The impact of lower urinary tract symptomatology on urine volumes in stone formers

Nathan Y. Hoy, MD; Nick S. Dean, MD; Jeremy Wu, MD; Timothy A. Wollin, MD, FRCSC; Shubha K. De, MD, FRCSC
Division of Urology, University of Alberta, Edmonton, AB, Canada

Cite as: *Can Urol Assoc J* 2018 December 3; Epub ahead of print.
http://dx.doi.org/10.5489/cuaj.5530

Published online December 3, 2018

***

Abstract

Introduction: We aimed to determine if there is a correlation between International Prostate Symptom scores (IPSS) and 24-hour urine collection volumes, as patients experiencing lower urinary tract symptoms (LUTS) may have impaired ability to increase fluid intake for stone prevention.
Methods: We conducted a single-centre, retrospective review was performed of stone-formers presenting from 2014–2016. Inclusion criteria were completion of an IPSS questionnaire and a 24-hour urine collection. Exclusion criteria included symptomatic stone or urinary tract infection at time of IPSS completion, inadequate 24-hour collection, or incomplete IPSS questionnaire.
Results: A total of 131 patients met inclusion criteria. Stratification by IPSS severity into mild (0–7), moderate (8–19), and severe (20–35) yielded groups of n=96, 28, and 7, respectively. Linear regression modelling did not reveal a correlation between IPSS score and volume (p=0.10). When compared to those with adequate urine volumes (>2 L/day, n=65), low-volume patients (<1 L/day, n=10) had a significantly higher total IPSS (11.7 vs. 6.1; p=0.036). These groups showed significant differences in their responses to questions about incomplete emptying (p=0.031), intermittency (p=0.011), and stranguria (p=0.0020), with higher scores noted in the low urine output group.
Conclusions: This study is the first to examine the correlation between IPSS and 24-hour urine volume. Though our data does not show a linear relationship between urine output and IPSS, those with lower urine volumes appear to have worse self-reported voiding symptoms when compared to those with adequate volumes (>2 L/day) for stone prevention. The overall number of patients in our study is relatively small, which may account for the lack of a relationship between IPSS and 24-hour urine volumes.

Introduction

Approximately 10% of North Americans will develop a kidney stone with rates of forming subsequent stones ranging from 30-40% within five years.[1,2] A common first-line preventative measure is to ensure adequate fluid intake in order to produce a urine volume of 2 to 2.5 L/day.[3] Although increasing fluid intake is effective in improving supersaturations, reducing recurrence of stones, compliance with this lifestyle modification remains modest. Parks et al. noted across a wide spectrum of practices, the mean increase in urine volume after urologic intervention was 0.3 L.[3,4]

The medical care costs alone associated with kidney stones totals approximately $5 billion annually.[5] Fluid intake has been demonstrated to be a simple, cost-effective stone prevention technique.[2] Thus, it is crucial to identify patient barriers to adequate fluid intake. Previously identified barriers to adequate fluid intake for the prevention of stones consist of patients forgetting to drink water, disliking the taste of water, and finally disruption of work and activities due to increased need to void.[6]

Approximately 46% of adult men >65 years old in the United States describe moderate to severe lower urinary tract symptoms (LUTS).[7] First line treatment for LUTS include behavioural modifications such as decreasing fluid intake at night-time, and decreased intake of mild diuretics.[6] Although LUTS are common amongst the population, there is currently no evidence that LUTS impairs adequate fluid intake in kidney stone patients.[6] The objective of this study is to determine if there is a correlation between International Prostate Symptom Scores (IPSS), a validated, quantitative measure of LUTS, and 24-hour urine collection volumes in patients after an initial urolithiasis presentation.[8] A secondary objective is to compare low urine volume patients to high urine volume patients on their IPSS questionnaire responses to determine if a particular set of symptoms may be more prevalent in one group. We hypothesize that as LUTS become more severe, ability to achieve satisfactory urine volumes will decrease.

Methods

Appropriate health research ethics approval was obtained from our institutional review board. We performed a retrospective review of patients presenting to two endourologists at the University of Alberta from January 2014 to July 2016. During registration to our clinic, a survey package is provided. After January 2014, an IPSS questionnaire was included for all kidney and ureteral stone patients to better characterize their LUTS. No specific treatment was initiated for these LUTS until any necessary 24-hour urine collections were completed. For ureteral stones, IPSS questionnaires were administered after the renal colic symptoms resolved and after the stone had been treated or cleared with conservative treatment. For renal stones, IPSS questionnaires were administered at the time of urology consultation if the stone was asymptomatic or after treatment if the stone was symptomatic.

