Predictors of early postoperative voiding dysfunction and other complications following a midurethral sling

Christopher M. Ripperda, MD; Joseph T. Kowalski, MD; Zaid Q. Chaudhry, MD; Aman S. Mahal, MD; Jennifer Lanzer, MD; Nabila Noor, MD; Meadow M. Good, DO; Linda S. Hynan, PhD; Peter C. Jeppson, MD; David D. Rahn, MD

BACKGROUND: The rates reported for postoperative urinary retention following midurethral sling procedures are highly variable. Determining which patients have a higher likelihood of failing a voiding trial will help with preoperative counseling prior to a midurethral sling.

OBJECTIVE: The objective of the study was to identify preoperative predictors for failed voiding trial following an isolated midurethral sling.

STUDY DESIGN: A retrospective, multicenter, case-control study was performed by including all isolated midurethral sling procedures performed between Jan. 1, 2010 to June 30, 2015, at 6 academic centers. We collected demographics, medical and surgical histories, voiding symptoms, urodynamic evaluation, and intraoperative data from the medical record. We excluded patients not eligible for attempted voiding trial after surgery (eg, bladder perforation requiring catheterization). Cases failed a postoperative voiding trial and were discharged with an indwelling catheter or taught intermittent self-catheterization; controls passed a voiding trial. We also recorded any adverse events such as urinary tract infection or voiding dysfunction up to 6 weeks after surgery. Bivariate analyses were completed using Mann-Whitney and Pearson χ^2 tests as appropriate. Multivariable stepwise logistic regression was used to determine predictors of failing a voiding trial.

RESULTS: A total of 464 patients had an isolated sling (70.9% retropubic, 28.4% transobturator, 0.6% single incision); 101 (21.8%) failed the initial voiding trial. At follow-up visits, 90.4% passed a second voiding trial, and 38.5% of the remainder passed on the third attempt. For the bivariate analyses, prior prolapse or incontinence surgery was similar in cases vs controls (31% vs 28%, $P = .610$) as were age, race, body mass index, and operative time. Significantly more of the cases (32%) than controls (22%) had a Charlson comorbidity index score of 1 or greater ($P = .039$). Overactive bladder symptoms of urgency, frequency, and urgency incontinence were similar in both groups as was detrusor overactivity in those with a urodynamic evaluation (29% vs 22%, $P = .136$), but nocturia was reported more in the cases (50% vs 38%, $P = .046$). Mean (SD) bladder capacity was similar in both groups (406 [148] mL vs 388 [122] mL, $P = .542$) as was maximum flow rate with uroflowmetry and pressure flow studies. Cases were significantly more likely to have a voiding type other than detrusor contraction: 37% vs 25%, $P = .027$, odds ratio, 1.79 (95% confidence interval, 1.07–3.00). There was no difference in voiding trial failures between retropubic and transobturator routes (23.1% vs 18.9%, $P = .329$). Within 6 weeks of surgery, the frequency of urinary tract infection in cases was greater than controls (20% vs 6%, $P < .001$; odds ratio, 3.51 [95% confidence interval, 1.82–6.75]). After passing a repeat voiding trial, cases were more likely to present with acute urinary retention (10% vs 3%, $P = .003$; odds ratio, 4.00 [95% confidence interval, 1.61–9.92]). For multivariable analyses, increasing Charlson comorbidity index increased the risk of a voiding trial failure; apart from this, we did not identify other demographic information among the patients who did not undergo urodynamic evaluation that reliably forecasted a voiding trial failure.

CONCLUSION: The majority of women will pass a voiding trial on the first attempt after an isolated midurethral sling. Current medical comorbidities are predictive of a voiding trial failure, whereas other demographic/examination findings are not. Patients failing the initial voiding trial are at an increased risk of postoperative urinary tract infection or developing acute retention after passing a subsequent voiding trial.

