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Relationship Among Symptom Score, Prostate Volume, and Urinary Flow Rates in 543 Patients With and Without Benign Prostatic Hyperplasia

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BACKGROUND. Studies on the relationship among symptom score, urinary flow rate, and prostate volume in men with lower urinary tract symptoms (LUTS) continue to be of great interest.

METHODS. A total of 2,418 men, aged 30–86 years, agreed to participate in an interview and to complete a questionnaire regarding voiding patterns. All subjects answering positively to one or more of the questions were submitted to a diagnostic assessment, based on the algorithm outlined by the guidelines of the International Consultation on Benign Prostatic Hyperplasia (BPH). Five hundred forty-three out of the 2,418 participants (22.45%) were evaluated. At the end of the diagnostic evaluation, 400 men with LUTS but without concomitant conditions (except BPH) known to interfere with normal voiding were selected. Descriptive statistics were used to characterize age, symptom score (International Prostate Symptom Score), prostate volume, and urinary flow rate distribution in these patients. Correlations among the aforementioned parameters were evaluated by means of a multivariate, multiple linear regression and logistic regression model.

RESULTS. As reported in other studies, only weak or modest correlations were found. Moreover, the 400 cases were classified according to four age decades. The decrease in peak and mean flow rate per decade of age was similar (0.5 and 0.4 ml/sec); the increase in prostate volume and in total symptom score per decade was 3.3 cc and 0.6, respectively. In patients less than 50 years old, most of the correlations were stronger than those observed in the entire population of 400 men (age and prostate volume, c.c. 0.2864; age and peak flow rate, c.c. −0.2689; age and mean flow rate, c.c. −0.3034). However, symptom score continued to be weakly correlated with age and prostate volume (c.c. 0.0498 and 0.1966, respectively). In the last part of the study, men were assigned to different treatment strategies. Patients who were assigned to surgical treatment had higher prostate volume and IPSS and lower urinary flow rate than those assigned to nonsurgical treatment.

CONCLUSIONS. We believe that the reason for the weak statistical association frequently reported in the literature is mainly the urology clinic-based population from which the patient samples were drawn. Data emerging from this analysis support the hypothesis that age is one of the principal factors influencing the relationship among symptom score, urinary flow rate, and prostate volume. *Prostate 34:121–128, 1998.*

KEY WORDS: **benign prostatic hyperplasia; symptom score; prostate volume; urinary flow rate**

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is a common condition among older men, generating considerable morbidity and health care costs. Lower urinary tract symptoms (LUTS), when associated with clinically detectable prostate enlargement, are presumed to be caused primarily by BPH.

The International Consultation on BPH agreed to use a symptom index which has been developed by the American Urological Association (AUA) Measurement Committee, as the official worldwide assessment for patients suffering from prostatism [1].

While the publications which utilize the International Prostate Symptom Score (IPSS) are numerous, several investigators have criticized it as not being specific for BPH [2–4].

BPH is the result of three interrelated pathophysiological phenomena, the symptom complex of prostatism, bladder outlet obstruction, and enlarged prostate gland; diagnostic assessments are mainly directed to one of these phenomena.

Several studies have reported weak correlations among symptom index, prostate volume, and urinary flow rate in men with LUTS [5–10]. The lack of knowledge of the natural history of BPH may be responsible for some of this poor agreement. Measures from many domains are used to define BPH: histology, anatomy, physiology, and symptoms. While the age-specific autopsy prevalence of histologically defined BPH shows relatively little variation, considerable variation has been found in studies concerning clinically diagnosed BPH [11]. Because of the lack of a standard definition of ''clinical BPH,'' the weak statistical association among clinical parameters analyzed in different studies may be partly due to sampling methodology and clinical criteria and partly due to actual clinical differences between populations which the studies are intended to represent.

Given these limitations, epidemiologists studying BPH will be left for the foreseeable future measuring LUTS, uroflow rates, and prostate size, and presenting the distribution of these variables in different selected and unselected populations [8].

