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Does Urethral Competence Affect Urodynamic Voiding Parameters in Women With Prolapse?

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Aims: To (1) compare voiding parameters and (2) correlate symptoms and urodynamic findings in women with pelvic organ prolapse (POP) and varying degrees of urethral competence. **Methods:** We compared three groups of women with stages II–IV POP. Groups 1 and 2 were symptomatically stress continent women participating in the Colpopexy and Urinary Reduction Efforts (CARE) trial; during prolapse reduction before sacrocolpopexy, Group 1 (n = 67) did not have and Group 2 (n = 84) had urodynamic stress incontinence (USI) during prolapse reduction. Group 3 participants (n = 74), recruited specifically for this study, had stress urinary incontinence (SUI) symptoms and planned sacrocolpopexy. Participants completed standardized uroflowmetry, pressure voiding studies, and validated symptom questionnaires. **Results:** Subjects' median age was 61 years, median parity 3 and 87% had stage III or IV POP. Fourteen percent of women in Group 3 demonstrated USI without, and 70% with, prolapse reduction. Women in Groups 2 and 3 had more detrusor overactivity (DO) than Group 1 (17 and 24% vs. 6%, $P = 0.02$) and detrusor overactivity incontinence (DOI) (15 and 8% vs. 0%, $P = 0.004$). Based on the Blaivis–Groutz nomogram, 60% of all women were obstructed. Post-void residual volume (PVR), peak flow rate, detrusor pressure at peak flow, voiding mechanisms, voiding patterns, obstruction and urinary retention did not differ among groups. Women in Group 3 had higher irritative and obstructive symptom scores than Group 1 or 2; neither score differed by presence of DO nor obstruction, respectively. **Conclusion:** Women with POP have significant rates of urodynamic obstruction and retention, independent of their continence status. Symptoms of obstruction and retention correlate poorly with urodynamic findings. *Neurourol. Urodynam. 26:1030–1035, 2007.* © 2007 Wiley-Liss, Inc.

Key words: obstruction; pelvic organ prolapse; urodynamics; voiding

INTRODUCTION

Pelvic organ prolapse (POP) is a complex condition often associated with both urinary incontinence and urinary retention. The studies that address urodynamic evaluation in women with POP have focused on uncovering urodynamic stress incontinence during prolapse reduction[1–5] or defining obstructive voiding on pressure flow studies.[6,7] Interpretation of these studies has been limited by their small sample sizes.

To better understand bladder function in women with prolapse, we conducted a prospective supplementary study to the NIH/NICHD's Pelvic Floor Disorders Network (PFDN) Colpopexy and Urinary Reduction Efforts (CARE) study.[8] The CARE study enrolled women without symptoms of stress incontinence undergoing sacrocolpopexy for pelvic organ prolapse with the primary aim of determining if adding a Burch urethropexy at the time of surgery would reduce symptoms of stress incontinence 3 months post-operatively. Since stress urinary incontinence (SUI) symptoms occur in 25–100% of women with advanced prolapse,[1,2,4–7] we recognized the opportunity to compare women enrolled in CARE with women who were also undergoing sacrocolpopexy for prolapse but who additionally had stress incontinence symptoms.

By studying a large group of women with POP who are similar except for their symptoms of stress incontinence, our overall aim was to better understand how concomitant urethral incompetence impacts patient symptoms and voiding parameters. Our hypothesis was that urethral incompetence as indicated by stress incontinence symptoms may modify the functional obstruction of pelvic organ prolapse.

The specific aims of this study were to compare voiding parameters and correlate symptoms and urodynamic findings in three groups of women with symptomatic pelvic organ prolapse (POP) who were planning sacrocolpopexy and who had varying degrees of urethral competence. We defined groups as follows: Group 1 (no SUI), women with no stress urinary

Heinz Koelbl led the review process.
Abbreviations: POP, pelvic organ prolapse; SUI, stress urinary incontinence; USI, urodynamic stress incontinence; PVR, post-void residual volume; DO, detrusor overactivity; DOI, detrusor overactivity incontinence; UDI, urinary distress inventory; NIF, non-instrumented flow study; PFS, pressure flow study
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incontinence (SUI) symptoms and no urodynamic stress incontinence (USI) during prolapse reduction; Group 2 (occult SUI), women with no SUI symptoms who demonstrated USI on reduction testing; Group 3 (overt SUI), women with SUI symptoms.