Key words: early postoperative complications, midurethral sling, voiding dysfunction

Midurethral sling surgeries are the main treatment for women with stress urinary incontinence.[1] Although highly effective procedures, one important adverse event not infrequently associated with the midurethral sling operation is postoperative voiding dysfunction, necessitating short-term bladder drainage and, rarely, reoperation.[2] Reports of short-term postoperative urinary retention following midurethral sling are highly variable, ranging from 7.8% to 84%.[3-9]

Immediate postoperative voiding dysfunction is influenced by multiple factors including the criteria used in postoperative voiding trials, concomitant procedures, patient characteristics, and surgical techniques.[3-9] Prolonged bladder drainage after acute urinary retention may be performed via an indwelling Foley or clean intermittent catheterization, which have been associated with increased urinary tract infections, greater health care costs, and substantially decreased patient satisfaction.[10,11] Thus, reducing the rates of postoperative voiding dysfunction and catheter use should be a priority.

Identification of risk factors associated with increased immediate postoperative voiding dysfunction would allow for improved patient counseling and preparation regarding potential discharge with a urinary catheter and may lead to practice changes.

There is currently no universally accepted protocol for performing voiding trials following midurethral sling procedures for stress urinary incontinence. In 2002, Kleeman et al[3] described a postoperative voiding test that

Cite this article as: Ripperda CM, Kowalski JT, Chaudhry ZQ, et al. Predictors of early postoperative voiding dysfunction and other complications following a midurethral sling. Am J Obstet Gynecol 2016;215:656.e1-6.

0002-9378/$36.00

http://dx.doi.org/10.1016/j.ajog.2016.06.010

consisted of retrograde filling the bladder with 300 mL of sterile water or to subjective maximum bladder capacity. If the postvoid residual was ≤50% of the instilled bladder volume within 30 minutes of filling, the catheter was left out.[3]

Several modifications of this voiding trial have been adopted in randomized control trials and described in gynecology textbooks.[9,12,13] Multiple studies previously described relationships between failed postoperative voiding trials and baseline patient clinical factors. Wheeler et al[6] identified that a baseline maximum flow rate on uroflowmetry of <15 mL/s predicted a higher risk of failed postoperative voiding trial.

Flow rate as a predictor of postoperative voiding trial failure was also corroborated by Hong et al,[4] Park et al,[14] and Kim et al.[15] Barron et al[16] identified Valsalva leak point pressure >60 cm H_2O as a risk factor for a failed voiding trial. A history of prior incontinence or prolapse surgery and increasing age were found to increase the risk for delayed voiding by Mutone et al.[17] Furthermore, increased preoperative postvoid residual on pressure flow studies was also correlated with a greater likelihood of having a postoperative voiding trial fail.[18]

Thus, past studies have found different variables that influence immediate postoperative voiding failure. The authors of this study sought to reexamine the relationships of perioperative characteristics and undesired outcomes in patients who have undergone a midurethral sling procedure. In particular, we aimed to identify predictors of postoperative voiding dysfunction and other complications in a large, diverse group of women utilizing their clinical characteristics and, when available, preoperative urodynamic studies.

Materials and Methods

Following institutional review board approval at each participating site, a retrospective multicenter case-control study was performed at 6 academic centers through the Society of Gynecologic Surgeons' Fellows' Pelvic Research Network. Women aged 18 years and older who had undergone an isolated retropubic midurethral sling, transobturator sling, or single-incision/minisling from Jan. 1, 2010, to June 30, 2015, with a recorded same-day postoperative voiding trial were identified. We excluded intraoperative procedures in which a day-of-surgery voiding trial would not be medically appropriate (ie, suprapubic tube placement, intraoperative complications) and patients undergoing concomitant pelvic reconstructive procedures or other anti-incontinence procedures.

Patient demographics, medical and surgical histories including prior anti-incontinence or pelvic reconstructive procedures, preoperative overactive bladder symptoms, preoperative complaints of voiding dysfunction, and a patient-reported history of recurrent urinary tract infection were collected from the electronic medical record. The Charlson comorbidity index was utilized to quantify the severity of patients' comorbidities.

