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CORRELATION BETWEEN UROFLOWMETRY, PROSTATE VOLUME, POSTVOID RESIDUE, AND LOWER URINARY TRACT SYMPTOMS AS MEASURED BY THE INTERNATIONAL PROSTATE SYMPTOM SCORE


ABSTRACT

Objectives. To evaluate the relation between lower urinary tract symptoms (LUTS) as measured by the International Prostate Symptom Score (IPSS) and noninvasive objective parameters of lower urinary tract dysfunction.

Methods. Eight hundred three consecutive patients with LUTS and/or benign prostatic hyperplasia were evaluated with IPSS, uroflowmetry, prostate volume estimation, and postvoiding residue measurement. The relations between these parameters were quantified by means of Spearman correlation coefficients.

Results. Statistically significant but weak correlations were found between the IPSS and results of uroflowmetry and postvoiding residual urine. There was no correlation between the IPSS and results of prostate volume measurements.

Conclusions. The correlation between objective noninvasive parameters of lower urinary tract dysfunction and LUTS is weak. UROLOGY 48: 393–397, 1996.

The development of prostatic enlargement secondary to benign prostatic hyperplasia (BPH) and the development of lower urinary tract symptoms (LUTS) are frequent events in aging males. Most patients who seek medical advice do so because of bothersome symptoms. Consequently, symptoms have become the major focus in the management of bladder outlet obstruction due to BPH. Many urologists use the symptoms as the basis for diagnosis of outlet obstruction and for assessment of treatment efficacy. A number of symptom scores have been designed in search of an objective and structured history of symptoms. Nowadays, the most widely used symptom score is the International Prostate Symptom Score (IPSS). It is generally assumed that the IPSS is a reliable and valid instrument to measure subjective severity of symptoms and symptom progression over time. Besides subjective parameters, changes in objective parameters are used to evaluate treatment success. Because treatment of BPH usually focuses on bladder outlet obstruction, the objective parameters ideally quantify the improvement in grade of obstruction. Urodynamic investigation with pressure-flow analysis is the reference standard to measure grade of obstruction. Its role in the diagnostic armamentarium of BPH, however, is controversial. Urodynamic investigations are invasive and time consuming. Moreover, there is a large equivocal area in the pressure-flow relationship in which "ruling-out" obstruction is difficult.

To document obstruction, most urologists still use noninvasive objective parameters such as urinary flow rate, residual urine, and prostate volume. Uroflowmetry is almost universally available and easy to perform, and it is probably the most frequently used test in urology today. Uroflow and, especially, maximum flow rate (Qmax) are used equivalently with pressure-flow studies to define bladder outlet obstruction. Although uroflow describes the relation between detrusor activity and outflow, current opinion holds that if Qmax is lower than 10 mL/s, the patient is most likely...
TABLE I. Results of age, uroflow, prostate volume, and postvoiding residual urine measurements according to three classes of the International Prostate Symptom Score (mild, moderate, and severe)

<table>
<thead>
<tr>
<th></th>
<th>All Patients (n = 729)</th>
<th>Mild (&lt;8; n = 71)</th>
<th>Moderate (8-19; n = 392)</th>
<th>Severe (&gt;19; n = 266)</th>
</tr>
</thead>
</table>
| Age (years)          | Mean 63.5  
SD 8.4 | Mean 63.7  
SD 8.0 | Mean 63.8  
SD 8.8 | Mean 63  
SD 7.9 |
| Qmax (mL/s)          | Mean 11.5  
SD 5.2 | Mean 11.3  
SD 7.0 | Mean 11.9  
SD 5.2 | Mean 10.3  
SD 4.3 |
| Prostate volume (cm³) | Mean 43  
SD 20 | Mean 40.4  
SD 20 | Mean 45  
SD 21 | Mean 42  
SD 19 |
| Residual urine (mL)  | Mean 17.0  
SD 7.0 | Mean 5  
SD 1.9 | Mean 14.1  
SD 3.2 | Mean 24.5  
SD 3.6 |
| IPSS total           | Mean 9.7  
SD 4.8 | Mean 2.6  
SD 1.8 | Mean 7.9  
SD 2.9 | Mean 14.4  
SD 3.0 |
| IPSS voiding         | Mean 7.3  
SD 3.4 | Mean 2.5  
SD 1.8 | Mean 6.3  
SD 2.6 | Mean 10.0  
SD 2.4 |
| IPSS filling         | Mean 9.7  
SD 4.8 | Mean 2.6  
SD 1.8 | Mean 7.9  
SD 2.9 | Mean 14.4  
SD 3.0 |

Key: IPSS = International Prostate Symptom Score; NS = not significant; Qmax = maximum flow rate; SD = standard deviation; S = significant.

obstructed; conversely, he is probably unobstructed if Qmax is higher than 15 mL/s.8 Also, prostate size and its changes are especially relevant to the choice of treatment to surgically or nonsurgically reduce prostatic bulk. Common practice dictates that the postvoid residual urine determination is a useful objective measurement of the effect of prostatic occlusion on the posterior urethra. The Second International Consultation on BPH Committee recommended the measurement of postvoid residual urine in the diagnostic workup of patients with symptoms of LUTS due to BPH.9

Currently, no agreement exists among urologists concerning the minimal requirements for diagnosis and follow-up of patients with LUTS or BPH. Moreover, the correlation between several of these parameters has been questioned. The present study was conducted on a large series of patients to evaluate the relation between LUTS, as measured by IPSS, and objective noninvasive parameters of lower urinary tract function.

