Surgical Treatment: Outlet Reduction, Men and Women

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Key Points

1. The most relevant preoperative test to determine the relative degree of DU and bladder outlet obstruction is a pressure flow urodynamic study, however the factors that predict outcome are not well characterized
2. For men outlet reduction, including TURP, HoLEP and PVP, has resulted in variable success in patients with DU.
3. The decision as to whether to perform surgical therapy in patients with DU should be highly individualized and include appropriate counseling as to the unpredictability of the outcome.
4. In absence of any demonstrable anatomical obstruction, there is currently no clear role for outlet reduction surgery in women with DU.

Introduction

The International Continence Society (ICS) defines detrusor underactivity (DU) as "a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within normal time span" [1]. DU is thus a urodynamic diagnosis [2] which occurs in almost 48 % of older men (>65) and 13 % of older women (>65) evaluated for lower urinary tract symptoms (LUTS) [4]. DU can occur in association with chronic bladder outlet

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C.R. Chapple et al. (eds.), *Underactive Bladder*,
DOI 10.1007/978-3-319-43087-4_7

obstruction, aging, myogenic or various neurogenic defects or idiopathic causes [2]. Clinically DU is characterized by voiding LUTS and reduced voiding efficiency [3]. DU is also associated with complications such as recurrent urinary tract infections and bladder stones.

Urodynamics are essential in the determination of the relative contribution of bladder outlet resistance and DU to patients' symptoms. This is particularly important when considering surgery to the bladder outlet. There has however been a lack of literature regarding the urodynamic evaluation of DU [5]. Clearly preoperative planning, extensive patient counselling are necessary before any surgical procedure in this cohort. The aim of this chapter is to provide an analysis of the role of outlet reduction surgery in both men and women with underlying DU.

Pre-operative Studies

The most useful test to determine the degree of BOO and detrusor contractility is a pressure flow urodynamic study [6]. In addition important information such as bladder sensation, compliance and capacity that is relevant to preoperative planning can also be gleaned [6]. Several urodynamic measures of bladder contractility are described and are described in detail in Chap. 3 . Estimation of post-void residual (PVR) with the use of ultrasound or catheterization is essential to determine to voiding efficiency. A synchronous videourodynamic study (VUDS) may provide valuable insight on the degree and nature of bladder outlet obstruction [7]. It is important to keep in mind that a major limitation in the use of more traditional methods for urodynamics when diagnosing DU compared to BOO is that when diagnosing BOO it is highly dependent on the degree of bladder contractility ref.

Outlet Reduction Surgery for Men

Transurethral Resection of the Prostate (TURP)

TURP is the gold standard when treating LUTS secondary to benign prostatic hyperplasia (BPH). There is limited data on patients with DU undergoing TURP. Tanaka et al. conducted a clinical study to evaluate the short-term efficacy of TURP on BOO, DO and DU. They recruited 92 males over the age of 50 who were considered suitable candidates for the procedure [10]. Patients underwent preoperative pressure flow study analyses before undergoing TURP. Overall, TURP demonstrated a 76 % overall efficacy rate amongst patients [10]. From baseline to 3-months follow-up patients showed improvements in all parameters across all degrees of bladder outlet obstruction based on linPURR scores. Furthermore, it was markedly higher amongst patients with BOO as these levels worsened, while TURP had no significant benefit on those with DU or DO [10]. In conclusion, 20 % of those with DU achieved good efficacy after undergoing TURP. IPSS scores for those with weak/very weak detrusor contractility at 3-months after TURP improved

from 14.8 to 4.7, $p<0.001$. Qmax improved from 10.8 to 18.9 mL/s, $p<0.001$ and PVR decreased from 47.1 to 24.3, $p<0.001$ 3-month after TURP.

Masumori et al. evaluated whether DU could potentially affect the long-term outcomes of TURP. Of the original 92 patients in the study by Tanaka et al., 34 were eligible to continue in the study. Those with DU that IPSS scores improved by 3-months post procedure, but degraded over time (3-months 5.2 vs. 12 years 10.1) [9]. This was similarly seen for QoL (3-months 1.8 vs. 12 years 2.2). Interestingly, despite poor objective results, 2/3 of patients diagnosed with DU reported being content with their current urinary symptoms [9].

Thomas et al. evaluated the outcome of TURP in men with DU [11]. In a cohort of 224 men who had been diagnosed with DU, 22 patients had undergone TURP. The rest of the cohort was treated with clean intermittent catheterization (CIC) or watchful waiting [11]. The authors showed a long-term reduction in obstruction as evaluated through detrusor pressure at Qmax (pdetQmax = baseline 31 vs. follow-up 25, $p=0.027$) and BOO index (BOOI = baseline 15 vs. follow-up 9, $p=0.029$) [11]. When compared to those who did not undergo any formal treatment, patients who underwent TURP did not show any significant urodynamic differences. Interestingly those who underwent TURP showed a statistically significant decrease in bladder voiding efficiency (BVE) for which there is no apparent explanation [11]. Those not undergoing any treatment who were followed up had a BVE = 82 compared to a BVE = 58 ($p=0.044$) in those who underwent TURP [11]. The authors concluded DU is a contraindication for TURP.