If available, results of preoperative multichannel urodynamics with uroflowmetry, cystometrics, pressure flow studies, and urethral pressure profilometry data were collected. This information included uninstrumented uroflowmetry maximum flow rate, postvoid residual, and voiding pattern; cystometric bladder capacity, presence of detrusor overactivity, or urodynamic stress incontinence, Valsalva and cough leak point pressures; maximum urethral closure pressure; and a pressure-flow study's maximum flow rate, maximum detrusor pressure, postvoid residual, and voiding type (detrusor-void vs Valsalva or mixed-type void).

If multichannel urodynamic studies were not performed during a patient's preoperative evaluation, simple cystometric data including postvoid residual, observed detrusor overactivity, bladder capacity, and the presence of stress urinary incontinence were collected. If no multichannel urodynamic or simple cystometric data were available, bladder capacity and postvoid residual were obtained from a preoperative voiding diary and office visit notes.

Intraoperative data including type of midurethral sling, estimated blood loss, type of anesthesia, anesthesia time, and surgical time were recorded. Postoperative follow-up information was obtained from the medical record up to 6 weeks after surgery, and any adverse events such as urinary tract infection or voiding dysfunction were collected.

Cases were defined as patients in who a postoperative voiding trial failed and were discharged with an indwelling catheter or taught intermittent self-catheterization. Controls were defined as patients who passed a voiding trial. Postoperative voiding trials were performed using an individual site's standard voiding trial procedure, including criteria for voiding trial success and failure. At all clinical sites but one, the procedure for a postoperative voiding trial was a retrograde fill to 300 mL sterile water (or patient tolerance) with success defined as voiding at least two thirds of the instilled volume (or postvoid residual less than 100 mL). The remaining site permitted time for a spontaneous void after surgery, with a successful trial similarly defined as a postvoid residual less than 100 mL. The criteria for indwelling catheter removal or discontinuation of self-catheterization were left to the discretion of each institution.

The Society of Gynecologic Surgeons' Fellows' Pelvic Research Network academic sites were recruited with the goal of both identifying approximately 90−100 cases and achieving geographic diversity for the greatest generalizability. It is generally accepted that 5−10 patient cases are needed to identify each predictor; because we used a multivariable model (ie, for each degree of freedom),[1,2] including approximately 100 cases would be sufficient for the evaluation of up to 10 predictors of a short-term postoperative voiding trial failure in the multivariable model.

Bivariate analyses were completed using Mann-Whitney and Pearson χ^2 or Fisher-Freeman-Halton tests as appropriate. Odds ratios and 95% confidence intervals were calculated. Variables were then considered jointly in a multivariable backward stepwise logistic regression model to determine predictors of failing a voiding trial.

Results

Chart review identified 464 eligible patients from 6 participating sites (University of Texas Southwestern Medical Center, Dallas, TX; University of Iowa, Iowa City, IA; University of California, Los Angeles, Los Angeles, CA; Stanford University, Palo Alto, CA; Emory University, Atlanta, GA; and Harvard Medical School, Cambridge, MA).

The majority of patients underwent retropubic operations (Table 1). There were no significant differences in age, race, body mass index, length of surgery, or history of prior prolapse or

TABLE 1
Demographics, subjective symptoms, and surgical data with bivariate analysis of voiding trial failure cases and controls

