Effect of Voiding Position on Uroflowmetric Parameters in Healthy and Obstructed Male Patients

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Purpose: Uroflowmetry is frequently used and simple urodynamic test, but it may be affected by various factors. Voiding position is one of the factors that can change the results. We tried to compare the uroflowmetric parameters in sitting and standing positions during urination.

Material and Methods: A total of 198 patients were enrolled to the study. All patients underwent an uroflowmetry in standing and sitting position at late afternoon (2-4 PM) of two corresponding days with a gravimetric uroflowmeter (Uroscan, Aymed, Turkey). A transabdominal ultrasonography was used to evaluate post voiding residue (PVR). All uroflowmetric parameters and PVR were compared with paired *t* test or Wilcoxon signed rank test.

Results: The median age of study population was 58.0 (36-69) years. There was no statistically significant difference at voided volume of patients in standing and sitting position as it was 271.5 ± 81.8 mL and 274.8 ± 82.4 mL, respectively (P = .505). Mean maximum flow rate (Qmax) during urination at standing position was 15.3 ± 6.7 mL/s while it was 15.0 ± 7.0 mL/s at sitting position (P = .29). Mean average flow rate in standing position was 8.60 ± 4.0 mL/s and 8.25 ± 3.8 mL/s in sitting position (P = .054). There was a statistically significant difference between the median post-voiding residues in standing and sitting urination which was 29.5 (0-257) mL in standing and 47.5 (2-209) mL in sitting position (P < .0001). Other uroflowmetric parameters (time to maximum flow and voiding time) was not statistically different between groups.

Conclusion: There are no clinically important uroflowmetric differences between voiding in sitting and standing positions so voiding position may be left to personal preferences during uroflowmetric evaluation.

Keywords: urination disorders; urodynamics; predictive value of tests; posture; male.

INTRODUCTION

Uroflowmetry is a frequently used and simple urodynamic test for both diagnosis and follow-up of obstructive lower urinary tract symptoms (LUTS). Although it is a non-specific test, it can give valuable objective data. On the other hand, uroflowmetry may be affected by various internal and external factors such as age, sex, ethnicity, voided volume (VV) and psychological status of patients.[1] Voiding position may be another factor affecting uroflowmetric results which is related with patients' health status, social and cultural characteristics.

There are some studies investigating the effect of voiding position on uroflowmetric parameters. These studies reported inconsistent results, some indicating voiding position affects uroflowmetric parameters, whereas some does not.[2-4] Authors who reported supportive data about this relation concluded that positional changes of pelvic floor and thigh muscles might be effective on their results. As sitting and squatting position is the most common way of voiding habit of eastern and Middle Eastern countries, ritual or religious causes were proposed to be another explanation for those positional differences. But these theories need to be proven with more interventions because there are also some studies opposing these results.[5-7] Daily preferred urination position may also affect uroflowmetric parameters. Positions other than patients' usual habit may change results causing misdiagnosis for patients. This theory also needs verification because there are very limited studies about this subject.

In our study, we tried to compare the uroflowmetric parameters in different voiding positions and to discriminate the better voiding position for elimination of misdiagnosis. As sitting and standing positions during urination was the most preferred voiding positions in the western part of our country, we designed a study evaluating the uroflowmetric differences between these two positions. Secondary objective of this study was to evaluate the uroflowmetric differences at patients voiding in a different position other than their natural voiding habit. The tertiary aim of this study was to investigate the effect of urination position on patients with low maximum flow rate values suggestive of bladder outlet obstruction (BOO).

MATERIAL AND METHODS

Study population

A total of 250 male patients, between 35 to 70 years old, admitted to urology outpatient clinic with unilateral or bilateral flank pain, from April 2011 to November 2011, were prospectively enrolled to the study. For the homogeneity of the study population, we excluded female patients. The study was approved by institutional ethic committee. Patients with a history of neurological disease, diabetes mellitus, urinary tract infection, prostate surgery, bladder and ureter stone, prostate cancer, bladder cancer, meatal stenosis, recent prostate biopsy and patients with ongoing medical treatment interfering lower urinary system function (like anticholinergics, alpha-blockers, 5-alpha reductase inhibitors, alpha stimulants, antibiotics etc.) were excluded.

