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Risk factors for postoperative urinary tract infection following midurethral sling procedures

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ABSTRACT

Objective: To identify the potential risk factors for urinary tract infections following midurethral sling procedures.

Study design: 556 women who underwent midurethral sling procedure due to stress urinary incontinence over a four-year period were reviewed in this retrospective study. Of the study population, 280 women underwent TVT procedures and 276 women underwent TOT procedures. Patients were evaluated at 4–8 weeks postoperatively and were investigated for the occurrence of a urinary tract infection. Patients who experienced urinary tract infection were defined as cases, and patients who didn't were defined as controls. All data were collected from medical records. Multivariate logistic regression model was used to identify the risk factors for urinary tract infection.

Results: Of 556 women, 58 (10.4%) were defined as cases while 498 (89.6%) were controls. The mean age of women in cases (57.8 ± 12.9 years) was significantly greater than in controls (51.8 ± 11.2 years) ($p < 0.001$). The presence of menopausal status, previous abdominal surgery, preoperative antibiotic treatment due to urinary tract infection, concomitant vaginal hysterectomy and cystocele repair, TVT procedure and postoperative postvoiding residual bladder volume ≥100 ml were more common in cases than in controls. However, in multivariate regression analysis model presence of preoperative urinary tract infection [OR (95% CI) = 0.1 (0.1–0.7); p = 0.013], TVT procedure [OR (95% CI) = 8.4 (3.1–22.3); p = 0.000] and postoperative postvoiding residual bladder volume ≥100 ml [OR (95% CI) = 4.6 (1.1–19.2); p = 0.036] were significant independent risk factors for urinary tract infection following midurethral slings

Conclusion: Urinary tract infection after midurethral sling procedures is a relatively common complication. The presence of preoperative urinary tract infection, TVT procedure and postoperative postvoiding residual bladder volume ≥100 ml may increase the risk of this complication. Identification of these factors could help surgeons to minimize this complicationby developing effective strategies.

Introduction

Anti-incontinence surgery has been associated with acute urinary tract infection (UTI) [1]. Depending on the diagnostic methods and criteria used, current literature estimates an incidence of 6–48% for acute UTIs following anti-incontinence surgery [2–5]. Nowadays, there are many surgical treatment options for female urinary incontinence. Burch retropubic colposuspension and pubovaginal slings are appropriate traditional treatment options for selected patients. Recently, because of the ease of performing them and the high success rates achieved, midurethral sling (MUS) procedures have revolutionized the surgical treatment of female urinary incontinence and have become the new gold standard surgical treatment option for female urinary incontinence. However, the incidence of acute UTI subsequent to MUS procedures compared to traditional anti-incontinence surgical options has not changed thus far [6].

The vagina is a clean/contaminated surgical space [7]. Thus, during MUSs, transvaginal and transurethral transactions may lead to UTIs [8]). However, there is still no exact consensus regarding routine postoperative antibiotic treatment for these operations [8–10]. Identifying women who are at risk for UTI following MUS procedures may be beneficial for empirical antibiotic treatment. In light of all this information, we aimed to identify the potential risk factors for UTI.

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Material and methods

This retrospective cohort study consisted of 556 women who had undergone MUS procedures for stress urinary incontinence (SUI) at the Department of Obstetrics and Gynaecology, Zekai Tahir Burak Woman's Health Education and Research Hospital, Ankara, Turkey, from January 2010–January 2014. Regional hospital ethics committee approval was obtained before beginning the study. 280 women underwent Tension free vaginal tape (TVT) procedures and 276 women underwent Transobturator tape (TOT) procedures. All surgeries were performed by the same surgical team (M.D., S.C., M. K.K., O.S.A.). The TOT technique was performed in accordance with Delorme's description [11] of the outside-in technique, while the TVT technique was carried out according to the method described by Ulmsten et al. [12,13]. The same type of tape material consisting of a polypropylene, monofilament mesh with pore diameters greater than 75 μm (macroporous) measuring 1.1 cm in width and 40 cm in length was used for both of the slings.