We reviewed all stone patients with completed IPSS questionnaires and 24-hour urine collection(s). Patients with symptomatic renal or ureteral stones, incomplete IPSS questionnaires, or inadequate 24-hour urine collections were excluded. Patient information collected included age at presentation, gender, location and size of stone, medications, co-morbidities, IPSS score, and 24-hour urine volume. All urine collections were analyzed at a single lab. Inadequate collections were excluded according to 24-hour urine creatinine levels. If patients performed two collections for the same evaluation, the mean total urine volume from the two collections were used in the statistical analysis.

IPSS severity was categorized into mild (0-7), moderate (8-19), and severe (20-35) symptoms. Mean 24 hour-urine volumes were categorized into low urine volumes (<1 L/day) and adequate urine volumes (>2 L/day).

Statistical analysis

Descriptive statistics were used to characterize our population. A univariate analysis was performed to calculate the Pearson correlation co-efficient for the association between IPSS and 24-hour urine volume. ANOVA modeling was used to compare 24-hr volumes across mild, moderate, and severe IPSS groups. The Mann-Whitney test was used to compare the mild-mod vs. severe and mild vs. mod-severe groups with respect to 24-hour urine volumes. Kruskal-Wallis statistical methodology was used to compare the scores assigned to each question of the IPSS questionnaire by the low urine volume and adequate urine volume groups, as well as comparing the number of patients on tamsulosin within each group. For all analyses, a p-value <0.05 was considered statistically significant. Statistical analysis was performed using GraphPad v6.0 for Mac.

Results

Overall, 131 patients met inclusion criteria, including 116 men and 15 women, with a mean age of 53 years old (95% CI: 50-55 years). Stratification by IPSS severity yielded groups of N=96, 28, and 7, for mild, moderate, and severe groups, respectively. There was no difference between mean age (p=0.88), gender (p=0.71), mean stone size (p=0.25), and urine volumes (p=0.070) in the mild, moderate and severe groups. Of those with severe LUTS, 86% (6/7) were males over 50, and 57% (4/7) had stones >10mm (Table 1). Only 5 patients were on tamsulosin at the time of their IPSS questionnaire. Of these, 2 had been on it prior to their stone event for benign prostatic hyperplasia (BPH) symptoms, and 3 were using it as medical expulsive therapy. There was no statistical difference in the number of patients on tamsulosin between the groups.

Linear regression modeling did not reveal a correlation between IPSS score and 24-hour urine volume, with a Pearson correlation co-efficient calculated at 0.021 (Figure 1).

When comparing those with severe IPSS scores to all other patients, significantly lower urine volumes were noted (1.4 L [95% CI: 0.9-1.9 L] vs. 2.0 L [95% CI: 1.9-2.1 L]; p=0.022).

There was no difference in mean age (p=0.78), gender (p=0.81), and mean stone size (p=0.71) between these two groups.

Those with low urine outputs (<1L/d) were predominantly men (N=9/10, mean age 54 years old [95% CI: 41-68]). When compared to those with >2L/d urine production (N=65), a significantly higher IPSS was noted (11.7 [95% CI: 5.0-18.4] vs. 6.2 [95% CI: 5.0-7.4]; p=0.036) (Table 2). These groups showed significant differences in their responses to question 1 (incomplete emptying, 1.78 [95% CI: 0.5-2.9] vs. 0.7 [95% CI: 0.5-1.1]; p=0.031), question 3 (intermittency, 1.7 [95% CI: 0.6-2.8] vs. 0.6 [95% CI: 0.4-0.9]; p=0.011), and question 6 (stranguria, 1.8 [95% CI: 0.4-3.2] vs. 0.35 [95% CI: 0.2-0.5]; p=0.0020), with higher scores noted in the low urine output group (Figure 2).

Discussion

To date no studies have assessed the association between LUTS and 24-hour urine volumes in patients after an initial presentation of urolithiasis. Our data does not show a linear relationship between IPSS and urine volumes. However, those patients with the most severe LUTS, as determined by an IPSS questionnaire, appear to have lower daily urine outputs compared to patients with mild-moderate LUTS. A potential explanation for this apparent discrepancy may be that only patients with severe LUTS, but not mild-moderate LUTS, are affected by their LUTS enough to reduce their fluid intake as a result. A recent review article by Callan et al. (2015) showed that LUTS can be reduced by a fluid intake reduction of 25% and that increasing fluid intake can exacerbate LUTS.[9]

