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ORIGINAL ARTICLE

Incidence of successful voiding and predictors of early voiding dysfunction after retropubic sling

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Abstract
Introduction and hypothesis There is a paucity of literature on resumption of normal voiding predictors after synthetic retropubic sling insertion and lack of a standardized method of determination. Our goals were to determine the incidence of a successful voiding trial; whether clinical, operative, or urodynamic variables predict discharge with a catheter; and incidence of later retention in those who were initially successful.
Methods We performed an internal-review-board (IRB)-approved retrospective chart review of 229 consecutive patients who underwent retropubic sling (TVT, Boston Scientific, Natick, MA, USA)) from 2001 to 2010. Exclusions were concomitant surgery or cystotomy at the time of retropubic sling insertion. All participants underwent a voiding trial in recovery consisting of 300 cc sterile-water retrograde fill and were discharged home without a catheter after single void of at least 200 cc following catheter removal.
Results Of 170 patients, 136 (80 %) passed the voiding trial the same day, with 165 (97 %) passing within 1 day. Factors associated with delayed voiding were age ≥65 years ($p<0.05$), presence of Valsalva voiding ($p<0.01$), lower body mass index (BMI) ($p<0.05$), and higher gravidity ($p<0.05$) and parity ($p<0.01$). Age ≥65 years [adjusted odds ratio (aOR) 3.72, 95 % confidence interval (CI) 1.40–9.90, $p<0.01$] and Valsalva voiding (aOR 3.89, 95 % CI 1.56–9.69, $p<0.01$) remained significant independent predictors in multivariate analysis.
Conclusions The majority of patients with retropubic sling can be safely discharged home the same day without a catheter after retrograde fill. Women >65 years or Valsalva voiders had nearly four times the odds of being discharged with a catheter.
Summary Most patients resume normal voiding within 24 h after retropubic sling insertion, but >65 years and Valsalva voiding are risk factors for voiding inability at discharge.

Keywords Retropubic sling · Voiding dysfunction · Urinary retention · Voiding trial · Risk factors

Introduction

Despite an evolution in the types of anti-incontinence procedures, voiding dysfunction has remained one of the consistent complications. While retropubic urethropexy was previously the gold standard treatment for stress urinary incontinence (SUI), transvaginal tape (TVT) has demonstrated a cure rate at least as successful as the retropubic urethropexy [1], and retropubic/midurethral slings have become the new gold standard. While rates of bladder perforation with TVT compared with retropubic urethropexy are reportedly higher, complication rates of retention and voiding dysfunction are lower. Rates of retention with midurethral slings have been reported from 2 to 19 % [2–4] and of voiding dysfunction requiring surgical intervention between 0.1 and 7 % for retropubic slings [3–6].

From the patient prospective, the ability to have a minimally invasive outpatient procedure with potentially earlier return to work is appealing. However, one aspect that may delay a

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patient's ability to return to work is the presence of a catheter or need to self-catheterize. While literature has identified age >65 years, increased body mass index (BMI), maximum flow rate <15-20 ml/s, and Valsalva voiding as potential risk factors for urinary retention with a fascial slings [7], not all of these risk factors have been confirmed for the synthetic retropubic sling. Reports have conflicting data but reported risks have included preoperative uroflow <15 ml/s [4] to 30 ml/s [8], high parity [9], leak-point pressure (LPP) >60 cm, and general anesthesia [9]. In clinical practice where slings have now become the new gold standard and are largely performed as outpatient procedures, data on risk factors for retention, both initially and after a successful voiding trial, for patient counseling is of increased importance. The specific aims of this study were to determine the incidence of a successful voiding trial; whether any clinical, operative, or urodynamic variables are predictive of being discharged with a catheter; and the incidence of delayed retention in those who were initially successful.

Materials and methods

After internal review board (IRB) approval, office and surgical records of 229 consecutive patients who underwent transvaginal tape (TVT) (Boston Scientific, Natick, MA, USA) sling insertion as an outpatient procedure from 2001 to 2010 were reviewed and abstracted. All cases were performed in a residency training program under the direction of a single senior female pelvic medicine and reconstructive surgery (FPMRS) physician (MM). Exclusion criteria were concomitant prolapse surgery or cystotomy at the time of TVT insertion. The latter were excluded, as all of these patients were managed with a catheter for 24 h.

