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Authors
Suskind, Anne M
Cox, Lindsey
Clemens, J Quentin
et al.

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The value of urodynamics in an academic specialty referral practice

Anne M. Suskind, MD, MS[1], **Lindsey Cox, MD**[2], **J. Quentin Clemens, MD, MS**[3], **Ann Oldendorf, MD**[3], **John T. Stoffel, MD**[3], **Bahaa Malaeb, MD**[3], **Yongmei Qin**[3], and **Anne P. Cameron, MD**[3]

[1]University of California, San Francisco, Department of Urology

[2]Medical University of South Carolina, Department of Urology

[3]University of Michigan, Department of Urology

Abstract

Objectives—To describe and evaluate the use of urodynamic (UDS) studies for all indications in an academic specialty referral urology practice.

Methods—This is a prospective questionnaire-based study wherein clinicians completed a pre- and post-UDS questionnaire on each UDS that they ordered for all clinical indications between May 2013 and August 2014. Questions pertained to patient demographics and history, the clinical indication for the UDS, the clinician's pre- and post-UDS clinical impressions, and changes in post-UDS management plans. Pre- and post-UDS diagnoses were compared using McNemar's test.

Results—Clinicians evaluated a total of 285 UDS studies during the study period. The average age of study participants was 56.0 (±16.4) years, 59.5% were female and 29.3% had a neurologic diagnosis. The most common indication for performing UDS was to discern the predominant type of urinary incontinence (stress versus urgency) in patients with mixed incontinence symptoms (38.5%) and to assess the safety of the bladder during filling (38.2%). UDS statistically significantly changed the ordering clinician's clinical impression of the patient's lower urinary tract diagnosis for stress urinary incontinence and for urgency/urgency urinary incontinence (both p values <0.05). Fluoroscopy was found to be helpful in 29.5% of UDS and clinicians reported that UDS changed their treatment plans in 42.5% of studies, most commonly pertaining to changes related to surgery (35.0%).

Conclusions—Overall, UDS was a clinically useful tool that altered the clinical impression and treatment plan in a large percentage of carefully selected patients.

Keywords

cystometry; fluoroscopy; stress urinary incontinence; urgency urinary incontinence; neurogenic bladder

Corresponding Author: Anne M. Suskind, MD, MS, Department of Urology, University of California, San Francisco, 400 Parnassus Ave, Box 0738, San Francisco, CA 94143, Anne.Suskind@ucsf.edu.

Introduction

Urodynamics (UDS) is a series of tests conducted to evaluate bladder function and physiology.[1] These tests are performed to assess a multitude of lower urinary tract disorders, ranging from stress urinary incontinence in women to bladder safety measures such as compliance and detrusor external sphincter dyssynergia in individuals with neurologic conditions of both genders.

Two recent studies demonstrated that the use of UDS among women with uncomplicated straightforward stress urinary incontinence offer no benefit when compared with clinical evaluation alone.[2,3] These findings have raised concerns among clinicians and policymakers alike for over-utilization of UDS, despite there being a paucity of data on how UDS are being utilized in clinical practice and the value of such tests among more complex patients.

We designed a study to describe and evaluate the utility of UDS in an academic referral specialty practice that serves both neurologic and non-neurologic patients of both genders. In this questionnaire-based study, clinicians completed a pre- and post-UDS questionnaire on each UDS study to get a better understanding of the clinical population undergoing UDS, the indications for UDS, and changes in urologic diagnoses and management plans as a result of UDS. Findings from this study will further our knowledge on the utility of urodynamic testing in specialty practice and will help to inform the conversation on the value of its use.

Material and Methods

This is a prospective questionnaire-based study designed to evaluate the use of UDS in clinical practice. Each patient age 18 and older presenting to their clinically indicated UDS study was asked if they would like to participate in this Institutional Review Board (IRB) approved research study. Patients that agreed to participate were consented and enrolled in the study.

