



The Argument For and Against the Use of Multichannel Urodynamics in the Assessment of Post-Prostatectomy Incontinence

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Abstract

Purpose of Review Prostate cancer is a common male malignancy. Radical prostatectomy is a common treatment option in patients with localised disease. Post-prostatectomy incontinence (PPI) is not uncommon, with a significant impact on the quality of life. However, it is often under-reported and undertreated. There are no standard international guidelines specifically for investigation and diagnosis of PPI. The routine use of urodynamic studies (UDS), with an attempt to assess urinary incontinence aetiology and to predict success prior to invasive surgical treatment, has been widely adopted but remains controversial.

Recent Findings Literature concerning the pros and cons of pre-operative UDS is reviewed. There are conflicting results on UDS findings post-prostatectomy. Few studies demonstrated that UDS findings are not predictive of outcomes of the artificial urinary sphincter (AUS). Other studies have shown the presence of detrusor overactivity (DO) to be an adverse prognostic factor, especially for PPI patients treated with male sling success. Currently, there is no consensus on the indication for UDS in patients with PPI.

Summary Despite conflicting results on the usefulness of UDS prior to PPI surgery, the majority of surgeons still routinely perform UDS pre-operatively. Further prospective and randomised controlled studies would be beneficial in determining if routine UDS is required before surgical treatment for PPI. The authors also gave their perspective on the application of personalised UDS in investigating patients PPI prior to treatment.

Keywords Radical prostatectomy · Post-prostatectomy incontinence · Urodynamics · Voiding dysfunction post-prostatectomy

Introduction

Prostate cancer is the second most common male malignancy, with an estimated 1.1 million new cases diagnosed in 2012 and makes up 15% of all diagnosed cancers [1]. Radical prostatectomy is one of the standard treatment options for localised prostate cancer [2•].

PPI is a not uncommon and often significant complication of radical prostatectomy. Urinary continence has been shown to be the single strongest predictor of patient health-related

quality of life (HRQoL) post-prostatectomy, with higher importance over treatment modality and erectile function [3].

The reported rates of PPI range from 2 to 57%. A recent large Swedish prospective non-randomised controlled trial at 14 centres showed 21.3% of robotic prostatectomy patients and 20.2% of open prostatectomy patients were incontinent at 12 months post-operatively [4]. Most patients with PPI reported improvement of symptoms during the initial 12–24 months following surgery with conservative treatment, but no further improvement thereafter. It is also important to acknowledge that PPI can also be caused by surgical treatment of benign prostatic hyperplasia (BPH). The incidence of incontinence after transurethral resection of the prostate (TURP) has been reported to be 2.2% and accounts for approximately 1% of PPI cases requiring surgical treatment [5].

One of the reasons why the reported PPI rate range has been so wide and variable is because currently, there is no well-accepted definition of PPI. Over 10 variables have been used in different studies to define continence or to measure the

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degree of incontinence. Moreover, there has been no fixed time frame to define PPI. There is heterogeneity in the literature for PPI description, and significant differences exist between surgeon-reported and patient-reported outcomes. For example, PPI definition ranges from zero pads to one security pad or up to one pad a day. A more stringent definition is more than 2-g urine loss in a 24-h pad test, but some may argue that the true continent should be absolutely no leak and not even ‘safety pads’ should be required.

Managing PPI can be costly, and the condition could seriously have a significant impact on the patient’s quality of life [6]. Complications of PPI including dermatitis and urinary tract infection have been shown to negatively affect men’s dignity and self-esteem. To make things worse, men with urinary incontinence are not uncommonly associated with depression, embarrassment, self-withdrawal from social activities and totally alter their lifestyle. Post-prostatectomy incontinence is indeed an important and often under-looked complication [7].

Pathophysiology and UDS Findings of PPI

The aetiology of PPI is multifactorial. Causes of PPI include direct damage to distal urethral sphincter as a result of surgery, injury to nerve supply or supporting structures, bladder dysfunction and the use of adjuvant radiotherapy. A recent review suggested that age greater than 65 years, not working, sexual dysfunction and pre-op incontinence were predictors of post-prostatectomy incontinence [8].

