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The Effect of Voiding Position on Uroflowmetry Findings of Healthy Men and Patients with Benign Prostatic Hyperplasia

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ABSTRACT

Introduction: We assessed the effect of different positions of voiding on uroflowmetry findings in healthy men and in patients with benign prostatic hyperplasia (BPH).

Materials and Methods: Ten men with symptomatic BPH and 10 healthy men were enrolled in this study. Urodynamic study was done for each subject in 3 positions: standing, crouching (the position used in the Iranian style toilets), and sitting. The following urodynamic parameters were studied: voided urine volume, residual urine volume, total flow time, flow time, maximum flow rate, average flow rate, delay to start voiding, and maximum flow time.

Results: There were no significant differences between the 3 voiding positions and urodynamic parameters of healthy men. In men with BPH, the postvoid residual urine volume was significantly lower in the sitting position compared with the crouching and standing positions (67 mL versus 130 m/L and 130 mL; $P < .001$). The median average flow rate was 2.5 mL/s in the crouching, 3.5 mL/s in the sitting, and 3 mL/s in the standing positions ($P = .016$). Also, delay to start voiding was longest in the crouching position (6.5 seconds, 6 seconds, and 5 seconds in the crouching, sitting, and standing positions; $P = .011$). Voided urine volume, total flow time, flow time, maximum flow rate, and maximum flow time were not different among the 3 positions.

Conclusion: In patients with BPH, voiding position may affect urodynamic parameters and the physician's decisions. Further studies are needed to elucidate the effects of voiding position on urodynamic parameters.

KEY WORDS: Uroflowmetry, voiding position, crouching, postvoid residual volume, average flow rate

Introduction

The lower urinary tract system is one of the few body systems controlled by both voluntary and autonomic nervous systems. This results in a complexity of function.[1,2] The lower urinary tract is associated with a nonlinear, multivariable, dynamic system that depends on internal alterations (convulsions, dysfunctions, infections, etc) and external alterations (coughing, sneezing, exercise, listening to running water, fear, cold, etc). Several models have been introduced to explain the mechanical properties of the urinary tract, but none of them address of all the system's aspects.[3] Voiding position is a parameter thought to influence urodynamic studies. This may alter the uroflowmetry findings affecting angles and cross-sectional area of the meatus. As yet however, no study has addressed the effect of voiding positions on uroflowmetry findings. In this study,

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we investigated the uroflowmetry findings of 3 different voiding positions in healthy men and patients with benign prostatic hyperplasia (BPH).

Materials and Methods

Between January 2003 and March 2003, we studied on the uroflowmetry findings of 10 men with BPH (mean age, 69.5 years; range, 58 to 76 years) who were candidates for open prostatectomy or transurethral resection of the prostate for reasons other than urinary retention. Also, urodynamic study was performed in 10 healthy volunteers (mean age, 23.6 years; range, 19 to 32 years).

The patients were informed of the study parameters and informed consent was obtained. The study design was approved by the bioethics board of Tehran University of Medical Sciences.

Urodynamic study was done 3 times for each patient and each healthy volunteer. Each was asked to urinate in 3 positions: standing, crouching (the position used in Iranian style toilets), and sitting (the position used in European style toilets). In each position, urodynamic findings including voided urine volume, residual urine volume, total flow time, flow time, maximum flow rate, average flow rate, delay to start voiding, and maximum flow time were measured using a Dantec UD 5500 MK2 Urology Cystometer Uroflowmetry (Dantec, Denmark).

Changes in uroflowmetry parameters in each group were analyzed using the Friedman and Wilcoxon signed rank tests, and the 2 groups' results were compared using the Mann-Whitney *U* test. Continuous variables are presented as medians (interquartile range), and a *P* values less than .05 were considered statistically significant. Data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 13.0, SPSS Inc, Chicago, Ill, USA).

Results

The voided urine volume, maximum flow rate, and average flow rate were significantly lower in men with BPH than in healthy men. Patients with BPH had longer total flow time and flow time, a greater postvoid residual urine volume, and a longer delay to start voiding, but maximum flow time was not different between the 2 groups. Urodynamic findings in the 2 groups are summarized in Table 1.