Pre-UDS questionnaire

There were 5 clinicians who participated in the study. Each clinician who ordered the UDS filled out a pre-UDS questionnaire including questions pertaining to patient demographics (age, gender, race), whether or not the patient had a prior UDS study, history of pelvic radiation, and history (and type) of neurologic condition. Additionally, the clinician recorded information about the indication for the UDS study based on the following categories: (1) to discern the type of incontinence (stress versus urgency), (2) to evaluate for bladder outlet obstruction in a patient with incomplete emptying, urinary retention, or refractory symptoms, (3) to determine the etiology of voiding dysfunction in a female patient with a history of incontinence surgery, (4) to assess the safety of bladder filling (e.g., bladder compliance, presence of vesicoureteral reflux), (5) to assess urinary incontinence in a neurogenic patient, and (6) to assess the bladder capacity/compliance and outlet in a patient preparing to undergo renal transplant. Categories were not mutually exclusive and each patient could have more than one indication for a given UDS study. Categories were created

based on expert opinion after retrospective review of 100 previous representative UDS studies typically performed in our practice.

Additional information regarding the clinician's pre-UDS clinical impression of the patient's lower urinary tract diagnosis was recorded based on whether or not they thought that the patient had each of the following diagnoses: (1) stress urinary incontinence, (2) urinary urgency or urgency urinary incontinence, (3) poor compliance, (4) atonic bladder/detrusor hypocontractility, (5) outlet obstruction/obstructive voiding, and (6) detrusor external sphincter dyssynergia/dysfunctional voiding. Categories were not mutually exclusive and each individual could have more than one diagnosis recorded.

Post-UDS questionnaire

Immediately after each UDS study was performed, the same clinician completed a post-UDS questionnaire. This questionnaire included questions pertaining to the clinician's post-UDS clinical impression of the patient's lower urinary tract diagnosis (listed above), and whether and how their management changed based on the UDS. If the management plan did change based on the UDS study, they were then asked how it changed based on yes or no answers to each of the following categories: (1) change involving surgery, (2) change in medication or dose of medication, (3) change in follow up interval, (4) change in catheterization need or schedule, or (5) change involving pelvic floor physical therapy.

UDS

All UDS studies were performed following the International Continence Society's (ICS) good urodynamic practices.[1] It is our standard practice to perform UDS in the seated position for ambulatory patients and in the supine position for non-ambulatory patients. If a patient has incontinence not demonstrated in the seated position they are positioned in a standing position for Valsalva and stress maneuvers. We use an 8F dual mircrotip UDS catheter at a fill rate of 30–50 ml/min of contrast for the first 250 ml and then transition to normal saline for the remainder of the filling. Rectal pressure is measured using a rectal balloon catheter filled with saline. All pressure transducers are zeroed to atmospheric pressure at the level of the bladder at the beginning of the procedure. Perineal pads are applied to measure electromyography (EMG). Fluoroscopy is used during filling and voiding phases of the study, where appropriate.

Data storage and analysis

Data were abstracted from the pre- and post-UDS questionnaires and remaining data were obtained from the electronic medical record and recorded in a RedCap database. Data are presented as averages with standard deviations and numbers with percentages, where appropriate. Comparisons between pre- and post-UDS clinical impressions were made using McNemar's test with a p value of <0.05 for significance. All analyses were performed using SAS v 9.4(Cary, NC).

Results

A total of 285 individuals, out of 836 patients presenting for UDS studies between May 2013 and August 2014, consented to be in our research study for an overall response rate of 33%. The average age of the cohort was 56.0 (± 16.4) years, 59.5% were female and 94.0% were white. In 83.0% of individuals this was their first UDS study. A history of pelvic radiation was present in 4.9% of individuals and 29.3% had a neurologic condition (34.9% spinal cord injury, 11.8% spina bifida, 12.9% multiple sclerosis, 4.7% stroke, 32% other) (Table 1).