A review by an Italian group on voiding dysfunction after radical prostatectomy analysed 19 studies on bladder dysfunction post-radical prostatectomy over a 20-year period. Results of post-radical prostatectomy bladder dysfunction varied widely and were often contradictory. Detrusor dysfunction rarely presented as an isolated diagnosis and was often coupled with intrinsic sphincter deficiency. Detrusor overactivity occurred as a de novo dysfunction in 2–77% of patients, and there was a wide range of persistence of DO, from 83% persistence to 95% normal detrusor function at 6 months post-op. Of the patients, 8–39% had impaired bladder compliance, de novo in 50% of patients. Of the patients, 29–61% had impaired detrusor contractility, de novo in 47% but subsequently recovered in 50% of patients. Intrinsic sphincter deficiency as the sole cause of urinary incontinence occurred from 8 to 71% of cases. ISD accounted for the main diagnosis in 55% of incontinent patients. It was also found to be variably associated with detrusor dysfunction in 0–88% of patients. Urodynamic findings of patients complaining of stressed urinary incontinence (SUI) and mixed urinary incontinence (MUI) were similar except for higher maximum cystometric capacity (MCC) in SUI patients. Interestingly,

the review showed that urinary symptoms correlated poorly with UDS parameters. The inconsistency in both definitions and findings of previous studies made a conclusion on usefulness of UDS challenging, and authors rightly recommended for further prospective urodynamic studies with standardised terminology [6].

A prospective study was conducted in 63 patients with prostate cancer, with UDS carried out immediately before radical prostatectomy, and then again at 2 months post-operatively. This study interestingly demonstrated that the main cause of incontinence post-prostatectomy was due to sphincteric weakness (90%). Isolated DO (10%) was rarely the sole cause of incontinence. Forty percent of patients had a combination of both ISD and DO [9]. Age was found to contribute to pre-existing bladder dysfunction. The study also suggested that bladder denervation and outlet obstruction can lead to de novo DO. Patients with significantly higher maximum urethral closure pressure values at rest and at voluntary sphincteric contraction pre-operatively appeared to have a much higher chance of achieving immediate continent post-operatively.

Workup of PPI

No dedicated guidelines for post-prostatectomy incontinence exist. The report from the 6th International Consultation on Incontinence on surgical treatment of post-prostatectomy incontinence states that good history (focus on the type of leakage and comorbidity) and physical examination (gross urine leakage per urethral meatus and brief neuro-urological examination) are vital during initial PPI workup. Urinalysis should be performed to rule out infection, inflammation and haematuria, which may require further investigations accordingly. A post-void residual urine volume should be measured. A significant residual urine volume of > 100 mL may indicate bladder outlet obstruction, which signifies that potential cause of PPI could be overflow incontinence which requires a completely different treatment algorithm. Failure to identify this prior to PPI surgery may lead to irreversible and catastrophic consequences on patient’s symptoms and increase further difficulties in treating the underlying cause afterwards. Most patients at the authors’ unit undergo a routine cystoscopy to further safely exclude the presence of bladder neck stenosis or urethral stricture disease, prior to surgical treatment of PPI [10••].

A bladder diary and a 24-h pad test should be obtained to get objective data. Not only that this will aid the confirmation and diagnosis of PPI, but also the severity of symptoms can also be estimated accordingly to guide appropriate treatment. Questionnaires such as ICIQ-UI SF and the use of patient-reported outcome measures in male incontinence surgery [11] are essential to assess patients subjectively before and after surgery, and it is our opinion that these tools should form

a crucial part in the assessment and determination of ‘success’ in PPI surgery.

According to ICS recommendation, routine use of UDS in men with PPI remains controversial. The EAU guidelines on incontinence also state: ‘There is no evidence that urodynamics predicts the outcomes of treatment for post-prostatectomy incontinence in men’ [2•].

However, in day-to-day clinical practice, the majority of urologists do perform urodynamics prior to invasive treatment for PPI, perhaps to obtain further investigative information to help counselling patients pre-operatively or for study purposes. UDS has been regularly carried out prior to PPI surgery in the most recent published series [12].

Treatment of PPI

(i) Conservative management

Conservative management for PPI includes pelvic floor muscle training, electrical stimulation, lifestyle modifications, extracorporeal magnetic innervation and the use of penile clamps. Conservative management is initially given for PPI as the incidence and severity of PPI improve from early post-operative period to 1 year post-op. A recent Cochrane review of more than 4000 post-prostatectomy men showed inconclusive long-term effectiveness of conservative management for PPI [13]. The 6th ICI suggests conservative management be offered for periods of up to 6 to 12 months post-op depending on whether the patient notes any progress (level of evidence 4; grade of recommendation C).

(ii) Surgical/minimally invasive treatment

Patients with persistent severe PPI can be offered surgical treatment after a period of conservative management of 6 to 12 months. Up to 10% of all PPI, patients undergo surgical treatment.