There were no significant differences between the 3 voiding positions regarding the urodynamic parameters of healthy men. In men with BPH, the postvoid residual urine volume was significantly lower in the sitting position compared with crouching and standing positions (67 mL versus 130 mL and 130 mL; $P < .001$; Figure 1). The average flow rate was slightly different in this group of patients when they changed their voiding position; the median

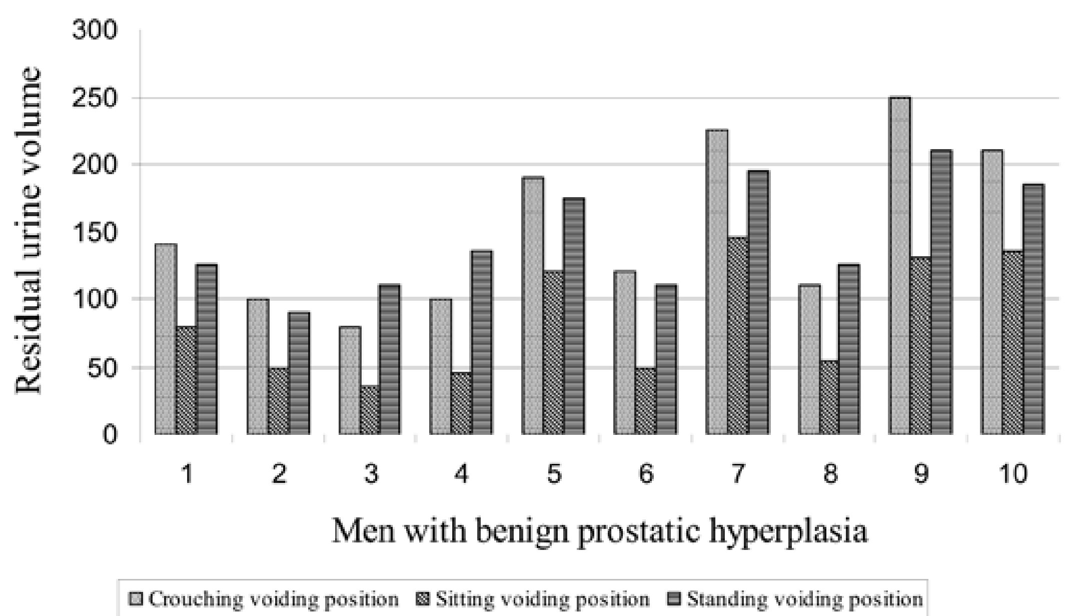

Fig. 1. Postvoid residual urine volume in 10 men with benign prostatic hyperplasia in 3 voiding positions

Table 1. *Urodynamic findings in healthy men and patients with BPH, in crouching, sitting, and standing positions, reported as medians (interquartile ranges)*

Position	Variable	Healthy men	Men with BPH	*P* value
Crouching	Voided urine volume (mL)	316 (96)	220 (90)	.003
	Total flow time (second)	18.5 (9)	87.5 (24)	< .001
	Flow time (second)	17.5 (8.5)	85 (23.5)	< .001
	Residual urine volume (mL)	0 (0)	130 (113)	< .001
	Maximum flow rate (mL/s)	25 (6.1)	6.7 (2.3)	< .001
	Average flow rate (mL/s)	16.5 (2.3)	2.5 (2)	< .001
	Delay to start voiding (second)	1 (1)	6.5 (8)	< .001
	Maximum flow time (second)	9.5 (2.25)	9 (7.25)	.988
Sitting	Voided urine volume (mL)	288 (27)	209 (101)	.026
	Total flow time (second)	18 (4.5)	81.5 (37.5)	< .001
	Flow time (second)	17 (4)	80 (37.5)	< .001
	Residual urine volume (mL)	0 (0)	67 (82)	< .001
	Maximum flow rate (mL/s)	25.5 (4.7)	7.2 (2.7)	< .001
	Average flow rate (mL/s)	17 (1.5)	3.5 (2)	< .001
	Delay to start voiding (second)	1 (1)	6 (8.25)	< .001
	Maximum flow time (second)	8.5 (2.25)	8.5 (2.75)	.847
Standing	Voided urine volume (mL)	307 (57)	235 (54)	.001
	Total flow time (second)	20.5 (6)	88 (23.5)	< .001
	Flow time (second)	19 (6)	86.5 (24.5)	< .001
	Residual urine volume (mL)	0 (0)	130 (77)	< .001
	Maximum flow rate (mL/s)	25 (5)	7 (3.6)	< .001
	Average flow rate (mL/s)	17 (2.3)	3 (2)	< .001
	Delay to start voiding (second)	1 (0.25)	5.5 (7.25)	< .001
	Maximum flow time (second)	8 (5.25)	7.5 (8)	.493

