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When Are Urodynamics Indicated in Patients with Stress Urinary Incontinence?

Benjamin E. Dillon and Philippe E. Zimmern

Department of Urology, University of Texas-Southwestern Medical Center, Dallas, Texas

Abstract

Despite technical and procedural advances in urodynamics over the past decade, the role of urodynamics in women with stress urinary incontinence (SUI) remains controversial. Many of these advancements have been the result of multicentric studies in the United States, such as the UITN and PFDN, which will be highlighted in this article. It appears to be the consensus that urodynamics may not be needed in pure stress incontinence. Urodynamics can be valuable in unmasking stress urinary incontinence in prolapse, although its impact on the ultimate management of occult incontinence remains debated. This article reviews the indications for urodynamic testing in women with SUI but will exclude more complex conditions such as mixed or recurrent incontinence which are outside the scope of this review.

Keywords

Urodynamics; stress urinary incontinence; women

Introduction

Urinary incontinence is a socially debilitating condition that affects women of all ages. It is estimated that 12–55% of women will be affected by urinary incontinence at some point in their life, with 15–35% of adult American women reporting that their quality of life is altered by urinary incontinence[1, 2]. Urinary incontinence is thought to be responsible for 12.4 billion dollars of healthcare spending with about 400 million dollars attributable to Urodynamics (UDS), at a cost of approximately 1,000 US dollars per study [1, 3, 4]. For many, performing UDS in women with incontinence and pelvic organ prolapse (POP) has become routine practice, without pausing to think if the information gleaned from the study will contribute to treatment options, assist in patient counseling, or help predict outcome. The purpose of this article is to review the role of UDS in the management of SUI.

Good UDS Practice Guidelines

The era of “modern” day urodynamics arguably began with the 2002 sentinel paper by Schäfer et al. detailing recommendations to perform “a good” UDS test. First and foremost, there must be a “question” or “questions” answered by the investigator based upon a detailed history and physical examination, and sometimes from a bladder diary. Moreover, this question must not be answered solely by the tester, but in concert with the patient to make sure the findings replicate a significantly bothersome condition. The second point

Corresponding Author: Philippe E. Zimmern, MD, UT Southwestern Medical Center, 5323 Harry Hines Blvd, Dallas, TX 75390-9110, Telephone: 214-648-9397, Fax: 214-648-8786, Philippe.Zimmern@utsouthwestern.edu; Benjamin.Dillon@UTSouthwestern.edu.

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touched on the voiding phase since voiding parameters can enter into the decision treatment. Invasive and noninvasive uroflowmetry should produce a “normal” flow, which should be a smooth, bell-shaped flow whereas any deviation from this normal pattern (interrupted, prolonged, plateaued) is likely abnormal. The authors stressed that if the noninvasive flow curve is abnormal, no conclusions as to the etiology of this abnormality can be reached. Definitive diagnosis can only be made with a combination of abdominal and intravesical recordings. In contrast to the noninvasive flow (NIF), flow recorded during pressure flow studies (PFS) is usually lower in women with SUI (Table 1). The authors suggest that this lower flow cannot be explained exclusively by the resistance from the urethral catheter (whose size should be preferably 8F or less) but the test condition can lead to physiologic and psychogenic changes that can affect the voiding phase [5, 6].

Although a discussion of UDS equipment is out of the scope of this review, a mention of the importance of the standardization of “zero” is critical. Schäfer and colleagues stressed the importance of adherence to the ICS definition so as to have reliability between centers and patients. Zero pressure is the value that is recorded when the transducer is open to air, or the open end of the catheter is at the same vertical level as the transducer. Furthermore, the reference height is the upper edge of the pubic symphysis, and this is the level at which the transducers must be placed so that all urodynamic pressures have the same hydrostatic component. When these requirements are met, the investigator should be able to arrive at standard values for resting intravesical and abdominal pressures according to position [5].

Urodynamics in Stress Urinary Incontinence

The role of UDS in stress urinary incontinence (SUI) in women has been heavily debated, as attested by the large number of published studies on this controversial topic over the past 15–20 years with limited evidence-based information. In 2007, the UITN published UDS values for women undergoing UDS for SUI in the SISTEr trial to serve as a reference point (Table 1). Key findings included baseline abdominal and vesical pressures between 12–60 cm H₂O in standing position, median maximum flow (Q_{max}) during PFS that were significantly lower than values obtained during non-instrumented flowmetry (NIF) (20.0 vs. 23.6 ml/sec, $p < 0.001$), and lower flow rates occurring at higher voided volumes than seen during NIF. Additionally, most subjects voided by detrusor contraction without the use of Valsalva voiding and approximately 10% of women who had a positive cough stress test and reported a mean of 3 pads/day for incontinence severity failed to demonstrate urodynamic stress incontinence [7].