The artificial urinary sphincter (AUS) has been the gold standard treatment for PPI for decades, with effective long-term results. The continence rate (0–1 pad/day) ranges from 59 to 90% [10••]. However, there is a high revision rate up to 49% due to AUS complications including mechanical failure, urethral atrophy, infection and erosion. Patients also need to have adequate manual dexterity skills and cognitive function to control the pump.

Male slings are increasingly gaining popularity as a treatment option for men with mild to moderate PPI as it is a less invasive option and avoids the insertion of a mechanical device. There are many different types of slings. Three main types of slings are described in the literature: bone anchored sling, retro-urethral transobturator and adjustable retropubic sling. There is limited data on the medium to long-term

continence outcomes post-sling surgery. The overall pooled cure rate for all male slings for PPI was 77.4% at a median of 15 months post-op. Erosion (3–13%) and infection (3–11%) rates were lower than AUS [14].

Injectable agents aim to provide a minimally invasive approach to improve coaptation of the bladder neck and distal sphincter. Different agents have been used as bulking agents, with similar efficacy, and share the same disadvantages of needing multiple injections and low cure rate. It is an inferior option, with the need for repeat injections or other incontinent procedures. The EAU Guidelines state that bulking agents do not cure PPI [2•]. The 6th International Consultation on Incontinence suggests that bulking agents should be reserved for those patients with contraindications for other surgical options [10••].

In reality, the choice of PPI continent surgery varies according to the patient’s preference, and availability and access to treatment at units with expertise in the procedures outlined. According to data from the SEER (Surveillance, Epidemiology and End Results) cancer registry data, 6% of 16,348 men with prior radical prostatectomy from 2000 to 2007 underwent procedures to treat PPI. Surprisingly, **bulking agents** were the most common (38% of cases), followed by AUS (36%) and male slings (26%). The widely use of bulking agents was likely due to easy accessibility, minimally invasive nature and straightforward administration nature of the treatment. However, patients with bulking agents had very high failure rates requiring further treatment procedures [15]. Another study showed that when patients were given the choice, slings were preferred, with 92% of patients choosing male sling over AUS [16]. This is not surprising, as ‘natural’ control of continence certainly is more appealing to patients than the use of a mechanical device which requires deactivating every time patient voids.

There is a paucity of level 1 evidence on choice of surgical treatment for PPI. A randomised controlled trial MASTER trial (male synthetic sling versus artificial urinary sphincter trial for men with urodynamic stress incontinence after prostate surgery) is underway in the UK to study whether the male sling is non-inferior to AUS for PPI [17].

Role of Urodynamics in PPI

UDS is commonly performed prior to all invasive surgical treatment for PPI. The aims of UDS are to identify the aetiology of urinary incontinence and to evaluate if other parameters which may potentially affect the success rate of future intervention, such as impaired compliance, detrusor overactivity and detrusor underactivity. It can also aid to diagnose obstructive anastomotic strictures and bladder neck contraction, which occur in 3 to 21% of men [2•, 18].

Previously, the 4th International Consultation on Incontinence suggested that a thorough urodynamic evaluation to characterise the underlying pathophysiology was useful prior to ‘invasive therapy’ [18]. However, in the latest update on the 6th International Consultation on Incontinence, the tone for suggesting UDS prior to surgical treatment has dampened, and it is stated that the indication for routine UDS in all men with PPI is controversial. Authors concluded that ‘multichannel urodynamics’ may be useful prior to invasive treatment for incontinence, with a low grade of recommendation of level C only [12].

Argument for the Routine Use of Urodynamics for PPI

Prognostic Evaluation

Bladder dysfunction may be present due to already pre-existing bladder outlet obstruction or age-related DO before prostatectomy. De novo occurrence of DO or poor bladder compliance following prostatectomy may also potentially as a result of bladder denervation during surgery. Various studies have suggested that the presence of DO is associated with poor mid-term outcomes following PPI surgery [19]. As such, uncovering any underlying bladder dysfunction with UDS could be beneficial. In particular, for patients with DO, early identification enables appropriate treatment prior to PPI surgery, such as the use of lifestyle modifications, bladder retraining exercises, anticholinergics or botulinum injection. In our opinion, not only that some patients may achieve improvement in incontinence symptoms following treatment of DO alone, but also identification and assessment of the degree of DO are also very helpful in managing patient’s expectation from PPI surgery. Risk of exacerbation of DO symptoms following PPI surgery could be assessed and patients could be adequately counselled accordingly.

