

ORIGINAL ARTICLE

Relationship between voided volume and the urge to void among patients with lower urinary tract symptoms

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Abstract

Objective. The aim of this study was to explore the relationship between voided volume (VV) and urge to void among patients with lower urinary tract symptoms. **Material and methods.** Consecutive adult patients (aged 23–90 years) were enrolled, and completed a 24 h bladder diary and the Urgency Perception Scale (UPS). Patients were categorized as urgency or non-urgency based on the Overactive Bladder Symptom Score. The relationship between UPS and VV (based on the bladder diary) was analyzed by Spearman's rho and proportional odds model. **Results.** In total, 1265 micturitions were evaluated in 117 individuals (41 men, 76 women; 56 individuals in the urgency and 61 in the non-urgency group). The mean (\pm SD) VV and UPS were 192 ± 127 ml and 2.4 ± 1.2 ml in the urgency group and 173 ± 124 ml and 1.7 ± 1.1 ml in the non-urgency group, respectively. Spearman's rho (between UPS and VV) was 0.21 [95% confidence interval (CI) 0.13–0.29, $p < 0.001$] for the urgency group, 0.32 (95% CI 0.25–0.39, $p < 0.001$) for the non-urgency group, and 0.28 (95% CI 0.23–0.33, $p < 0.001$) for the total cohort. Urgency patients had higher UPS [odds ratio (OR) 3.1, 95% CI 2.5–3.8]. Overall, each additional 50 ml VV increased the odds of having a higher UPS with OR 1.2 (95% CI 1.2–1.3). The relationship between VV and UPS score was similar in both groups ($p = 0.548$ for interaction). **Conclusion.** Although urgency patients void with a higher UPS score, among both urgency and non-urgency patients there is only a weak correlation between VV and the urge to void. This suggests that there are factors other than VV that cause the urge to void.

Key Words: lower urinary tract symptoms, overactive bladder, urgency, urinary incontinence, voiding dysfunction

Introduction

It is intuitive that the urge to void is related to bladder volume and, by implication, voided volume (VV): the greater the urge to void, the larger the VV. However, in a review of contemporary literature, the authors came across a paucity of studies that even address this hypothesis. The lack of data arises partly from the difficulty in quantifying urge [1]. The International Continence Society defines urgency as a “sudden compelling desire to void that is difficult to defer”

[2]”. However, there is increasing evidence that the urge to urinate is better considered along a continuum [3–5]. For this purpose, this study used the Urgency Perception Scale (UPS), a validated and proven means of grading urinary urgency, and evaluated the relationship between the UPS and VV [6].

Material and methods

This is a study of consecutive patients with lower urinary tract symptoms (LUTS), seen at a tertiary

care center in New York (USA) in 2009 and 2010. Patients completed the Overactive Bladder Symptom Score (OABSS) questionnaire [7,8]. Patients were categorized as urgency or non-urgency based on OABSS questions 3, 4, 5 and 6 (which grade different aspects of urgency on a five-point scale ranging from 0 to 4) (see Appendix: Table S1) [8]. Patients who reported a severity corresponding to 3 or 4 on the five-point scale to any of those four questions were categorized within the urgency group. All subjects completed a 24 h bladder diary in which they recorded: the time; the VV; and the intensity of the urge to void for each micturition, which was graded on the diary form according to the UPS (Appendix: Table S1) [6]. The UPS is a validated single-question instrument with five graded responses (0–4) that asks why the patient voided each time [9]. Responses range from 0 (the patient voided out of convenience without an urge) to 4 (the patient voided because of a desperate urge). Exclusion criteria (a priori) included patients who had failed to complete a bladder diary and patients who had had prior pelvic radiation and enterocystoplasty.

The relationship between UPS and VV was analyzed using Spearman’s rank correlation coefficient for ordinal data. Furthermore, UPS (as an ordinal-dependent variable) was analyzed using a proportional odds model. The odds ratio for a

predictor can be interpreted as a summary of the odds ratios obtained from separate binary logistic regressions using all possible cut-points of the ordinal outcome. Explanatory variables included urgency status (no/yes), gender and VV [10].