All variables, including preoperative history, general physical examination, detailed urogynecological examination, intra- and preoperative data, prescriptions, and all postoperative visits involving laboratory results in the first 8 weeks following MUS procedures, were collected from hospital records.

Intravenous prophylactic antibiotics were systematically administered to all women within 1 h before incision time. For non-penicillin-allergic patients, a first-generation cephalosporin (cefazolin 2 g) was given preoperatively and was repeated at 3 h for extended surgeries. For penicillin-allergic patients, clindamycin (600 mg) was used as a single agent.

A urinary catheter was inserted for 24 h postoperatively into each patient, and removed on the first postoperative day. In order to assess for adequate emptying, the residual bladder volume following the first void was measured by urinary catheterization. If the postvoiding residual bladder volume was ≥150 ml and/or difficulty in emptying the bladder was present (defined as voiding dysfunction), urinary catheterization was reinserted for three days and a daily 50 mg dose of nitrofurantoin was utilized during this period. If the voiding dysfunction was persistent, mesh materials were surgically released before discharge from the hospital.

Patients were seen at 4–8 weeks postoperatively for their first examination. During this evaluation, all patients were investigated for the occurrence of a symptomatic UTI, which was defined in accordance with Centers for Disease Control criteria [14]. For UTI definition, patients were asked about postoperative lower urinary tract symptoms, including urgency, frequency, dysuria, and suprapubic or costovertebral angle pain. For patients with any of these symptoms, an urinalysis and culture were ordered to evaluate UTI. Additionally, urinalysis and urine culture were also performed if a patient complained about febrile morbidity or any of the lower urinary tract symptoms mentioned above and admitted to hospital in the first postoperative 8 weeks. The urine samples were collected as clean-catch midstream urine in sterile bottles. Significant bacteriuria was considered positive if the urine culture grew only a single species of bacteria at a density of at least 10^5 colony-forming units (CFU) per ml of urine.

Patients who experienced UTI during the postoperative period were defined as cases, and patients who did not, were defined as controls. Patients who were discharged from the surgery center with a Foley catheter after the repair of an intraoperative bladder (since postoperative antibiotics treatments which may lead bias were used for these patients), who had any documented infection site such as an infected wound or current pneumonia, or who had insufficient data were excluded.

Statistical analyses were carried out by using the statistical packages for SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA). Data are presented as mean ±standard deviation or number and percentage. In order to examine risk factors, Student's *t*-test was used to compare means of continuous data, and Chi-squared test was used for analysis of numbers and percentages. Risk factors for UTI following MUS procedures identified in the two tailed statistical analyses were included in the multivariate logistic regression analysis. A significance level of $p < 0.05$ was used for all analyses.

Results

For this study, primarily 606 women who underwent TOT or TVT procedure were reviewed retrospectively. 12 patients were excluded because of intraoperative bladder perforation and

Table 1
Characteristics of the cases and controls.

	Cases (n = 58)	Controls (n = 498)	p*
Woman's age (years)	57.8 ± 12.9	51.8 ± 11.2	<0.001
Parity (numbers)	3.9 ± 1.2	3.7 ± 1.2	0.561
BMI (kg/m^2)	29.6 ± 4.9	29.5 ± 4.2	0.950
BMI ≥30 kg/m^2	22 (37.9)	232 (46.6)	0.218
Menopausal status	42 (72.4)	248 (49.8)	0.001
Current smoking	6 (10.3)	88 (17.7)	0.156
Diabetes mellitus	10 (17.2)	76 (15.3)	0.698
Previous POP surgery	4 (6.9)	56 (11.2)	0.340
Previous anti-incontinence surgery	4 (6.9)	21 (4.2)	0.652
Previous abdominal surgery	17 (29.3)	63 (12.7)	**0.018**
Preoperative treatment for UTI	35 (60.3)	198 (39.8)	**<0.001**
Concomitant abdominal hysterectomy	1 (1.7)	14 (2.8)	0.635
Concomitant vaginal hysterectomy	35 (60.3)	197 (39.6)	**0.018**
Concomitant cystocele repair	47 (81.0)	343 (68.9)	**0.048**
Concomitant rectocele repair	51 (87.9)	388 (77.9)	0.078
TOT/TVT	15 (25.9)/43 (74.1)	261 (52.4)/237 (47.6)	**<0.001**
Postoperative hospital stay (day)	2.2 ± 1.0	1.96 ± 1.0	0.799
Postvoiding residual volume ≥100 ml	33 (56.9)	141 (28.3)	**<0.001**
Postoperative voiding dysfuction	11 (19.0)	58 (11.6)	0.108