All patients underwent complete medical history, physical examination, digital rectal examination, urine analysis, urine culture, serum prostate specific antigen (PSA) (in patients over 40 years) and urinary system ultrasonography. Specific blood tests and radiological examination were performed according to symptoms by the choice of the clinician. Natural voiding position and the duration was asked to the patients before uroflowmetric evaluation. Natural voiding position was defined as the voiding position of patients that was used at more than 80% of their daily life micturations for a minimum of 15 years. As we evaluated sitting and standing positions, patients who had urination habit other than these positions (like squatting) were also excluded from the survey.

Study design

All participants were cooperative and able to urinate in both sitting and standing position. As all patients were informed about study and given a written informed consent, an uroflowmetry in standing and sitting position was performed at late afternoon (2-4 PM) of two corresponding days with a gravimetric uroflowmeter (Uroscan, Aymed, Turkey). Patients were randomized according to voiding position for the first and second day evaluation. For the privacy and comfort of patients, uroflowmetric study was performed in a private room. The entire study group was informed to urinate as their usual way of urination without any straining in both sitting and standing positions. Uroflowmetries with a voided volume less than 150 mL were disregarded and patients recalled for a new measurement at the same time of the corresponding day. Post voiding residue (PVR) was evaluated by transabdominal ultrasonography (Accuson X 300, Siemens AG, Munich, Germany). For this measurement, we used prolate ellipsoid method (Volume = Lenght × Width × Heigth × 0.52) which was shown to be effective for evaluation of bladder volumes.[8]

Patients were enrolled to uroflowmetry at the same time of the next day with a similar desire for urination, at a position other than the first day evaluation. Bladder capacity before voiding was the most important parameter that may change the results of uroflowmetric evaluation. We calculated the exact bladder capacity by adding PVR to voided volume during the test. The difference between the bladder capacities of corresponding days over 20% was thought to be a bias for the results. Study was repeated for the patients who had minimum 20% differences between the sum of voided volumes and PVR of corresponding days. All of the uroflowmetric parameters and PVR were compared in standing and sitting position. In order to evaluate the effect of urinary position on uroflowmetric parameters at different maximum flow rate (Qmax) values, we also subdivided the patients into three groups; as patients with Qmax < 10 mL/s, Qmax 10-15 mL/s and Qmax > 15 mL/s.

Statistical Analysis

As we had 2 dependent groups in our study, we evaluated the normalcy of data by using one sample Kolmogorov-Smirnov test. Statistical analysis for normal data was performed by parametric test (paired *t*-test) and non-parametric test (Wilcoxon signed rank test) was performed for non-normal data. The statistical package for social science (SPSS Inc, Chicago, Illinois, USA) version 16.0 was used for statistical analysis. Differences were stated as statistically significant as $P < .05$.

RESULTS

After the exclusion of 52 patients, a total of 198 patients were enrolled to study (Figure). The mean age of study population was 57.1 ± 11.6 years. All patients were able to urinate in both standing and sitting positions. Only 13 patients urinate less than 150 mL during second uroflowmetric evaluation and re-evaluated in the subsequent day. There was no statistically significant difference at voided volume of patients in standing and sitting position as it was 271.5 ± 81.8 mL and 274.8 ± 82.4 mL, respectively ($P = .505$).

Mean Qmax during urination at standing position was 15.3 ± 6.7 mL/s while it was 15.0 ± 7.0 mL/s at sitting position ($P = .29$). Mean average flow rate in standing position was 8.60 ± 4.0 mL/s and 8.25 ± 3.8 mL/s in sitting position ($P = .054$). There was a statistically significant difference between the median post-voiding residues in standing and sitting urination which was 29.5 (0-257) mL in standing and 47.5 (2-209) mL in sitting position ($P < .0001$). Other uroflowmetric parameters (time to Qmax and voiding time) was not statistically different between groups (Table 1).