Variable	Cases (n = 101)	Controls (n = 363)	*P* value	OR (95% CI)
Age, y	50 (43.0, 59.5)	50 (43.0, 58.0)	.961	na
Race				
Asian	6 (6%)	11 (3%)		
Black or African American	5 (5%)	16 (4%)		
Unknown/other	4 (4%)	15 (4%)		
White	86 (85%)	321 (88%)		
Ethnicity				
Hispanic/Latino	40 (40%)	116 (32%)		
Non-Hispanic	54 (53%)	229 (63%)		
Unknown/other	7 (7%)	18 (5%)		
Gravidity	3 (2, 4)	3 (2, 4)	.667	na
Parity	3 (2, 3)	3 (2, 3)	.872	na
BMI, kg/m^2	29.2 (25.4, 34.7)	29.8 (25.8, 34.3)	.801	na
CCI, 1 or greater	32 (32%)	79 (22%)	.039	1.67 (1.02–2.72)
Prior pelvic surgery	31 (31%)	102 (28%)	.610	na
Overactive bladder symptoms				
Urgency	62 (61%)	220 (61%)	.911	na
Frequency	50 (50%)	168 (47%)	0.647	na
Nocturia	50 (50%)	136 (38%)	.046	1.57 (1.01–2.45)
Urgency urinary incontinence	63 (62%)	215 (59%)	.588	na
Incomplete emptying (subjective)	27 (29%)	77 (22%)	.160	na
Postvoid dribble	25 (29%)	109 (33%)	.445	na
Recurrent UTI	12 (13%)	31 (9%)	.255	na
Surgery route				
Transobturator	25 (25%)	107 (29.5%)	.329[a]	na
Retropubic	76 (75%)	253 (69.7%)		
Single incision	0 (0%)	3 (0.8%)		
Anesthesia type				
General	84 (83%)	288 (79%)	.021[b]	na
Local	14 (14%)	74 (20%)		
Regional	3 (3%)	1 (0%)		
Surgical time, min	38.5 (31.0, 50.0)	39.0 (30.0, 51.0)	.804	na

Data are presented as median (25th, 75th percentiles) or number (percentage). *P* values represent Mann-Whitney *U* or χ^2 tests.

BMI, body mass index; *CCI*, Charlson comorbidity index; *CI*, confidence interval; *OR*, odds ratio; *UTI*, urinary tract infection.

[a] χ^2 test comparing transobturator to retropubic; [b] Fisher-Freeman-Halton test; χ^2 test comparing general to local ($P = .194$).

Ripperda et al. Predictors of short-term complications after midurethral sling. Am J Obstet Gynecol 2016.

TABLE 2
Urodynamic evaluation data of voiding trial failure of cases and controls

Variable	Case	n	Control	n	*P* value	OR (95% CI)
Uroflowmetry						
Normal voiding pattern	54 (73%)	54	218 (76%)	218	.562	na
Voided volume, mL	17 (116, 270)	77	150 (90, 267)	315	.157	na
Postvoid residual, mL	10 (5, 29)	84	10 (0, 25)	320	.189	na
Maximum flow rate, mL/s	17.9 (11.6, 25.2)	74	18.1 (13.0, 25.4)	295	.717	na
Cystometrogram						
Bladder capacity, mL	374 (300, 478)	93	370 (304, 450)	343	.542	na
Detrusor overactivity	28 (29%)	28	75 (22%)	75	.136	na
Valsalva leak point pressure, cm H_2O	90 (68, 131)	87	95 (70, 122)	320	.940	na
Cough leak point pressure, cm H_2O	94 (74, 142)	70	113 (87, 143)	268	.029	
Urethral pressure profile						
Maximum urethral closure pressure, cm H_2O	53 (42, 73)	65	56 (41, 75)	245	.870	na
Pressure flow study						
Abnormal voiding type[a]	31 (37%)	31	72 (25%)	72	.027	1.79 (1.06–3.00)
Voided volume, mL	351 (257, 459)	86	330 (273, 427)	313	.475	na
Postvoid residual, mL	0 (0, 50)	82	0 (0, 43)	308	.367	na
Maximum flow rate, mL/s	18.4 (13.2, 22.7)	81	18.9 (13.0, 25.9)	308	.611	na
Maximum detrusor pressure, cm H_2O	22 (16, 32)	75	25 (15, 38)	290	.246	na

Data are presented as median (25th, 75th percentiles) or number (percentage). *P* values represent Mann-Whitney *U* or χ^2 tests.

CI, confidence interval; *OR*, odds ratio.

[a] Abnormal voiding pattern is a combination of abdominal/Valsalva void and mixed voiding pattern.

