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Original Research Article

Lower urinary tract symptoms evaluation with uroflowmetry in patients with benign prostatic hyperplasia

Shivendra Agrawal*, Srinath N., Prathvi, Sreedhar Reddy, Raju L. N., Deepak Bolbandi

Department of Urology, Rajarajeswari Medical College and Hospital, Bangalore, Karnataka, India

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***Correspondence:**
Dr. Shivendra Agrawal,
E-mail: agrawal shivendra@xahoo.co.in

ABSTRACT

Background: Uroflowmetry, a non-invasive urodynamic technique, is commonly employed in evaluating patients with potential lower urinary tract dysfunction. Accurate assessment of the severity of lower urinary tract symptoms (LUTS) can be achieved through the utilization of various validated questionnaires, such as the International Prostate Symptom Score (IPSS). The objective of this study was to investigate the correlation between uroflowmetry parameters and the severity of symptoms.
Methods: Fifty patients with LUTS caused by benign prostatic hyperplasia were evaluated by using uroflowmetry, IPSS, prostate volume estimation from May 2022 to December 2023. The correlations between these parameters were quantified by means of Spearman correlation co-efficients.
Results: Significant statistical correlations were identified between the IPSS and uroflowmetry outcomes, including peak flow rate, average flow rate, and post-void residual urine. However, no correlation was observed between the IPSS and measurements of prostate volume.
Conclusions: A positive correlation was observed between the measured peak flow rate through uroflowmetry and the severity of lower urinary tract symptoms.

Keywords: Benign prostatic hyperplasia, Lower urinary tract symptoms, Uroflowmetry

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a well-known contributor to urinary obstruction and stands as the most prevalent condition affecting aging men.[1] In individuals with BPH, the enlargement of the prostate typically results in bladder outlet obstruction (BOO), giving rise to various bothersome lower urinary tract symptoms (LUTS).[2] During the management of BPH, it is crucial to evaluate the severity of symptoms rather than focusing solely on the increase in prostatic volume.[3] Reliable measurement of the severity of lower urinary symptoms can be achieved through various validated questionnaires, such as the International Prostate Symptom Score (IPSS), Boyarsky score, Madsen Iversen score, and Danish prostatic symptom score. The IPSS, specifically, is recommended as a symptom-scoring instrument for baseline assessment in men presenting with LUTS.The uroflowmeter, introduced by Von Garrelts in 1957, has proven to be a valuable, straightforward, and non-invasive urodynamic tool.[4] It facilitates the objective assessment of intravesicular obstruction, aiding in the decision-making process and management of benign prostatic hyperplasia.[5,6] Indications for uroflowmetry include patients exhibiting signs and symptoms suggestive of bladder outlet obstruction. A Q max (maximum flow rate) of <15 ml/s is often considered indicative of BOO, serving as a common inclusion

criterion in clinical trials.[7] Q max is frequently used interchangeably with pressure flow studies to define bladder outflow obstruction.[8] The objective of this study was to investigate the correlation between uroflowmetry parameters and the severity of symptoms.

METHODS

A retrospective study of prospectively collected data from May 2022 to December 2023 was conducted at Rajarajeswari Medical College and Hospital (RRMCH), Bangalore, focusing on patients admitted with lower urinary tract symptoms (LUTS) indicative of benign prostatic hyperplasia (BPH). The study included fifty consenting patients exhibiting LUTS suggestive of BPH. Each participant underwent a comprehensive assessment, involving detailed history taking, physical examinations, evaluation using the International Prostatic Symptom Score (IPSS), digital rectal examinations (DREs), renal function tests (blood urea, serum creatinine), complete urine analysis, ultrasound, and uroflowmetry.

Inclusion criteria

Patients presenting with LUTS, patients with age >50 years, and patients with IPSS of >12 were included.

Exclusion criteria

Patients who had undergone prior urinary tract or pelvic surgeries, patients who had past history of prostatic surgery, prostatic carcinoma, urethral stricture, vesical calculus or neurogenic bladder were excluded. Patients who had systemic disorders that could influence bladder function, such as neurological disorders, diabetes also excluded. Patients whose voided urine volume was less than 150 ml and patients who were on medical treatment of BPH were excluded.