Prostate weight is an age-related variable; according to 10 independent studies from the United States and Europe on prostate weight at autopsy and operation, the normal prostate reaches 20 ± 6 g in men 21–30 years old, and this weight remains essentially constant with increasing age, unless BPH develops [12].

Also, LUTS and urinary flow are age-related urological variables [13], and the nature of the relationship among these parameters may be age-dependent. Thus, aging can be considered one of the factors in urinary disturbance.

The aim of this investigation was to study a selected population with LUTS, their urinary flow rate, symptom score, and prostate volume, and to correlate these parameters across age decades.

MATERIALS AND METHODS

From December 1993–July 1994, 2,418 men 30–86 years old (mean age 59 years) were interviewed. The men answered an advertisement placed in several Italian national newspapers inviting males over age 30 years to call for a telephone interview and to answer a questionnaire concerning voiding patterns. A total of 543 men (22.45%) replied positively to one or more of the questions and was submitted to diagnostic assessment. These men were evaluated and treated according to the algorithm set out in the guidelines of the International Consultation on BPH [1].

The evaluation utilized a detailed medical history and chart, physical examination including neurological assessment and digital rectal examination (DRE), urinalysis by dipstick or microscopic examination of sediment, measurement of serum creatinine and prostate-specific antigen (PSA), self-administered questionnaire on urinary symptoms and quality of life, uroflowmetry, and transrectal ultrasonography (TRUS). As stated by the International Consensus, if other conditions known to interfere with normal voiding (except BPH) were suspected with these initial examinations, further assessment was made using optional tests (urodynamic studies including pressure-flow study, filling cystometry, and electromyography; urinary tract imaging studies including voiding and retrograde cystourethrography; cystourethroscopy; prostatic biopsy; and analysis and culture of urine, ejaculate, and prostatic secretion).

The IPSS questionnaire was administered to all patients with instructions to answer all questions to the best of their ability. Patients were also asked to rate their quality of life status using the questions recommended by the International Consultation on BPH [1].

The IPSS questionnaire was translated into Italian by the staff in our Department of Urology.

In all patients, prostate volume was uniformly determined by the transrectal ultrasonographic estimates of the anteroposterior, transverse, and sagittal prostate dimensions, assuming a prolate ellipsoid shape. Moreover, patients voided into a portable device (Urodyn 1000 Dantec, Dantec Elektronik, Skovlunde, Denmark) to determine urinary flow rate (peak and mean flow rate). Patients were instructed to have a full bladder at the time of the appointment, when they were asked to void. Repeat urination was attempted if the voided urinary volume was less than

TABLE I. Patients With Confounding Conditions Known to Interfere With Normal Voiding (Group 2)

Concomitant conditions	No. of patients
Urethral stricture	29
Prostate cancer	14
Acute or chronic prostatitis	36
Parkinsonism or cerebrovascular accident (without hemiparesis)	31
Concomitant therapies with agents known to influence vesico-urethral function	33

150 ml. In all analyses only the void with a volume of more than 150 ml was used.

At the end of the diagnostic evaluation, the 543 patients were allocated to 1 of 2 categories.

Group 1 consisted of patients with LUTS but no history of previous outlet surgery (transurethral resection of the prostate, or transurethral incision of the bladder neck), histologically diagnosed prostate carcinoma, neurogenic disorders, urethral stricture, urinary retention, prostatitis or other conditions known to interfere with normal voiding (except BPH), and concomitant therapies with agents known to influence vesico-urethral function.

Group 2 included patients complaining of LUTS with some of the aforementioned conditions (Table I). No classification on the bases of IPSS value, prostate volume, and uroflow indices was attempted. Although the IPSS may not be applicable for group 2, these outpatients were given the questionnaire because they were initially diagnosed as having LUTS. Only after detailed chart reviews, further investigation of history, and examinations (optional tests) were the patients categorized into group 2. The symptom score in these patients (group 2) was included in our evaluation to determine whether the symptom indices were different from those patients belonging to group 1.

