weight.

The principle idea of removal of prostate tissue is to relieve outlet obstruction. However, not all men with micturition complaints treated by TURP have bladder-outlet obstruction (BOO). The introduction of advanced urodynamics investigation, which is considered to be the “gold standard” for the measurement of outlet obstruction, has shed a new light on this topic. Several authors came to the conclusion that up to one-third of the patients treated for benign prostatic hyperplasia (BPH) had no proven BOO [16–18]. On the other hand, several other investigators found that the estimated prostate size was associated inversely with urethral obstruction [19–21].

In view of the data available at the moment, an increasing number of urologists are questioning the relationship between prostate size and outlet obstruction. In this article we attempt to clarify this issue and present the results of a retrospective study conducted to investigate the correlation of prostate size with urodynamic parameters.

Patients and methods

The results of urodynamics investigations of 521 men with lower urinary-tract symptoms were evaluated. These results were correlated with the results of prostate size, measured by TRUS, and with the results of the (I-PSS and Madsen) symptom scores. Urodynamics investigations were performed with an 8-F transurethral lumen catheter equipped with an intravesical microtip pressure sensor for bladder pressure recording. Abdominal pressure was recorded intrarectally with an 8-F microtip sensor catheter (MTC, Dräger, Germany). Before cystometry the bladder was emptied through the lumen of the transurethral catheter. The bladder was filled with water of 20°C with a filling speed of 50 ml/min. Commercially available equipment (UD 2000; MMS, Enschede, the Netherlands) was used to record the pressure and flow data. Digitally stored data were translated to a urodynamics-analysis computer program developed at our department (UIC/BME Research Center, Department of Urology, Nijmegen, the Netherlands).
To provide an objective and precise grade of obstruction, P/Q graphs were fitted with a passive urethral resistance relation (PURR) curve at the lowest pressure part of the graph. The minimal urethral opening pressure (Pmuo) and theoretical urethral lumen (Atheo) were calculated automatically on the basis of the manually adjusted PURR curves [22]. The urethral resistance factor (URA) was computed to enable the classification of patients on a continuous, one-parameter scale of obstruction [23]. Calculation of the URA was based on the positioning of a haircross on the point of maximal flow and corresponding detrusor pressure (Pdet at Qmax). Correction for (maximal) flow artifacts was performed when necessary. We also added a nonparametric analysis of obstruction and prostate size with clinical classes according to the linearized PURR (L-PURR) P/Q nomogram [24]. For evaluation of the voiding efficiency, the voided percentage, which is the relative amount of bladder content that was expelled, was calculated.

The TRUS examinations were performed using a Kretz combination 330 ultrasound scanner with a 7.5-MHz transrectal transducer (Multiplane 3-D VRW 77AK). The prostate was imaged in the transverse plane starting at the base, and cross-section images were stored every 4 mm by retracting the probe with a fixture until the apex of the prostate was reached. After outlining of the prostate at every cross section with a pencil-follower, the volume is calculated.

For statistical analysis, we used Spearman correlation coefficients in the analysis of correlation, chi-square tests to compare proportional groups, and Student’s t-test to test the mean differences between groups.

**Results**

The mean prostate size in this group of patients was 44.1 cm³ (range, 12–170 cm³). Figure 1 shows a histogram of the prostate sizes. The mean age of the patients was 64.5 years (range, 42.7–90.7). The mean maximal uroflow was 7.6 ml/s (SD, 4.1 ml/s; range, 1.0–42.0 ml/s). According to the L-PURR nomogram, 140 patients (26.9%) were considered unobstructed (L-PURR grades 0 and 1), 317 patients (60.8%) had a moderate grade of outlet obstruction (L-PURR grades 2–4), and 63 (12.1%) had a severe outlet obstruction (grades 5 and 6). Figure 2 shows the bar chart of 20-cm³ prostate-volume groups subdivided into relative numbers of patients in the various L-PURR classes.

Table 1 shows the mean cystometry parameters. The mean URA value was 37.6 cmH²O. As value of more than 28 cmH²O is considered to be indicative for BOO, the mean outlet obstruction in these patients was “moderate” [25]. The Pmuo value of 32.0 cmH²O and the Atheo value of 3.6 mm² indicate a moderate, average degree of outlet obstruction for the entire group as well. Table 2 shows the mean age and prostate size, the voided percentages, the total symptom scores of the patients, and the various L-PURR classes of BOO. One can recognize a trend toward an increase in age and prostate volume with increasing obstruction class. There appears to be no correlation between the results of the I-PSS or Madsen symptom scores and the classes of BOO. In Table 3 the age and symptom scores in 10-cm³ classes of prostate size are listed and confirm the aforementioned conclusions. Table 4 shows the results of the pressure-flow analysis for each prostate-size class. With increasing prostate size, a decrease in maximal uroflow, Atheo, and voiding percentage is apparent. The outlet parameters URA and Pmuo increase with prostate size.

The correlations of prostate size with age (0.33), voided percentage (−0.19), Qmax (−0.20), Pdet at Qmax (0.29), Pmuo (0.32), Atheo (−0.19), and URA (0.32) were statistically significant at the P < 0.001 level. The correlation of prostate size with the I-PSS and Madsen symptom scores and with residual urine was not statistically significant. Neither the total Madsen score nor the total