All enrolled patients underwent assessment using the IPSS questionnaire, recognized as the ideal tool for grading baseline symptom severity. The IPSS comprises seven questions related to urinary symptoms, with each question assigned points ranging from 0 to 5, indicating increasing severity of the respective symptom. The total score, ranging from 0 to 35, provides an overall measure of symptom severity. Uroflowmetry, a straightforward procedure, was employed to calculate the flow rate of urine over time. The machine provided results in terms of peak flow rate (Q max), flow time, voided volume, and average flow rate. Uroflowmetry was conducted with patients having full bladders, ensuring privacy, and participants were instructed to void when feeling a 'normal' urge. The procedure involved urinating into a special funnel connected to a measuring instrument. Patients used a special urinal in a toilet equipped with a machine featuring a measuring device. Before starting urination, patients pressed a button, and the machine yielded results such as peak flow rate, voiding time, voiding volume, and time to peak flow. The test caused no discomfort as it involved normal urination. Patient data was analysed, and individuals were categorized based on their symptom severities assessed by the IPSS. The results obtained from uroflowmetry in these patients were compared using various statistical techniques, with Pearson's correlation coefficient employed to assess correlations between different variables.

RESULTS

The average age of the patients in our study was 67.7 years, with a majority (46%) falling within the age group of 60-69 years (Table 1).

Table 1: Demographic data.

Age group	Number of cases
50-59 years	20
60-69 years	23
>70 years	07

According to the IPSS scoring, out of the 50 patients, 31 were classified as having severe symptoms, while 19 had moderate symptoms (Table 2).

Table 2: IPSS.

IPSS	Number of cases
Mild	18
Moderate	19
Severe	13

The mean prostatic size was recorded as 60.9, ranging from 22 to 110. When categorizing patients based on symptom severity scores, those with moderate symptoms showed a mean prostatic size of 54.2, while those with severe symptoms had a mean prostatic size of 65.0. The calculated p-value exceeded 0.05, indicating non-significance. The correlation coefficient of prostatic size in patients with moderate symptoms was 0.26, and in patients with severe symptoms, it was 0.18. The overall correlation coefficient of IPSS with prostatic size was determined to be 0.24. Regarding post voiding residual urine (PVRU), the mean value was 118, ranging from 25 to 322 (Table 3).

Table 3: Post voiding residual urine.

PVRU (ml)	**Mean (SD)**	**118 (48.5)**
	Range	25-322
	Correlation co-efficient (r) with IPSS	0.49
	IPSS moderate mean (SD)	93.3 (27.7)
	IPSS severe mean (SD)	143.5 (52.1)
	t- test; p-value*	3.2; <0.05, S

*NS: Non-Significant; S: Significant; HS: Highly Significant Correlation co-efficient (r) ranges from –1 to +1, with –1 describing a perfect negative linear relationship and +1 describing a perfect positive linear relationship

In our study, the mean peak flow rate was 9.6, with a minimum recording of 3 ml/s and a maximum recording of 19 ml/s (Table 4).

Table 4: Peak flow rate.

Peak flow rate (ml/sec)	**Mean (SD)**	**9.6 (4.0)**
	Range	3-19
	Correlation co-efficient (r) with IPSS	-0.67
	IPSS moderate mean (SD)	12.3 (2.9)
	IPSS severe mean (SD)	7.8 (3.5)
	t- test; p-value*	4.7;<0.001, HS

*NS: Non-Significant; S: Significant; HS: Highly Significant Correlation co-efficient (r) ranges from –1 to +1, with -1 describing a perfect negative linear relationship and +1 describing a perfect positive linear relationship

The mean average flow rate was 5.8 ml/sec, with a minimum recording of 2 ml/sec and a maximum recording of 14 ml/sec (Table 5). Additionally, our analysis revealed that the mean time to peak flow, voided volume, voiding time, and flow time showed an insignificant relationship with symptom severity.