All patients were evaluated preoperatively by the senior surgeon in the office using history, clinical examination, postvoid residual (PVR), assessment of urethral mobility, and deemed appropriate for treatment with a retropubic sling. All patients had preoperative urodynamic testing except those with a history of stress urinary incontinence (SUI) alone without mixed features and had positive supine empty stress test in the office ($n = 15$). The standard urodynamic measurements were collected, and for the purpose of this study, the maximal capacity, leak-point pressure (LPP) measurement at 150 ml, volume voided, maximal flow rate, and presence or absence of Valsalva during void were determined based on uroflow pattern.

The TVT procedure was performed, as previously described [10], with exception of mesh tensioning. For tensioning, the 16-F Foley catheter was replaced and a Metzebaum scissor was placed between the tape and the urethra as the outer sheath was removed. A gap of 1–2 mm was left between the tape and the urethra so that when the scissor was removed, the tape stayed in place and did not spring back, indicating there was no tension in the arms. If tape did recoil, a hemostat was placed on either side of the midline and the tape released until the sling did not spring back against the urethra when the scissor was withdrawn. Anesthesia was left to the discretion of the anesthesiologist. Patients left the operating room with the catheter.

After a standard 1 h in the postoperative recovery room, patients were taken to same-day surgery where they had a voiding trial. The bladder was retrograde filled with 300 ml of sterile water, the catheter removed, and patients were asked to void. The patient was discharged home without the catheter if she voided at least 200 ml (two thirds of the volume) in a single void. If the patient failed this voiding trial, a 16-F Foley catheter was replaced, which she was instructed to remove at home the next morning. If she was unable to void, she was instructed to call the office within 4–6 h, or sooner if she had discomfort.

For the purpose of this study, successful voiding was defined as discharge without a Foley catheter. Delayed voiding was defined as total inability to void or symptoms leading to catheterization with a resultant PVR >100 cc occurring between day 0 and 6 weeks postoperatively. PVRs were only checked if the patient had symptoms of urinary frequency or feeling of incomplete emptying.

Continuous variables initially were expressed as medians and ranges due to lack of normality of distributions. Categorical variables were expressed as numbers and percentages. Differences in demographic characteristics, surgical/obstetrical history, and urodynamic characteristics between women discharged with and without a catheter were assessed using chi-square test and Fisher's exact test for categorical variables. The independent Student's t test was used for continuous variables that were normally distributed, while the nonparametric Mann–Whitney U test was used for continuous variables that were not normally distributed. The independent predictability of demographic characteristics, surgical/obstetrical history, and urodynamic characteristics on being discharged with a catheter was examined using multiple logistic regression. A p value ≤ 0.05 was used to denote statistical significance. All analyses were performed using SPSS version 23.0 for Windows.

Results

Of the 229 patient charts reviewed, 170 consecutive patients met inclusion criteria during the study period. Median age of the 170 women was 51 years (Table 1). The study population was predominately white (96.4 %). Body mass index (BMI) varied greatly, with a median of 28.2 kg/m^2 and a range of 18.4–46.9 kg/m^2; 10 % were nulliparous. The majority of women had SUI only (69.2 %), while 30.8 % had both SUI

Table 1 Demographic, surgical, obstetric, and urodynamic data for 170 women receiving a retropubic sling