Ripperda et al. Predictors of short-term complications after midurethral sling. Am J Obstet Gynecol 2016.

incontinence surgery between the cases and controls (Table 1). Significantly more of the cases (32%) than controls (22%) had a Charlson comorbidity index score of 1 or greater ($P = .039$). There were no significant differences in sensation of incomplete emptying or a history of recurrent urinary tract infection. Overactive bladder symptoms of urgency, frequency, and urgency urinary incontinence were similar between groups, but nocturia was more common in the cases (50% vs 38%, $P = .046$, odds ratio, 1.57) (Table 1).

Overall, in 363 of patients (78.2%) the initial voiding trial succeeded and in 101 (21.8%) the initial voiding trial failed. Ninety percent of those in whom the initial voiding trial failed succeeded at the second void trial, and 38.5% of the remaining patients succeeded at the third voiding trial. Bladder capacity and peak flow rate as measured by uroflowmetry and pressure flow studies were similar in both groups.

A voiding mechanism other than detrusor contraction (ie, Valsalva or mixed voiding) as measured by complex urodynamics was significantly higher in those in whom the initial voiding trial (failed Table 2). Sling route was not predictive of voiding trial failure (23.1% retropubic vs 18.9% transobturator, $P = .329$). The frequency of postoperative urinary tract infection within 6 weeks of surgery was significantly higher in cases (20% vs 6%, $P < .001$, odds ratio, 3.51, 95% confidence interval, 1.82–6.75). Subsequent occurrences of acute urinary retention in cases was significantly higher than in controls, even after passing a subsequent voiding trial (10% vs 3%, $P = .003$; odds ratio, 4.00 [95% confidence interval, 1.61–9.92]).

A multivariable analysis was performed for all patients and in the subset (91.8%) having undergone multichannel urodynamics. Considering all patients, increasing Charlson comorbidity index by 1 unit predicted an increased likelihood of voiding trial failure (odds ratio, 1.41, 95% confidence interval, 1.045–1.907). A receiver-operating characteristic was performed, and the area under the curve was not statistically different from 0.5. Otherwise, there were no historical or demographic characteristics that forecasted an increased odds of voiding trial failure.

Drawing from patients with multichannel urodynamics data, in a model including presence/absence of detrusor overactivity and increasing postvoid residual on a pressure flow study, an increase in postvoid residual (per 10 mL increase, odds ratio, 1.03, 95% confidence interval, 1.003−1.058) also predicted an increased likelihood of voiding trial failure, but detrusor overactivity was not significant and no definitive cut point for postvoid residual was identified because the receiver-operating characteristic analysis performed found the area under the curve was not significant.

Comment

We found that the majority of women will pass a voiding trial on the first attempt after isolated midurethral sling. This finding is in agreement with previously published studies, including a large secondary analysis of risk factors for incomplete bladder emptying after midurethral sling published by Norton et al.[19] Our finding that cases were significantly more likely to void by a mechanism other than detrusor contraction is also in agreement with this series.

In contrast to the findings of Norton et al,[19] we found that certain variables in a patient's history and on preoperative urodynamics suggest an increased likelihood of failing the initial voiding trial after midurethral sling. Medical comorbidities that would increase a patient from a Charlson comorbidity index of 0 (ie, normal health) to Charlson comorbidity index of 1 (eg, diabetes mellitus without organ damage, history of myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, ulcer, chronic liver or lung disease) increases the likelihood of a failed voiding trial by 41%.

Because the receiver-operating characteristic analysis was not significant, there was no discrete Charlson comorbidity index value that determined significance. Only in a model investigating detrusor overactivity and increasing postvoid residual, increasing residual on the pressure-flow study during preoperative complex urodynamics also predicted an increased probability of failing the initial voiding trial. Importantly, patients in whom the initial voiding trial failed are at an increased risk of postoperative urinary tract infection or developing acute retention, even after passing a subsequent voiding trial.