average flow rate was 2.5 mL/s in the crouching, 3.5 mL/s in the sitting, and 3 mL/s in the standing positions ($P = .016$; Figure 2). Also, the delay to start voiding was longest in the crouching position (6.5 seconds, 6 seconds, and 5 seconds in crouching, sitting, and standing positions; $P = .011$; Figure 3). Other parameters including voided urine volume, total flow time, flow time, maximum flow rate, and maximum flow time were not different in the 3 positions in men with BPH ($P = .90$, $P = .33$, $P = .27$, $P = .22$, and $P = .10$, respectively). Comparing sitting and standing positions in this group of patients, the postvoid residual urine volume was less, and the delay to start voiding was longer in the sitting position ($P = .005$, $P = .012$), but the average flow rate was not significantly different.

Discussion

The physiology of voiding is dependent on mechanical characteristics of the detrusor muscle, mechanical characteristics of meatus, shape of meatus, and hydrodynamics of elastic tubes.[4] Various models have been introduced to describe the mechanical and neurologic characteristics of the lower urinary system. In the hydrodynamic model, meatus is characterized as a heterogenous elastic tube in which urinary flow depends on time, cross-sectional area, and pressures of its segments. This model shows that

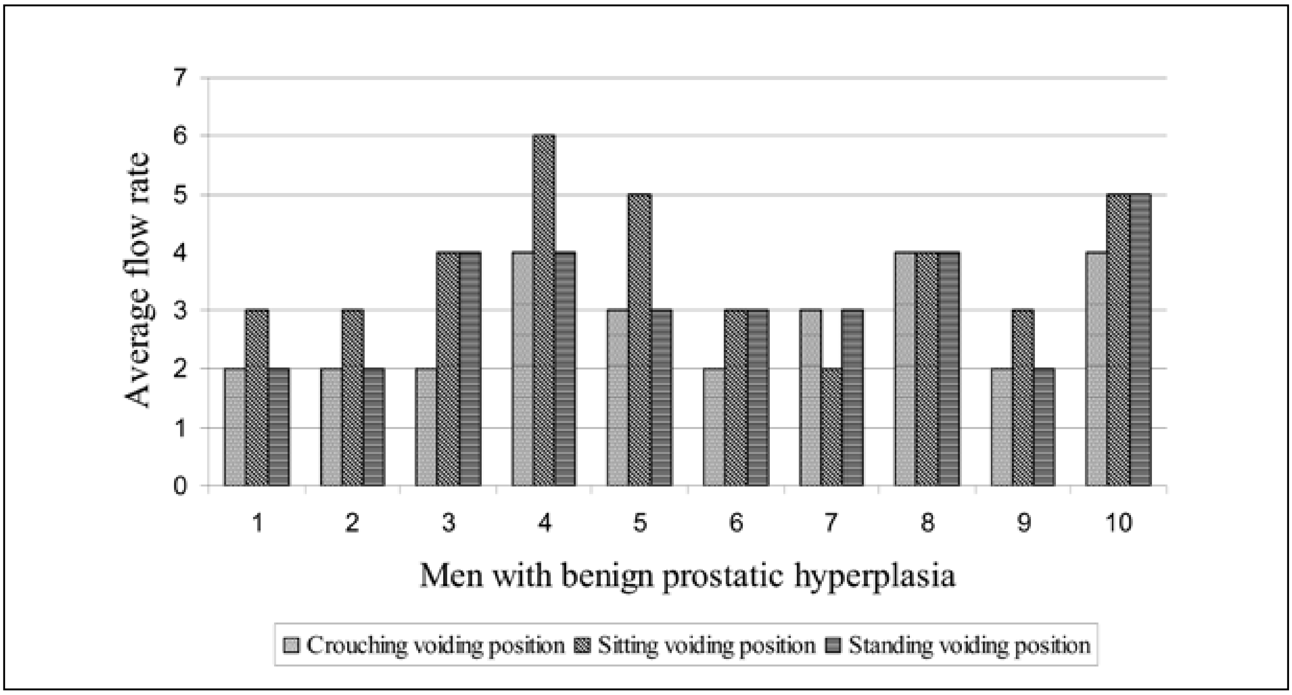

FIG. 2. Average flow rate in 10 men with benign prostatic hyperplasia in 3 voiding positions

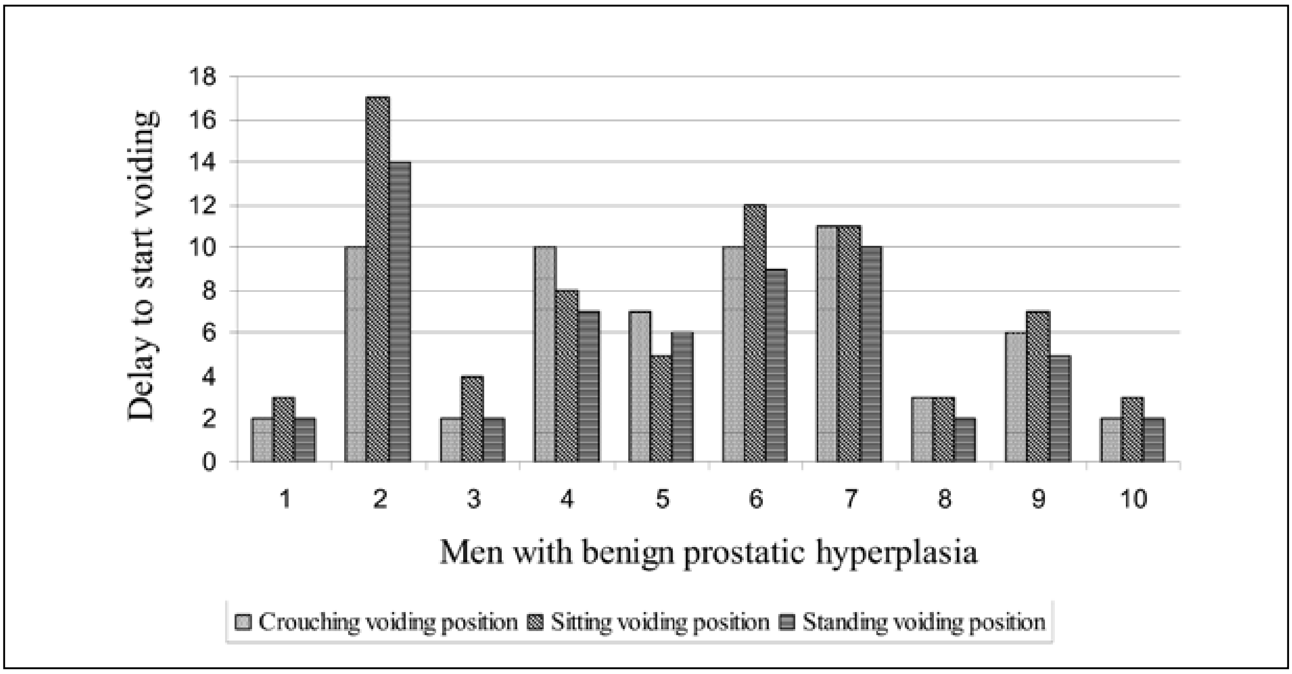

FIG. 3. Delay to start voiding in 10 men with benign prostatic hyperplasia in 3 voiding positions

the initial and final flows of micturition are influenced by the bladder neck, and midurinary flow (plateau phase) is produced by prostatic meatus.[5] Urinary flow curve is also affected by sex and urinary volume in the bladder. In men with symptomatic BPH, another parameter, pressure changes on the prostatic meatus and bladder neck from an enlarged prostate, impacts the uroflometry parameters.[4]