The indications for the UDS studies performed in our cohort are listed in Table 2. The most common indications were to discern the type of urinary incontinence (stress versus urgency incontinence) in 38.5% of studies and to assess the safety of the bladder during filling in 38.2% of studies. Discernment of bladder outlet obstruction from detrusor underactivity in individuals with incomplete bladder emptying or urinary retention was the third most common indication for UDS in 30.4% of studies. Of note, no UDS studies were performed for straightforward stress urinary incontinence in female patients.

Table 3 compares lower urinary tract diagnoses based on pre- and post-UDS questionnaires. UDS studies yielded statistically significant changes in the clinician's diagnosis of stress urinary incontinence (30.4% pre- and 25.4% post-study, $p=0.02$) and of urgency and urgency urinary incontinence (48.9% pre- and 26.5% post-study, $p<0.01$). Diagnoses of poor compliance, detrusor hypocontractility, outlet obstruction and detrusor external sphincter dyssynergia/dysfunctional voiding did not significantly change after UDS, however, our study is underpowered to detect such differences if they do indeed exist.

Fluoroscopy was used in 273 (97.2%) of UDS studies and was found to be helpful in 82 (29.5%) studies. Clinicians indicated that overall clinical impression changed based on the UDS in 130 (46.4%) studies and that their management plan changed in 119 (42.5%) studies. Changes in management plans as a result of UDS are shown in Table 4. Changes involving surgery were the most common, which occurred in 35.0% of UDS studies, followed by changes in medications or doses of medications (14.6%), changes in follow up interval (11.5), changes in catheterization need or schedule (7.1%) and changes related to pelvic floor physical therapy (4.3%).

Comment

In our practice, UDS was performed for a limited number of indications, with results that proved to be clinically useful and which changed the diagnosis and management plan in a high percentage of our patients. Approximately 60% of studies were performed in women and 30% were performed in individuals with neurologic conditions. The most common reason for UDS in our cohort were to discern the type of urinary incontinence (stress versus urgency). Examples include patients who report severe urinary incontinence without clear symptoms of SUI or UUI, OR those with severe symptoms of both SUI and UUI. In these settings, UDS can help to clarify the severity of SUI and the presence of detrusor overactivity to determine the appropriate next step in treatment. UDS changed the diagnosis

for stress urinary incontinence and for urgency/urgency urinary incontinence in a statistically significant number of individuals. Fluoroscopy was helpful in approximately 30% of studies and the management plan changed in 43% of studies.

The use of urodynamics has been most widely studied among women with uncomplicated straightforward stress urinary incontinence. The Value of Urodynamic Evaluation Trial (ValUE) is a multi-centered trial that randomized 630 women with uncomplicated stress urinary incontinence to preoperative UDS versus office-based evaluation alone. The study concluded non-inferiority of UDS testing based on questionnaire outcomes at 12 months.[2] A different multicenter study performed in The Netherlands evaluated women with uncomplicated stress urinary incontinence who were eligible for surgery based on clinical assessment alone. They then randomized women to either receive immediate midurethral sling surgery or to undergo UDS and be treated based on the findings of the UDS. The results slightly favored the group receiving immediate surgery, concluding that immediate midurethral sling surgery is not inferior to individually tailored treatment based on UDS findings.[3,4] Taken together, these two studies have changed the opinions of many on the utility and use of urodynamics, particularly among women with straightforward uncomplicated stress urinary incontinence and we agree that there is little value in UDS in this straightforward diagnosis. However, as shown in our study, the value of UDS spans far beyond this one indication, as we did not perform any UDS studies for straightforward SUI in women and did find meaningful utility of UDS testing in the diagnosis and treatment of a large percentage of individuals.