The recently published Valsartan Antihypertensive Long-term Use Evaluation (VALUE) study has called into question the usefulness of preoperative complex urodynamics for isolated midurethral sling procedures in patients with uncomplicated stress urinary incontinence, meaning stress-predominant symptoms, demonstrable leakage with urethral mobility but no prolapse beyond the hymen, no evidence of infection, and postvoid residual less than 150 mL. Furthermore, these patients had not had prior continence procedures.[20]

However, many patients undergoing isolated midurethral sling procedures have more complex clinical pictures. Complicating factors may include multiple medical comorbidities, significant urinary urgency and frequency, physical examinations inconsistent with clinical symptoms, and prior urogynecological surgeries. These patients may be more likely to present to large academic referral practices such as the centers included in this study.

We found that a Charlson comorbidity index greater than 0 increased the probability of failing the initial voiding trial, whereas other demographic variables and history/examination findings were not predictive. In the select model investigating detrusor overactivity and increased postvoid residual on a pressure-flow study, the increasing residual also corresponded to an increased risk of voiding trial failure. Therefore, preoperative complex urodynamics may allow for improved counseling and risk stratification in this subset of patients and in particular patients with comorbid medical conditions.

Patients in whom the initial voiding trial failed are also at an increased risk of postoperative urinary tract infection or acute retention, even after succeeding at subsequent voiding trials. Patients who succeed at subsequent voiding trials following midurethral sling surgery should be counseled that they are still at an elevated risk for acute urinary retention or development of urinary tract infection. Warning signs such as fever, dysuria, bladder pain, decreased force of stream, and sensation of incomplete bladder emptying should be discussed with patients in whom the initial voiding trial failed.

Surgeons and other health care providers caring for these patients should also have a heightened index of suspicion for these complications (ie, retention and urinary tract infection) and a low threshold to evaluate postoperative patients in whom the initial voiding trial failed, even after they pass a subsequent voiding trial.

The major strength of this study is the large number of subjects included from 6 academic medical centers in geographically diverse areas of the United States. Thus, the results may be widely applicable to varying populations. Other strengths are the inclusion of retropubic, transobturator, and single-incision approaches and that 91.8% of patients had complex urodynamics data available for review. The primary limitations are the retrospective nature of the study and the heterogeneity of defining voiding trial success and failure across institutions and individual providers.

We found that a Charlson comorbidity index greater than 0 and increasing postvoid residual on pressure-flow study during a preoperative complex urodynamic evaluation predicted an increased probability of failing the initial voiding trial and that patients in whom the initial voiding trial failed are at an increased risk of postoperative urinary tract infection or developing acute retention after passing a subsequent voiding trial. These findings may lead to enhanced preoperative patient counseling and postoperative management of those who fail a postoperative voiding trial. Future research is needed to determine the optimal postoperative voiding trial method for the prediction of complications such as urinary tract infection and urinary retention. ■