As Qmax values was shown to be related with the degree of bladder outlet obstruction, we sub-classified the patients as Qmax at standing position > 15 mL/s, 10-15 mL/s and < 10 mL/s.[9] We evaluated the change of uroflowmetric parameters at different Qmax values of each group in standing and sitting position. There were 96 (48.5%) patients with Qmax > 15 mL/s, 64 (32.3%) patients with Qmax 10-15 mL/s and 38 (19.2%) patients with Qmax < 10 mL/s. Voided volumes of all groups were similar in both sitting and standing positions and there was no statistically significant difference. Maximum flow rates in sitting and standing position were not significantly different in patients with different Qmax values (as subgroups are Qmax > 15 mL/s, Qmax 10-15 mL/s and Qmax < 15 mL/s) whereas average flow rate presented a statistical difference in patients whose Qmax < 10 mL/s. The mean average flow rate increased 0.5mL/s in sitting position and this difference was found to be significant ($P = .022$). It was not surprising that mean time to peak flow and voiding time increased as mean maximum flow rates decreased, but there was no statistically significant difference between groups for those parameters. As it was documented in whole groups, PVR was significantly higher in sitting position of all subgroups ($P < .001$) (Table 2).

Our study population was composed of patients who use sitting or standing position for voiding in their daily life.

Table 1. Comparison of uroflowmetric parameters in standing and sitting position of whole study group.

	Standing Position	Sitting Position	*P*
Qmax (mL/s)	15.3 ± 6.7	15.0 ± 7.0	*P* = .112**
Time to peak flow, s	8.0 (1.6-48.2)	8.3 (3.0-50.8)	*P* = .247*
Average flow rate, mL/s	8.60 ± 4.0	8.25 ± 3.8	*P* = .054**
Voiding time, s	37.2 ± 19.3	38.9 ± 18.9	*P* = .124**
Voided volume, mL	271.5 ± 81.8	274.8 ± 82.4	*P* = .505**
Post voiding residue, mL	29.5 (0-257)	47.5 (2-209)	*P* < .0001*

Key: Qmax, maximum flow rate.
*Data were distributed non-normally according to Kolmogorov-Smirrov test so Wilcoxon signed rank test was performed for statistical analysis and *P* value was calculated using the median data values.
**Data were distributed normally according to Kolmogorov-Smirrov test so paired *t* test was performed for statistical analysis and *P* value was calculated using the mean data values.

There were 114 (57.6%) patients voiding at standing and 84 (42.4%) patients voiding in sitting position. We used patients' natural voiding position as control group and evaluated the uroflowmetric parameter and PVR differences according to their natural voiding habit. The mean age of patients voiding in standing position was 56.4 ± 12.6 years. The mean age of patients voiding in sitting position was 58.2 ± 10.2 years ($P = .062$). Although it was not statistically significant, patients who were voiding in sitting position in their daily life had better Qmax values in sitting position. Patients who void in standing position in their daily life had significantly better uroflowmetric parameters at standing position. Nearly all uroflowmetric parameters except time to peak flow were significantly better when these patients performed uroflowmetry at their natural voiding position (standing position). On the other hand PVR was still significantly higher in sitting position unrelated to natural voiding position of patients (Table 3).

DISCUSSION

Uroflowmetry with PVR determination is an important and widely used urodynamic testing for evaluation of voiding dysfunction. Although it does not discriminate bladder outlet obstruction from detrusor insufficiency, it can give valuable objective data about both degree of obstruction and affectivity of the treatment. As micturition is a dynamic event, various external and internal factors may influence this event. External factors are generally related with patients like; age, sex and psychological characteristics, whereas internal factors are mainly composed of the anatomical properties of lower urinary tract and corresponding tissues. Neurological innervations of bladder and urethra and the biomechanical properties of detrusor muscle, urethra and urethral meatus are supposed to be the main determinants of micturition in all voiding models.[10,11] At myocybernetic model defined by Bastiaanssen and colleagues, normal activity of sphincter was also supposed to be one of the factors related to micturition. According to this model, voiding position may affect striated muscle activity and geometrical properties of urethra and meatus.[10] Rad and colleagues found that, average angle between rectum and anal canal was 92◦ while sitting and becomes 132◦ when the patient gets to squatting position and concluded that this may cause relaxation of puborectalis muscles leading more easier bladder and bowel evacuation.[12] In another study, Bockus and colleagues reported that sitting position stretches the puborectalis muscle which slightly close urogenital hiatus.[13] Although there were no significant difference at Qmax and Q average values of patients in standing and sitting position, we found statistically significant higher PVR values at voiding in sitting position. This data also shows a slight obstruction at urogenital hiatus during micturition at sitting position independent to presence or absence of bladder outlet obstruction.

