Significance of cystoscopic bladder trabeculations in women undergoing midurethral sling

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Introduction: To determine the significance of bladder trabeculations seen on preoperative cystoscopy prior to midurethral sling surgery with respect to lower urinary tract symptoms and sling outcomes.

Materials and methods: This retrospective study included women with preoperative cystoscopy who underwent midurethral slings for urinary incontinence from 2006-2009. Cystoscopic findings of bladder trabeculations, as well as pre and postoperative urinary symptoms were recorded. Patients with and without bladder trabeculations were compared with respect to baseline characteristics, lower urinary tract symptoms, and sling outcomes.

Results: Of the 241 women included in the study, 14.9% had trabeculations on preoperative cystoscopy.

At baseline, women with trabeculations were more likely to be older (64.8 years versus 57.8 years, p < 0.01), and have lower mean maximum cystometric capacity (341 mL \pm 136 versus 436 mL \pm 148, p < 0.01), compared to those without trabeculations. More women with trabeculations had mixed incontinence (p < 0.01) and less pure stress incontinence (p < 0.01) preoperatively. There was no difference between women with and without trabeculations with respect to pre and postoperative symptoms of urgency, frequency, and nocturia. Women with preoperative trabeculations were more likely to have preoperative treatment with anticholinergics (p = 0.02) and had a three times higher risk of postoperative sling failure (HR 2.95 [CI 1.11-7.85], p = 0.03).

Conclusions: Preoperative cystoscopic bladder trabeculations are associated with significantly higher rate of midurethral sling failure. Trabeculations were not associated with pre or postoperative lower urinary tract symptoms.

Key Words: bladder, cystoscopy, sling, trabeculations

Introduction

Bladder trabeculations, seen on cystoscopy, are hypertrophic and enlarged detrusor smooth muscle bundles. Trabeculations are associated with bladder outlet obstruction, urinary retention, and neurogenic bladder.^{1,2} Trabeculations have also been found to be

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Address correspondence to Dr. Ladin A. Yurteri-Kaplan, National Center for Advanced Pelvic Surgery, MedStar Washington Hospital Center, 106 Irving Street NW, POB South Suite 405, Washington, DC 20010 USA associated with urge urinary incontinence (UUI).^{3,4} However, trabeculations are common findings during routine cystoscopy in women with pelvic floor disorders. Lee at al documented incidental trabeculations in 29% of women presenting for urogynecologic evaluation on outpatient cystoscopy.⁵

Women with urinary urgency, the primary component of overactive bladder (OAB), commonly present to urogynecologists and urologists for evaluation and treatment. Urgency is defined by the International Continence Society as a sudden compelling desire to urinate, which is difficult to defer.⁶ Despite the high incidence of UUI and bladder wall trabeculations, minimal data exist regarding this relationship. UUI is one component of mixed urinary incontinence. Midurethral slings have been commonly used for the treatment of stress predominant mixed urinary incontinence.⁷ Women with UUI may have increased trabeculations on preoperative cystoscopy.³ The effect of trabeculations on sling outcomes and its impact on postoperative overactive bladder symptoms is poorly understood.

The primary aim of this study was to determine the incidence of bladder trabeculations on preoperative cystoscopy for patients undergoing sling placement for stress or mixed urinary incontinence and to evaluate associations with postoperative urgency and overactive bladder symptoms. Our secondary aim was to determine if the presence of bladder trabeculations was associated with sling outcome.

Material and methods

This IRB approved retrospective study included women who underwent preoperative cystoscopy prior to midurethral sling placement for stress or mixed urinary incontinence between January 2006 and September 2009 at a single academic center. Outpatient and inpatient medical records were reviewed for medical history, baseline patient characteristics, Pelvic Organ Prolapse Quantification (POP-Q) exams, urodynamic evaluations, and cystoscopic findings. Patient characteristics such as age, body mass index, parity, race, tobacco history, hormone therapy, medical comorbidities (hypertension, diabetes, chronic lung disease, heart disease, malignancy, and psychiatric disease), and prior pelvic surgery (hysterectomy, prolapse and incontinence procedures) were recorded. Fellowship trained urogynecologists performed cystoscopies by filling the bladder with sterile water to 300 mL or the patient's maximum cystometric capacity (MCC), if the MCC was < 300 mL. Indications for cystoscopy included refractory urgency or UUI, microscopic hematuria, or recurrent urinary tract infections. The presence or absence of trabeculations is routinely documented in the electronic medical record for all office cystoscopies. Urodynamics were performed following the Good Urodynamic Practice guidelines of the International Continence Society⁸ and included a non-instrumented uroflowmetry study, a cystometrogram filling patients to 150 mL, 300 mL, and maximal cystometric capacity (whichever came earlier) and assessment of different parameters including, urodynamic detrusor overactivity, urodynamic stress incontinence, and valsalva leak point pressure measurement, as well as pressure-flow studies.