Four hundred (73.66%) patients were included in group 1 and 143 (26.34%) in group 2.

Patients in group 1 were then assigned to different treatment strategies. None of the 400 patients had imperative indications for surgical treatment as defined by the International Consultation [1], and therefore chose their treatment in consultation with the urologist who discussed all treatment options, in the same order and in a neutral, nonjudgmental fashion. Patients were fully informed of the risks and benefits of watchful waiting, medical therapies, and surgical treatments. The potential benefits of various options were described relative to the severity of the condition.

All descriptions and success/failure probabilities supplied to the patient were based on information in the literature.

Based on this consultation, 331 (82.75%) patients were submitted to medical therapy or watchful waiting, whereas 69 (17.25%) underwent immediate surgery. We considered medical therapy and watchful waiting together in order to distinguish between patients undergoing surgical or nonsurgical treatment.

Statistical Analysis

Descriptive statistics were used to characterize age, total symptom score, prostate volume, and urinary flow rate distribution in the different groups. Results are presented as mean ± SD. Moreover, the 400 cases included in group 1 were further classified according to four age decades: less than 50 years old (48 cases); 50–59 years old (120 cases); 60–69 old (152 cases); and 70 years old or more (80 cases). Variations in the parameters per decade of age were reported.

Before starting treatment, attempts were made to establish a correlation among prostate volume, symptom score, and urinary flow rate in: men with LUTS included in group 1; men with LUTS included in group 2; men in group 1 classified by age decades; men in group 1 assigned to surgical treatment; and men in group 1 assigned to nonsurgical treatment. Relationships among these parameters were quantified using multivariate models to estimate partial correlations between variables adjusting for age. Multiple linear regression and a logistic regression model were also used.

In the last model, symptomatology, defined as moderate to severe (8–35) vs. mild (0–7), was used as a dependent variable [3].

Considering the high number of patients in this study, we assumed as significant only those correlation coefficients explaining more than 5% of the variance of one factor on the other ($r \geqslant 0.2236 - R^2$ 0.05 [5%]).

RESULTS

Group 1

Overall, in the 400 cases included in group 1, mean age was 61.6 ± 8.49 years (range 45–86 years), prostate volume 41.28 ± 16.77 cc (range 23–117 cc), peak flow rate 11.92 ± 5.03 ml/sec (range 2.5–26 ml/sec), mean flow rate 6.15 ± 2.79 ml/sec (range 1.6–15.2 ml/sec), and symptom score 14.22 ± 5.39 (range 2–29).

A modest correlation between age and prostate volume (correlation coefficient 0.2343) was found. The inverse correlation between age and mean flow rate

TABLE II. Correlations Between Age, Prostate Volume, Symptom Score, and Peak and Mean Flow Rates in Men Categorized in Groups 1 and 2, Using a Multivariate Model

Correlation	Group 1	Group 2
Age and peak flow	−0.1740	−0.0835
Age and mean flow	−0.2000	−0.1617
Age and prostate volume	0.2343	0.0874
Age and symptom score	0.1506	0.0033
Symptom score and peak flow	−0.1603	−0.2550
Symptom score and mean flow	−0.1461	−0.2695
Symptom score and prostate volume	0.0400	0.0246
Peak flow and prostate volume	−0.1662	−0.0503
Mean flow and prostate volume	−0.2032	−0.1138

was somewhat stronger than that between age and peak flow rate (correlation coefficients −0.2000 and −0.1740, respectively). On the contrary, a weak correlation between age and symptom score was found (correlation coefficient 0.1506). The inverse correlation between prostate volume and mean flow rate was stronger than that between prostate volume and peak flow rate (−0.2032 and −0.1662, respectively), while the correlation between prostate volume and symptom score was very low (correlation coefficient 0.0400). Weak inverse correlations were also found between symptom score and peak flow rate and between symptom score and mean flow rate (−0.1603 and −0.1461, respectively) (Table II). After removing linear effect of age, the partial correlation of symptom score vs. peak flow rate (−0.1390) and that of prostate volume vs. peak flow rate (−0.1280) remained weak.