Although, patients with DU undergoing TURP do not seem to derive much benefit based on objective urodynamic parameters, there is some evidence of patient satisfaction following the procedure. Overall there is a paucity of information available to make any firm recommendation as to which patients with DU should undergo TURP and case by case approach is advocated.

Laser Prostatectomy

An alternative method of reducing outlet resistance is the transurethral laser prostatectomy. Laser prostatectomy differs from TURP by "delivering heat to the prostatic tissue through a laser fiber under cystoscopic vision" [12]. As with TURP, there is a limited number of published studies examining its effect on patients with DU. Currently, laser prostatectomy is performed with several different lasers such as Holium laser enucleation (HoLEP) and Greenlight laser.

In a prospective clinical trial, Mitchell et al. evaluated 33 men with DU, 14 men with detrusor hypocontractility and 19 patients with detrusor acontractility undergoing HoLEP [13]. Impaired bladder contractility was defined using the bladder contractility index (BCI) <100. Pre-operatively each patient underwent an urodynamic assessment. Overall there was a significant reduction in IPSS scores 6-month post-operatively compared to baseline (21.5 vs. 3, $p=0.014$) [13]. Furthermore, Qmax significantly improved (10 vs. 21 mL/s, $p=0.001$), while PVR was significantly reduced (250 vs. 53 mL, $p=0.007$) [13]. In terms of patient satisfaction, 55.6% of men with

DU were "delighted" with the results [13]. A major limitation of the study was the lack of long-term follow-up data to assess the durability of the treatment response.

Photoselective vaporization (PVP) with the Greenlight laser is a minimally invasive procedure using 532 nm high-powered laser light to ablate obstructing prostatic tissue. Several studies have demonstrated the relative efficiency when treating DU. Monoski et al. retrospectively reviewed 40 men to determine whether preoperative urodynamic parameters can predict outcome in men with urinary retention undergoing PVP [14]. The purpose of the urodynamic study was to identify men with either impaired detrusor contractility (IDC) or detrusor overactivity (DO). IDC was defined using criteria defined by the International Continence Society ref. In total, 8 men had IDC, while 30 had DO pre-operatively. Subjects were followed post-operatively for 12 months. IPSS for men with IDC showed a 25% reduction from baseline to 12-months (12.0 vs. 9.0) [14]. Furthermore, Qmax showed a 155% improvement at 12-months post-operatively (4.8 vs 12.3 mL/s) [14]. Lastly, an 80% reduction was seen in patients' PVR (918.3 vs. 181.5 mL) [14]. Monoski and colleagues noted that men without IDC or DO showed the greatest improvement.

In a study by Cho et al., the impact of HoLEP or PVP on DU was investigated. In the study, Du was defined as a patient having a bladder contractility index of <100. One thousand four-hundred and twenty-three men were recruited and categorized into four different groups: 239 men without DU and 432 with DU were randomized to receive HoLEP treatment. Furthermore, 329 men without DU and 423 men with DU were randomized to receive PVP as a treatment [15]. When comparing patients with and without DU preoperatively, IPSS, subtotal voiding symptom score and Qmax were worse in the DU group [15]. When comparing across procedures, those with DU in the HoLEP groups showed the greatest degree of post-operative improvement in total IPSS, Qmax and subtotal voiding symptom score [15]. However, none of these parameters showed statistical significance. Although this treatment showed relatively good efficacy, researchers concluded that patients with DU seemed to improve to a lesser extent when undergoing PVP or HoLEP compared to those without DU.

These studies suggest that HoLEP and PVP are viable outlet reduction surgeries in patients with DU. The severity of DU can affect surgical efficacy although it has not well defined in these studies. We can speculate that the substantial recovery of spontaneous urination and restoration of some contractility of detrusor muscle is due to the degree of DU being mild, relief of stressed detrusor muscle and minimal damage from operation [13]. By contrast where there is a lack of surgical efficacy there is likely to be a greater degree of impairment of detriusor activity preoperatively. As such, further studies evaluating the differences in impairment of detrusor activity may be beneficial in understanding the variability of surgical outcomes.

Outlet Reduction Surgery for Women

DU is even less well characterized in women than in men and shows a lower prevalence [6]. Choi et al. performed a multi-center study to investigate the prevalence and characteristics of voiding dysfunctions in women across nine hospitals [8].

Seven-hundred and ninety-two women visited clinics with symptoms of lower urinary tract symptoms (LUTS). In order to examine urinary function, researchers performed uroflowmetry and residual urine volume by urethral catherization. For the purposes of this study DU was defined as "Qmax <15 ml/s and detrusor pressure <20 cmH_2O at Qmax" [8]. Of those with voiding difficulty, a total of 13 (12.7 %) of patients had DU. When comparing characteristics of female voiding difficulty, researchers found no significant differences between those with functional BOO or DU, except when looking at detrusor pressure at Qmax BOO = 45.4 ± 18.7 cmH_2O vs. DU = 13.0 ± 4.9 cmH_2O, $P < 0.05$.