Table 5: Average flow rate.

Average flow rate	**Mean (SD)**	**5.8 (2.9)**
	Range	2-14
	Correlation co-efficient (r) with IPSS	-0.64
	IPSS moderate mean (SD)	7.9 (2.7)
	IPSS severe mean (SD)	4.4 (2.2)
	t- test; p-value*	4.6; <0.001, HS

*NS: Non-Significant; S: Significant; HS: Highly Significant Correlation co-efficient (r) anges from -1 to +1, with -1 describing a perfect negative linear relationship and +1 describing a perfect positive linear relationship

DISCUSSION

The current study, conducted on a cohort of 50 patients, aimed to establish connections among uroflowmetry parameters and symptom severity. The average age of the participants was 67.7 years, with a significant portion (46%) falling within the 60-69 age group. Comparable findings were observed in the study by Mebust et al, where patients exhibited an average age of 69 years, specifically in the context of benign prostatic hyperplasia.[9] Additionally, Iqbal T et al and Saleem et al reported mean ages of 63.4 and 65.6 years, respectively, aligning with the age demographic observed in our study.

In our study involving 50 patients, the mean prostatic size was determined to be 60.9 cm^3, with a range spanning from 22 to 110. The assessment of prostate volume serves various useful purposes, aiding in the selection of appropriate therapeutic interventions. In a study conducted by Vesely et al comprising 354 patients, the average prostate volume was reported to be 40.1 cm^3, while Dicuio et al found an average prostate volume of 41 cm^3 in their study involving 25 men.[10,11] Discrepancies in these measurements may be attributed to the delayed presentations of patients, as Rajarajeswari Medical College & Hospital (RRMCH) functions as a tertiary care center. Upon categorizing patients based on symptom severity scores, the mean prostatic size for those with moderate symptoms was 54.2, whereas for patients with severe symptoms, it was 65.0. The calculated p-value exceeded 0.05, indicating non-significance. The correlation coefficient of prostatic size in patients with moderate symptoms was 0.26, and in those with severe symptoms, it was 0.18. The overall correlation coefficient of IPSS with prostatic size was 0.24, suggesting no significant correlation between prostatic volume and IPSS. This finding is consistent with a study conducted by Ezz et al on 803 patients, further supporting the lack of a substantial correlation between prostatic volume and IPSS.[12]

In our study, we observed a weakly positive correlation between post voiding residual urine (PVRU) and the severity of urinary symptoms. This finding is in line with the results obtained by Kolman et al who reported a statistically significant association between PVRU, prostate volume, and the severity of symptoms.[13] Likewise, Barry MJ and Girman CJ conducted an analysis involving 198 patients after the treatment of BPH, demonstrating a significant correlation between the reduction of symptom scores and improvements in uroflowmetry, including PVRU.[14] These consistent findings further support the notion that PVRU may be linked to the severity of urinary symptoms in patients with BPH.

In our study, the mean peak flow rate was determined to be 9.6, with a recorded minimum of 3 and a maximum of 19 ml/s. Notably, the peak flow rate exhibited a strongly positive correlation with symptom scores. Similar findings have been observed in various other studies. For instance, Hideaki Itoh et al conducted a study involving 206 males and concluded that among the parameters obtained through uroflowmetry, the maximum flow rate was the most representative. It was adopted for both diagnostic and severity criteria for benign prostatic hyperplasia (BPH), as well as for assessing the efficacy of BPH treatment. Additionally, studies by Barry MJ and Girman CJ, Bosch et al, and Din et al, reported weakly positive correlations between peak flow rate and symptom scores.[14-16] These consistent results emphasize the significance of the peak flow rate as a representative parameter in evaluating BPH severity and treatment efficacy.

In our study, the mean time to peak flow rate was calculated to be 11.8, with a minimum recording of 1 and a maximum recording of 71 seconds. Upon comparison of variables using Student's t-test, the calculated p-value

was found to be >0.05, indicating non-significance. Consistent with our findings, most studies have reported similar results, showing no significant correlation between symptom scores and the time to peak flow rate. This suggests that the time to peak flow rate may not be strongly associated with the severity of urinary symptoms in the context of this study.