Urethral dysfunction has been traditionally assessed with urethral pressure profile (UPP) and more recently by Valsalva leak point pressure (VLPP). Data from the SISTEr trial by Lemack et al. indicated disappointingly that VLPP did not correlate with several indices of SUI severity like physical exam parameters (BMI, POPQ stage, POPQ Aa measurement, Q-tip angle at rest and strain, and change in angle) as well as UDS parameters (volume of first leakage, volume at first sensation, presence of detrusor overactivity (DO), maximum cystometric capacity (MCC), Q_{max} and detrusor pressure at maximum flow (pdet Q_{max}) [8].

In the Trial of Mid-Urethral Slings (TOMUS), preoperative UDS was performed before randomization into a retropubic mid-urethral sling (RMUS) or a transobturator mid-urethral sling (TMUS), and repeated at 12 months post-surgery. Patients and surgeons were blinded to the findings of the preoperative UDS so that they would not be influenced in their treatment decision [9]. The study supported the fact that VLPP did not impact surgical outcome. The Supine Empty Bladder Stress Test (SEBST), which indicates a low threshold for leakage in supine position and with an empty bladder, was expected to correlate with

more severe forms of incontinence and lower VLPP. In a study published in 2010 from the UITN, VLPP and Maximal Urethral Closing Pressure (MUCP) showed a moderate correlation to each other ($r=0.36$, $P<0.001$), but little to no correlation to the SEBST [10]. UPP is a technically demanding test with a great deal of variability in its reproducibility [11]. This variability is evident in the numerous definitions of intrinsic sphincter deficiency (ISD), as determined by the maximal urethral closing pressure (MUCP) [12]. UDS data from the TOMUS trial suggests a limited future for the UPP in clinical practice.

The UITN recently published the results of the Value of Urodynamic Evaluation (ValUE), a study purely focused on UDS [4, 13]. Women meeting criteria for an anti-incontinence procedure were randomized to preoperative UDS or a simple office-based evaluation. The primary outcome of the study was treatment success determined by a 70% reduction or more from baseline to 12 months in the Urogenital Distress Inventory (UDI) and a Patient Global Impression of Improvement (PGI-I) response of “very much better” or “much better” at 12 months. Secondary outcomes sought to determine if preoperative UDS findings in women with stress predominant incontinence would affect surgical outcome, with secondary outcomes being cost and utility of performing UDS.(13)

At 12 months, no significant difference was seen between the urodynamic testing group and the evaluation-only group with respect to treatment success (76.9% and 77.2%, respectively). When secondary outcomes were examined, there was no difference between the two groups for changes in Incontinence Severity Index, PGI-I, and global quality of life measures. Additionally, the two groups had similar rates of positive provocative stress tests. The report concluded that UDS did not improve the rate of treatment success and was not necessary in place of a well performed office-based evaluation (including demonstration of SUI) in women with uncomplicated SUI [13].

In the United Kingdom, the National Institute for Health and Clinical Excellence (NICE) issued in their October 2006 document the recommendation that UDS in women with pure SUI is no longer recommended. UDS was indicated only in women with urinary incontinence when there was a clinical suspicion of DO, in those who have undergone surgery for SUI or anterior compartment prolapse, or in women with symptoms suggestive of voiding dysfunction. This recommendation contrasted to the one from the Netherlands in which it is advised to perform UDS prior to surgery for SUI. In fact, to better understand the role of UDS prior to surgery for stress incontinence, the Value of Urodynamics Prior to Stress Incontinence Surgery (VUSIS) is still being conducted in the Netherlands [14]. This multicentric RCT is examining the role of UDS in women with symptoms of SUI who have UDS findings discordant from history and physical findings, and are then randomized to receive either midurethral sling or “individual treatment”. Individual treatment can include pessary, medical treatment, physiotherapy or surgery at the discretion of the provider. The primary outcome will be clinical improvement in incontinence as measured by the validated Dutch version of the long form of the Urogenital Distress Inventory (UDI), with a secondary outcome being cost. It is anticipated that after the results of the VUSIS and in conjunction with the recent ValUE study, the role of UDS in women with pure SUI and its cost will be better delineated.