Population based trends using administrative health care claims have described the use of UDS on a national level. Among 16,574 UDS performed between 2002 and 2007, the most common coded indication for studies was for stress urinary incontinence (33.7%), followed by urgency urinary incontinence and neurogenic overactive bladder (16.3%) and urinary retention, obstruction or incomplete emptying (12.4%).[5] Another study looking at the use of UDS among female Medicare beneficiaries demonstrates that its use has substantially increased by 23% between 2000 and 2010.[6] While it is difficult to compare these findings using billing data to our study, which individually evaluated the indications for UDS, the national trends show that UDS studies are commonly performed for the assessment of stress urinary incontinence, which again, differs from our academic specialty referral practice.

When performing UDS, it is very important to understand the clinical question(s) that the testing is attempting to answer. In our practice, we found that there are six such questions which are encountered: (1) to provide insight into the severity of each type of incontinence (stress versus urgency) in patients with extremely severe and/or mixed incontinence symptoms, (2) to evaluate for bladder outlet obstruction in a patient with incomplete emptying, urinary retention, or refractory urinary symptoms, (3) to determine the etiology of voiding dysfunction in a female patient with a history of incontinence surgery, (4) to assess the safety of bladder filling in patients at risk for reduced bladder compliance (e.g., neurogenic bladder, radiation, certain prior pelvic surgeries), (5) to determine the etiology of urinary incontinence in a neurogenic bladder patient, and (6) to assess the bladder and outlet in a patient preparing to undergo renal transplant. We have found this list to be very useful

when teaching UDS to residents and fellows. Furthermore, it suggests that the use of UDS for the uncomplicated female SUI patient may be very rare in many practices.

A large part of our UDS practice evaluated the safety of bladder filling and emptying in the neurogenic population. This is not surprising, since UDS are a documented cornerstone of the evaluation of neurogenic patients to assess bladder compliance and detrusor external sphincter dyssynergia/voiding dysfunction, which have known prognostic significance in this population.[7–10] The use of UDS in the neurogenic population is also supported by the American Urological Association (AUA) and the Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction (SUFU) Guidelines for urodynamics.[11]

We also found that UDS changed the clinician's diagnosis of stress urinary incontinence and of urgency/urgency urinary incontinence in a statistically significant number of individuals. Physicians recorded a diagnosis of stress urinary incontinence in 30.4% and 25.4% of patients before and after the UDS study ($p=0.02$), respectively, and recorded a diagnosis of urgency/urgency urinary incontinence in 48.9% and 26.5% of patients before and after the UDS study ($p<0.01$), respectively. It is not surprising that there was a statistically significant difference in the diagnosis of urgency/urgency urinary incontinence, as detrusor overactivity, the urodynamic sign that often correlates with these symptoms, can be absent in up to 50% of symptomatic individuals.[12] Therefore, the focus of UDS in our practice is often to determine the presence and severity of SUI in patients with severe urinary incontinence symptoms who cannot be well categorized by history and physical examination alone. Our study did not find statistically significant changes in other lower urinary tract diagnoses, likely due to our limited sample size and being underpowered to detect a difference.

Fluoroscopy was found to affect clinical management in approximately 30% of cases. While we used fluoroscopy in almost all (97.2%) of our UDS studies, this is unusual based on national trends. Administrative claims data have shown that only 6.2% of studies use fluoroscopy nationally,[5] raising the possibility that these studies may potentially be missing clinically meaningful information in certain patient populations. The AUA/SUFU guidelines recommend the use of fluoroscopy, when available, in patients with neurologic disorders (recommendation) and in properly selected patients with lower urinary tract symptoms to help localize the level of obstruction (based on expert opinion),[11] as fluoroscopy can be helpful to assess bladder diverticulae or vesicoureteral reflux that may alter measurement of compliance, aid in the diagnosis of detrusor external sphincter dyssynergia, or identify abnormal anatomy such as a reconstructed bladder.