A multiple linear regression model with symptom score as dependent variable and age, prostate volume, and peak flow rate as independent variables is shown in Table III. Using this model, age and peak flow rate show statistically significant coefficients (positive for age and negative for peak flow rate) when correlated with symptom score. The statistically significant inverse correlation between symptom score and peak flow rate, even after adjustment for age, may suggest the importance of peak flow in predicting symptom score. On the other hand, the multiple R^2 analysis shows that the proportion of symptom score variance (less than 5%) is only modestly explained by the other determinants available in this study.

A logistic regression model was also used, with the symptom score as a dependent variable (defined, in this case, as moderate vs. mild) and age, prostate volume, and peak flow rate as possible predictors. Table IV shows the coefficients, *t*-values, and relative risks (RR), with their 95% confidence limits (c.l.), of all the variables considered in the model. Also in this case, peak flow rate seems to be an independent predictor of symptom score in spite of adjustment for age and prostate volume.

TABLE III. Multiple Linear Regression Model With Symptom Score as Dependent Variable and Age, Prostate Volume, and Peak Flow Rate as Independent Variables, With Coefficients and *t*-Values Determined

	Coefficient	*t* value
Age	0.0533	2.25*
Prostate volume	−0.0027	−0.24
Peak flow rate	−0.0973	−2.47*
Intercept	5.5349	
Multiple R^2	0.0414	

*$P < 0.05$.

TABLE IV. Logistic Regression Model, With Symptom Score as Dependent Variable and Age, Prostate Volume, and Peak Flow Rate as Possible Predictors†

	Coefficient	*t*	RR	95% c.I.
Age	0.03603	2.54*	1.04	1.01–1.07
Prostate volume	0.00337	0.50		
Peak flow rate	−0.05092	−2.16*	0.95	0.91–0.99
Constant	−1.724			

†Coefficients, *t*-values and relative risks (RR) with their 95% confidence limits of all the variables considered in the model are described.
*$P < 0.05$.

Group 1 Classified by Age Decades

We classified the 400 cases with LUTS according to four age decades: less than 50 years old (48 cases); 50–59 years old (120 cases); 60–69 years old (152 cases); and 70 years old or more (80 cases).

A fairly steady decrease in peak flow rate with increasing age, ranging from a mean value of the peak flow rate of 13.07 ± 5.20 ml/sec for men 40–49 years old to 10.97 ± 4.93 ml/sec for men aged 70–79, was shown. The decrease in peak flow rate per decade of age was approximately 0.5 ml/sec. Results of mean flow rate were similar to those for peak flow rate. Mean flow rate ranged from a mean of 7.10 ± 2.55 ml/sec for men 40–49 years old to 5.55 ± 2.88 ml/sec for men 70–79. The decrease in mean flow rate per decade of age was approximately 0.4 ml/sec. Moreover, mean prostate volume ranged from 31.66 ± 7.62 cc for men 40–49 years old to 45.13 ± 20.12 cc for men 70–79. The increase in prostate volume per decade of age was approximately 3.3 ml. Mean IPSS ranged from 12.24 ± 3.69 for men 40–49 years old to 14.93 ± 4.63 for

TABLE V. Correlations Between Age, Prostate Volume, Symptom Score, and Peak and Mean Flow Rates in 400 Men (Group 1) Classified by Age Decades, Using a Multivariate Model

