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Original Article

Urodynamics of men with urinary retention

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Abbreviations & Acronyms
BCI = bladder contractility index
BOO = bladder outlet obstruction
BOOI = bladder outlet obstruction index
BPH = benign prostatic hyperplasia
CIC = clean intermittent catheterization
DUA = detrusor underactivity
LUTS = lower urinary tract symptoms
PdetQ_{max} = detrusor pressure at maximum flow
Piso = isometric detrusor pressure
PVR = post-void residual
Q_{max} = maximum flow rate
SNS = sacral nerve stimulator
TURP = transurethral resection of the prostate
TWOC = trial without catheter

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Objectives: To describe the urodynamic characteristics of men with urinary retention, and to show the diverse treatment plans based on urodynamic findings.
Methods: We carried out a 3-year retrospective review of men with urinary retention who were referred to our clinic for urodynamic evaluation. Men with a history of neurogenic voiding dysfunction or major pelvic surgery were excluded. Multichannel videourodynamic studies were carried out, and the subsequent treatment modality offered was recorded.
Results: A total of 67 men with urinary retention and a median age of 68 years underwent urodynamic evaluation. The median maximum flow rate was 3 mL/s, and the median detrusor pressure at maximum flow was 54 cm H_2O. Bladder outlet obstruction was diagnosed in 60%. Detrusor underactivity was present in 73% according to the bladder contractility index; however, just 29% were classified as having detrusor underactivity according to isometric detrusor pressure, an alternative measure of contractility. A total of 76% of patients had low detrusor reserve (<20 cm H_2O). Based on urodynamic findings, just 57% of patients were offered de-obstructive surgery.
Conclusions: In the present cohort, just 60% of men with urinary retention showed urodynamic evidence of bladder outlet obstruction. Depending on how contractility is measured (bladder contractility index *vs* isometric detrusor pressure), the rate of detrusor underactivity varies. The majority of men with retention had a low detrusor reserve. Given the wide spectrum of urodynamic findings in men with retention, surgical intervention might not be necessary for all. Furthermore, a careful consideration of urodynamics can assist in the selection of optimal treatment.

Key words: bladder outlet obstruction, detrusor reserve, detrusor underactivity, urinary retention, urodynamics.

Introduction

In adult men, urinary retention is most often presumed to result from BOO secondary to BPH.[1] As such, treatment is typically directed towards decreasing outflow obstruction through pharmacotherapy, such as alpha-blockers and 5-alpha reductase inhibitors, and/or surgery, including TURP or equivalent procedures. Men with urinary retention who fail medical therapy are often recommended a surgical procedure, in accordance with North American and European guidelines for management of BPH.[2–4]

It is not clear, however, that all, or even most cases, of retention are related to BOO. Urinary retention can occur secondary to weak detrusor strength or a combination of BOO and DUA. This has been confirmed in long-term urodynamic studies of men with LUTS, in which 52% have BOO, 11% have weak bladders and 37% are equivocal with respect to BOO.[5] However, although this breakdown has been documented in men with LUTS, few studies have examined the urodynamic characteristics of men with urinary retention, an extreme subset of LUTS.

We question the utility of a one-therapy-fits-all approach for urinary retention, and describe the urodynamic characteristics of men with urinary retention with particular attention to measures of bladder contractility and outlet obstruction. Based on urodynamic findings, we propose a potentially more appropriate algorithmic treatment plan, with either surgical or non-operative management.

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Methods

After receiving institutional review board approval, we carried out a retrospective review of all men referred to our institution for urinary retention who underwent urodynamic evaluation between January 2008 and June 2011. As there is not a standardized definition for urinary retention, we defined urinary retention in two ways.[6] First, we classified men who required a urinary catheter for bladder drainage and failed a subsequent voiding trial as being in “overt” urinary retention. We also classified men who had an office post-void residual of >500 mL (documented by bladder scan), along with the sensation of incomplete emptying, as being in “covert” retention. Additional data including age, history of diabetes, prior urological surgeries and post-evaluation treatment were noted. Men with voiding dysfunction associated with documented neurological disorders (including, but not limited to, spinal cord injury and multiple sclerosis) were excluded, as were those who had undergone radical prostatectomy or major pelvic surgery, such as abdominoperineal resection.