Both retropubic and transobturator slings were performed in the standard fashion described by Ulmsten and DeLorme.^{9,10} Hydrodissection of the anterior vaginal wall at the midurethra was performed. An incision was made at the midurethra and sharp dissection used to create two bilateral tunnels to the level of the inferior pubic ramus. For a retropubic sling, the needle was passed blinded through the retropubic space toward the ipsilateral shoulder while hugging the pubic symphysis and exiting out of the premarked skin site 2.5 cm lateral to the midline. For the transobturator tape, the trocar was placed through the stab incision made at the level of the clitoris and inferior edge of adductor longus tendon. The trocar is passed through the muscles, obturator membrane, and through the predissected periurethral tunnels. Tensioning of sling assured it lay loosely at the midurethra. Vaginal epithelium was reapproximated with absorbable suture. Midurethral sling type was chosen by provider.

Patients were seen for postoperative visits at 2 weeks, 6 to 8 weeks, and 1 year. Data were recorded for these postoperative visits. Urinary incontinence, urgency, frequency, and nocturia symptoms, defined by the International Continence Society⁶, were recorded at the initial visit using a non-validated questionnaire and at postoperative office visits based on subjective complaints. Incomplete bladder emptying following sling placement was defined as a post-void residual > 100 mL. Objective evidence for sling failure was defined as any loss of urine on cough stress testing at greater than 6 week postoperative visit. Subjective stress incontinence symptoms were document if patient responded affirmatively when verbally asked by her provider, if she had any urinary leakage with coughing, sneezing, or laughing. We also compared lower urinary tract symptoms (e.g. urinary urgency, frequency, and nocturia) and sling failure rates between women with and without preoperative trabeculations.

Statistical analysis was performed using Statistical Analysis System software version 9.3 (Cary, NC, USA). For normally distributed continuous variables t-test and not normally distributed continuous variables non-parametric Wilcoxon rank sum test were used. Chi-square and Fisher's exact test were used for categorical variables. Bivarate analyses using cox proportional hazard regression were performed to determine the effect of trabeculations on sling success. A level of significance of p < 0.05 was used for all statistical tests.

Results

A total of 241 patients had preoperative cystoscopy and subsequently underwent midurethral slings for stress or mixed urinary incontinence during the study period; 14.9 % (36/241) had cystoscopic evidence of bladder trabeculations and demographic data on women with and without trabeculation is noted in Table 1. No bladder neoplasms were reported. When comparing the two cohorts of women with and without

	Trabeculations $(n - 36)$	No trabeculations $(n - 205)$	p value
Age (years)	(11 = 30) 64 8 + 12	(n = 203) 57 8 + 10 8	< 0.01
Body mass index	28.6 ± 6.8	29.0 ± 5.8	0.45
Parity	24 + 13	24 + 13	0.68
Race	2.1 ± 1.5	2.1 ± 1.5	0.87
White	17/26 (65%)	94/133 (71%)	0.07
Black	4/26 (15%)	23/133 (17%)	
Hispanic	3/26 (12%)	11/133 (8%)	
Asian	1/26 (4%)	3/133 (2%)	
Other	1/26 (4%)	2/133 (2%)	
Sexually active	15 (42%)	140 (69%)	< 0.01
Tobacco use	12 (33%)	60 (29%)	0.64
Comorbidities	28 (78%)	124 (60%)	0.04
Hypertension	21 (58%)	74 (36%)	0.01
Menopausal	32 (89%)	135 (66%)	< 0.01
Hormone therapy	13 (36%)	43 (22%)	0.06
Prior pelvic surgery	28 (78%)	126 (61%)	0.06
Prior hysterectomy	21 (58%)	84 (41%)	0.05
Prior prolapse surgery	4 (11%)	41 (20%)	0.31
Prior anti-incontinence procedure	1 (3%)	36 (18%)	0.01
Anterior wall prolapse stage II-IV	27 (75%)	112 (54%)	0.02
Overall prolapse stage II-IV	28 (78%)	133 (65%)	0.12

TABLE 1. Baseline characteristics of patients

trabeculations at baseline, those with trabeculations were older, more likely to be menopausal, had more comorbidities, hypertension, prior hysterectomy, and more severe anterior vaginal wall prolapse. Women without trabeculations were more likely to be sexually active and have a history of prior anti-incontinence procedure. There was no difference in race, parity, body mass index, or tobacco use. One hundred and thirty-six (56%) underwent retropubic sling, 95 (39%) underwent transobturator sling, and 10 (5%) underwent a single incision sling. Women were followed postoperatively for an average of 6.1 months \pm 6.4.