METHODS

Urodynamic data for this study were obtained from 298 women with stages II–IV pelvic organ prolapse.[9] Of these, 225 were planning sacrocolpopexy and represent the three comparison groups; we enrolled an additional 73 women to provide descriptive data only (see below). Groups 1 and 2 consist of women with no or minimal subjective symptoms of stress urinary incontinence who participated in the Colpopexy and Reduction Efforts Trial[8] and underwent urodynamics prior to surgery. Group 3, recruited specifically for this study, consists of women with SUI symptoms who were planning to undergo a sacrocolpopexy. Women in Group 3 met all the inclusion/exclusion criteria for CARE except that they had symptomatic SUI, an exclusion criterion for CARE. As noted, we also enrolled an additional 73 women (Group 4) for descriptive purposes only; these women had SUI symptoms but were not planning to undergo sacrocolpopexy. Because women with POP undergoing urodynamics who are not planning abdominal surgery differ demographically from our study groups, we decided a priori not to compare them to the other three groups, but to describe them in order to add to the scarce literature in this area.

We excluded women who were unable to provide informed consent or participate in a quality of life telephone interview in English, were currently pregnant or within 6 months postpartum, had neurological diagnoses that may affect voiding function such as multiple sclerosis or spinal cord injury.

Patients were considered stress continent (and thus eligible for CARE) if they responded "never" or "rarely" to six MESA[10] stress incontinence questions: coughing hard, sneezing, lifting, bending, laughing, and walking briskly or jogging[8] and stress incontinent if they responded "sometimes" or "usually" to any of these same MESA questions.

The make-up of the three comparative groups is summarized as follows:

(1) Group 1 (no SUI): 67 women randomly selected from women enrolled in the CARE study who had no subjective symptoms of SUI on the MESA and demonstrated no USI with prolapse reduction testing.
(2) Group 2 (occult SUI): 84 women randomly selected from women enrolled in the CARE study who had no subjective symptoms of SUI on the MESA, but who did demonstrate USI with reduction testing (i.e., urinary leakage from the urethral meatus with cough or valsalva).
(3) Group 3 (overt SUI): 74 women who were similar to CARE patients, i.e., they were planning sacrocolpopexy for repair of prolapse and they did have subjective symptoms of SUI on the MESA.

Women enrolled in this supplementary study completed questionnaires and procedures identical to those completed at baseline in CARE. Relevant to this study were: demographic and history questions, standardized pelvic organ prolapse quantification[11] examination by a certified research nurse, standardized urodynamic evaluation (described in detail below), and the pelvic floor distress inventory (PFDI).[12] These survey instruments were completed via a telephone interview from the Quality of Life Interviewing Center at the University of Michigan.

Lower urinary tract storage symptoms (urgency, frequency, sensation) were obtained by positive responses and report of at least moderate bother to the items in the urinary distress inventory (UDI) of the PFDI[12] (i.e., questions 17, 18, 19, 23, 26, 27, 29, 33, 34, 28). Voiding symptoms were obtained by positive responses and report of at least moderate bother to the items in the obstructive/discomfort scale of the UDI in PFDI[12] (i.e., questions 11, 12, 13, 14, 15, 16).

Urodynamics Protocol

Non-fluoroscopic urodynamic studies with external water pressure transducers were performed on all participants preoperatively. Uroflowmetry was done with participants in a seated position with a comfortably full bladder before urethral instrumentation. Post-void residual (PVR) urine volume was obtained by catheterization within 15 min of voiding. Urodynamics were rescheduled if dipstick urinalysis suggested infection. The uroflowmeter was calibrated in accordance with routine clinical practice standards and the scale was set to zero before each study. We did not repeat the uroflowmetry if the participant was unable to void or had a voided volume $<$150 ml as the applicability of this minimum voiding volume, in terms of study interpretation, is not known for women with pelvic organ prolapse.