Urodynamics changed the management plan in 42.5% of UDS in this study. The most common changes in management plans were clinically significant in that they involved surgery (35.0%) and changes in medications or dosing of existing medications (14.6%). Examples include the finding of a poorly compliant bladder in a patient with SCI but no symptoms who was presumed to be safe, but due to urodynamic findings his therapy was transitioned from oral medication to botulinum toxin. Other examples include a woman who presented with urgency incontinence following a sling procedure who had failed medical therapy who was found to have bladder outlet obstruction requiring sling division and not sacral neuromodulation which was the pre urodynamics plan. Ours is the first study to offer

this level of outcome data as a result of UDS testing and thereby lends further evidence to the importance of their use among complex urologic patients.

This study should be interpreted with certain limitations in mind. First, findings are representative of our academic specialty referral practice and may be generalizable to other like practices, but potentially not to all types of practices. We do feel, however, that our findings are valuable within this context and suggest that the use of clinically indicated UDS testing in this setting can be extremely valuable and impact patient care. Second, our study is currently underpowered to detect potential differences in pre- and post-UDS diagnoses and to perform subset analyses, which would yield additional informative information. Despite this limitation, based on the numbers that we do have, we found several significant and valuable findings, further supporting the use of UDS in like practices. Third, there is a subjective component to the study, as each of the five clinicians that participated in the study may have slightly different expertise and different management methods for their patients. We believe that these differences only lend themselves to the strength of this study in that they help with generalizability of the findings.

Conclusions

Overall, we found that urodynamics was a clinically useful tool that had a large effect on both the diagnosis and treatment of carefully selected neurologic and non-neurologic patients of both genders. We feel that these findings significantly contribute to the conversation on the use and value of urodynamics, particularly among more complex patients and in individuals with neurologic disorders.

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Table 1

Demographics and patient characteristics

Variable	N	%
Age (avg)	56.0 (16.4)	
Age		
18–30	29	10.2
31–40	28	9.8
41–50	37	13.0
51–60	64	22.5
61–70	76	26.7
71–80	33	11.6
>80	18	6.3
Race		
White	267	94.0
Non-white	17	6.0
Female	166	59.5
1st urodynamics at institution	235	83.0
History of pelvic radiation	14	4.9
History of neurologic problem	83	29.3
Spinal cord injury	28	32.9
Spina bifida	10	11.8
Multiple sclerosis	11	12.9
Stroke	4	4.7
Other	32	37.7

Table 2

Indications for urodynamics. (Indications are not mutually exclusive)

Indication	N (%)
To discern type of incontinence (stress versus urgency)	109 (38.5)
To assess safety of the bladder during bladder filling	108 (38.2)
To discern bladder outlet obstruction from detrusor underactivity in cases of incomplete emptying/urinary retention	86 (30.4)
To assess urinary incontinence in a neurogenic patient	50 (17.7)
To determine the etiology of voiding dysfunction in a female status post incontinence surgery	42 (14.8)
To assess bladder and outlet function/safety in the pre-transplant setting	8 (2.8)

Table 3

Lower urinary tract diagnoses before and after urodynamics.

Impression	Pre-study	Post-study	P value
Stress urinary incontinence	85 (30.4)	71 (25.4)	0.02
Urgency/urgency urinary incontinence/detrusor overactivity	137 (48.9)	74 (26.5)	<0.01
Poor compliance	27 (9.6)	24 (8.63)	0.59
Atonic bladder/detrusor hypocontractility	59 (21.1)	60 (21.4)	1.00
Obstruction/obstructive voiding	55 (19.6)	44 (15.8)	0.08
Detrusor external sphincter dyssynergia/dysfunctional voiding	24 (8.6)	26 (9.3)	0.58

Table 4

Changes in management plan after urodynamics

	N (%)
Change involving surgical plan	98 (35.0)
Change in medication or dose of medication	41 (14.6)
Change in follow up interval	32 (11.5)
Change in catheterization need or schedule	20 (7.1)
Change involving pelvic floor physical therapy	12(4.3)