Original

**Assessment of the Daily Variation in Urinary Symptoms
in Patients with Benign Prostatic Hyperplasia
Using 24-Hr Home Uroflowmetry**

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Abstract : We used home uroflowmetry to assess urinary excretion over a 24-hr period and used the results of this study to evaluate the reliability of the International Prostate Symptom Score (IPSS) and to determine the daily variation in urinary excretion. Fifteen patients (mean age 68.3 years) with benign prostatic hyperplasia (BPH) were examined using home uroflowmetry. These patients also completed the IPSS questionnaire. The IPSS score was checked for agreement with the data recorded by home uroflowmetry. Urinations were classified into the following 4 periods. The 24-hr period was divided into the active period and the sleeping period. The home uroflowmetry parameters were compared to these periods. The IPSS scores for frequency and intermittency of urination correlated well with the respective home uroflowmetry scores. Regarding daily variation, maximum flow rate (Q_{max}) was often highest in the evening and lowest at night, and the voided volume and voiding time tended to be highest at night, and lowest in the afternoon. The mean Q_{max} and mean average flow rate (Q_{ave}) were significantly higher during the active period than during the sleeping period. In contrast, the mean voided volume and mean voiding time were significantly higher values during the sleeping period than during the active period. Two items on the IPSS questionnaire, frequency and interruption of the urinary stream, were found to be highly reliable. Q_{max} and Q_{ave} values varied during the 24-hr period and were an estimated 10% and 20% higher, respectively, during the active period than during sleeping period.

Key words : IPSS (International Prostate Symptom Score), home uroflowmetry, BPH (benign prostatic hyperplasia)

Introduction

The International Prostate Symptom Score (IPSS) has been proposed for assessing the severity of benign prostatic hyperplasia (BPH), choosing therapy, and evaluating the effectiveness of treatment¹⁾. This score is based on the AUA Symptom Score established by the American Urological Association (AUA) to numerically express the severity of urinary symptoms, and has been supported by international conferences on BPH. For this reason, the IPSS is the most commonly used score to assess prostate symptoms. Its reliability and

characteristics have been widely discussed and it has been reported to be useful in evaluating the effectiveness of treatment for BPH²⁾. However, it has also been reported that there is only a weak correlation between the symptom score, the degree of prostatic enlargement, and parameters of lower urinary tract obstruction³⁾. Also, the reproducibility of the IPSS has been questioned⁴⁾ and it has been reported that it should not be used for making a diagnosis of BPH⁵⁾. Actual use of the IPSS makes it difficult to answer the questionnaire in such frequency as less than 1 time in 5 or about half the time.

Many patients show differences in urinary symptoms between day and night, and some reports have indicated that Uroflowmetry produces widely varying results at different times during a 24-hr period⁶⁾. However, daily variation of urinary excretion has not yet been confirmed.

In this study, we used home uroflowmetry to assess urinary excretion over a 24-hr period at home and evaluated (1) the reliability of the IPSS and (2) the daily variation in urinary excretion, in order to make a precise assessment of urinary symptoms in patients with BPH.

Materials and Methods

The patients included in this study were males aged 60–77 years (mean age: 68.3 years) who had BPH diagnosed by transrectal ultrasonography or digital rectal examination. In addition to patients with systemic complications, such as diabetes mellitus and heart disease, we excluded those with a neurogenic bladder, bladder neck obstruction, urethral stricture, and prostate cancer, which were diagnosed by intravenous urography, urethrocystography, cystometry, and biopsy of the prostate, respectively. On visiting an outpatient clinic office, the subjects were provided with a home uroflowmeter (Dantec, the Da CapoTM Home Uroflowmeter) to monitor all urinations. After the device was returned, the data was entered into a personal computer. All subjects were required to report the time of awakening and retiring to bed, and this information was entered into the home uroflowmeter. Thirteen subjects also completed the IPSS questionnaire before home monitoring.