Results

In total, 123 individuals were assessed and six were excluded (two due to prior pelvic radiation and four due to incomplete bladder diary entry). Of the 117 included individuals, 41 were men and 76 women (age range 23–90 years) with a total of 1265 micturi-tions recorded in the diaries. A total of 56 patients, 17 males and 39 females, were classified as having urgency. The urgency group had a mean ± SD age of 70 ± 14 years and accounted for a total of 596 of the voids studied. There were 61 patients, 24 males and 37 females, classified as without urgency. The non-urgency group had a mean age of 66 ± 15 years and accounted for a total of 669 of the voids studied. The primary clinical diagnosis based on the patient’s presenting complaints included: benign prostatic hyperplasia, male LUTS, stress incontinence, over-active bladder (wet and dry), and neurogenic bladder. No attempt was made to characterize the population further owing to the limited number of individuals in each subgroup.

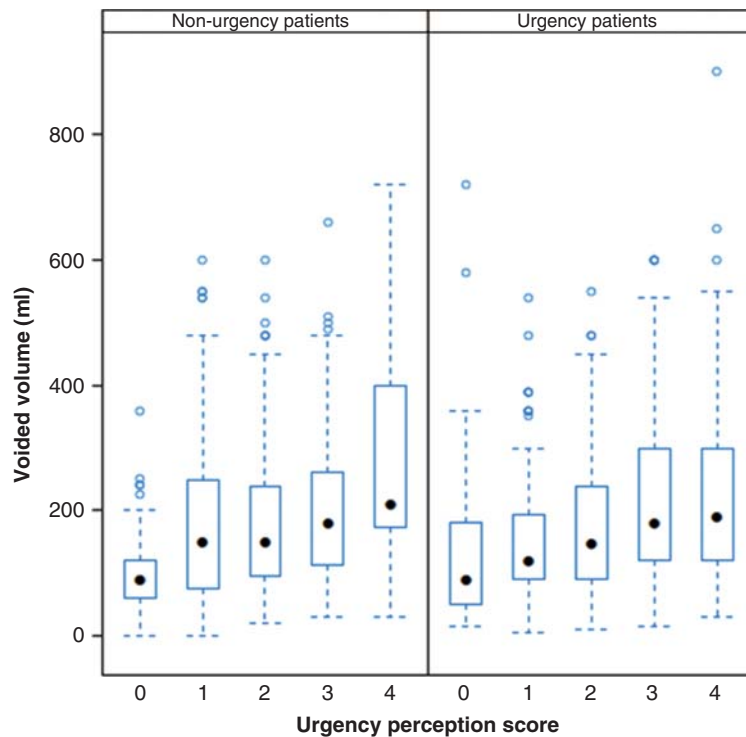


Figure 1. Relationship of voided volume and Urgency Perception Scale score by urgency status. Each box represents the lower and upper quartiles, the dot in the box represents the median and points outside whiskers are outlier observations.

Table I. Overactive Bladder Symptom Score (OABSS) and International Prostate Symptom Score (IPSS) for urgency and non-urgency bladder patients.

Subjects (<i>n</i>)	OABSS		IPSS		Spearman's rho ^a (CI)
	Mean ± SD	Median (range)	Mean ± SD	Median (range)	
Urgency (56)	18 ± 5*	18 (7–26)	17 ± 7*	16 (2–31)	0.21 [†] (0.13–0.29)
Non-urgency (61)	10 ± 6*	10 (2–20)	14 ± 8*	14 (0–34)	0.32 [†] (0.25–0.39)
Total (117)	14 ± 6	15 (2–26)	15 ± 7	15 (0–34)	0.28 [†] (0.23–0.33)

^aUrgency Perception Scale score versus voided volume; CI = confidence interval.

*Difference was statistically significant between overactive bladder (OAB) and non-OAB groups ($p < 0.001$ for each);

[†]correlation was statistically significant ($p < 0.001$ for each).

The correlation between UPS and VV was relatively low among both non-urgency and urgency patients (Figure 1). Overall, Spearman's rho for the relationship between UPS and VV was 0.28 (0.23–0.33) for the entire cohort, and 0.32 (0.25–0.39) for non-urgency and 0.21 (0.13–0.29) for urgency groups. More information on OABSS, International Prostate Symptom Score, VV, UPS, postvoid residual and Spearman's rho for both groups is shown in Tables I and II. Additional information is also provided for urgency patients with (urgency – wet) or without (urgency – dry) urgency incontinence in Table II. Within both the urgency and non-urgency groups, there was considerable variation in individual correlations between UPS and VV. In the urgency group, nine (16%) showed a negative correlation ($r < -0.1$), eight (14%) showed no correlation ($-0.1 < r < 0.1$), 10 (18%) showed a weak correlation, five (9%) showed a moderate correlation ($0.3 < r < 0.5$) and 24 (43%) showed a strong correlation ($r > 0.5$). In the non-urgency group, five (8%) showed a negative correlation ($r < -0.1$), four (7%) showed no correlation ($-0.1 < r < 0.1$), seven (11%) showed a weak correlation, 11 (18%) showed a moderate correlation ($0.3 < r < 0.5$) and 34 (56%) showed a strong correlation ($r > 0.5$).