Changes in parameters in healthy males

There are some studies reporting controversial results about this subject. Yamanishi and colleagues, evaluated 21 healthy male patients in 5 different voiding positions (standing, sitting, lateral, supine and prone) and reported no difference between standing and sitting position in terms of uroflowmetric parameters.[5] In another study, Aghamir and colleagues evaluated 10 healthy males' uroflowmetric parameters in standing and sitting position. They also found no difference and concluded that different voiding positions in healthy people did not influence uroflowmetric findings and PVR.[6] Confirming these findings, Unsal and colleagues found no difference in uroflowmetric parameters and PVR in standing and sitting position of 44 healthy

Table 2. Changes in uroflowmetric parameters in standing and sitting position according to maximum flow rates (Qmax).

	Qmax > 15 mL/s (n = 96)			Qmax < 15 mL/s (n = 102)		
	Standing	**Sitting**	***P***	**Standing**	**Sitting**	***P***
Qmax (mL/s)	20.7 ± 5.5	19.9 ± 6.4	.155**	10.3 ± 2.7	10.3 ± 3.5	.880**
Time to peak flow, s	7.4 (1.6-25.8)	7.4 (3.2-45.2)	.944*	8.5 (2.6-48.2)	9.6 (3-50.8)	.149*
Average flow rate, mL/s	11.5 ± 3.6	11.2 ± 3.6	.11**	5.7 ± 1.7	5.7 ± 1.8	.698**
Voiding time, s	28.5 ± 11.1	29.1 ± 11.7	.083**	47.3 ± 20.1	48.4 ± 19.7	.572**
Voided volume, mL	288.7 ± 80.2	291.0 ± 81.4	.737**	254 ± 80.6	258 ± 80.9	.554**
Post voiding residue, mL	19 (0-100.0)	35.5 (0-128)	< .001*	44.0 (0-257)	66.5 (4-209)	< .001*
	Qmax 10-15 mL/s (n = 64)			Qmax < 10 mL/s (n = 38)		
	Standing	**Sitting**	***P***	**Standing**	**Sitting**	***P***
Qmax, mL/s	12.0 ± 1.5	11.6 ± 3.1	.335**	7.4 ± 1.5	8.1 ± 3.0	.072**
Time to peak flow, s	8.1 (2.6-38.0)	9.4 (3.0-50.8)	.120*	14.7 ± 12.3	13.7 ± 10.1	.687**
Average flow rate, mL/s	6.7 ± 1.5	6.2 ± 1.7	.068**	4.2 ± 0.8	4.7 ± 1.4	.022**
Voiding time, s	41.7 ± 1.9	44.1 ± 13.0	.092**	55.5 (27.8-113.2)	47.3 (18.8-118.2)	.231**
Voided volume, mL	258.7 ± 76.3	266.7 ± 77.5	.381**	247 ± 88.1	245 ± 85.8	.844**
Post voiding residue, mL	49.1 ± 41.3	69.9 ± 47.9	< .001◊	49.5 ± 44.2	75.0 ± 38.9	< .001◊

Key: Qmax, maximum flow rate.
*Data were distributed non-normally according to Kolmogorov-Smirrov test so Wilcoxon signed rank test was performed for statistical analysis and *P* value was calculated using the median data values.
**Data were distributed normally according to Kolmogorov-Smirrov test so paired *t* test was performed for statistical analysis and *P* value was calculated using the mean data values.

Table 3. Comparison of uroflowmetric parameters in standing and sitting position according to preferred voiding position in daily life.