The scores obtained from the IPSS questionnaire for the frequency of urination, intermittency of urination, and frequency of nocturia, were compared to the data recorded by the home uroflowmeter. For comparison with IPSS scores, the respective incidence of the above 3 items recorded by the home uroflowmeter was divided by the total number of urinations recorded, and the values (%) were designated as follows: 0 % = not at all, 1–19 % = less than 1 time in 5, 20–39 % = less than half the time, 40–59 % = about half the time, 60–79 % = more than half the time, and 80 % = almost always. Urination recorded within 2 hours of the previous urination, during the day or at night, was defined as frequent urination. A polymodal urinary flow curve was defined as interruption of the urinary stream, and likewise when it was difficult to judge whether dribbling had occurred this was also defined as interruption of the urinary stream. The time of awakening and retiring to bed were recorded before commencing the 24-hr period of home uroflowmetry. All urinations occurring between bedtime and awakening were defined as frequency of nocturia. All urinations recorded by the home uroflowmeter were classified into the following 4 periods: (1) the morning period (from awakening to 12:00); (2) the afternoon period (from 12:00 to 18:00); (3) the evening period (from 18:00 to bedtime); and (4) the nocturnal period (from bedtime to awakening).

Table 1. Correlation of results from the IPSS questionnaire and home uroflowmetry

item of IPSS	correlation coefficient (r)	p value
frequency of urination	0.606	0.028
intermittency of urination	0.565	0.044
frequency of nocturia	-0.246	0.396

n = 13

Table 2. Timing of the maximum and minimum values for Qmax, Qave, voided volume and voiding time

uroflow parameter		morning	afternoon	evening	nocturnal
Qmax	maximum	13	33	41	13
	minimum	20	20	27	33
Qave	maximum	0	66	27	7
	minimum	40	7	20	33
voided volume	maximum	33	13	13	41
	minimum	20	40	33	7
voiding time	maximum	40	0	13	47
	minimum	13	54	33	0

(%)

morning period : from awakening to 12:00, afternoon period : from 12:00 to 18:00
 evening period : from 18:00 to bedtime, nocturnal period : from bedtime to awakening

The maximum flow rate (Qmax), the average flow rate (Qave), the voided volume, and the voiding time of the 15 patients were averaged and the timing of the maximum and minimum values for these parameters was determined. Periods (1) to (3) were defined as the active period (from awakening to bedtime) and period (4) was defined as the sleeping period. The intra-day variation of urination was then averaged for all patients and mean values were calculated for Qmax, Qave, mean voided volume, and mean voiding time. Wilcoxon's rank sum test was performed, which corresponded to Spearman's rank correlation coefficient.

Results

The average prostate volume was 32.5 g (range: 20.9–54 g), and the average IPSS score was 14.8 (range: 6–23). The average number of urinations recorded for each patient by the home uroflowmeter was 20.3 and the average number of days of recording was 3.6. The total number of urinations for all 15 patients was 308, of which 294 (95.5%) were correctly measured.

The IPSS scores for frequent urination and interruption of the urinary stream determined for 13 patients gave correlation coefficients of 0.606 and 0.565, respectively, when compared to the corresponding scores obtained by the home uroflowmeter. These correlations were significant ($p=0.028$ and 0.044). However, the IPSS score for nocturia showed a correlation coefficient of only -0.246 for the corresponding home uroflowmetry score, this

Table 3. Comparison between the active period and sleeping period of the uroflow parameters used by home uroflowmetry

uroflow parameter	n	mean $\pm$ SD
Mean Qmzx (ml/s)	15	
Active period		10.4 $\pm$ 4.2
Sleeping period		9.4 $\pm$ 3.9 *
Mean Qave (ml/s)	15	
Active period		6.2 $\pm$ 2.2
Sleeping period		5.2 $\pm$ 2.4 *
Mean voided volume (ml)	15	
Active period		153.9 $\pm$ 69.3
Sleeping period		224.7 $\pm$ 191.3 *
Mean voiding time (s)	15	
Active period		31.0 $\pm$ 14.7
Sleeping period		45.5 $\pm$ 18.6 *
active period : from awakening to bedtime		* $p < 0.05$
sleeping period : from bedtime to awakening		

correlation was not significant ($p=0.396$) (Table 1).