For any micturition volume, patients with urgency had significantly higher UPS scores, with an odds ratio (OR) of 3.1 [95% confidence interval (CI) 2.5–3.8, $p < 0.001$] (Figure 2). Among urgency and non-urgency patients, each additional 50 ml VV increased the odds of having a higher UPS score, with OR 1.2 (95% CI 1.2–1.3, $p < 0.001$). The OR of 1.2 for having a higher UPS score per 50 ml VV demonstrates that for every 50 ml VV, the risk of a higher UPS score increases by 20%. That is, an increase in VV from 50 ml to 250 ml approximately doubles the risk of a higher UPS score. This relationship between VV and UPS was similar in urgency and non-urgency groups ($p = 0.548$ for interaction term).

Discussion

This study suggests that the relationship between the intensity of the urge to void and VV is not straightforward. The correlation between the urge to void and VV was weak for the entire cohort ($\rho = 0.28$); it was moderate among non-urgency ($\rho = 0.32$) and weak among urgency ($\rho = 0.21$) patients. However, the difference between urgency and non-urgency patients was not statistically significant, which may be due to sample size. Regardless, in neither group was the

Table II. Results for urgency and non-urgency bladder patients including urgency patients with and without urgency incontinence.

Subjects (<i>n</i>)	UPS		VV		PVR		24 h volume	
	Mean ± SD	Median (range)	Mean ± SD	Median (range)	Mean ± SD	Median (range)	Mean ± SD	Median (range)
Urgency – wet (35)	2.5 ± 1.2 [‡]	3 (0–4)	192 ± 132	150 (15–900)	28 ± 17 [‡]	3 (0–175)	2020 ± 669	1992 (645–5340)
Urgency – dry (21)	2.2 ± 1.1 [‡]	2 (0–4)	191 ± 118	160 (5–600)	38 ± 17 [‡]	4 (0–142)	2077 ± 692	1781 (611–5745)
Total urgency (56)	2.4 ± 1.2*	3 (0–4)	192 ± 127	150 (5–900)	55 ± 76	3 (0–175)	1897 ± 1021	1917 (611–5745)
Non-urgency (61)	1.7 ± 1.1*	2 (0–4)	173 ± 124	150 (10–720)	51 ± 90	86 (0–670)	2040 ± 948	1744 (440–5310)
Total cohort (117)	2.0 ± 1.2	2 (0–4)	182 ± 126	150 (5–900)	53 ± 83	26 (0–670)	1966 ± 982	1825 (440–5745)

UPS = Urgency Perception Scale score; VV = voided volume; PVR = postvoid residual.

*Difference was statistically significant between overactive bladder (OAB) and non-OAB groups ($p < 0.05$ for each);

[‡]difference was statistically significant between OAB-wet and OAB-dry groups ($p < 0.05$ for each).

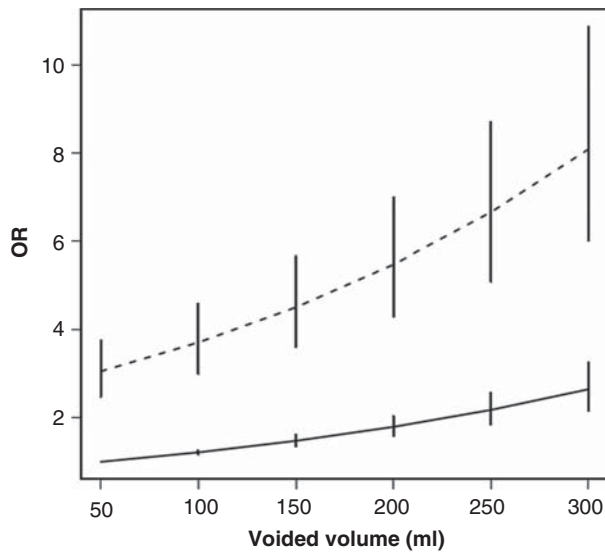


Figure 2. Odds ratio (OR) of increased Urgency Perception Scale score by voided volumes, with solid and dashed line representing non-urgency and urgency patients, respectively. Error bars represent 95% confidence intervals. The reference level for calculations is 50 ml voided volume for non-urgency patients.

correlation strong. Furthermore, in 48% of urgency patients and 26% of non-urgency patients, the urge to void was weakly, not or negatively correlated with VV.