The cystometrogram was performed with participants seated at a 45° angle using the same multichannel urodynamic recorder as was used for the CARE protocol. External water transducer catheters $\leq$ 8 French were used and zeroed to atmosphere at the superior level of the symphysis pubis prior to insertion. Intravesical pressure (Pves), intra-abdominal pressure (Pabd), and subtracted detrusor pressure (Pdet) were continuously recorded on a multichannel urodynamics recorder throughout the cystometrogram. The bladder was filled with saline or sterile water at 50 ml/min. A rectal catheter was used to estimate intra-abdominal pressure. If the detrusor pressure was not between 0 and 5 cm H_2O during early filling, the ports were flushed and the equipment was re-zeroed. Baseline intravesical pressure was recorded at the start of infusion. If a detrusor contraction occurred that caused a large volume of leakage during bladder filling at a volume less than 300 ml, the bladder was emptied and filling restarted at an infusion rate half of the original rate (i.e., 25 ml/min).

At 300 ml or maximum bladder capacity, whichever was lower, baseline intravesical pressure was recorded at rest. Participants then did a series of three coughs and three valsalva efforts, first with the prolapse out and then with each of two methods of prolapse reduction. Details of the prolapse reduction technique have been previously published.[13] Briefly, each site used two of five methods to reduce prolapse (hand, speculum, pessary, cotton swab, and ring forceps). Each site used the same two methods for the whole study. At 300 ml bladder volume, the prolapse was reduced with the first and then the second of two methods assigned to each clinical site. At this point, the second prolapse reduction method was left in place and the bladder was filled to maximum capacity. The valsalva and cough sequences were repeated at maximum capacity with only the second prolapse reduction method.

If the participant had not leaked following valsalva and cough testing at maximum capacity, the transurethral catheter was removed and the participant was instructed to valsalva and cough with maximal effort. Any urine leakage was recorded. Regardless of whether leakage occurred, the prolapse reduction method was removed and the transure-

thral catheter was replaced for the pressure flow voiding study.

The prolapse was not reduced at the time of the pressure flow study by the research staff and the patient was instructed to bear down or cough to encourage the prolapse to become maximal again prior to voiding. Urethral relaxation was not documented during the pressure flow voiding study.

In accordance with recommendation of the ICS Standardization Committee of Good Urodynamic Practice,[14] the scaling of the tracings was standardized across centers as follows: One millimeter was equal to 1 sec on the x-axis for both flow and volume; and on the y-axis, 1 mm was equal to 1 ml/sec for flow and equal to 10 ml for volume. For the cystometrogram and pressure flow signals, a minimum scaling was set at 25 cm H_2O/cm for pressure; 25 ml/sec/cm for flow; and 1 min/3 cm for the time axis. The signals of the non-instrumented uroflowmetry and pressure flow study were clearly labeled to simplify a central review. The tracings were annotated in accordance with the required data points.

Each urodynamic tracing including the non-instrumented uroflow (NIF) and pressure flow study (PFS) were independently reviewed centrally by three PFDN investigators (IN, KK, JW). The voiding pattern, derived independently from both the NIF and the PFS, was classified based on the tracing as continuous (flow rate reaches zero only at the end of void), interrupted (flow rate diminishes to zero at least once prior to end of void) or unable to determine. Voiding mechanism was classified based on the PFS as detrusor (any increase in Pdet during peak flow), strain (greater than or equal to 15 cm H_2O increase in Pabd during peak flow), detrusor and strain, neither, or unable to determine (catheter fell out or significant artifact). The individual interpretations of the three reviewers were collated and where all three differed for any given data element, the tracings were arbitrated with all three investigators present. During arbitration, the tracings were reviewed and majority vote was required to arrive at final determination for each data element.