Correlation	<50 years	50–59 years	60–69 years	>70 years
Age and peak flow	−0.2689	−0.0248	0.1839	−0.2618
Age and mean flow	−0.3034	−0.0287	0.1818	−0.2670
Age and prostate volume	0.2864	0.1422	−0.0076	0.0447
Age and symptom score	0.0498	0.0632	0.1030	0.0825
Symptom score and peak flow	−0.2724	−0.2810	0.0012	−0.1936
Symptom score and mean flow	−0.2563	−0.2094	−0.0320	−0.1496
Symptom score and prostate volume	0.1966	0.0589	−0.0301	0.0066
Peak flow and prostate volume	−0.2022	−0.0471	−0.1267	−0.2316
Mean flow and prostate volume	−0.2576	−0.0673	−0.1711	−0.2463

men 70–79. The increase in total symptom score per decade of age was approximately 0.6. The same correlations evaluated in the entire population of 400 men (group 1) were also estimated in each of the four age decades.

In the first decade, the correlation between age and prostate volume (correlation coefficient 0.2864) and the inverse correlation between age and peak or mean flow rate (correlation coefficients −0.2689 and −0.3034, respectively) was stronger than that observed in the entire population (group 1). Similar results were observed for the inverse correlation between prostate volume and peak or mean flow rate (correlation coefficients −0.2022 and −0.2576, respectively) and the inverse correlation between symptom score and peak or mean flow rate (correlation coefficients −0.2724 and −0.2563, respectively). Also, the correlation between symptom score and prostate volume, albeit always weak, showed an increase in magnitude (correlation coefficient 0.1966). On the contrary, the correlation between symptom score and age remained weak (correlation coefficient 0.0498). In the next two decades, 50–59 and 60–69, most of the correlations were weak, whereas in the last decade (70 or more), a new partial increase in magnitude was observed (Table V).

Group 1 Patients Assigned to Nonsurgical (Group 1a) or Surgical (Group 1b) Treatment

The difference in total symptom score between patients assigned to surgery or to a nonsurgical strategy was statistically significant ($P < 0.05$). Also, the differences in prostate volume, and peak and mean flow rates between subgroup 1a and subgroup 1b were statistically significant ($P < 0.001$) (Table VI). Correlations among age, symptom score, prostate volume, and urinary flow rates in each of the two subgroups showed coefficients comparable to those found in the whole of group 1.

TABLE VI. Mean Values of Symptom Score, Prostate Volume, and Peak and Mean Flow Rates in 400 Men (Group 1) Assigned to Surgical and Nonsurgical Treatments (Mean ± SD)

	Nonsurgical	Surgical	*P*
Number of patients	331	69	
IPSS	13.99 ± 5.33	15.45 ± 5.53	<0.05
Prostate volume (cc)	38.33 ± 15.92	55.06 ± 19.50	<0.001
Peak flow rate (ml/sec)	12.35 ± 5.09	9.92 ± 4.27	<0.001
Mean flow rate (ml/sec)	6.39 ± 2.81	5.05 ± 2.41	<0.001

Group 2

Overall, in the 143 men in group 2, mean age was 53.48 ± 9.79 (range 32–80 years old), prostate volume 16.63 ± 2.31 cc (range 9–20 cc), peak flow rate 16.95 ± 8.17 ml/sec (range 3.9–36.50 ml/sec), mean flow rate 9.43 ± 6.46 ml/sec (range 2.4–20.0 ml/sec), and symptom score 13.59 ± 6.57 (range 2–32). In this group, mean age and mean prostate volume were significantly lower ($P < 0.001$), whereas peak and mean flow rates were significantly higher ($P < 0.001$) than those observed in group 1. Symptom score did not differ significantly between the two groups ($P > 0.2$).

In group 2, a modest correlation was found only between symptom score and peak flow rate and between symptom score and mean flow rate (correlation coefficients −0.2550 and −0.2695, respectively). All other correlations showed very low coefficients (Table II).

DISCUSSION

Various attempts have been made to establish a relationship among symptom severity, urinary flow rate, and prostate size in selected and unselected populations. In studies that have recruited patients from urology clinics, these variables have shown very weak or no correlations [14–16]. Moreover, Chute et al. [17] demonstrated that symptoms of prostatism do not correlate strongly with urodynamic findings.