Only a few studies have explored the relationship of intensity of the urge to void with VV. In a study of 310 Japanese women, VV was found to increase with increasing bladder perception ($r = 0.40$) [11]. In a Belgian study of 15 college-aged female volunteers, participants were asked to report their grade of perception of bladder fullness for each void on a 3 day frequency-volume chart. An increase in the grade of perception of bladder fullness with increased VV was noted. However, 65% of the subjects voided without any sensation of fullness and no patient had a severe urge [9]. In a subsequent Belgian study (conducted among 251 women, of whom 224 were incontinent), the authors found that the mean VV increased with increased grades of bladder sensation [12].

Despite some differences between these studies and the present investigation [9,11,12], it seems that the relationship between VV and the intensity of the urge to void is not straightforward. In the LUTS patients in this study, the correlation coefficient was 0.28 for VV and UPS. In the proportional OR model, for every 50 ml of VV there was an OR of only 1.2 of having a higher UPS, supporting the hypothesis that urgency is multifactorial, with VV being only one determinant.

Nevertheless, these conclusions are counterintuitive. Empirically, one would think that the relationship between UPS and VV would be a strong direct one. There are several reasons why this may not be

true. One of the most common known causes, if not the most common cause, of urinary urgency is urethral obstruction, but the mechanism by which this occurs has not been determined, nor has the relationship between urgency and VV been studied in such patients [13]. It is widely believed, although not well documented, that many factors other than bladder volume may contribute to urgency. These include caffeine [14,15], spicy foods, and pavlovian responses to stimuli such as running water, latchkey syndrome and ambient temperature [16]. A study aimed at quantifying the symptoms of overactive bladder reported that identifying urgency and urgency incontinence through the situation in which they are experienced supports this contention [16]. They found that urgency was related to such events as waking and rising, hearing running water, arriving home (“key-in-the-door syndrome”), ambient temperature, and feeling worried or tired [16].

It is known that urgency may be caused by neurological conditions [17,18]. A more subtle abnormality, suggestive of a neurogenic cause, is the pattern seen in some patients wherein they do not perceive an urge to void at all until near bladder capacity, at which time they develop an increasing sensation of the urge to void over a very short period [19]. There may be other variables that affect the urge to void that have not been studied at all, such as the rate of urine production, changes in urinary pH, and behavioral and psychological factors affecting the central nervous system.

All of these factors are likely to contribute to the reasons why the relationship between VV and urge to void is so weak in studies of patient cohorts. For individual patients, though, the correlation, or lack thereof, is of more critical importance. For patients in whom there is a very strong correlation between VV and the UPS a simple behavioral program without further evaluation is more likely to be successful than in patients in whom there is no relationship at all between the urge to void and VV. In such patients, a further diagnostic evaluation to pinpoint the cause of urgency is appropriate.

This study benefits from the use of validated instruments for assessing LUTS, urgency and grading the different aspects of urgency. Furthermore, the observation that patients with urgency have a three times higher odds of having a higher UPS score compared with patients without urgency constitutes criterion validation of the UPS. However, there are also weaknesses in this study. The study sample is relatively small and based on a tertiary center patient population. A study with a larger sample size may show statistically significant differences in correlation strengths for VV and UPS between the urgency and

non-urgency groups. The results may be different if a larger group of patients could be stratified according to the severity of their urgency symptoms. Nevertheless, in viewing urgency with a wider scope, it appears evident that VV is only one of a number of factors that contribute to urgency and the intensity of the urge to void. Understanding the relationship between VV and urgency may lead to different diagnostic and treatment strategies.

In conclusion, although patients with urgency void with a higher UPS score than patients without urgency, in both groups the relationship between VV and the urge to void was weak. This suggests that VV is but one variable in the multifactorial nature of urgency.

Declaration of interest: The authors have no conflicts of interest or sources of funding to disclose.

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Supplementary materials available online

Table S1.