Regarding daily variation, Qmax was highest in the evening in 6 patients (41%) and lowest at night in 5 patients (38%). The voided volume and voiding time were highest at night in 6 (41%) and 7 cases (45%), respectively, however these parameters were lowest in the afternoon in 6 (40%) and 8 cases (54%), respectively (Table 2). The mean Qmax and mean Qave were significantly higher (both $p < 0.05$) during the active period than during the sleeping period. In contrast, the mean voided volume and mean voiding time were significantly higher (both $p < 0.05$, respectively) during the sleeping period than during the active period (Table 3).

Discussion

The assessment of urination by uroflowmetry can be influenced by the psychological suppression of urination. Measurements are usually made in a laboratory or an outpatient clinic and in such environments the patient is often under stress. This results in some patients being unable to urinate and some complain that urinary conditions are different to normal. Home uroflowmetry is reported to provide more concrete and precise information than the data obtained from a single test with a laboratory uroflowmeter⁷⁾. For this reason, we used a home uroflowmeter to assess urinary symptoms in patients with BPH.

In a previous study, patients were subjected to a 24-hr uroflowmetric evaluation to assess whether scores from IPSS questionnaires agreed with data obtained by uroflowmetry⁸⁾. The scores correlated highly for nocturia and interruption of the urinary stream, while the correlation with frequency was weaker. In this study we used home uroflowmetry to assess the IPSS questionnaire items for frequency, interruption of the urinary stream, and nocturia, and found that frequency and interruption of the stream reflected actual urination with a high degree of reliability. Home uroflowmetry allows the evaluation of urination under conditions as close as possible to normal daily life, rather than under conditions of restricted activity or hospitalization. Among 13 subjects, 7 showed a higher IPSS score for nocturia

than was recorded by uroflowmetric monitoring of urination. This may be because the patients included urination on awakening with nocturia when answering the IPSS questionnaire. When home uroflowmetry was used to measure nocturia, the results varied depending on the day of measurement. Among 13 patients, 4 reported the most frequent urinations within a few days as measured by home uroflowmetry as an IPSS score. It is possible that these patients would complain strongly of these symptoms. It is necessary for patients to be fully educated on these matters at the time of receiving the home uroflowmeter and answering the IPSS questionnaire.

Boci *et al.*⁹⁾ and Jacob *et al.*⁶⁾ investigated the daily variation of urination and reported differences between day and night. We also found two marked differences. The mean Qmax and mean Qave were significantly higher during the active period, with values at an estimated 10% and 20% respectively, and the mean voided volume and mean voiding time were significantly higher during the sleeping period, both estimated at 50%. These findings suggest that excess urine tends to accumulate during the night at a time when patients took longer to pass urine and their flow was weak. Whether an increase of urine output during the night and early morning has some relationship with nocturia remains unknown, and needs further investigation. Another possibility is that the desire for micturition may be less at the same bladder capacity during the sleeping period. The weak urinary flow is explained by the fact that Qmax and Qave depend on the voided volume and increase as the volume increases¹⁰⁾. However, residual urine volume is related to bladder capacity and is not measured by home uroflowmetry. So, this study was unable to assess the correlation between voided volume and Qmax and Qave during the night because residual urine volume could not be measured. Our results confirmed that the mean voided volume was 153.9 ml during the active period and 224.7 ml during the sleeping period, which were lower volumes than those reported in other studies. The residual urine volume, as described above, may explain these lower volumes. Alternatively, these volumes may be usual for urination at home in patients with BPH. Further study is needed to assess residual urine volumes in these patients.

Two items on the IPSS questionnaire, frequency and interruption of the urinary stream, were found to be highly reliable.

Qmax and Qave values varied during the 24-hr period and were an estimated 10% and 20% higher, respectively, during the active period than during the sleeping period.

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