Another model for description of lower urinary tract function is the myocybernetic model. This model introduces 3 variables: volume of bladder contents, normalized activity of the detrusor muscle, and normalized activity of the sphincter. Normalized activity of the detrusor is influenced by detrusor innervation, dynamics of smooth muscles, and changes in bladder geometrics. Normal sphincter activity is affected by sphincter innervation, dynamics of striated muscles, and amount of changes to the meatal geometry.[5]

Different positions may alter these factors, and subsequently, urodynamic characteristics.

Voiding position has been studied in healthy persons, but the findings are controversial. Riehmann and colleagues have shown that the urinary flow rate decreases in the recumbent position.(6) In 1999, Yamanishi and coworkers studied 5 voiding positions in 21 healthy men aged 24 to 40 years. They reported that the maximum flow rate was 20.7 ± 6.59 mL/s with voided volume of 262 ± 77.8 mL in the lateral, 22.1 ± 7.05 mL/s with a voided volume of 309 ± 130 mL in the supine, 25.0 ± 8.25 mL/s with a voided volume of 287 ± 122 mL in the sitting, 27.1 ± 8.89 mL/s with voided volume of 263 ± 102 mL in the standing, and 28.7 ± 10.6 mL/s with voided volume of 303 ± 98 mL in the prone positions.(7) Unsal and Cimentepe studied sitting and standing positions in 44 healthy men and found no significant differences in uroflowmetry parameters and postvoid residual volume.(8)

We found no differences in urodynamic parameters of healthy men in crouching, sitting, and standing positions. The crouching position also has been investigated by Unsal and Cimentepe. They evaluated 36 men and reported that the mean maximum flow rate, average flow rate, voided volume, and postvoid residual volume values in the sitting, crouching, and standing positions in men were not significantly different. They also studied 36 women in sitting and crouching positions and reported no differences in this group, either.(9) However, Moore and colleagues, in 80 healthy British women, have shown that the crouching position causes a 21% reduction in average flow rate and a 149% increase in residual urine volume compared with the sitting position.(10)

Benign prostatic hyperplasia may have an additional effect on voiding position. This, however, has not been studied extensively. In Unsal and Cimentepe's study,(8) 44 patients with symptomatic BPH were also evaluated in sitting and standing positions. Their results are as follows: the mean maximum flow rate values for the standing and sitting positions in the patient group were 10.2 ± 0.49 mL/s and 9.5 ± 0.55 mL/s, respectively, and the mean average flow rate values were 4.7 ± 0.25 mL/s and 4.7 ± 0.31 mL/s, respectively. The mean voided volume values for the standing and sitting positions in the patient group were 292.6 ± 17.19 mL and 271.1 ± 15.51 mL, respectively, and the mean postvoid residual volume values were 82.2 ± 10.97 mL and 85.5 ± 12.46 mL, respectively. They found no differences in this group of patients, but in our patients, the postvoid residual urine volume was less, and the delay to start voiding was longer in sitting position. To our best knowledge, there is no study examining the effect of voiding positions of patients with BPH on the angle and cross-sectional area of different segments of meatus, and consequently, on uroflowmetry findings. The present study, albeit on a small sample size of patients, indicates an apparent effect of the crouching position in the urodynamic findings of patients with BPH, making consideration of this factor necessary when uroflowmetry is performed.

Conclusion

It seems that different voiding positions in healthy people do not influence uroflowmetry findings and residual urine volume. However, in patients with BPH, though trivial, these parameters may be affected by standing and crouching positions. In patients whose lower urinary tract function is borderline (eg, patients with BPH), a more obtuse angel between the bladder and the urethral axes while sitting might be better for bladder emptying.

The crouching position is the most common voiding position among Iranian patients. Thus, it may affect the urodynamic findings and physician's decision to treat. Sitting at micturition may decrease the need for medical or surgical therapy or may postpone it. Nevertheless, further studies are warranted.

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