Urodynamic studies were carried out according to International Continence Society standards by a single operator.[7] All patients began the study with a free uroflowmetry in the standing position, followed by a measurement of the post-void residual urine volume. Videourodynamic evaluation was then carried out using a 7-Fr urodynamic catheter with concomitant rectal manometry. Urethral pressure profilometry was carried out, and the maximal urethral closure pressure was measured. The urodynamic catheter was then advanced into the bladder, and filling commenced with room temperature Cystografin (Bracco Diagnostics, Monroe Township, NJ, USA) at a rate of 50 mL/min. Electromyographic sphincter activity was measured with perianal patch electrodes. Fluoroscopic images and pressure measurements were obtained during the filling and voiding phases. The Q_{max} and PdetQ_{max} were measured. Detrusor overactivity was defined as the occurrence of any uninhibited bladder contractions during filling.[8] The presence of bladder diverticula was also noted during fluoroscopic examination.

After a standard pressure-flow study, the bladder was refilled to capacity and measures of Piso were made using a “mechanical stop test”.[9] This involved gentle occlusion of the penile urethra during the mid-voiding phase to prevent urinary flow, with the maximum detrusor pressure generated during this maneuver recorded as Piso.

The BOOI was calculated as PdetQ_{max} – 2 × Q_{max}. A BOOI >40 was considered BOO.[10] The BCI was calculated as PdetQ_{max} + 5 × Q_{max}. A BCI <100 was considered to signify detrusor underactivity.[10] As an alternative method to evaluating detrusor contractility, in accordance with prior studies, a Piso measurement <50 cm H_2O was diagnostic of detrusor underactivity.[11] Finally, the detrusor reserve, a measure of the residual bladder strength after meeting requirements for voiding, was calculated as Piso – PdetQ_{max}. A value <20 cm H_2O was used to identify men with low reserve.[12]

After urodynamic evaluation, different treatment modalities were offered to patients according to their findings: (i) men with BOO with poor detrusor reserve were offered TURP (considered the surgical gold standard in the USA) or simple open prostatectomy (for large prostates);[2] (ii) men with BOO and adequate detrusor reserve were offered a TWOC, and if they failed, were treated with TURP; and (iii) men with detrusor underactivity were offered UroLume (American Medical Systems, Minnetonka, MN, USA) stent placement, SNS placement or CIC (note: UroLume stent is no longer manufactured).

Statistical analysis in the present study was carried out using MedCalc statistical software (Ostend, Belgium).

Results

A total of 67 men who met the study criteria for urinary retention underwent multichannel videourodynamic examination. Of these 67 men, 56 men (84%) were in “overt” retention and 11 men (16%) were in “covert” retention. The median age was 68 years. A total of 17 patients (25%) had a diagnosis of diabetes; 12 (18%) had previously undergone transurethral resection of prostate tissue and three (5%) had received prior treatment for urethral stricture (no men had recurrent stricture at the time of examination). The median time to urodynamic study was 1 month (range 1 week to 10 years).

On urodynamic examination, detrusor overactivity was identified in 36 patients (54%), and bladder diverticula were noted in five patients (7%). During pressure-flow study, the median Q_{max} was 3 mL/s, and the median PdetQ_{max} was 54 cm H_2O for the entire cohort (Table 1). A total of 60% of men had a BOOI >40, suggestive of urodynamic outlet obstruction (median BOOI 50 cm H_2O; Fig. 1). With regard to detrusor contractility, 73% of men had a BCI <100 (median BCI 85; Fig. 2). However, when evaluating bladder strength using isometric detrusor contraction pressure, just 29% generated a Piso <50 cm H_2O (median Piso 67 cm H_2O; Fig. 3). The median detrusor reserve in the cohort was 7 cm H_2O, and 76% of the cohort had a detrusor reserve <20 cm H_2O (Fig. 4). Men with detrusor underactivity (Piso <50 cm H_2O) were no more likely to have diabetes than patients with normal bladder contraction (26.7% *vs* 19%, respectively, $P = 0.53$).