	Patients preferring standing position for micturition			Patients preferring sitting position for micturition		
	Standing	**Sitting**	***P***	**Sitting**	**Standing**	***P***
Qmax, mL/sec	15.0 ± 6.6	14.1 ± 7.0	.033**	16.16 ± 6.9	15.7 ± 6.8	.251**
Time to peak flow, s	8.4 (1.6-48.2)	9.2 (3.0-45.2)	.257*	7.4 (3.2-50.8)	7.5 (2.6-43.4)	.653*
Average flow rate, mL/s	8.4 ± 3.9	7.8 ± 3.7	.015**	8.7 ± 3.8	8.7 ± 4.1	.830**
Voiding time, s	37.5 ± 19.4	40.5 ± 19.7	.031**	37.0 ± 17.8	36.9 ± 19.5	.963**
Voided volume, mL	270 ± 78.8	271 ± 87.9	.761**	277.8 ± 74.9	272.8 ± 86.6	.505**
Post voiding residue, mL	32.0 (0-257)	48 (2-209)	< .001*	45.5 (2.198)	25.0 (0-166)	< .001*

Key: Qmax, maximum flow rate.
*Data were distributed non-normally according to Kolmogorov-Smirrov test so Wilcoxon signed rank test was performed for statistical analysis and *P* value was calculated using the median data values.
**Data were distributed normally according to Kolmogorov-Smirrov test so paired *t* test was performed for statistical analysis and *P* value was calculated using the mean data values.

males and concluded that patients might be asked for their preference voiding position during uroflowmetric evaluation.[7] In contrast, Eryildirim and colleagues reported that maximum and average flow rates were significantly higher in sitting position at their 30 healthy males series, but there was no difference in PVR values between these positions.[1] In another study with 61 young male participants, Choudhury and colleagues found significant lower flow rates at sitting position than standing position, but PVR was still not different between the groups.[2] We also did not find any significant difference in uroflowmetric parameters at standing and sitting position. Although it was not statistically significant, patients who had Qmax > 10 mL/s was able to void with higher flow rates and lower voiding time at standing position. It was not surprising that PVR increased as Qmax decreased. According to statistical analysis PVR was significantly higher in sitting position in all groups, but this difference was not over 25 mL and had no clinical importance in terms of treatment opportunities. According to our results patients who had high Qmax values were able to void better at standing position with significant lower PVR values.

Changes of parameters in patients with lower Qmax values

There are also limited numbers of studies evaluating the effect of voiding position on uroflowmetric parameters in patients with obstructive LUTS. Unsal and colleagues, reported the results of uroflowmetric parameters of 44 BPH and 44 healthy patients in both sitting and standing positions. They used maximum flow rate of 15 mL/s as cut-off point and did not find any difference in uroflowmetric parameters and PVR between the groups.[7] In another study with 10 BPH patients, authors found no difference in uroflowmetric parameters in standing and sitting position while PVR was significantly lower in sitting position.[6] We evaluated 102 patients with Qmax < 15 mL/s and did not find any difference in uroflowmetric parameters including Qmax, Q average and voided volume, but there was a significant difference in PVR. Same relation was also observed in patients with Qmax > 15 mL/s that PVR was significantly higher in sitting position while Qmax, Q average and voided volume was not statistically different in those patients. Opposing to Unsal and colleagues results, our study did not show any significant difference that Qmax value of 15 mL/s was a cut-off point for uroflowmetric parameters in standing and sitting position. We also did not find any difference at uroflowmetric parameters of patients who had borderline obstruction with Qmax 10-15 mL/s. But, as obstruction became severe (Qmax < 10 mL/s), sitting position was seem to be more advantageous for flow rates that average flow rate was significantly higher in sitting position. This was the only significant difference of uroflowmetric parameters in our study. So the patients with Qmax values < 10 mL/s may be advised to urinate in sitting position to have higher Qmax values. Post voiding residue of patients with lower Qmax values was also significantly higher in sitting position, but like patients with high Qmax values, the difference was not over 25 mL and did not change treatment protocol for those patients.

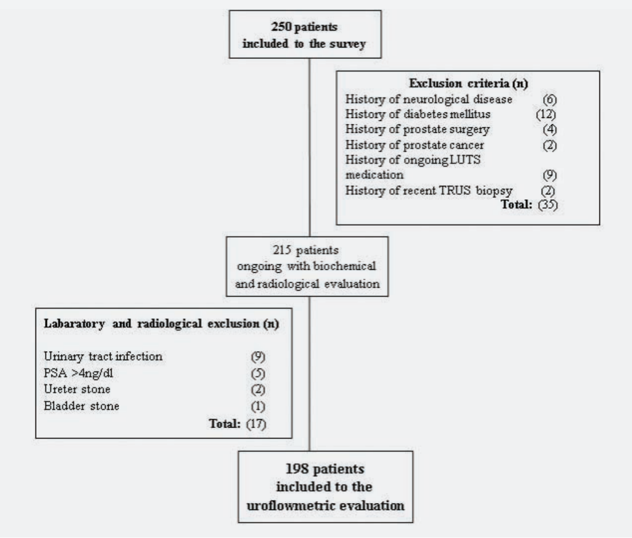

Figure. The study flow chart.