Urodynamics as a Predictor of Success After an Anti-Incontinence Procedure

A great deal has been written about the use of UDS as a predictor of the development of lower urinary tract symptoms (LUTS) following anti-incontinence procedures. Based on the results of the SISTER trial, the predicting value of VLPP for success after surgery was not confirmed. A similar finding was noted for urodynamic DO [3]. However, in regards to this

particular urodynamic finding, one should note that the SISTEr trial had a low incidence of women with urge incontinence, as the entry criteria was “stress predominant incontinence.” Furthermore, no provocative maneuvers were used to unmask DO during UDS.

Miller and associates attempted to predict who will develop urinary retention following a pubovaginal sling (PVS) in their study of 98 women who had a cadaveric fascia lata sling for SUI. In their final analysis of 73 women, among those voiding without evidence of a detrusor contraction, four (19%) developed urinary retention postoperatively, compared to 0% in those who voided with a detrusor contraction ($p=0.007$). One patient who Valsalva voided developed retention compared to three without Valsalva voiding ($p=0.603$). The authors concluded that women who void with a weak or absent detrusor contraction are most likely to have postoperative urinary retention [15]. Alperin et al. studied clinical and UDS parameters of 200 women who underwent midurethral sling (TVT or SPARC) for SUI. In the final analysis including 92 patients subjected to preoperative directed questions about incontinence, none of these questions, except increased daytime frequency (OR 3.3), was predictive of development of de novo DO postoperatively. In addition, 56% of patients with $\text{pdet} > 15 \text{ cm H}_2\text{O}$ during filling developed de novo urge incontinence, compared to 21% in patients whose pressure was $< 15 \text{ cm H}_2\text{O}$, (OR 4.6) [16]. In a study of 79 women undergoing TVT for SUI, Wang et al. concluded that women with normal pressure flow studies preoperatively were more likely to have a better QOL and pad test result as compared to patients who had abnormal PFS as determined by $\text{Qmax} < 12 \text{ ml/sec}$ and $\text{pdet Qmax} > 20 \text{ cm H}_2\text{O}$. (17) There is also data to suggest that patients who develop voiding dysfunction post TVT are more likely to have a lower pdet Qmax than those who fail to develop voiding dysfunction postoperatively. Lastly, Lemack and associates from the UITN published their findings on the relationship between VLPP and UDS findings. Voiding dysfunction was defined as the need for surgical revision to improve voiding at any point 6 weeks postoperatively. In an analysis of 579 participants from the SISTEr trial, PVR, Qmax (on NIF and PFS), ΔPves , ΔPabd and ΔPdet did not predict which patients would develop voiding dysfunction following pubovaginal sling or Burch colposuspension after 6 weeks of follow-up [8, 18]. Certainly, extended studies are still needed to more accurately determine the usefulness of UDS as a long-term predictor of voiding dysfunction following anti-incontinence procedures for urinary incontinence.

The Role of Urodynamics in Prolapse

The role of UDS in assessing and predicting incontinence in women undergoing surgery for POP has been debated for years. Borstad and Rud examined risk factors that may contribute to the development of SUI following surgery for POP. In a retrospective study of 102 women presenting for POP, 73 were continent prior to undergoing a Manchester procedure for POP, with UDS being performed both before and after surgery. Postoperative SUI developed in 22% of patients. When preoperative UDS parameters were investigated, women who developed SUI had lower mean urethral closing pressure (53.3 vs. 43.2 cm water $p=0.04$) [19]. Roovers et al. published results from a retrospective study of 76 women undergoing vaginal prolapse (anterior colporrhaphy and/or posterior colporrhaphy, and/or vaginal hysterectomy) surgery, all of whom had UDS (without reduction) prior to their procedure. The authors found that preoperative UDS (specifically DO, urodynamic SUI, MCC, and MUCP) poorly predicted postoperative SUI with a likelihood ratio of 1.2 [20].

Jha and colleagues reported that preoperative UDS changed the surgical management in a significant number of patients with prolapse. In a retrospective study, the authors examined 72 patients who underwent prolapse (anterior repair and/or vaginal hysterectomy) surgery. Sixty percent of the subjects had preoperative UDS (both with and without prolapse reduction), of which 53% demonstrated abnormal results with prolapse reduction. Pure

urodynamic SUI was seen in 19% of patients, compared to 30% with DO, with or without associated urge urinary incontinence. The surgical management was altered in 7% of patients (two underwent TVT and one received SPT for voiding dysfunction) following preoperative UDS with prolapse reduction [21].