Of the study sample, 78% had preoperative urinary urgency, 49% had preoperative urinary frequency, and 77% had preoperative nocturia symptoms. There was no significant difference between women with and without trabeculations with respect to preoperative urinary urgency, frequency, and nocturia symptoms, Table 2.

TABLE 2.	Preoperative	bladder syn	nptoms in	patients
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	Trabeculations (n = 36)	No trabeculations (n = 205)	p value	
Preoperative urgency	32/36 (89%)	157/202 (76%)	0.06	
Preoperative frequency	18/36 (50%)	94/194 (49%)	0.87	
Preoperative nocturia	27/36 (75%)	148/192 (77%)	0.79	
Stress urinary incontinence	7/36 (19%)	89/206 (43%)	< 0.01	
Mixed urinary incontinence	28/36 (78%)	105/206 (51%)	< 0.01	

TABLE 5. Preoperative urodynamic testing in patients				
	Trabeculations (n = 36)	No trabeculations (n = 205)	p value	
Maximum cystometric capacity (mL)	340.6 ± 135.9	435.7 ± 147.6	< 0.01	
Leak point pressure (cm H ₂ 0)	66.6 ± 32.9	65.9 ± 34.9	0.93	
Pressure flow void volume (mL)	346.1 ± 181.6	465.2 ± 200.7	< 0.01	
Max flow rate (mL/min)	17.7 ± 10.0	22.4 ± 11.1	0.03	
Detrusor pressure at max flow (cm H ₂ 0)	29.7 ± 24.2	28.6 ± 20.2	0.95	
Abdominal pressure at max flow (cm H ₂ 0)	15.0 ± 20.3	18.8 ± 25.2	0.38	
Detrusor overactivity	18 (50%)	57 (28%)	0.01	
Positive cough stress test	24 (67%)	184 (90%)	< 0.01	
Voiding mechanism			0.51	
Detrusor	19 (59%)	95 (50%)		
Valsalva	7 (22%)	44 (23%)		
Mixed	6 (19%)	53 (28%)		

TABLE 3. Preoperative urodynamic testing in patients

Patients with trabeculations were more likely to have preoperative mixed urinary incontinence and less likely to have pure stress urinary incontinence symptoms compared to those without trabeculations. There was no difference between groups for preoperative incomplete bladder emptying (p = 0.11). More women with trabeculations were treated preoperatively with anticholinergics (31% versus 14%, p = 0.02).

On preoperative urodynamic testing, women with trabeculations had lower mean MCC, lower pressure flow voided volume, lower maximum flow, and more likely to have detrusor overactivity compared to women without trabeculations, Table 3. Women without trabeculations were more likely to have a positive cough stress test (90% versus 67%, p < 0.01). There was no difference between groups in leak point pressure, detrusor pressure, abdominal pressure, and voiding mechanism, Table 3.

There was no difference between groups in type of sling used (trabeculations versus without trabeculations: retropubic 50% versus 58%, transobturator 50% versus 38%, mini-sling 0% versus 5%, p = 0.24) or whether the patient underwent a concomitant hysterectomy (19% versus 15%, p = 0.48), additional procedures (69% versus 58%, p = 0.20), or posterior repair (36% versus 37%, p = 0.88). More women with trabeculations underwent an anterior and or apical repair compared to women without trabeculations (69% versus 45%, p < 0.01).

There was no difference between women with and without trabeculations who had a positive objective postoperative cough stress test (9% versus 2%, p = 0.07). Additionally, women with preoperative trabeculations

symptoms (17% (6/36) versus 7% (14/202), p = 0.02), resulting in sling failure. The hazard ratio of experiencing sling failure, defined as postoperative subjective stress urinary incontinence symptoms, is three times higher for patients with trabeculations (HR 2.95 [CI 1.11-(7.85], p = 0.03). Postoperative urgency, nocturia, and frequency symptoms were not different in patients with and without trabeculations (p = 0.72, p = 0.32, and p = 0.26, respectively). Similarly, there was no difference in postoperative retention (p = 0.56) or need for an additional procedure (p = 0.35) between women with and without trabeculations. There was a trend toward more postoperatively anticholinergic use among women with trabeculations (25% versus 12%, p = 0.05). We were unable to determine if trabeculations were associated with postoperative de novo urinary urgency due to the small number of patients in this group. Discussion