Description of Variables

We assessed obstruction using the parameters of non-instrumented maximum flow rate ($Q_{max\ NIF}$) and maximum detrusor pressure ($Pdet_{max}$) from the pressure flow studies as outlined by Blaivis–Groutz.[15] The void was defined as obstructed when values fell outside of the "unobstructed area" on the nomogram.

Urinary retention was defined as voiding <75% of total bladder volume. Maximum bladder capacity was defined as the volume at which women stated they could no longer delay a trip to the bathroom.

Statistical Analysis

The three groups were compared by either a chi-square test when the measure was discrete or by an analysis of variance when the measure was continuous. Urodynamic data for the three groups were also compared after adjustment for age as a continuous measure and prior surgery for prolapse or incontinence. Correlations were computed to assess associations between measures.

With approximately 70 subjects per group there is almost 80% power to identify a difference of 0.5SD when testing a continuous outcome or a difference of 25% when testing a dichotomous outcome at a 5% level of significance.

RESULTS

Demographic characteristics and physical exam findings of the three groups, shown in Table I, were similar among cohorts except women in Group II were older ($P = 0.022$) and the proportion of women that had undergone previous incontinence surgery differed between all three groups ($P < 0.001$).

Only 13.7% of women with pre-operative symptoms demonstrated leakage during cough or valsalva testing without reduction; however, when prolapse reduction was performed in these same women, over two thirds (69.7%) demonstrated leakage (Table II). Women without SUI symptoms and without USI on prolapse reduction (Group 1) were less likely to have detrusor overactivity (DO) or detrusor overactivity incontinence (DOI) on urodynamics than were women with occult or overt SUI (6, 16.7, 23.6%, respectively for DO; $P = 0.016$ and 0, 8.3, 15.3%, respectively for DOI; $P = 0.004$).

The median PVR for the three groups combined was 46 ml based on catheterization after the NIF and 25 ml based on

TABLE I. Characteristics of Study Population

Characteristic: mean ± SD or n (%)	No SUI (N = 67)	Occult SUI (N = 84)	Overt SUI (N = 74)	*P*-value
Age	58.2 ± 10.4	62.2 ± 10.8	57.2 ± 14.4	0.02[a]
Parity	2.8 ± 1.3, median 2.0, range 1–8	3.0 ± 1.3, median 3.0, range 1–7	2.9 ± 1.5, median 3.0, range 0–8	0.75
Education				0.37
Less than high school	6 (9.0%)	3 (3.6%)	7 (9.5%)	
Completed high school or equivalent	26 (38.8%)	38 (45.2%)	22 (29.7%)	
Some college/Associate degree	16 (23.9%)	26 (31.0%)	29 (39.2%)	
Completed 4 years of college	9 (13.4%)	8 (9.5%)	7 (9.5%)	
Graduate/Professional degree	10 (14.9%)	9 (10.7%)	9 (12.2%)	
POP-Q stage				0.99
II	8 (11.9%)	11 (13.1%)	10 (13.5%)	
III	48 (71.6%)	61 (72.6%)	54 (73.0%)	
IV	11 (16.4%)	12 (14.3%)	10 (13.5%)	
Prior surgery for POP	18 (26.9%)	35 (42.2%)	30 (41.1%)	0.11
Prior surgery for UI	0 (%)	8 (9.6%)	19 (25.7%)	<0.001[b]
Maximum anterior prolapse (cm)	+3.0 ± 2.5	+3.2 ± 2.6	+2.8 ± 2.8	0.72
Maximum posterior prolapse (cm)	+2.6 ± 3.0	+2.4 ± 3.4	+2.0 ± 3.4	0.52
Maximum vaginal descent (cm)	+3.6 ± 2.2	+3.9 ± 2.2	+3.6 ± 2.4	0.75

[a]Women with occult SUI are older than either of the other two groups.
[b]All three groups differ.