Changes in parameters according to natural voiding position

There are very limited studies evaluating the changes of uroflowmetric parameters related to voiding position other than patients' daily life habit. In a study designed in Saudi Arabia, where participants void in sitting position because of religious traditions, authors found no difference in uroflowmetric parameters, whereas patients had significantly higher PVR values at standing position. But this difference between the mean PVR was not over 15 mL (73 ± 80.2 in sitting and 86.1 ± 77 in standing position). Although authors did not find any statistically significant difference at their series, they concluded that obliging the patients to void in a position to which they are not familiar may alter micturition act and might produce higher cerebellar inhibitory effect during voiding.[3] In our study, we had nearly equal number of patients who use standing or sitting position in their daily life (57.4% vs. 42.6%, respectively). In both group, patients had higher Qmax values when they performed uroflowmetric evaluation in their natural position and this relation was significant in patients who use standing position in their daily life. Patients, who were voiding in standing position, had 6% decrease in Qmax and 7% decrease in Q average values when they performed uroflowmetry at sitting position. This decrease was lower and statistically insignificant in patients who use sitting position in their daily life as; 2.5% worsening in Qmax and no change on Q average. On the other hand, post voiding residue was significantly higher in sitting position in both groups, unrelated to natural voiding position. So, the uroflowmetric parameters were not affected by the natural voiding habit of patients in our study.

Different voiding positions other than sitting and standing were also evaluated by some authors. Aghamir and colleagues, also evaluated crouching position and report no difference in uroflowmetric parameters.[6] Similar conclusion was also reported by Unsal and colleagues that crouching position did not alter uroflowmetric parameters in healthy males.[7] Although sitting position was seem to be advantageous than standing position, Eryildirim and colleagues reported no difference between sitting and squatting position.[1] On the other hand, Amjadi and colleagues reported a significant improvement of uroflowmetric parameters of obstructed patients as they micturate in crouching position.[4] In our study we were not able to analyze uroflowmetric differences in other voiding positions like crouching, squatting, recombinant or supine. But our entire study group was using standing or sitting position in their daily life.

Different theories had been proposed to define the effect of voiding position on uroflowmetric parameters. According to their results, El-Bahnasawy and colleagues proposed that patients who void in the sitting position throughout their life will have micturitional reflexes modified and conditioned to this position.[3] But in our study we were able to observe that patients who void at sitting position in their whole life was able to void in standing position without any change in uroflowmetric parameters. Amjadi and colleagues, propose another theory according to their results and proposed that relaxation of pelvic floor musculature may be a reason for decrease in bladder outlet resistance and abdominal musculature may help to increase intra-abdominal pressure helping micturition in crouching position.[4] This may be true for crouching position but it does not seem to work in sitting position according to our results. Although we did not find significant uroflowmetric differences among voiding positions, we have similar results with Choudhury and colleagues and Uluocak and colleagues who demonstrated a decrease in uroflowmetric parameters in sitting position.[2,14] As it was shown at Uluocak's study, patients may have lower voiding detrusor pressure in sitting position. On the other hand gravity, slower detrusor contractions and altered geometry of bladder may be an advantage for voiding in standing position.

Uroflowmetric evaluation is a popular and frequently used test that has been performed by many centers in all around the world. Although we had large number of patients in our study, this may not be enough to make a direct conclusion for general population. In order to understand the exact effect of voiding position on uroflowmetric parameters, more well-organized, prospective studies with higher number of participants are needed.

CONCLUSION

As a conclusion, the preferred voiding positions may differ among people because of several factors like social, cultural and medical reasons. As there are no clinically important uroflowmetric differences between voiding in sitting and standing positions, voiding position may be left to personal preferences during uroflowmetric evaluation. According to our results it seems that the best voiding position is the position in which patient feels most comfortable.

CONFLICT OF INTEREST

None declared.

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