MATERIAL AND METHODS

We studied 803 consecutive patients with LUTS and/or BPH. All patients included in the present study were subjected to a standardized diagnostic program including history (including IPSS), physical examination (including digital rectal examination), biochemistry (including prostate-specific antigen), urinalysis and culture, urine cytology, and urodynamics investigations that included pressure-flow studies. Patients with a total IPSS of less than 8, 8 to 19, or greater than 19 were considered to have mild, moderate, or severe symptoms, respectively.10 The total score of questions 2, 4, and 7 represents the filling component of the IPSS, whereas the total score of questions 1, 3, 5, and 6 represents the voiding component. Free uroflowmetry was performed in private when the patient presented with normal to severe urge to void. Flow was measured using a Dantec Urodyn 1000 flowmeter. According to Abrams and Griffiths,8 a maximum flow rate exceeding 15 mL/s generally indicates unobstructed micturition, whereas values below 10 mL/s indicate infravesical obstruction, provided detrusor insufficiency is absent. Patients involved in uroflowmetry studies were considered for the study if the voided volume was 150 mL or greater. Seventy-four patients did not fulfill this requirement. The data from the remaining 729 patients were used for analysis.

The prostate size was determined using the Kretz Combison 330 ultrasound scanner with a 7.5-MHz transrectal probe (Multi 3-D VRW 77 AK). The prostate was imaged from base to apex; the presence of prostate abnormalities was documented. Prostate volume was measured by the planimetric method.11 The same ultrasound scanner was used in combination with a transabdominal probe (Kretz AWP 3.5) for the estimation of urine residue directly after performing uroflowmetry.

For statistical analysis, we used descriptive statistics and the Spearman correlation coefficient (r) to describe the association between IPSS questions and the various tested parameters. Comparisons among groups of symptom score were made using the Kruskal-Wallis test.

RESULTS

Descriptive statistics with respect to the patients' ages, flow results, prostate volumes, and postvoiding residual urine measurements are summarized in Table I. The mean (±SD) age of the patients was 63.5 ± 8.4 years, and the mean total IPSS, the voiding subscore, and the filling subscore were 17 ± 7, 9.7 ± 4.8, and 7.3 ± 3.4, respectively. When the patients were classified according to the IPSS, the mild-symptom group included 71 patients, the moderate-symptom group included 392 patients, and the severe-symptom group included 266 patients. There were small but statistically significant differences between IPSS classes and Qmax and residual urine measurement. In Table II, we correlated the individual IPSS questions with each of the four parameters mentioned above. Interestingly, we found only a small correlation between the Qmax and weak stream (question 5). The same holds for incomplete emptying of the bladder (question 1) and residual urine (r = 0.17). Statistically significant but weak correlations were also found between all questions of IPSS and

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Qmax and residual urine, and for prostate volume with questions 4 (urgency) and 5 (weak stream). All the tested parameters have a correlation with the total IPSS except prostate volume. In addition, the ages of the patients correlated significantly with Qmax, prostate volume, and residual urine but not with the total IPSS. However, all correlations are small (Table III).

The relationship between the grade of total IPSS and the results of the Qmax is shown in Figure 1A. An increase in the severity of symptoms significantly correlates with a decrease in flow rate, but the overlap in flow rate between patients with different scores is considerable. Figures 1B and 1C represent the relationships between postvoid residual urine measurements and prostate volumes and the different grade of the IPSS. A weak association exists between the residual urine and different grades of symptoms, but no correlation was found between prostate volume and severity of symptoms.

**COMMENT**

In the present study, we evaluated the relationship between LUTS due to BPH as measured by IPSS and objective noninvasive parameters of lower urinary tract dysfunction. Our study shows that the overall symptom severity correlates only weakly with the results of uroflowmetry and postvoiding residual urine measurements. Symptom severity does not correlate at all with the prostate volume and ages of the patients. The weak correlation between symptoms and urinary flow rate was shown before by Barry et al. However, problems with the urinary flow rate in regard to measurement errors, systematic learning effect, and the main difference between physiologic outlet obstruction and the symptoms associated with BPH are known. As illustrated by Figure 1A, there is a weak association between severity of symptoms and urinary flow rate. This supports the hypothesis that the symptoms may originate from neurophysiologic changes that may or may not be associated with histologic and anatomic BPH. From this we conclude that, for an individual patient, the lack of correlation between symptoms and flow rate results should not alter the diagnosis of BPH.