TABLE II. Urodynamic Findings

Characteristic: mean ± SD or N (%)	No SUI (N = 67)	Occult SUI (N = 84)	Overt SUI (N = 74)	*P*-value
USI without prolapse reduction	0 (%)	9 (11.0%)	10 (13.7%)	0.01
USI with prolapse reduction[a]	0 (%)	84 (100%)	46 (69.7%)	<0.001
Detrusor overactivity on cystometrogram	4 (6.0%)	14 (16.7%)	17 (23.6%)	0.01
Detrusor overactivity incontinence on cystometrogram	0 (%)	7 (8.3%)	11 (15.3%)	0.02
Instrumented pressure flow study: voiding mechanism				
Detrusor	35 (52.2%)	47 (56.0%)	36 (48.6%)	
Strain	1 (1.5%)	0 (%)	3 (4.1%)	
Detrusor and strain	23 (34.3%)	15 (17.9%)	13 (17.6%)	
Neither	2 (3.0%)	5 (6.0%)	6 (8.1%)	
Unable to determine or unable to void	6 (9.0%)	17 (20.2%)	16 (21.6%)	
Instrumented pressure flow study: voiding pattern				
Continuous	25 (37.3%)	33 (39.3%)	40 (54.1%)	
Interrupted	38 (56.7%)	43 (51.2%)	29 (39.2%)	
Unable to determine or unable to void	4 (6.0%)	8 (9.5%)	5 (6.8%)	
Obstruction by nomogram	36 (65%)	42 (60%)	24 (49%)	0.23
Urinary retention on NIF (volume voided < 75% of bladder capacity)	36 (42.1%)	30 (38.0%)	23 (37.1%)	0.84
Urinary retention on PFS (volume voided < 75% of bladder capacity)	22 (32.8%)	21 (27.3%)	20 (29.9%)	0.77
Post-void residual volume (cm^3) (non-instrumented uroflowmetry)[b] (median)	80.7 ± 95.7 (50.0)	76.5 ± 101.5 (50.0)	67.1 ± 72.6 (40.0)	0.67
Post-void residual volume (cm^3) (pressure flow study) (median)	90.5 ± 118.2 (33.0)	74.6 ± 129.5 (25.0)	74.1 ± 96.7 (30.0)	0.64
Maximum flow (median)	19.2 ± 11.7 (18.0)	19.2 ± 10.6 (18.0)	21.3 ± 12.3 (17.0)	0.49
Detrusor pressure at maximum flow (median)	31.6 (24.8) (25.0)	30.3 (21.6) (26.0)	26.8 (22.1) (23.0)	0.46

[a]Significant due to definition of cohorts.
[b]Derived from calculating maximum bladder capacity minus volume voided. When this difference was a negative number (N = 92), the PVR was deemed 0 cm^3.

calculation after the pressure flow study. Overall, 59.6% (102/171) met the definition for obstruction. The median peak flow for all groups combined was 14 ml/sec during the NIF and 17 ml/sec during the PFS. The median detrusor pressure at peak flow was 25 cm H_2O. The PVR, median peak flow rate, median detrusor pressure at peak flow, rates of urinary retention, and rates of obstruction were similar across the three groups (Table II).

Of the 186 women for whom a voiding mechanism could be determined, 118 (63.4%) voided by detrusor contraction alone, 51 (27.4%) voided with a combination of detrusor contraction and strain, 4 voided by strain alone, and 13 voided with neither strain nor detrusor contraction. We were unable to determine the voiding mechanism in 39 (17.3%) women. There were no differences in voiding mechanism or voiding pattern by study group (Table II). There was no statistically significant difference in the voiding mechanisms whether or not women were obstructed, as defined by the nomogram.

We evaluated the association between urodynamic findings and bladder symptoms as reported on the PFDI. While women with overt SUI were more likely to have higher irritative and obstructive symptom scores, neither the irritative or obstructive symptom subscale score differed according to whether urodynamics revealed DO or obstruction, respectively (Table III). There was a weak correlation between the PVR from the pressure flow study and the UDI obstructive subscale score (r = 0.25).