A secondary objective of our study was to determine how specific LUTS differed between lower urinary volume patients and adequate urinary volume patients. The low volume group had significantly worse subjective incomplete emptying, intermittency, and straining scores, in addition to a lower total IPSS. It has yet to be established what difference in score on a single question of the IPSS is clinically perceptible. However, it is generally accepted that a change in 3 points on the overall score is clinically significant.[10] The difference in total IPSS scores between the adequate and low urine output groups surpasses this threshold. On the basis of this finding, a prospective analysis assessing whether or not treatment of voiding LUTS in stone formers results in improved urine volumes would be both interesting and clinically relevant. In our study, the majority of the patients were men over the age of 50. Though we did not record the specific etiology for the LUTS, it is reasonable to hypothesize a large portion of these could be attributed to benign prostatic hyperplasia (BPH). Given many patients are started on alpha blockers for medical expulsive therapy, the acceptance of these medications may be bolstered by the familiarity.

We recognize a number of limitations in this study including the retrospective design. Although there were no significant differences in the demographics of patients with mild, moderate, and severe LUTS, interpretation of any results is tempered. There were 3 patients on tamsulosin for medical expulsive therapy and this may have affected their IPSS scores. However,

the impact on the overall analysis is minimal with such a small number. The overall numbers are relatively small which may account for the lack of a relationship between IPSS and 24-hour urine volumes. Furthermore, patients varied in their timing of investigations, and often patients with stones are counselled on hydration, prior to formal evaluation. It is possible that the patients who received counseling prior to the urologic evaluation implemented changes to their daily fluid intake, therefore influencing the results of our study. Ideally all of the patients included in the study would have all received standardized preventative counseling, and had the same amount of time between their appointment and the urine collection.

Conclusion

International Prostate Symptom Scores and 24-hour urine volumes do not appear to have a linear relationship. However, it appears patients with low urine volumes self-report worse voiding symptoms than those with adequate urinary volumes. Based on our results, lower urinary tract symptoms may be a barrier to adequate fluid intake in patients with a past presentation of urolithiasis. These findings may be used to consider treatment of severe lower urinary tract symptoms in urolithiasis patients to encourage adequate fluid intake and subsequently decrease the recurrence of kidney stones.

References

1. Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease. *World J Urol* 2017;35:1301-1320.
2. Lotan Y, Buendia Jimenez I, Lenoir-Wijnkoop I, Daudon M, Molinier L, Tack I, Nuijten MJ. Increased water intake as a prevention strategy for recurrent urolithiasis: Major impact of compliance on cost-effectiveness. *J Urol* 2013;189(3):935–939.
3. Borghi L, Meschi T, Amato F, Briganti A, Novarini A, Giannini A. Urinary volume, water and recurrences in idiopathic calcium nephrolithiasis: A 5-year randomized prospective study. *J Urol* 1996;155(3):839-843.
4. Parks J, Goldfischer E, Coe F. Changes in urine volume accomplished by physicians treating nephrolithiasis. *J Urol* 2003;169(3):863-866.
5. Hyams ES, Matlaga BR. Economic impact of urinary stones. *Translational Andrology and Urology* 2014;3(3):278-283.
6. McCauley L, Dyer A, Stern K, Hicks T, Nguyen M. Factors influencing fluid intake behavior among kidney stone formers. *J Urol* 2012;187(4):1282-1286.
7. Taylor B, Wilt T, Fink H, Lambert L, Marshall L, Hoffman A, Beer T, Bauer D, Zmuda J, Orwoll E. Prevalence, severity, and health correlates of lower urinary tract symptoms among older men: The MrOS study. *Urology*. 2006;68(4):804.
8. Quek KF, Low WY, Razack AH, Loh CS. Reliability and validity of the International Prostate Symptom Score in a Malaysian population. *BJU international* 2001;88(1):21-25.
9. Callan L, Thompson D, Netsch D. Does increasing or decreasing the daily intake of water/fluid by adults affect overactive bladder symptoms? *Journal Wound Ostomy Continence Nursing* 2015;42(6):614-620.
10. Barry M, Williford W, Chang Y, Machi M, Jones K, Walker-Corkery E, Lepor H. Benign prostatic hyperplasia specific health status measures in clinical research: How much change in the American Urological Association symptom index and the benign prostatic hyperplasia impact index is perceptible to patients? *J Urol* 1995;154(5):1770-1774.

Figures and Tables

Fig. 1. Logistic regression analysis of International Prostate Symptom Score (IPPS) as a function of 24-hour urine collection volume.