The relationship between prostate volume and parameters for bladder outlet obstruction has also been studied by others. In our study, it was shown that no correlation exists between the IPSS and prostate volume. This lack of correlation can occur because hyperplasia may be associated with striking lateral lobe enlargement but symptoms may be negligible if the degree of obstruction is not severe. Conversely, BPH may be associated with a relatively small-sized prostate and marked obstructive symptoms if the obstructing tissue originates exclusively within the central zone of the periurethral gland area. In Figure 1C, we demonstrated the absence of any relationship between prostate volume and the severity of symptoms.

**TABLE II. Spearman correlation between the International Prostate Symptom Score questions and noninvasive parameters of lower urinary tract symptoms**

<table>
<thead>
<tr>
<th>Question</th>
<th>Median</th>
<th>Age</th>
<th>Qmax</th>
<th>Prostate Volume</th>
<th>Residual Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPSS1</td>
<td>2</td>
<td>0.12</td>
<td>-0.10</td>
<td>0.05 (NS)</td>
<td>0.17</td>
</tr>
<tr>
<td>IPSS2</td>
<td>3</td>
<td>0.04 (NS)</td>
<td>-0.09</td>
<td>0.05 (NS)</td>
<td>0.13</td>
</tr>
<tr>
<td>IPSS3</td>
<td>2</td>
<td>0.06 (NS)</td>
<td>-0.19</td>
<td>0.01 (NS)</td>
<td>0.09</td>
</tr>
<tr>
<td>IPSS4</td>
<td>2</td>
<td>0.06 (NS)</td>
<td>-0.05 (NS)</td>
<td>0.15</td>
<td>0.07</td>
</tr>
<tr>
<td>IPSS5</td>
<td>4</td>
<td>0.07</td>
<td>-0.23</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>IPSS6</td>
<td>1</td>
<td>0.08</td>
<td>-0.12</td>
<td>0.01 (NS)</td>
<td>0.14</td>
</tr>
<tr>
<td>IPSS7</td>
<td>2</td>
<td>0.16</td>
<td>-0.12</td>
<td>0.06 (NS)</td>
<td>0.10</td>
</tr>
<tr>
<td>Qo</td>
<td>4</td>
<td>0.06 (NS)</td>
<td>-0.15</td>
<td>0.04 (NS)</td>
<td>0.18</td>
</tr>
<tr>
<td>IPSS total</td>
<td>17</td>
<td>0.05 (NS)</td>
<td>-0.20</td>
<td>0.03 (NS)</td>
<td>0.18</td>
</tr>
<tr>
<td>IPSS voiding</td>
<td>10</td>
<td>0.11</td>
<td>-0.21</td>
<td>0.02 (NS)</td>
<td>0.17</td>
</tr>
<tr>
<td>IPSS filling</td>
<td>7</td>
<td>0.06 (NS)</td>
<td>-0.10</td>
<td>0.11</td>
<td>0.13</td>
</tr>
</tbody>
</table>

**Key:** IPSS = International Prostate Symptom Score; NS = not statistically significant (all other coefficients were statistically significant at P < 0.05); Qmax = maximum flow rate; Qo = quality of life.

*The correlation coefficient ranges from -1 to +1, with -1 describing a perfect negative linear, or straight line, relationship and +1 describing a perfect positive linear, or straight line, relationship.*

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1 *Urology* 48 (3), 1996
TABLE III. The International Prostate Symptom Score (IPSS)

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at All</th>
<th>Less Than 1 Time in 5</th>
<th>Less Than Half the Time</th>
<th>About Half the Time</th>
<th>More Than Half the Time</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Over the past month, how often have you had a sensation of not emptying your bladder completely after you finished urinating?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Over the past month, how often have you had to urinate again less than 2 hours after you finished urinating?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Over the past month, how often have you found you stopped and started again several times when you urinated?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Over the past month, how often have you found it difficult to postpone urination?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Over the past month, how often have you had a weak urinary system?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Over the past month, how often have you had to push or strain to begin urination?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Over the past month, how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

TOTAL IPPS Score $S = QUALITY \ OF \ LIFE \ DUE \ TO \ URINARY \ SYMPTOMS$

<table>
<thead>
<tr>
<th>Quality of Life Due to Urinary Symptoms</th>
<th>Delighted</th>
<th>Pleased</th>
<th>Mostly Satisfied and Dissatisfied</th>
<th>Mixed About</th>
<th>Mostly Dissatisfied</th>
<th>Unhappy</th>
<th>Terrible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about this?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>
From the current study, we conclude that the correlation between the uroflowmetry results, prostate volume, postvoid residual urine, and LUTS as measured by the IPSS is weak. Moreover, the main problem in the documentation of outcome of treatment of BPH consists of achieving agreement in the use of the different parameters. Should we aim at improvement of symptoms only, at improvement of the objective voiding parameters, or even at improvement of both?

REFERENCES