Data presented as mean ± standard deviation or n (%).
BMI: Body mass index; POP: Pelvic organ prolapse; UTI: Urinary tract infection; TOT: Transobturator tape.
TVT: Tension free vaginal tape.
*$p < 0.05$ was considered as statistically significant.

discharged from hospital with Foley catheter. During the postoperative period, in 11 and 5 women, wound infections and respiratory system infections were reported, respectively. They received multiple-dose antibiotics treatment for 7–14 days and were excluded. 22 patients were excluded because of insufficient data. Finally, 556 patients were available for the analysis. Among this study population, 58 (10.4%) patients were defined as cases while 498 (89.6%) patients were controls.

Table 1 summarizes the characteristics of the groups. Cases and controls were similar with regard to mean of parity, body mass index (BMI), hospital stay period and incidence of BMI $\geq$30 kg/m^2, current smoking, diabetes mellitus, previous pelvic organ prolapse and anti-incontinence surgery, concomitant abdominal hysterectomy and rectocele repair and postoperative voiding dysfunction. The mean age of women in cases (57.8 $\pm$ 12.9 years) was significantly greater than in controls (51.8 $\pm$ 11.2 years) ($p < 0.001$). When we compared with controls, the incidence of menopausal status (72.4% and 49.8%, respectively) and previous abdominal surgery (29.3% and 12.7%, respectively) were more common in cases ($p = 0.001$ and $p = 0.018$, respectively). 35 (60.3%) women in cases and 198 (39.8) women in controls received preoperative antibiotics treatment for UTI. Cases were more likely to have preoperative UTI ($p < 0.001$). During the operations, concomitant vaginal hysterectomy and cystocele repair were performed with a higher incedence among cases (60.3% and 81.05, respectively) compared to controls (39.6% and 68.9%, respectively) ($p = 0.018$ and $p = 0.048$, respectively). Comparisons of the MUS types between the groups revealed that cases were more likely to be undergoing TVT instead of TOT ($p < 0.001$). Also, the incidence of postoperative postvoiding residual bladder volume $\geq$100 ml was significantly higher in cases (56.9%) than in controls (28.3%) ($p < 0.001$).

The effects of all factors in Table 1 on each other were evaluated with multivariate logistic regression model. Table 2 shows the results of the multivariate analysis and lists the independent risk factors for postoperative UTI following MUS procedures. Receiving preoperative antibiotics treatment for UTI, TVT procedure and the presence of postoperative postvoiding residual bladder volume $\geq$100 ml were significant independent risk factors for developing UTI after MUS.

Comment

In our study, UTI after MUS operations was documented as a relatively common complication, with an incidence of 10.4%, in which UTI was found in 15 of 276 (5.4%) and 43 of 280 (15.4%) women who had undergone TOT and TVT, respectively. Our results were similar to the recent Trial of Midurethral Slings (TOMUS) involving 588 patients, which reported a 12% (34/293) incidence of postoperative UTI with retropubic MUS procedures and a 7% (21/295) incidence with transobturator MUS procedures within the first postoperative 6 weeks [15].

Table 2
Multivariate logistic regression analysis of the risk factors.