In all, 75% of the patients were treated surgically for retention. TURP or repeat TURP was offered to 54%, a UroLume stent was placed in 13%, SNS placement was carried out in

Table 1 Urodynamic findings in men with urinary retention based on overt versus covert retention

Urodynamic parameter	Median (range) Overt retention (n = 56)	Covert retention (n = 11)
Capacity (mL)	380 (66–1200)	650 (315–1800)
Q_{max} (mL/s)	3 (0–17)	3 (0–10)
PdetQ_{max} (cm H_2O)	53 (0–280)	79 (5–140)
Piso (cm H_2O)	67 (0–280)	81 (5–150)
Detrusor reserve (cm H_2O)	6 (0–75)	9 (0–27)

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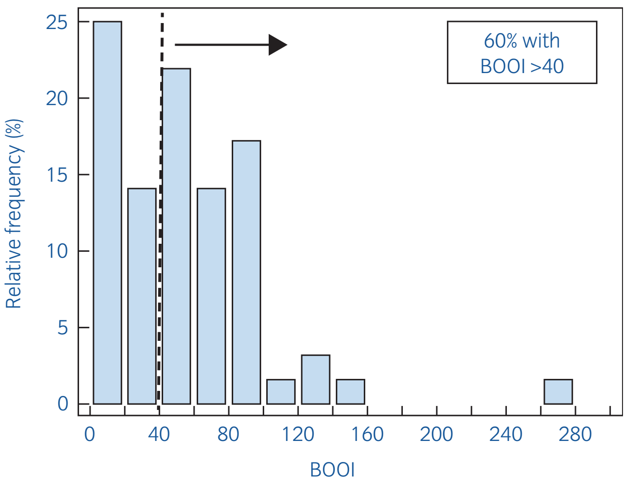

Fig. 1 Histogram of BOOI in study cohort. A total of 60% of patients had BOOI >40, consistent with BOO.

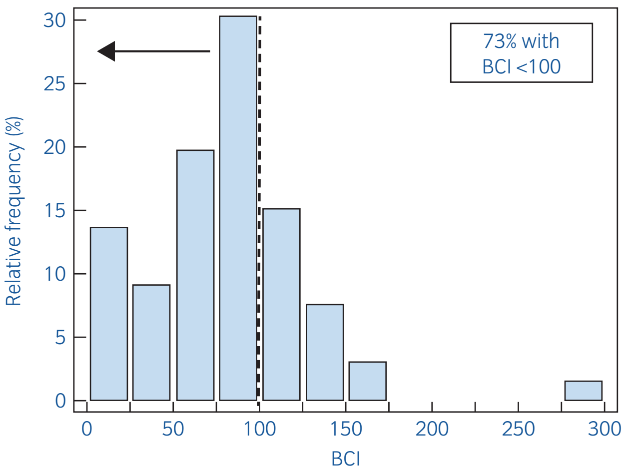

Fig. 2 Histogram of BCI in study cohort. A total of 73% of patients had BCI <100, consistent with weak bladder contractility.

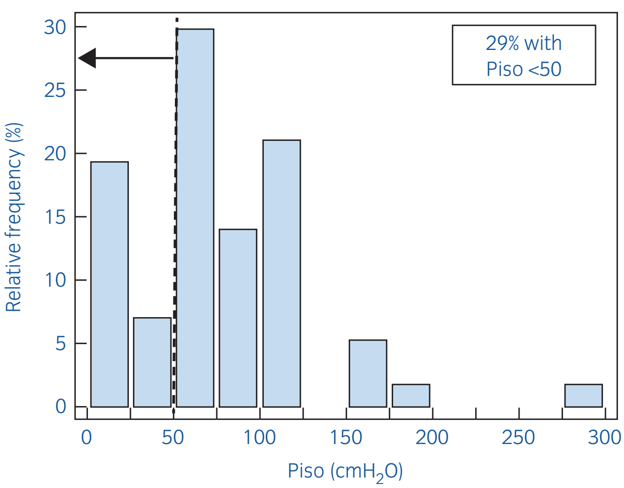

Fig. 3 Histogram of maximum Piso in study cohort. A total of 29% of patients had Piso <50, consistent with weak bladder contractility.