DISCUSSION

This is the largest study to rigorously compare the urodynamic findings of well-characterized women with advanced pelvic organ prolapse with and without stress incontinence symptoms. For decades, clinicians have assumed that advanced POP and obstruction commonly coexist. If obstruction is an entity of importance in women, a cohort with POP is the most logical clinical population to study.

The measure of obstruction in women (including women with POP) was initially modeled on male obstruction, although the entity of obstruction in women may be a different clinical phenomenon than obstruction in men. Our study highlights a high rate of obstruction, defined by one

TABLE III. Association Between Symptoms on the PFDI and Urodynamic Findings

Characteristic: mean ± SD (median) N	No SUI	Occult SUI	Overt SUI	*P*-value	Adjusted *P*-value[a]
Irritative subscale score (median)[b]					
DO present	25.6 ± 24 (18.8) 4	26.1 ± 16.9 (32.5) 14	46.1 ± 22.2 (47.5) 17	0.02[c]	0.05
DO absent	17.0 ± 15.4 (15.0) 62	21.4 ± 16.9 (18.8) 70	39.9 ± 24.3 (37.5) 52	<0.001[d]	<0.001
Obstructive subscale score (median)[e]					
Obstruction present	32.0 ± 18.4 (27.9) 36	44.5 ± 22.8 (45.2) 42	45.2 ± 28.5 (42.3) 24	0.03	0.05
Obstruction absent	34.0 ± 19.8 (28.8) 18	34.6 ± 21.4 (28.8) 28	49.5 ± 20.2 (46.2) 23	0.02	0.06

[a]Adjusted for age (continuous) and prior surgery for prolapse or incontinence.
[b]Irritative subscale scores did not differ according to whether or not DO was present.
[c]Mean score for overt SUI group is higher than score for no SUI group.
[d]Score for overt SUI group is higher than score for no SUI group and occult SUI group.
[e]Obstructive subscale score did not differ according to whether or not obstruction (defined by the nomogram) was present.

commonly used nomogram in women with POP, but this finding did not correlate with symptoms, regardless of degree of urethral competence.

The current ICS nomenclature does not provide terms for urodynamic findings during testing of women with POP. The storage phase term "urodynamic stress incontinence" does not discriminate as to whether advanced prolapse is reduced nor does it report preferred reduction techniques. Similarly, there are no recommendations for uninstrumented and instrumented voiding studies in women with prolapse. Aside from these nomenclature limitations, the urodynamic finding of "reduced" USI or "obstruction" are of uncertain clinical significance.

Most clinicians would assume that a woman with a weaker sphincter (as evidenced by her SUI symptoms) should have fewer obstructive symptoms. Indeed, we had a priori hypothesized that as the degree of urethral competence decreased from no SUI to occult SUI to overt SUI that obstruction, retention, irritative symptoms, and obstructive symptoms would decrease, because of the potential pressure release valve effect of the less competent urethra in the face of obstruction from prolapse. However, there is no evidence to support this widely held belief. Obstruction, as defined, is a voiding phase entity as opposed to stress incontinence which is a filling phase entity. Given that our findings did not, in fact, support our hypothesis, it is likely that urethral sphincter function during storage does not relate to sphincter function during emptying, when the normal sphincter relaxes. This would explain why maximum flow rates and detrusor pressures at maximum flow rates do not differ between women with and without stress incontinence regardless of their prolapse status (Table IV).[15,16]

That women with SUI have more irritative and obstructive symptoms than women without SUI may reflect a more endstage process in the evolution of pelvic floor disorders. Women with SUI were more likely to have had prior SUI surgery. We did adjust for this in our analyses, but the possibility remains that some dysfunction may have been caused by operative factors, such as denervation. We also did not measure urethral pressures in this study and so cannot comment on the correlation between actual pressures and symptoms.