	Wald	OR (95% CI)	p
Woman's age $\geq$60	0.9	1.9 (0.5–7.0)	0.349
Menopausal status	2.0	0.4 (0.1–1.4)	0.159
Previous abdominal surgery	0.5	2.6 (0.2–34.0)	0.466
Preoperative treatment for UTI	6.2	0.1 (0.1–0.7)	0.013
Concomitant vaginal hysterectomy	0.1	1.3 (0.4–4.3)	0.721
Concomitant cystocele repair	2.6	5.1 (1.0–26.7)	0.086
TVT procedure	18.1	8.4 (3.1–22.3)	0.000
Postvoiding residual volume $\geq$ 100 ml	4.4	4.6 (1.1–19.2)	**0.036**

OR: odds ratio; CI: confidence interval.
UTI: Urinary tract infection; TVT: Tension free vaginal tape.
*$p < 0.05$ was considered as statistically significant.

Currently, there is a lack of well-defined data about the potential risk factors for UTI after MUS procedures. Unique to our study, we analyzed several pre-, intra-, and postoperative potentially associated risk factors with the hope of suggesting relevant precautions in order to minimize postoperative UTI rates following the MUSs.

Our study revealed that receiving antibiotics treatment due to preoperative UTI was the only preoperative risk factor for postoperative UTI following MUS surgery, which is similar to the largest study to date combining the results of SISTER and TOMUS trials, conducted by Nygaard et al. [16]. There is no obvious reason why preoperative UTI increased the risk of postoperative UTI, even if it was treated properly. It is possible that there may be some patient-related factor which could not be detected due to the retrospective design of our study, such as behavioral or genetic properties.

MUS type was a significant risk factor for postoperative UTI. Namely, TVT has increased the risk as compared to TOT. Our clinical practice may be the cause of this difference. We perform cystoscopy during TVT procedures in order to rule out lower urinary tract injury, but not during TOT procedures. This increased instrumentation may predispose to introduction of uropathogens into the urethral and bladder cavity. This instrumental introduction of pathogens, in addition to the possible mechanical microtraumas caused by cystoscopy, potentially induces the colonization of uropathogens [17,18].

Postoperative postvoiding residual bladder volume $\geq$100 ml was found to increase the postoperative UTIs in our study. This similar finding has also been documented in some previous studies, but not in others [19,20]. The exact mechanism of impaired bladder emptying in the etiology of UTI is not well-determined. However, especially for early postoperative voiding problems, longer catheterization is used, which may further induce the accumulation of uropathogens, in combination with elevated postvoiding residual bladder volume. Therefore, we believe that more studies are needed to clarify the role of elevated postvoiding residual bladder volume.

Several possible pre-, intra-, and postoperative risk factors for UTI following MUS procedures have been evaluated in our study. However, most of these have not proven to be significant factors. Among these, age, menopausal status, previous abdominal surgery, preoperative cystocele and rectocele, and concomitant cystocele repair seemed to have a trend toward significance with risk of UTI that is likely due to the lack of power.

This study had some weaknesses. The major weakness was its retrospective design, which may lack enough strength to establish a causal relationship between possible risk factors for UTI after MUS. Also, as mentioned above, we were unable to include several other factors that may be associated with UTI such as behavioral and genetic properties and sexual activity. The same type and size of mesh materials were used for the procedures, so we could not evaluate any mesh-related risks. Lastly, our study was conducted using data from a single center in Turkey, thus someone may think that our findings cannot be generalized to other populations.

In conclusion, the present study demonstrated that UTI following MUS procedures was a relatively common complication. The presence of preoperative UTI, the TVT procedure, and postoperative postvoiding residual bladder volume $\geq$100 ml were defined as significant risk factors for postoperative UTI. Identification of these factors could allow prevention and minimization of this complication through the development of effective strategies and the optimization of antibiotics usage. However, we believe that further prospective studies are needed before more definitive recommendations can be made.

Conflict of interest

The authors report no conflict of interest.

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