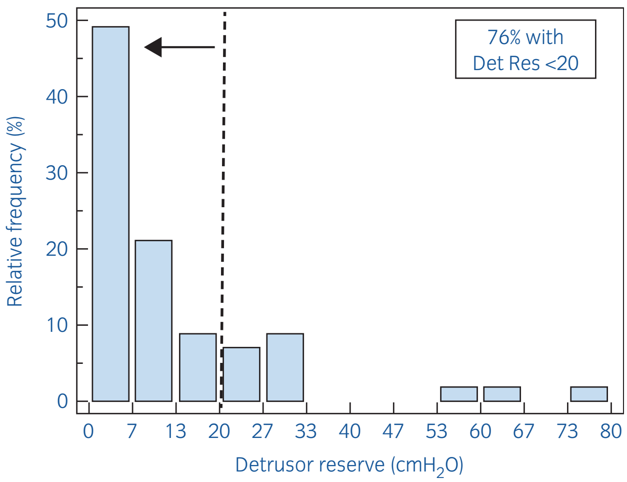

Fig. 4 Histogram of detrusor reserve in study cohort. A total of 76% of patients had detrusor reserve <20, consistent with decompensated bladder.

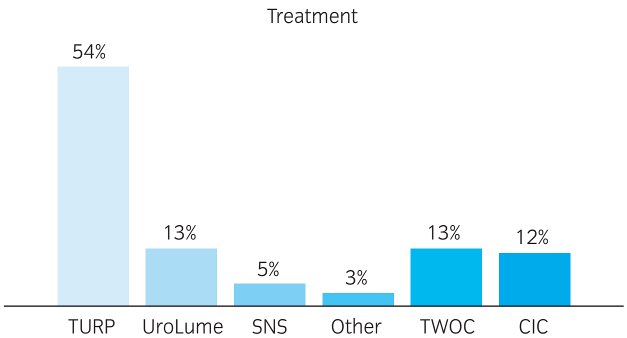

Fig. 5 Treatments offered to patients based on urodynamic findings. "Other" refers to one patient who underwent simple prostatectomy and one patient who underwent radical prostatectomy.

5% of patients and the remaining 3% underwent other surgical procedures (one had simple prostatectomy and one underwent robot-assisted radical prostatectomy for a localized prostate cancer found during the preoperative workup). One-quarter of the cohort was treated non-operatively: 13% of men had a successful trial without catheter, and 12% of men chose to carry out clean intermittent catheterization (Fig. 5). In those men with detrusor underactivity undergoing a surgical treatment (TURP, SNS, UroLume stent), the details of success are included in Table 2.

Discussion

Although urinary retention in men is often considered a result of benign prostatic obstruction, just 60% of the present cohort met the urodynamic criteria for BOO. Our findings are consistent with prior studies that noted just 50–80% of men with urinary retention indeed have BOO.[13,14] This finding suggests that not all men with urinary retention require surgical de-obstruction. In the present series of men with urinary retention, de-obstructive surgery (TURP or open prostatectomy) was offered to just 57% of patients.

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Table 2 Outcomes of surgical intervention in men by definition of detrusor underactivity

	Success rate	Comment
Using Piso <50 cm H_2O		
TURP (*n* = 1)	1/1	Strong stream at 1 month exam – however, no further follow up
SNS (*n* = 2)	2/2	One patient with no follow up after device placement – considered success
UroLume stent (*n* = 5)	2/5	One success patient with PVR 296 mL at 1 year, but voiding on own and satisfied
Using BCI <100		
TURP (*n* = 17)	11/17	Six patients requiring subsequent CIC or SP tube
		One success patient with strong stream at 1 month exam – however, no further follow up
TURP at another institution (*n* = 5)	–	No follow-up data
SNS (*n* = 3)	2/3	One patient with no follow up after device placement – considered success
UroLume stent (*n* = 8)	3/8	Two success patients with ~PVR 300 mL at 1 year, but voiding on own and satisfied