In 2008, the CARE trial was published by the Pelvic Floor Dysfunction Network (PFDN). One goal of the CARE trial was to assess the importance of prolapse reduction in predicting SUI following sacrocolpopexy. Preoperative UDS was performed with clinicians blinded to its results. At the time of sacrocolpopexy, patients were randomized to receive a Burch cystopexy (BC) or no BC. The study ended early because the BC group had a significantly lower rate of SUI than the no BC group. In the trial, there were five different methods of reduction used (Pessary, Manual, Swab, Forceps, and Speculum). SUI without prolapse reduction was uncommon, seen in only 3.7% of women (all with advanced prolapse). Overall, there was a 19% incidence of urodynamic SUI with prolapse reduction, with speculum reduction having the highest incidence of SUI at 30% and pessary the lowest rate at 6%. Furthermore, women who demonstrated SUI on prolapse reduction were more likely to report postoperative SUI at 3 months [22].

Although prolapse reduction during UDS may be beneficial in predicting which patients will exhibit SUI in the postoperative setting, reducing the prolapse at the time of the study has little bearing on most other UDS parameters. Mueller et al. confirmed this point in a study of 31 women with prolapse undergoing UDS. They examined MCC, voided volume, Qmax, pdet Qmax, time to Qmax and MUCP in the reduced and non-reduced states. The authors did not find any significant difference in UDS parameters after prolapse reduction, with the exception of MUCP (58 vs. 40 cm H₂O, p=0.001) [23].

Ballert and colleagues examined the role of preoperative UDS in determining the need for MUS at the time of prolapse repair. One hundred and forty patients had UDS performed without prolapse reduction. If SUI was not documented, prolapse was reduced and UDS repeated with pessary reduction. Patients were then categorized as having urodynamic SUI (SUI without prolapse reduction), occult SUI (SUI only after prolapse reduction) or no SUI (with or without prolapse reduction). At time of surgery, patients with either urodynamic SUI or occult SUI had MUS placed during prolapse repair. The authors found that the risk of later intervention for SUI due to obstruction from MUS was similar to the risk of intervention in patients who developed SUI but did not demonstrate its presence on preoperative evaluation (8.5% vs 8.3%). Furthermore, the risk of intervention in patients who demonstrated clinical SUI only (no occult or UDS SUI) and did not receive MUS at the time of prolapse repair was 30%. The authors concluded that based on their protocol, UDS may not be necessary prior to undergoing surgery for POP in patients who demonstrate clinical SUI (by report) [24].

Most recently, Elser et al. reported on the use of preoperative UDS to determine the need for anti-incontinence procedures at the time of abdominal sacrocolpopexy. In a retrospective review, 463 patients were categorized into two groups. Two hundred and four (46.3%) women were categorized into Group 1 (consisting of patients demonstrating any evidence of SUI on UDS, including occult SUI), with 122 (59.8%) overall having urodynamic SUI (with or without reduction) and 82 (40.2%) having occult SUI only. The remaining 53.7% (Group 2) of patients did not have SUI. All patients who demonstrated preoperative SUI underwent MUS placement. At 6 weeks postoperatively, significantly more women from Group 2 reported being dry compared to Group 1 (92.8% vs 87.3%, p=0.049). The authors subsequently reported that preoperative UDS is a valuable test prior to surgery for POP. Specifically, in women who do not report SUI preoperatively, there is no benefit in performing a concomitant anti-incontinence procedure at time of sacrocolpopexy [25].

At present, the debate continues between those in favor of prophylactic SUI treatment at time of prolapse repair and others who worry about the potential risks of performing a surgical procedure that may never have been needed. For now, patient counseling remains essential to minimize postoperative dissatisfaction, with the precise role of urodynamic testing being unclear. Clearly, the presence of urodynamic SUI suggests that a concomitant anti-incontinence procedure may be considered at the time of POP repair in a properly consented patient, although it cannot be stated with certainty that UDS is indicated prior to any prolapse repair.

Conclusion

Since its inception, UDS has benefitted from technical and procedural refinements with the latest evolution being multicentric studies in the United States such as those initiated by the UITN and PFDN networks. These studies have helped establish procedural guidelines and reference points for practitioners utilizing UDS. The use of VLPP and UPP measurements to assess urethral dysfunction has produced disappointing results. The evolving consensus appears to be that UDS is not necessary in all cases of pure SUI as recently shown by the results of the ValUE study. Furthermore, UDS has a limited predictive role for LUTS following anti-incontinence procedures and cannot be used in isolation to diagnose bladder outlet obstruction. Until more definitive studies are published about the use of UDS in women, it should be used judiciously with both patient and practitioner having a clear understanding as to why UDS is being performed and what clinically relevant information may be gleaned from it.