Bladder Neck Incisions

For women with BOO at the bladder neck, transurethral bladder-neck incisions (TUI-BN) have been utilized to reduce outlet resistance [16]. The procedure has demonstrated long-term efficacy in restoring spontaneous voiding and relieving voiding difficulties [16]. It is postulated that this procedure may be effective in treating patients, especially women with DU due to potential bladder neck obstruction [16].

In a retrospective study, Jhang et al. 31 assessed female patients with DU who had underwent TUI-BN. The technique was performed using a resectoscope and a diathermy electrode. Incisions were made 5 o'clock and 7 o'clock positions of the bladder neck. Urodynamic parameters were collected for each patient preoperatively to determine any additional etiologies in relation to their DU diagnosis [16]. Three-months post-operatively patients showed a statistically significant improvement in voided volume, Qmax, PVR and voiding efficiency. In total, PVR decreased by 56.3 % when comparing patients post TUI-BN to baseline (391.5 vs 171.1, $p < 0.0001$). Similarly, voiding efficiency, defined as the voided volume/total bladder capacity × 100 %, increased from 5 to 52 %, $p < 0.0001$ [16]. Qmax and voiding volume showed significant improvement amongst this cohort of patients, increasing from 1.10 vs 7.82 mL/s and 22.0 vs 171.9 mL, respectively with a p value <0.0001 [16]. Researchers conclude TUI-BN to be an effective treatment for female patients with DU and bladder neck obstruction given its ability to improve PVR, voiding volume and efficiency and Qmax.

In a long-term follow up study, Jhang et al. again evaluated the effect TUI-BN for female patients with DU. Fifty women who had not responded favorably to other treatment options for DU underwent TUI-BN [17]. At baseline and at each follow-up time point (mean follow-up 61.8 months), urodynamic parameters were obtained. Similarly to their previous study, voiding efficiency (0.0 vs 50 %, $p < 0.0001$), voided volume (0.0 vs 167 mL, $p < 0.0001$), PVR (400 vs 150 mL, $p < 0.0001$) and Qmax (0.0 vs 5.0 mL/s, $p < 0.0001$) all demonstrated significant improvements [17]. Interestingly, maximum detrusor pressure at Qmax (pdetQmax) showed statistically significant improvement as well (0.0 vs 7.5 cmH_2O, $p = 0.002$) [17]. Twenty-six patients reported overall satisfaction following treatment. It is noteworthy "higher Pves compared to a lower Pves was predictive of

satisfactory surgical outcomes" [17]. Overall, TUI-BN is an effective treatment for female patients with DU and has shown durable results during the post-operative years (>5 years). However it should be noted that there are a limited number of studies and a lack of randomized-control trials addressing the efficacy of treatment options appropriate for women with DU.

Although limited in the number of studies, TUI-BN may potentially be a treatment option for women with DU who have not responded well to other options. A major shortcoming however in these studies was researchers failed to take into account the clinical severity of the participants' DU. Thus, more research is necessary to determine if TUI-BN can be a safe procedure to alleviate urine retention and other LUTS for women regardless of DU. Furthermore TUI-BN in women comes with attendant risks of stress urinary incontinence and bladder neck contracture and cannot be advocated as a standard approach in clinical practice before more robust data is available as to the safety and efficacy of the technique.

Outlet Reduction Follow-Up

Post-treatment follow-up typically comprises of uroflowmetry, PVR and validated symptom scores such as IPSS. However, more detailed urodynamics such as the pressure flow studies in the bladder are not routinely conducted. As a result, many long-term studies [9, 10] do not have urodynamic data on patients to analyze parameters of improvement. For example, Masumori et al. reported at least 1/3 of the surviving participants were lost to follow up suggesting long-term studies may be subject to bias.

In order to increase the flow and empty the bladder, patients can apply several different physical/behavioral techniques in addition to surgical therapy. Physicians can teach patients to void via the Valsalva maneuver. Also known as Crede voiding, the Valsalva technique involves squeezing the abdominal muscles or application of pressure to the abdomen during urination with voluntary relaxation of the external sphincter [18]. This can help to apply the additional pressure to the weakened bladder to empty. This learned voiding process can be supplemented/guided with pelvic floor therapy training or biofeedback.

Conclusion

DU is a complex condition, with common symptoms overlapping with other bladder disorders. This has likely lead to an underestimation of the incidence of DU within the population [19]. The treatment options in DU are limited in their scope in comparison to those available for patients with overactive bladder. The results from the available studies discussed in this chapter demonstrate that success of outlet reduction is limited and there is risk of adverse effects such as incontinence which is particularly of concern in women. Furthermore, there is a

lack of validated methods to determine patient satisfaction after outlet reducing therapies. There is a pressing need for better methods to select those patients most likely to benefit from invasive outlet reducing treatment.

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