The utility of TURP for men with BOO and for men with DUA has been described. In men with urodynamically diagnosed BOO, Han *et al.* showed an improved flow rate and an 85% satisfaction rate after TURP. For men with DUA who underwent TURP, there was no significant change in flow rate, and just 64% of these men expressed satisfaction with the procedure.[15] Additionally, in a long-term urodynamic study with >10 years of follow up, Thomas *et al.* showed that men with DUA who underwent TURP had a small improvement in the calculated BOOI, but did not have a significant improvement in flow rate or LUTS.[16] These authors discouraged TURP in men with weak bladder strength.

The present study also highlights the discordance in determination of bladder strength between the BCI and isometric detrusor contractility. Because the satisfaction rate for TURP in men with DUA is lower than in men with adequate detrusor contractility, it is vital to determine which men have sufficient bladder contractility to be able to void successfully after surgery, whereas alternative methods should be found for men with DUA without proven BOO. In the present cohort, when using the BCI, 73% of men were considered to have weaker than normal detrusor strength. In contrast, when using Piso, a more direct measure of detrusor contractility, just 29% showed a subnormal detrusor contractile strength. This discrepancy might be related to the fact that men in retention, or near retention, exist at an extreme ($Q_{\max}$ near 0 mL/s) such that if using the BCI, only a Pdet$Q_{\max}$ close to 100 cm H_2O would be classified as normal detrusor contractility. This suggests that the BCI nomogram might not be ideal for assessing the bladder strength in men with overt urinary retention. Similarly, for men at the other end of the extreme, such as those with low sphincteric resistance (men with post-prostatectomy incontinence), the BCI has been shown to be a poor measure of detrusor contractility.[17]

Consistent with prior studies, the present data shows that detrusor reserve, a measure of potential bladder compensation, was low in nearly 76% of patients in our cohort.[13] This finding supports the hypothesis that detrusor decompensation (i.e. weakening of the bladder in the setting of prolonged untreated BOO) or loss of ongoing detrusor compensation leads to poor bladder emptying, and ultimately to frank retention as the ratio of Piso to Pdet$Q_{\max}$ approaches unity. In other words, even with the bladder contracting maximally, this contractile pressure is not sufficient to achieve adequate evacuation of urine. Although detrusor reserve is not widely used, it might be particularly helpful in identifying men who are at a higher risk for urinary retention. Men with very low detrusor reserve might be poor candidates for medical BPH therapy, and might obtain more benefit from surgical de-obstruction. When we identify such men, if they choose pharmacotherapy over surgery, they are additionally taught clean intermittent catheterization, as they are at high risk for future episodes of retention.

The present study indeed had limitations. The men in our cohort were all referred to a single, tertiary academic medical center; thus, the study had a limited number of participants, and the academic setting might not be generalizable to a typical urology practice. Our definition of "covert" retention might also be debated, as no specific level of post-void residual has ever been identified to be pathological. For this reason, we subdivided our cohort when possible. In addition, although the ascertainment of Pdet$Q_{\max}$ might be more ideal in patients who void smoothly, men with urinary retention are a subgroup for whom this might not be possible. Thus, obtaining Pdet$Q_{\max}$ with the addition of other metrics, such as Piso, provides at least some insight to the detrusor contractility characteristics of these men. Finally, because the present study was not designed to specifically examine the success rates of the various treatment options, the follow up on many patients was incomplete and limited our ability to definitively report on retention treatment outcomes.

Despite our noted limitations, the present cohort study shows the varied pathophysiology for a unique subset of men with LUTS. The various treatments that were ultimately offered to our patients illustrates our contention that surgical de-obstruction is not necessarily the preferred treatment for all men with urinary retention, nor is it likely to adequately treat all patients who present with retention. Urodynamic investigation of men with urinary retention can elucidate the underlying pathophysiology, thereby guiding appropriate treatment.

Conflict of interest

None declared.

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