Choice of Male Sling

Male slings are increasingly gaining popularity as a surgical treatment option for patients with PPI, and studies have shown that men prefer male sling over AUS when given a choice [16]. However, many different types of slings in the market with different mechanisms of action are available, and not all patients do well following slings surgery. There have been suggestions that UDS findings may have a role in predicting success following male sling surgery. A previous study suggested that good outcomes were anticipated when Valsalva leak point pressure (VLPP) > 100 cm H₂O on UDS. The presence of DO has been shown to be a negative outcome predictor for the advance male sling [19]. The use of UDS may help to decide if the male sling is an appropriate treatment option

for each individual patient or the alternative treatment method should be considered instead.

Adequate detrusor contractility is essential during micturition, in particular for patients following insertion of the male sling. However, often under-reported, underactive bladder occurs in up to 40% of post-radical prostatectomy patients. Difficulty in diagnosing this condition is associated with the fact that there is currently no standard definition for underactive bladder in the post-radical prostatectomy group of patients. Carrying out UDS in clinically suspicious patients offer the opportunity to diagnose the condition, with measurements of bladder contractility index and isovolumetric detrusor contraction pressure [20]. However, caution must be taken when interpreting these parameters. Outflow resistance is often low following prostatectomy and may lead to an inaccurate evaluation of true detrusor strength.

The diagnosis of the underactive bladder may potentially alter the management plan for patients with PPI. Patients with underactive bladder have increased risk of post-sling insertion urinary retention due to the inability to create adequate detrusor contraction to overcome the fixed resistance of a compressive sling [20]. On the other hand, outcomes for AUS in patients with the underactive bladder are not worse than those with normal bladder contractility, and as such, perhaps these patients should be considered for an AUS rather than a male sling.

Alternatively, in patients diagnosed with an underactive bladder on UDS who are adamant to be treated with insertion of male slings, the transobturator sling is a preferable option as the mechanism is via a dynamic compression rather than actual urethral obstruction. However, evidence for such practice is poor, and adequate counselling is paramount prior to such procedure in these patients.

Complex Cases

The need for UDS to evaluate patients who had previous sling surgery or AUS implantation developing recurrent urinary incontinence is perhaps less controversial. Patients who had previous radiotherapy are often associated with an increased risk of significant bladder dysfunction. UDS in these patients would allow identification and earlier treatment of co-existing bladder dysfunction, which may have contributed significantly to a patient’s overall symptoms.

Poor Correlation Between Symptoms/Symptom Score and Urodynamic Values

The International Consultation on Incontinence Questionnaire-Urinary Incontinence: Short Form (ICIQ-UISF) recommended by the International Continence Society allows a subjective evaluation of the severity of urine loss and quality of life and also acts as an important tool for

patients reporting outcome assessments. However, various studies have demonstrated that there is a poor correlation between symptoms and symptom scores when compared with UDS values.

A Brazilian group was the first group to evaluate specifically for correlations between the ICIQ-UISF and UDS findings in men with UI following RP. Despite the correlations found in women, the total score of the ICIQ-UISF could not discriminate whether stress incontinence or bladder dysfunction was the main cause of urinary incontinence in this male study. The main cause of PPI based on subjective assessment alone was not adequate [21, 22]. As such, patients with clinically significant PPI symptoms such as pad use and bothersome symptoms seeking for treatment but not reflected by ICIQ-UISF score should be considered for UDS assessment before surgery.

Argument AGAINST Use of Urodynamic

Complications of UDS

Despite being a common office procedure, UDS do carry risks of urinary retention, gross haematuria and symptomatic urinary tract infection. The overall complication rate for urodynamics in men in an Austrian series was 19%. A more recent Chinese series showed an incidence of UTI to be almost 10% in men undergoing urodynamics study [23]. These are not insignificant and are potentially life-threatening if urosepsis was developed. UDS should not be routine, but to be considered only if there is a question it can answer; results of which would subsequently affect treatment option or outcome.

Abdominal Leak Point Pressure Not Correlating with Actual Urine Loss

UDS with the use of abdominal leak point pressure (ALPP) to diagnose PPI has been controversial. ALPP has been used with an attempt to assess sphincter insufficiency and leakage severity urodynamically. However, its accuracy is debatable, and it has been shown not to correlate with pad weight (severity of symptoms). The actual amount and severity of leakage are more accurately measured by the pad test [24]. In this sense, UDS probably does not offer any additional information if a pad test has already been performed.