Characteristic[a]	Number	Percent
Age (years) (median and range)	51 (25–87)	
Age (years)		
<65	141	83.4
≥65	28	16.6
Race		
White	162	96.4
Black	4	2.4
Hispanic	2	1.2
Height (in.) (median and range)	65 (52–71)	
Weight (lb) (median and range)	169 (104–288)	
BMI (kg/m^2) (median and range)	28.2 (18.4–46.9)	
BMI ≥30 kg/m^2	63	37.1
Gravidity (median and range)	2 (0–8)	
Parity (median and range)	2 (0–6)	
Nulliparous	17	10.0
HRT[b]	41	36.9
Diagnosis		
SUI	117	69.2
SUI and UUI	52	30.8
Previous bladder surgery	27	16.1
Valsalva voiding (based on noninstrumented uroflows)	70	50.4
Maximum capacity (ml) (median and range)	473 (180–802)	
Valsalva LPP (cm H_2O) (median and range)	75 (15–220)	
Volume voided (ml) (median and range)	436 (0–1178)	
Maximum flow rate (ml/s) (median and range)	27 (4–425)	
Maximum flow rate (ml/s)		
<15	10	7.2
≥15	129	92.8
Type of anesthesia		
General	156	92.3
Regional	13	7.7
Anesthesia time (min) (median and range)	71 (45–120)	
Operating time (min) (median and range)	41 (15–80)	
Subjective improvement	153	91.6

BMI body mass index, *HRT* hormone replacement therapy, *SUI* stress urinary incontinence, *UUI* urge urinary incontinence, *LPP* leak-point pressure

[a] Age, diagnosis, and type of anesthesia unknown for one; race and previous bladder surgery unknown for two; Valsalva voiding and maximum flow rate unknown for 31; maximum capacity unknown for 24; volume voided unknown for 26; patient subjective improvement unknown for three

[b] Calculated for the 111 postmenopausal women

and urge urinary incontinence (UUI). Approximately half of the women had Valsalva voiding (50.4 %). The median maximum flow rate was 27 ml/s; only ten (7.2 %) women had a maximum flow rate <15 ml/s. General anesthesia was given in 92.3 % of cases. Subjective improvement in urinary incontinence was reported by 91.6 % of women.

Several variables differentiated women discharged with and without a catheter (Table 2). Those with had a significantly higher proportion ≥65 years of age (32.4 % versus 12.6 %, $p<0.05$), a significantly lower median BMI (26.4 kg/m^2 versus 28.7 kg/m^2, $p<0.05$), and a significantly higher median gravidity (3 versus 2, $p<0.05$), and parity (3 versus 2, $p<0.01$) . They also had a much higher proportion with Valsalva voiding than women discharged without a catheter (75.0 % versus 43.0 %, $p<0.01$). Age ≥65 years and Valsalva voiding remained significant independent predictors of being discharged with a catheter in the final multiple logistic regression model (Table 3). Women ≥65 years had 3.72 times the

Table 2 Demographic, surgical, obstetric, and urodynamic data for 170 women receiving a retropubic sling

	Discharged without catheter[a] (*N* = 136)		Discharged with catheter[b] (*N* = 34)		*P* value
Characteristic	*n*	%	*n*	%	
Age (years) (median and IQR)	51 (46–61)		53 (47–70)		0.11
Age (years)					
<65	118	87.4	23	67.6	<0.05
≥65	17	12.6	11	32.4	
Race					
White	129	96.3	33	97.1	1.00
Other	5	3.7	1	2.9	
Height (in.) (median and IQR)	65.0 (62.6–67.0)		64.5 (64.0–66.0)		0.78
Weight (lb) (median and IQR)	171.0 (150.0–195.8)		161.5 (142.0–188.8)		0.11
Body Mass Index (kg/m^2) (median and IQR)	28.7 (26.4–32.4)		26.4 (25.1–31.8)		<0.05
BMI ≥30 kg/m^2	53	39.0	10	29.4	0.40
Gravidity (median and IQR)	2 (2–3)		3 (2–4)		<0.05
Parity (median and IQR)	2 (1–3)		3 (2–3)		<0.01
Nulliparous	16	11.8	1	2.9	0.20
HRT[c]	32	36.8	9	37.5	1.00
Diagnosis					
SUI	96	71.1	21	61.8	0.40
SUI and UUI	39	28.9	13	38.2	
Previous bladder surgery	19	14.2	8	23.5	0.29
Valsalva voiding (based on noninstrumented uroflows)	46	43.0	24	75.0	<0.01
Maximum Capacity (ml) (median and IQR)	474 (359–590)		459 (384–564)		0.77
Valsalva LPP (cm H_2O) (median and IQR)	75 (52–92)		64 (47–99)		0.50
Volume voided (ml) (median and IQR)	434 (353–546)		478 (320–568)		0.92
Maximum flow rate (ml/s) (median and IQR)	29.0 (21.0–36.0)		24.5 (19.5–33.8)		0.25
Maximum flow rate (ml/s)					
<15	7	6.5	3	9.4	0.70
≥15	100	93.5	29	90.6	
Anesthesia					
General	127	94.1	29	85.3	0.14
Regional	8	5.9	5	14.7	
Anesthesia time (min) (median and IQR)	72.0 (65.0–81.0)		65.5 (59.5–81.5)		0.16
Operating time (min) (median and IQR)	40.0 (35.0–49.8)		41.0 (34.0–46.0)		0.72
Subjective improvement	122	90.4	31	96.9	0.31