References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- Of major importance
 - Of importance
1. Ward RM, Hampton BS, Blume JD, Sung VW, Rardin CR, Myers DL. The impact of multichannel urodynamics upon treatment recommendations for female urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct.* 2008 Sep; 19(9):1235–41. [PubMed: 18425401]
 2. Klutke C, Siegel S, Carlin B, Paszkiewicz E, Kirkemo A, Klutke J. Urinary retention after tension-free vaginal tape procedure: incidence and treatment. *Urology.* 2001 Nov; 58(5):697–701. [PubMed: 11711343]
 3. Nager CW, FitzGerald M, Kraus SR, Chai TC, Zyczynski H, Sirls L, et al. Urodynamic measures do not predict stress continence outcomes after surgery for stress urinary incontinence in selected women. *J Urol.* 2008 Apr; 179(4):1470–4. [PubMed: 18295276]
 4. Nager CW, Brubaker L, Daneshgari F, Litman HJ, Dandreo KJ, Sirls L, et al. Design of the Value of Urodynamic Evaluation (ValUE) trial: A non-inferiority randomized trial of preoperative urodynamic investigations. *Contemp Clin Trials.* 2009 Nov; 30(6):531–9. [PubMed: 19635587]
 5. Schafer W, Abrams P, Liao L, Mattiasson A, Pesce F, Spangberg A, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn.* 2002; 21(3):261–74. [PubMed: 11948720]
 6. Groutz A, Blaivas JG, Sassone AM. Detrusor Pressure Uroflowmetry Studies in Women: Effect of a 7FR Transurethral Catheter. *The Journal of Urology.* 2000; 164(1):109–14. [PubMed: 10840435]
 7. Nager CW, Albo ME, Fitzgerald MP, McDermott S, Wruck L, Kraus S, et al. Reference urodynamic values for stress incontinent women. *Neurourol Urodyn.* 2007; 26(3):333–40. [PubMed: 17315221]
 8. Albo ME, Richter HE, Brubaker L, Norton P, Kraus SR, Zimmern PE, et al. Burch colposuspension versus fascial sling to reduce urinary stress incontinence. *N Engl J Med.* 2007 May 24; 356(21):2143–55. [PubMed: 17517855]