Incontinence Not Demonstrated on UDS and Falsely Elevated ALPP

The presence of a transurethral catheter during UDS could mask urinary incontinence and artificially raise the ALPP. A New York group showed 35% of patients with PPI did not

leak with a 7 Fr urethral catheter in situ. But, all leaked after the urethral catheter was removed. False-negative UDS for PPI is, therefore, very high. Moreover, ALPP (125 cm H₂O versus 67 cm H₂O, *p* 0.002) was significantly higher with catheters in situ [25]. False-negative results due to the presence of stenosis and the calibre of the multichannel catheter can occur.

Inaccurate UDS Findings Due to Leakage During Filling Cystometry

Some men with PPI leak continuously during filling cystometry and are unable to retain an adequate volume of contrast for reliable recording of storage function, thereby missing crucial urodynamic parameters such as compliance, cystometric capacity and the presence of DO [26].

AUS Outcomes Not Predicted by UDS Results

Another more recent Korean single surgeon series of 103 PPI patients undergoing either AUS or adjustable male sling found that UDS findings (DO, VLPP, impaired detrusor contractility, poor compliance and MCC) did not predict treatment outcome and suggested pre-op UDS be performed only in limited cases [27]. The result of this study echoes the recommendation by the EAU guidelines, which stated that the use of UDS does not predict outcomes of AUS.

Suggestions/Improvements

False Negative/Elevated Values of ALPP

Incontinence can be masked on standard UDS due to the presence of a transurethral catheter. A New York group proposed a new urodynamics protocol to optimally assess men with PPI follows is done according to ICS standards [28] with the additional of a second fill phase to 50 to 75% of bladder volume. Subsequently, the bladder catheter is removed, and the ALPP is reassessed using the rectal line [25].

The use of two separate tubes (one for filling, and another fine tube for measuring Pves) instead of multichannel catheters could allow for a fine Pves pressure transducer to be left transurethally during voiding phase. It also allows for recording of the urethral pressure profile and identification of the maximum urethral closure pressure.

Penile Clamp to Prevent Leakage

In men with severe PPI, the bladder may not adequately fill to allow for the identification of crucial urodynamic findings. A study by the Bristol group showed that the use of penile clamp in severe SUI group could allow further filling and bladder

function assessment by preventing continual leakage and to avoid stopping the test prematurely [26].

At our unit, the penile clamp is also used as a trial before surgery, for patients following treatment of co-existing bladder dysfunction identified on UDS. It mimics post-operative urethral pressure changes and offers a pragmatic way to assess if symptoms associated with co-existing bladder dysfunction has been adequately treated prior to surgery.

Use of Retrograde Leak Point Pressure

Most parameters used in urodynamic for assessment of PPI appear to vary greatly between studies and not reproducible. One exception is RLPP, which is a simple adjunct to routine UDS and appears to be more replicable. RLPP offers an objective way to measure urethral resistance to flow. It has been validated as a useful measurement of urethral resistance in male anti-incontinence surgical treatment. It is measured using a perfusion sphincterometry technique and acts as an adjunct to urodynamic assessment to give an objective measurement of the external urethral sphincter's closure pressure. RLPP has been shown to have a good correlation with the 24-h pad test, in contrast to ALPP. RLPP is potentially a more reliable substitute to pad tests, to stratify SUI in post-prostatectomy patients and to guide the most suitable treatment option for PPI patients [29•].

Conclusion

UDS has been commonly used as part of the workup of PPI patients prior to surgical intervention. However, whether the routine use of UDS for these patients before surgery remains controversial. Proponents for UDS prior to PPI surgery suggest that although UDS is invasive, time-consuming, bothersome and expensive, it provides information on the functional integrity of the lower urinary tract and that identifying co-existing bladder dysfunction that may have contributed to patients' symptoms which require treatment. If the aetiology of PPI in patients could be identified on UDS, this may guide surgeons to choose the most appropriate treatment. In particular, UDS is useful when investigating PPI patients with pre-existing voiding dysfunction or significant bladder outlet obstruction before prostatectomy or in patients who had the previous radiotherapy. On the other hand, some may argue that UDS should not be routine as they are associated with false negatives and inaccuracies, and the decision should rely on symptoms and pad tests. In our opinion, the use of separate bladder catheters instead of the multichannel catheter, penile clamp to prevent leak during the filling phase and measurement of RLPP may improve UDS accuracy

when assessing patients with PPI. In our institution, UDS is performed in all men considering surgical treatment for PPI surgery. We believe that UDS helps to determine the most suitable and personalised choice of treatment for PPI patients and, importantly, helps to counsel patients and to manage their expectations.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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