IQR interquartile range, *HRT* hormone replacement therapy, *BMI* body mass index, *SUI* stress urinary incontinence, *UUI* urge urinary incontinence

[a] Age, diagnosis, type of anesthesia, and subjective improvement unknown for one woman; race and previous bladder surgery unknown for two; Valsalva voiding and maximum flow rate unknown for 29; maximum capacity unknown for 23; volume voided unknown for 25

[b] Valsalva voiding, maximum flow rate, and subjective improvement unknown for two women; maximum capacity and volume voided unknown for one

[c] Calculated for 87 postmenopausal women discharged without and 24 with a catheter

Table 3 Final multiple logistic regression model predicting discharged with catheter for 170 women

Characteristic	OR	95 % CI	*P* value
Age >65 years	3.72	1.40–9.90	<0.01
Valsalva voiding (based on noninstrumented uroflows)	3.89	1.56–9.69	<0.01

OR odds ratio, *CI* confidence interval

Thirty-two women not included in the model due to missing variables. The initial full model included age ≥65 years, body mass index, gravidity, parity, and Valsalva voiding. Variables not significantly predicting discharged with catheter were removed from the model in subsequent steps; estimates for the remaining variables recalculated

odds of being discharged with a catheter than women <65 years. Women who had Valsalva voiding had almost four times the odds (3.89) of being discharged with a catheter.

One hundred thirty-six (136) patients (80 %) were discharged home without a catheter after a successful voiding trial. One (0.7 %) of these patients who was initially successful and discharged home without a catheter presented to the emergency room (ER) with urinary retention of 1 L the night of surgery. She had a catheter placed for 1 week and had no residual voiding difficulties after its removal. Of the 34 patients discharged with a catheter, 29 (85 %) were able to void on postoperative day 1 after removing their own catheter. Therefore, 165 (97 %) patients voided by the end of postoperative day 1 and had no residual voiding difficulties. Of the five patients who were still not successfully voiding by the end of postoperative day 1, one presented to the ER on postoperative day 1 after failing to void following removal of her own catheter, and the remaining four patients returned to the office with complaints of voiding difficulty at <10 days postoperatively. All had a PVR >100 cc. The ER patient had a catheter placed for 5 days. Of the office patients, one had a catheter for 7 days, one for 14 days, and two were taught self-catheterization and catheterized for 8 and 17 days, respectively. No patient had persistent voiding dysfunction beyond day 17.

Discussion

Incomplete bladder emptying and urinary retention are well-recognized complications of TVT retropubic sling insertion, with reported rates between 2 and 19 % [2–4]. However, the true incidence of voiding dysfunction and retention is unclear, as the methods used to determine normal voiding are variable. On the day of surgery, time until resumption of normal voiding is difficult to determine from the literature but is a very important variable in patient counseling, as these are largely outpatient surgeries. Heterogenous surgical groups and rates are highly variable between studies; many include patients with concurrent prolapse surgery. Rates of successful voiding within 24 h in these mixed groups has been reported as ~60 % [9, 11], with 9–11 % having retention [6, 12]. A higher proportion of patients in our study were discharged without a catheter (80 %), and 97 % voided by the end of postoperative day 1. The difference with this study was that all patients had a TVT sling only, so our results were not potentially confounded by other surgeries. Retrograde filling was useful in our setting, as <1 % of patients who passed this trial re-presented with retention. No patient had voiding dysfunction at 6 weeks, and none required surgical revision. Every surgeon has their own method of determining appropriate sling tension, making a comparison between studies impossible.