had postoperatively more subjective stress incontinence

In women requiring preoperative cystoscopy, the presence of preoperative bladder trabeculations increased sling failure defined as postoperative stress urinary incontinence symptoms. In our study, trabeculations were associated with older age and urodynamic findings of lower cystometric capacity, lower maximum flow, and detrusor overactivity in women undergoing midurethral slings. Patients with trabeculations were more likely to have preoperative mixed urinary incontinence compared to pure stress urinary incontinence. Despite this, there

was no association found between preoperative or postoperative urgency symptoms in women with and without trabeculations. Urinary urgency was common (78%) in this patient population. This is not surprising given the fact that many of the preoperative cystoscopies were performed to evaluate refractory urinary urgency symptoms.

The presence of trabeculations is associated with a 3-fold higher rate of sling failure. One explanation maybe those women may have difficulty subjectively differentiating between stress and urgency incontinence as evident based on prior studies findings to validated questionnaires.¹¹ Since women with trabeculations have a higher rate of mixed urinary incontinence, these women may perceive any postoperative urinary incontinence as a sling failure even if it is due to UUI. Another possible explanation is UUI may represent a severe form of stress incontinence. When urine enters the proximal urethra due to intrinsic sphincter deficiency, this causes a detrusor contraction which may be categorized as UUI, but is actually severe stress incontinence thus leading to higher failure rates.^{7,12} A higher failure rate among women with mixed urinary incontinence after a midurethral sling was evident in prior studies.^{7,12} In a meta-analysis reviewing 13 studies looking at women with mixed urinary incontinence who underwent any type of midurethral sling, cure rates of stress urinary incontinence were 85%-97% compared to lower cure rates of UUI 30%-85%.7

Other studies have suggested an association between trabeculations and UUI. Fielding et al compared voiding cystourethrography in elderly women with UUI and continent controls.3 The study found that 35 patients (70%) with UUI had trabeculations noted on voiding cystourethrogram compared to three controls (16%), suggesting a relationship between trabeculations and UUI.³ Furthermore, they found an association with trabeculations and mild to moderate cystoceles. Gowda et al retrospectively evaluated women presenting with pelvic floor disorders and controlled for age. They found trabeculations to be associated with an eight fold increased risk of stage 4 anterior compartment prolapse, two fold risk of detrusor overactivity, and increased UUI symptoms based on the Pelvic Floor Distress Inventory.¹³ A third study of 169 postmenopausal women with severe pelvic organ prolapse found a four fold higher risk of detrusor overactivity associated with bladder trabeculations.¹⁴ Similarly, we demonstrated an association between trabeculations and mixed urinary incontinence, detrusor overactivity, and advanced anterior wall prolapse.

Trabeculations have been associated with bladder outlet obstruction.¹⁵ This is a known finding in men

with urinary retention due to enlarged prostates. Similarly, it was described for women with bladder outlet obstruction due to prolapse¹⁵ and has been noted to be more significant in severe prolapse¹⁴ for patients with long-standing obstruction, decreased bladder compliance and capacity. Thus, in our study, it is not surprising to find that women with trabeculations have significantly lower maximum flow rates compared to those without trabeculations.

Strengths of the study include the large number of study subjects and the novelty of the subject, given our limited knowledge on this common clinical finding. Limitations of this study include selection bias due to the retrospective design and heterogeneous indications for performing a cystoscopy prior to sling placement. Physicians performing the cystoscopies were aware of the patients' underlying diagnosis of mixed urinary incontinence or overactive bladder and had reviewed the urodynamic tracings prior to cystoscopy, which may have influenced their decision to record the presence or absence of trabeculations. Although there was a large sample size, the overall number of patients with trabeculations was relatively small and data were not consistently available regarding the grade or severity of trabeculations. We were able to calculate the prevalence of bladder trabeculations in this sample, but we may not have been adequately powered to show individual differences in preoperative and postoperative urgency, frequency, and nocturia. Furthermore, subjective symptoms were not based on validated questionnaires.

Conclusions

The presence of bladder trabeculations on preoperative cystoscopy was associated with older age, lower cystometric capacity, and detrusor overactivity in women undergoing midurethral slings. There was no association found between preoperative or postoperative urgency symptoms in women with and without bladder trabeculations. Patients with bladder trabeculations had higher risk of failure after midurethral slings.

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