On the other hand, in the Olmsted County study, in an age-stratified, community-based sample of men 40–79 years old, these relationships were somewhat stronger and statistically significant: a correlation of 0.18 was found between symptom severity and prostate size, of −0.35 between symptom severity and peak uroflow, and of −0.24 between prostate size and peak uroflow [18]. The strength of this study lay in examining these relationships in both the diseased and nondiseased individuals that the random sampling provided. Correlations of this order of magnitude were also recently reported by Bosch et al. [19] in a community-based study from The Netherlands. The authors concluded that a reason for the weak statistical associations reported in most of the literature may be the urology clinic-based populations from which patient samples were drawn.

In our analysis, the diagnostic algorithm outlined by the guidelines of the International Consultation on BPH was used to select men with LUTS but with no previous outlet surgery, or concomitant therapies with agents known to influence vesico-urethral function, or other conditions known to interfere with normal voiding (except BPH). Patients were not classified according to IPSS value, prostate volume, or uroflow indexes.

Attention was thereby focused primarily on 400 of 543 men evaluated (group 1). Since group 2 was an extremely heterogeneous sample of 143 men with some of the aforementioned conditions, no definitive comparison with group 1 was possible. However, even if group 2 had significantly differed from group 1 in mean age, prostate volume, and urinary flow rate, no significant differences in IPSS were found (group 1, 14.22; group 2, 13.59). Similarly, Yalla et al. [14] divided all patients who presented at their prostatic center into 1 of 2 categories. Group 1 consisted of patients with BPH-related voiding dysfunction but without confounding conditions such as additional comorbidities that may have interfered with normal voiding or previous outlet surgery. Group 2 included patients complaining of prostatism with some of the aforementioned comorbid conditions. The study concluded that the symptom score assessment in the two groups was similar and confirmed the nonspecific nature of the symptom score.

We evaluated the correlation between symptom score, prostate volume, and urinary flow rate in the 400 men selected in group 1. As reported in other studies, only weak or modest correlations were found and, after removing the linear effect of age, correlations remained not statistically significant.

Altogether, correlations between mean flow rate and prostate volume or symptom score were somewhat stronger than those between peak flow rate and the other two parameters, suggesting more reliability for the first variable. A logistic regression model was also used, with symptom score as dependent variable and prostate volume and urinary flow rates as possible predictors of symptom score variations. In this case, flow rate proved to be an independent predictor of symptom score in spite of adjustment for age and prostate volume. The meaning of the analysis may be that, keeping all other factors fixed, a 1-unit decrease in flow rate corresponds to a 5% increase in risk of having a high symptom score. This model may suggest the statistical importance of peak flow variation in predicting risk of a high symptom score in the patient. The clinical applicability of these statistical results is debatable.

According to several epidemiologic studies, prostate volume, urinary flow rate, and LUTS are all age-related urologic variables and the nature of their relationship may be age-dependent [12]. In group 1, we analyzed the distribution of these three variables and their correlations across four age decades. The decrease in peak and mean flow rate per decade of age was similar (0.5 ml/sec and 0.4 ml/sec, respectively): moreover, the increase in prostate volume and in total symptom score per decade was 3.3 ml and 0.6, respectively.

Herbison et al. [20] evaluating 128 consecutive patients with LUTS, did not find any differences in urinary flow rate across age decades. On the contrary, in a community-based study including a random sample of 2,113 men 40–79 years old, Girman et al. [21] reported a decrease in peak flow rate per decade of age of 2 ml/sec. In a cohort of 2,245 men, who presented for examination during Prostate Cancer Awareness Week, Moon et al. [22] demonstrated an increase in symptom score with increasing patient age from 4.59 at age 40 years to 8.17 at age 70 years. In a large community-based sample, differences in urinary flow rate and symptoms across age could just as easily be due to changes in bladder muscle tone due to aging and, therefore, may have little association with bladder outlet obstruction [21,23].