Clinicians recommend treating elevated PVRs associated with advanced prolapse by reducing the prolapse, either with surgery or pessary, as this nearly universally returns the PVR to the normal range.[17] Given this, it is reasonable to question what additional value can be gained from pressure flow voiding studies for women who already plan treatment of POP. Our evaluation examined whether voiding studies played a role in discriminating which women have storage phase abnormalities, such as stress incontinence to better understand bladder function in women with advanced prolapse. We did not find evidence to support nor recommend use a voiding phase study to "triage" the stress incontinence procedure. However, the value of a pressure flow study in patients with advanced prolapse undergoing a concurrent stress incontinence procedure remains unclear. There would be clinical value to such a voiding study if it were able to predict patients who develop retention postoperatively. Our study was not designed to answer this

TABLE IV. Characteristics of Women With Prolapse and SUI Symptoms That Were Not Planning Sacrocolpopexy (n = 73)

Characteristic: mean ± SD or N (%)	
Age (years)	59.6 ± 13.7
Parity	2.9 ± 1.4, median 3.0, range 0–7
POP-Q stage	
II	32 (43.8%)
III	36 (49.3%)
IV	5 (6.8%)
Prior surgery for POP	19 (26.0%)
Prior surgery for UI	16 (21.9%)
USI without reduction	11 (15.1%)
USI with prolapse reduced	54 (78.3%)
USI only at capacity with prolapse reduced and catheter removed	5 (29.4%)
DO	11 (15.3%)
DO incontinence	7 (9.7%)
Obstruction (by nomogram)	33 (57.9%)
Retention (on non-instrumented uroflowmetry)	26 (40.6%)
Peak flow (cm^3/sec)	22.5 ± 11.5
Detrusor pressure at peak flow (cm H_2O)	34.6 ± 22.1
Voiding mechanism	
Detrusor	35 (47.9%)
Strain only	0
Detrusor and strain	16 (21.9%)
Neither	6 (8.2%)
Unable to determine	16 (21.9%)
Voiding pattern (pressure flow study)	
Continuous	36 (49.3%)
Interrupted	30 (41.1%)
Unable to determine	7 (9.6%)
Irritative symptom subscale score	
DO present	36.7 ± 21.6
DO absent	28.1 ± 22.4
Obstructive symptom subscale score	
Obstruction present (by nomogram)	41.0 ± 23.7
Obstruction absent	40.7 ± 24.0

question and the anti-incontinence procedure was limited to Burch colposuspension that is generally associated with a low rate of post-operative retention.[18] Given the increase in the use of mid-urethral mesh slings and the potentially higher rate of post-operative urinary retention, future studies are warranted to examine the value of uninstrumented uroflowmetry studies and pressure flow studies in predicting post-operative urinary retention associated with slings in patients undergoing surgery for advanced prolapse.

Our study is limited by the lack of a gold standard for obstruction in women. It is possible that alternative measuring techniques may be more useful than the ones selected in this study. Our study population is limited to women with advanced prolapse planning sacrocolpopexy so we cannot comment on the findings of "obstruction" in women with better vaginal support or other cause of obstruction, including iatrogenic causes.

Strengths of our study include the large sample size, multisite recruitment, standardized urodynamics procedures with independent secondary review of voiding studies, and use of validated condition-specific instruments to assess symptoms.

If future research finds that voiding abnormalities, including obstruction, are of clinical importance in women with POP, the appropriate diagnostic tests require careful validation and testing for clinical relevance.

AUTHOR DISCLOSURES

Karl Kreder—Equity interests: Merck; consultant: Pfizer; speaker honorarium: Pfizer, Lilly, Astellas, Merck, Boehringer; research grant: Pfizer, Lilly, Astellas. Elizabeth Mueller—Trial participation: Pfizer, Allergan. Linda Brubaker—Trial participation: Pfizer, Allergan; research grant: Pfizer. Patricia Goode—Consultant: Johnson & Johnson; trial participation: Pfizer.

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