References

1. Jonsson Funk M, Levin PJ, Wu JM. Trends in the surgical management of stress urinary

incontinence. Obstet Gynecol 2012;119:845-51.
2. Daneshgari F, Kong W, Swartz M. Complications of mid urethral slings: important outcomes for future clinical trials. J Urol 2008;180:1890-7.
3. Kleeman S, Goldwasser S, Vassallo B, Karram M. Predicting postoperative voiding efficiency after operation for incontinence and prolapse. Am J Obstet Gynecol 2002;187:49-52.
4. Hong B, Park S, Kim HS, Choo MS. Factors predictive of urinary retention after a tension-free vaginal tape procedure for female stress urinary incontinence. J Urol 2003;170:852-6.
5. Vervest HA, Bisseling TM, Heintz AP, Schraffordt Koops SE. The prevalence of voiding difficulty after TVT, its impact on quality of life, and related risk factors. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:173-82.
6. Wheeler TL 2nd, Richter HE, Greer WJ, Bowling CB, Redden DT, Varner RE. Predictors of success with postoperative voiding trials after a mid urethral sling procedure. J Urol 2008;179:600-4.
7. Pham KN, Topp N, Guralnick ML, Koduri S, Newcomer JR, O'Connor RC. Preoperative Valsalva voiding increases the risk of urinary retention after midurethral sling placement. Int Urogynecol J 2010;21:1243-6.
8. Sanses TV, Brubaker L, Xu Y, et al. Preoperative hesitating urinary stream is associated with postoperative voiding dysfunction and surgical failure following Burch colposuspension or pubovaginal rectus fascial sling surgery. Int Urogynecol J 2011;22:713-9.
9. Geller EJ, Hankins KJ, Parnell BA, Robinson BL, Dunivan GC. Diagnostic accuracy of retrograde and spontaneous voiding trials for postoperative voiding dysfunction: a randomized controlled trial. Obstet Gynecol 2011;118:637-42.
10. Hooton TM, Bradley SF, Cardenas DD, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 international clinical practice guidelines from the Infectious Diseases Society of America. Clin Infect Dis 2010;50:625-63.
11. Kenton K, Pham T, Mueller E, Brubaker L. Patient preparedness: an important predictor of surgical outcome. Am J Obstet Gynecol 2007;197:654.e1-6.
12. Foster RT Sr, Borawski KM, South MM, Weidner AC, Webster GD, Amundsen CL. A randomized, controlled trial evaluating 2 techniques of postoperative bladder testing after transvaginal surgery. Am J Obstet Gynecol 2007;197:627.e1-4.
13. Hoffman B, Schorge J, Schaffer J, Halvorson L, Bradshaw K, Cunningham F. Williams gynecology. New York, NY: McGraw Hill Professional; 2008.
14. Park S, Hong B, Lee KS, Choo MS. Risk factors of voiding dysfunction and patient satisfaction after tension-free vaginal tape procedure. J Korean Med Sci 2005;20:1006-10.
15. Kim JW, Moon du G, Shin JH, Bae JH, Lee JG, Oh MM. Predictors of voiding dysfunction after mid-urethral sling surgery for stress urinary incontinence. Int Neurourol J 2012;16:30-6.
16. Barron KI, Savageau JA, Young SB, Labin LC, Morse AN. Prediction of successful voiding immediately after outpatient mid-urethral sling. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:570-5.
17. Mutone N, Brizendine E, Hale D. Factors that influence voiding function after the tension-free vaginal tape procedure for stress urinary incontinence. Am J Obstet Gynecol 2003;188:1477-81; discussion 81-3.
18. 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;169:2234-7.
19. Norton PA, Nager CW, Chai TC, et al. Risk factors for incomplete bladder emptying after midurethral sling. Urology 2013;82:1038-41.
20. Nager CW, Brubaker L, Litman HJ, et al. A randomized trial of urodynamic testing before stress-incontinence surgery. N Engl J Med 2012;366:1987-97.

Author and article information

From the Department of Obstetrics and Gynecology (Drs Ripperda, Good, and Rahn), Department of Clinical Sciences (Dr Hynan), Division of Biostatistics, and Department of Psychiatry (Dr Hynan), University of Texas Southwestern Medical Center, Dallas, TX; Department of Obstetrics and Gynecology, University of Iowa, Iowa City, IA (Dr Kowalski); Department of Obstetrics and Gynecology, University of California, Los Angeles, Los Angeles, CA (Dr Chaudhry); Department of Obstetrics and Gynecology, Stanford University, Palo Alto, CA (Dr Mahal); Department of Gynecology and Obstetrics, Emory University, Atlanta, GA (Dr Lanzer); Department of Obstetrics and Gynecology, Mount Auburn Hospital/Harvard Medical School, Cambridge, MA (Dr Noor); and Department of Obstetrics and Gynecology, University of New Mexico, Albuquerque, NM (Dr Jeppson).

Received Jan. 5, 2016; revised May 20, 2016; accepted June 7, 2016.

The authors report no conflict of interest.

Presented at the 42nd annual scientific meeting of the Society of Gynecologic Surgeons, Indian Wells, CA, April 10—13, 2016.

Corresponding author: Christopher Ripperda, MD. Christopher.Ripperda@utsouthwestern.edu