The secondary outcome was to determine any identifiable risk factors for successful voiding. Age >65 years has been noted as a risk factor for catheterization after traditional fascia sling placement. On multivariate analysis by Salin et al. [13], age was noted to be a risk factor of voiding dysfunction at 3 months in a study of 100 patients undergoing TVT sling insertion. Similarly, in a study of patients having a TVT procedure only, age >65 conferred a 4.89-fold greater odds of failing a postoperative voiding trial, but on multivariate analysis, this failed to persist as a predictor. Mutone noted a trend toward an association with age but none of their reported characteristics reached statistical significance [14]. Age was not noted to be a predictor of voiding dysfunction in a report by Madhuvrata, which included patients having both a retropubic sling and a transobturator sling with or without prolapse surgery [15]. Our study noted women >65 had nearly four times the odds of being discharged home with a catheter, but only one patient had voiding dysfunction beyond 17 days.

The effect of preoperative flow rate as a risk factor for postoperative voiding is uncertain as results in the literature conflict. Studies by Minassian, Mostafa, and Bailey showed no urodynamic predictors on early postoperative voiding dysfunction [16–18]. None of those studies, however, looked at retropubic sling insertion alone; in contrast, several studies reported low flow (<15 ml/s) as a risk factor for voiding dysfunction. Duckett found low flow a risk factor for early voiding dysfunction at variable time intervals postoperatively [4]; Wang indicated a risk factor for abnormal voiding for at least 3 months [19]. While our study showed no difference between groups with regard to flow rate, patients with Valsalva voiding had almost a four-fold higher risk of being discharged with a catheter. Duckett found voiding by anything other than detrusor contraction was a risk factor, while Wang showed that an abnormal preoperative uroflow pattern was a factor for abnormal voiding [4].

Strengths of our study include a clearly defined patient population undergoing retropubic sling insertion without concomitant procedures, all operated by a single surgeon, which allowed the same surgical technique and catheter management for all patients. Also, we performed Uniform retrograde filling. This voiding trial is quick and efficient for nursing staff. If the patient failed the voiding trial, she was instructed to remove the catheter the next day in the privacy of her home, thus not requiring an office visit. Only one patient who passed the initial trial returned with retention. There was also excellent follow-up. Weaknesses of the study are that procedures were performed at a single center and analyzed retrospectively, and that Valsalva voiding was determined by the curve on uroflowmetry and not with an instrumented voiding study. This, however, was deliberate, as it was felt that this method more closely resembled a normal void. We also acknowledge the limitation of generalizability, given the low number of patients with postoperative voiding dysfunction. Multivariate

analysis was performed to control for potential confounding variables and identify significant independent predictors of being discharged with a catheter (Table 3). We readily acknowledge that characteristics of our study population, such as patients being 96.4 % Caucasian, and realize this may limit generalizability of our findings to other patient populations.

At our center, retrograde fill with measurement of voided volume was an accurate means of assessing immediate voiding function following outpatient retropubic midurethral sling placement. Patients can be counseled that most will be discharged without a catheter and that those with a catheter will be able to successfully remove it at home and have a very low risk of returning with urinary retention. Patients ≥65 years and/or those who strain to void need to be made aware that they are at higher risk of going home with a catheter; however, based on our study, long-term voiding dysfunction is uncommon.

Compliance with ethical standards

Conflicts of interest None.