9. Richter HE, Albo ME, Zyczynski HM, Kenton K, Norton PA, Sirls LT, et al. Retropubic versus transobturator midurethral slings for stress incontinence. *N Engl J Med*. 2010 Jun 3; 362(22): 2066–76. This paper reports the results of the primary outcomes multicenter study TOMUS trial. [PubMed: 20479459]
10. Nager CW, Kraus SR, Kenton K, Sirls L, Chai TC, Wai C, et al. Urodynamics, the supine empty bladder stress test, and incontinence severity. *Neurourol Urodyn*. 2010 Sep; 29(7):1306–11. [PubMed: 20127832]
11. Kuhn A, Nager CW, Hawkins E, Schulz J, Stanton SL. A comparative study of water perfusion catheters and microtip transducer catheters for urethral pressure measurements. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007 Aug; 18(8):931–5. [PubMed: 17131168]
12. Martan A, Masata J, Petri E, Svabik K, Drahoradova P, Voigt R, et al. Weak VLPP and MUCP correlation and their relationship with objective and subjective measures of severity of urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007 Mar; 18(3):267–71. [PubMed: 16897128]
13. Nager CW, Brubaker L, Litman HJ, Zyczynski HM, Varner RE, Amundsen C, et al. A randomized trial of urodynamic testing before stress-incontinence surgery. *N Engl J Med*. 2012 May 24; 366(21):1987–97. This paper reports the primary outcomes of the VALUE study, investigating the role of UDS prior to anti-incontinence surgery. [PubMed: 22551104]
14. van Leijssen SA, Kluivers KB, Mol BW, Broekhuis SR, Milani FL, van der Vaart CH, et al. Protocol for the value of urodynamics prior to stress incontinence surgery (VUSIS) study: a multicenter randomized controlled trial to assess the cost effectiveness of urodynamics in women with symptoms of stress urinary incontinence in whom surgical treatment is considered. *BMC Womens Health*. 2009; 9:22. [PubMed: 19622153]
15. Miller EA, Amundsen CL, Toh KL, Flynn BJ, Webster GD. Preoperative urodynamic evaluation may predict voiding dysfunction in women undergoing pubovaginal sling. *J Urol*. 2003 Jun; 169(6):2234–7. [PubMed: 12771757]
16. Alperin M, Abrahams-Gessel S, Wakamatsu MM. Development of de novo urge incontinence in women post sling: the role of preoperative urodynamics in assessing the risk. *Neurourol Urodyn*. 2008; 27(5):407–11. [PubMed: 17985373]
17. Wang AC, Chen MC. The correlation between preoperative voiding mechanism and surgical outcome of the tension-free vaginal tape procedure, with reference to quality of life. *BJU Int*. 2003 Apr; 91(6):502–6. [PubMed: 12656903]
18. Lemack GE, Krauss S, Litman H, FitzGerald MP, Chai T, Nager C, et al. Normal preoperative urodynamic testing does not predict voiding dysfunction after Burch colposuspension versus pubovaginal sling. *J Urol*. 2008 Nov; 180(5):2076–80. [PubMed: 18804239]
19. Borstad E, Rud T. The risk of developing urinary stress-incontinence after vaginal repair in continent women. A clinical and urodynamic follow-up study. *Acta Obstet Gynecol Scand*. 1989; 68(6):545–9. [PubMed: 2520812]
20. Roovers JP, van Laar JO, Loffeld C, Bremer GL, Mol BW, Bongers MY. Does urodynamic investigation improve outcome in patients undergoing prolapse surgery? *Neurourol Urodyn*. 2007; 26(2):170–5. [PubMed: 17016798]
21. Jha S, Toozs-Hobson P, Parsons M, Gull F. Does preoperative urodynamics change the management of prolapse? *Journal of Obstetrics & Gynaecology*. 2008; 28(3):320–2. [PubMed: 18569478]
22. Visco AG, Brubaker L, Nygaard I, Richter HE, Cundiff G, Fine P, et al. The role of preoperative urodynamic testing in stress-continent women undergoing sacrocolpopexy: the Colpopexy and Urinary Reduction Efforts (CARE) randomized surgical trial. *Int Urogynecol J Pelvic Floor Dysfunct*. 2008 May; 19(5):607–14. [PubMed: 18185903]
23. Mueller ER, Kenton K, Mahajan S, FitzGerald MP, Brubaker L. Urodynamic Prolapse Reduction Alters Urethral Pressure but Not Filling or Pressure Flow Parameters. *The Journal of Urology*. 2007; 177(2):600–3. [PubMed: 17222641]
24. Ballert KN, Biggs GY, Isenalumhe A Jr, Rosenblum N, Nitti VW. Managing the urethra at transvaginal pelvic organ prolapse repair: a urodynamic approach. *J Urol*. 2009 Feb; 181(2):679–84. [PubMed: 19091337]

25. Elser DM, Moen MD, Stanford EJ, Keil K, Matthews CA, Kohli N, et al. Abdominal sacrocolpopexy and urinary incontinence: surgical planning based on urodynamics. *Am J Obstet Gynecol*. 2010 Apr; 202(4):375 e1–5. [PubMed: 19683689]

Table 1

Reference Values for Women Undergoing UDS for SUI*

	N	Mean (SD)	Median (IQR)	2.5 %tile	5 th %tile	95 th %tile	97.5 %tile
CMG Values							
Volume at first desire	647	142 (96)	122 (110)	30	40	328	387
Volume at MCC (ml)	645	392(138)	362 (180)	200	202	666	746
VLP Average (cm H ₂ O)	428	117 (38)	114 (49)	55	63	183	199
PFS Values							
Qmax (ml/sec)	620	21 (10)	20.0 (12)	6	8	40	46
Time to Qmax (sec)	617	19.7 (26.9)	12.8 (14.0)	3.0	4.0	52.0	80.0
Voided Volume (ml)	621	393 (160)	376 (197)	110	150	691	772
Pdet at Qmax (cm H ₂ O)	384	19 (13)	18 (15)	-2	1	39	47

This table is adapted from the UITN SISTER trial results. The SISTER trial was an RCT to assess the efficacy of Burch colposuspension versus pubovaginal fascial sling for the treatment of SUI. This table offering reference values on a large population of women with SUI is intended to assist any urodynamic tester and/or interpreter in their everyday practice when dealing with women undergoing UDS for “stress-predominant” urinary incontinence.

* Adapted from Nager et al, *Reference Urodynamic Values for Stress Urinary Incontinent Women* [7].