In our study, the mean voided volume was determined to be 269.6, ranging from 181 to 584. Upon comparison of variables using Student's t-test, the p-value was found to be >0.05, indicating non-significance. Consequently, no correlation was identified between symptom scores and voided volume. Furthermore, multivariate logistic regression analyses demonstrated that the presence of moderate to severe symptoms (International Prostate Symptom Score greater than 7) was independent of prostate volume. However, it was found to be dependent on factors such as age, a reduced flow rate, postvoid residual volume, and voided volume. These results suggest that, in this study, voided volume may not be a significant predictor of the severity of urinary symptoms, with other factors playing a more influential role.

In our study, the mean flow time was calculated to be 51.9 seconds, with a range of 16 to 111 seconds. When comparing the variables using Student's t-test, the p-value was found to be >0.05, indicating non-significance. Therefore, no significant correlation was identified between symptom scores and mean flow time. These results suggest that, in this study, mean flow time may not be a significant factor influencing the severity of urinary symptoms.

In our study, the mean voiding time was determined to be 67.4 seconds, with a range of 17 to 250 seconds. The mean voiding time for patients with moderate symptoms was found to be 60.6 seconds, while for patients with severe symptoms, it was 71.6 seconds. Upon comparing the variables using Student's t-test, the p-value was found to be >0.05, indicating non-significance. Therefore, in this study, no significant correlation was identified between symptom scores and voiding time.

It's worth noting that while this study did not find a correlation between symptom scores and voiding time, the absence of available data on voiding time and its association with lower urinary tract symptoms (LUTS) or symptom scores in other studies might limit a broader understanding of this relationship. Further research in this area could provide valuable insights into the potential influence of voiding time on LUTS severity.

In our study, the mean average flow rate was calculated to be 5.8, ranging from 2 to 14 ml/s. The mean average flow rate for patients with moderate symptoms was 7.9, while for patients with severe symptoms, it was 4.4. Upon comparing the variables using Student's t-test, the p-value was found to be <0.001, indicating high significance. Consequently, a strongly positive correlation was identified between symptom scores and average flow rate. These findings align with the study by Itoh H et al who investigated 206 males and obtained relatively high correlation coefficients exceeding 0.3 between average flow rate and symptom scores. Their results strongly suggested that time-dependent factors in micturition significantly influenced lower urinary tract symptoms (LUTS) in elderly patients.[16] On the other hand, Barry MJ and Girman CJ reported no significant correlation (r = 0.13) between average flow rate and symptom scores.[14] In contrast, Wadie et al reported a statistically significant correlation (r = 0.16, p<0.01) between average flow rate and the International Prostate Symptom Score (IPSS).[17] The varying results across studies underscore the complexity of the relationship between average flow rate and symptom scores, possibly influenced by factors such as population demographics and measurement methodologies.

CONCLUSION

Based on the data obtained from the evaluation of 50 patients with benign prostatic hyperplasia (BPH), several conclusions can be drawn:

Prostate size, as measured by ultrasound, shows no correlation with the severity of Lower Urinary Tract Symptoms (LUTS). The limitation of ultrasound in not considering zonal enlargement suggests that other assessments, such as uroflowmetry and the International Prostate Symptom Score (IPSS), are more relevant for judging disease severity. Post void residual urine has a strongly positive correlation with the severity of LUTS. This implies that higher post void residual urine volumes are associated with more severe lower urinary symptoms. Among the uroflowmetry parameters, peak flow rate is identified as the most representative of the symptom severity in patients with BPH. Average flow rate also correlates positively with the symptoms, suggesting it can be considered as a valuable parameter in assessing symptom severity. In Conclusion, this study shows that, for a comprehensive assessment of BPH and its impact on urinary function, a combination of uroflowmetry and IPSS, particularly focusing on parameters like peak flow rate and post void residual urine, proves to be valuable. This approach takes into account both the flow dynamics and subjective experiences reported by patients, providing a more nuanced understanding of the condition.

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