References

1. Ward KL, Hilton P, UK and Ireland TVT Trial Group (2008) Tension-free vaginal tape versus colposuspension for primary urodynamic stress incontinence: 5-year follow up. BJOG 115(2): 226–233
2. Norton PA, Nager CW, Chai TC et al (2013) Risk factors for incomplete bladder emptying after midurethral sling. Urology 82(5): 1038–1041
3. Glavind K, Shim S (2015) Incidence and treatment of postoperative voiding dysfunction after the tension-free vaginal tape procedure. Int Urogynecol J
4. Duckett JR, Patil A, Papanikolaou NS (2008) Predicting early voiding dysfunction after tension-free vaginal tape. J Obstet Gynaecol 28(1):89–92. doi:10.1080/01443610701811837
5. Richter HE, Albo ME, Zyczynski HM et al (2010) Retropubic versus transobturator midurethral slings for stress incontinence. N Engl J Med 362(22):2066–2076. doi:10.1056/NEJMoa0912658
6. Sokol AI, Jelovsek JE, Walters MD, Paraiso MF, Barber MD (2005) Incidence and predictors of prolonged urinary retention after TVT with and without concurrent prolapse surgery. Am J Obstet Gynecol 192(5):1537–1543
7. McLennan MT, Melick CF, Bent AE (1998) Clinical and urodynamic predictors of delayed voiding after fascia lata suburethral sling. Obstet Gynecol 92(4 Pt 1):608–612
8. Wheeler TL, Richter HE, Greer WJ et al (2008) Predictors of success with postoperative voiding trials after a midurethral sling procedure. J Urol 179(2):600–604
9. Barron KI, Savageau JA, Young SB, Labin LC, Morse AN (2006) Prediction of successful voiding immediately after outpatient mid-urethral sling. Int Urogynecol J Pelvic Floor Dysfunct 17(6):570–575
10. Ulmsten U, Petros P (1995) Intravaginal slingplasty (IVS): an ambulatory surgical procedure for treatment of female urinary incontinence. Scand J Urol Nephrol 29:75–82
11. Moore KH, Shahab RB, Walsh CA et al (2012) Randomized controlled trial of cough test versus no cough test in the tension-free vaginal tape procedure: effect upon voiding dysfunction and 12-month efficacy. Int Urogynecol J 23(4):435–441. doi:10.1007/s00192-011-1594-x
12. Revicky V, Mukhopadhyay S, de Boer F, Morris EP (2011) Obesity and the incidence of bladder injury and urinary retention following tension-free vaginal tape procedure: retrospective cohort study. Obstet Gynecol Int. doi:10.1155/2011/746393
13. Salin A, Conquy S, Elie C et al (2007) Identification of risk factors for voiding dysfunction following TVT placement. Eur Urol 51(3): 782–787, discussion 787
14. Mutone N, Brizendine E, Hale D (2003) Factors that influence voiding function after the tension-free vaginal tape procedure for stress urinary incontinence. Am J Obstet Gynecol 188(6): 1477–1481
15. Madhuvrata P, Ford J, Merrick K, Boachie C, Abdel-Fattah M (2011) Voiding dysfunction following suburethral tape. J Obstet Gynaecol 31(5):424–428. doi:10.3109/01443615.2011.568074
16. Minassian VA, Al-Badr A, Drutz HP, Lovatsis D (2004) Tension-free vaginal tape, Burch, and slings: are there predictors for early postoperative voiding dysfunction? Int Urogynecol J Pelvic Floor Dysfunct 15(3):183–187
17. Mostafa A, Madhuvrata P, Abdel-Fattah M (2011) Preoperative urodynamic predictors of short-term voiding dysfunction following a transobturator tension-free vaginal tape procedure. Int J Gynaecol Obstet 115(1):49–52. doi:10.1016/j.ijgo.2011.04.009
18. Bailey C, Matharu G (2012) Conservative management as an initial approach for postoperative voiding dysfunction. Eur J Obstet Gynecol Reprod Biol 160(1):106–109. doi:10.1016/j.ejogrb.2011.09.025k
19. Wang KH, Wang KH, Neimark M, Davila GW (2002) Voiding dysfunction following TVT procedure. Int Urogynecol J Pelvic Floor Dysfunct 13(6):353–357, discussion 358