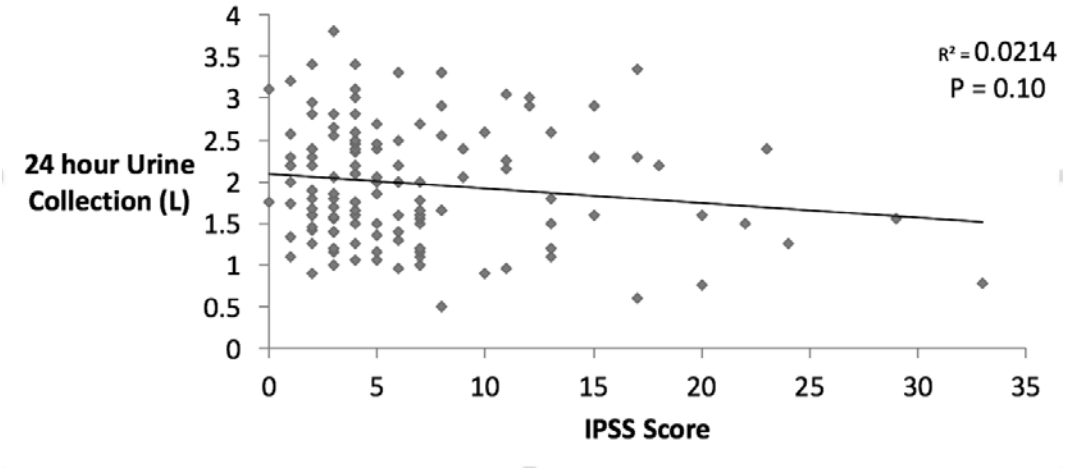
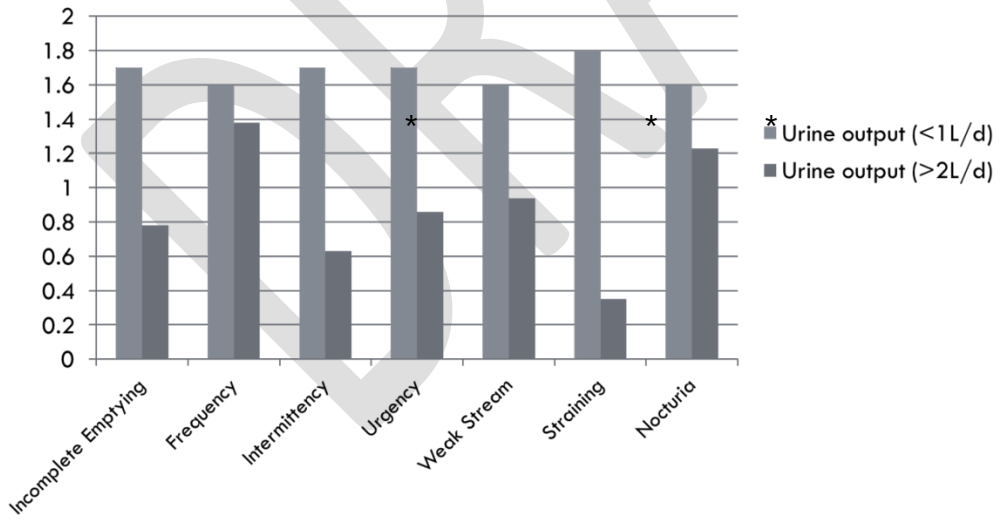


Fig. 2. Mean score on each question of International Prostate Symptom Score (IPSS) questionnaire stratified into low (<1 L/day) and adequate (>2 L/day) urine output groups.



*Denotes statistically significant difference $p<0.05$.

Table 1. Patient demographics stratified by IPSS					
Demographic	**Mild n=96**	**Moderate n=28**	**Severe n=7**	**Total n=131**	**p**
Mean age (years)	52.3	53.6	53.9	53.3	0.88
Gender (% male)	87.5%	92.8%	85.7%	87.9%	0.71
Mean size of stone (mm)	9.3	8.6	12.9	10.3	0.25
Mean 24-hour urine collection volume (L)	1.99	2.08	1.40	1.82	0.07
Patients on tamsulosin at time of questionnaire (%)	1 (1.0)	3 (1.1)	1 (14.3)	5 (3.8)	0.66

IPSS: International Prostate Symptom Score.

Table 2. Demographics stratified by urine outputs			
Demographic	**Low urine output (<1 L/day) n=10 (95% CI)**	**Adequate urine output (>2 L/day) n=65 (95% CI)**	**p**
Mean age (years)	54.4 (41.2–67.6)	52.0 (49.0–55.1)	0.62
Gender (% male)	90%	91%	0.94
Mean size of stone (mm)	8.3 (4.4–12.2)	9.7 (8.2–11.2)	0.46
Mean IPSS	11.7 (5.0–18.4)	6.2 (5.0–7.4)	0.036*

*Denotes statistically significant difference $p<0.05$. CI: confidence interval; IPSS: International Prostate Symptom Score.