In our analysis, the same correlations evaluated in the entire population of 400 men with LUTS were also estimated in each of four age decades. Only in men less than 50 years old were most of the correlations stronger than those observed in the entire group 1. It might be suggested that in this first age decade there are fewer changes in bladder muscle tone, due to aging, likely to influence normal voiding and symptoms, and thus each clinical parameter can better measure pathophysiological phenomena and can be better correlated with the others.

However, in this same decade, symptom score continues to be weakly correlated with age and prostate

volume. To explain the lack of relationship between prostate volume and symptom score, it seems feasible to conclude that accurate measurement is not the major problem, since it is indeed not the overall prostate enlargement that is the critical factor in the production both of symptoms and of physiological outlet obstruction. A likely explanation is that in some patients a relatively small degree of strategically located hyperplasia in the periurethral area might cause considerable obstruction, while in other individuals, considerable hyperplasia can occur without producing obstruction. A parameter recently receiving increased attention is the transition zone (TZ) volume of the prostate. The transition zone is thought to be the part of the prostate which experiences the most growth with advancing age, and it may be responsible for the symptoms. Kaplan et al. [24] found that TZ volume correlates better than the total volume of the prostate with symptom score and peak flow rate.

The lack of a relationship between urinary flow rate and symptoms is more likely to reflect a measurement problem. Questions in the IPSS index ask patients to describe their experience with symptoms during the previous month. Such integration with time is not possible with a single flow rate measurement. A weakness of our own study may be that we did not include more sophisticated urodynamic studies in the evaluation of group 1 from which we might have extracted pressure flow variables that many experts believe are the gold standard for assessing the severity of outflow obstruction. However, most studies have found only a weak correlation between symptoms and urodynamic findings [25,26], confirming that symptoms may be produced through mechanisms other than outflow obstruction.

The recommendation from the International Consensus, that urodynamic evaluations be optional, tempts clinicians to refrain from their use except in indicated cases [10]. In our study, the men in group 1 were submitted to different treatment strategies, following consultation with the urologist, rather than having the treatment randomly assigned. Despite the fact that no selection was made on the grounds of IPSS value, prostate volume, or uroflow indices, the patients who were assigned to surgical treatment had higher prostate volume and IPSS and lower urinary flow rate than those undergoing nonsurgical treatment.

At baseline, symptom severity, uroflowmetry, and prostate size remained weakly correlated in each of the two subgroups. We pooled data across all treatment strategies for the patients who completed the 12-month follow-up. By pooling data for a spectrum of treatments of different effectiveness (from watchful waiting to prostatectomy), a full range of symptoms, urinary flow rate, and prostate volume change with time can be detected: results are still being collected.

Similarly, Barry et al. [27], as part of a prospective cohort study on the efficacy of BPH treatment in four university-based urology practices, correlated, in 219 patients, symptoms, urinary flow rate, and prostate size between baseline and the 6-month follow up visit. Interestingly, changes in symptom score did correlate inversely, to some degree, with peak flow rate (coefficient −0.35) and average flow rate (coefficient −0.36). Although the relationship between symptom score and flow rate change was statistically significant, it remained modest.

The study of the relationship among symptom score, urinary flow rate, and prostate volume in men with LUTS continues to be of great interest. However, due to the lack of a generally accepted operational definition of ''clinical,'' it is practically impossible to compare the results emerging from the various studies. The lack of correlation may reflect unreliable or inappropriate measurements, or the fact that these variables cannot in themselves be correlated. We believe that the reason for the weak statistical association is principally the urology clinic-based population from which patient samples were drawn. Moreover, data emerging from this analysis support the hypothesis that age is one of the principal factors influencing the relationship among symptom score, urinary flow rate, and prostate volume. Further studies and confirmation of these findings by other investigators are still necessary.

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