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Risk factors for voiding dysfunction following midurethral sling operations

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Abstract

We aimed to identify risk factors for postoperative voiding dysfunction following tension-free vaginal tape (TVT) or trans obturator tape (TOT). A retrospective case-control study was conducted on patients who underwent mid-urethral sling procedures over a four-year- period by the same surgical team. The patients were divided into two groups. Patients who needed to loosen the tape materials surgically before being discharged due to persistent postvoid residual bladder volume ≥150 ml and/or difficulty in emptying the bladder were described as postoperative voiding dysfunction (case group). The patients who did not need it were the control group. Demographic information, voiding symptoms, urodynamic evaluation, and intraoperative data were collected from the hospital's medical records. Of 167 patients, 29 (17.4%) were in the case group and 138 (82.6%) were in the control group. At univariate analysis, age, menopausal status, preoperative valsalva leak point pressure measurement, presence of preoperative ≥ grade 3 pelvic organ prolapse, TVT procedure, concomitant anterior colporrhaphy, and vaginal hysterectomy were associated with voiding dysfunction. Multivariate logistic regression revealed that menopausal status, TVT procedure, and concomitant anterior colporrhaphy were significant predictors of postoperative voiding dysfunction.The present study indicated that postoperative voiding dysfunction is more often after TVT than after TOT procedures. Menopausal status and concomitant anterior colporrhaphy increased the risk of postoperative voiding dysfunction. Recognition of these risk factors may enable surgeons to minimize this complication.

Keywords: postoperative complication, TOT, TVT, voiding dysfunction

1. Introduction

Urinary incontinence (UI) is identified as ‘‘objectively demonstrable unintended urinary leakage that can cause social and hygienic problems’’ (1). It is critical to accurately state the kind of incontinence so as to choose the cheapest and most effective treatment method for the treatment of UI (2). The most widespread kind of UI is the stress urinary incontinence (SUI). It is urinary incontinence during conditions that elevate intra-abdominal pressure and is defined as a form of UI that happens when the intravesical pressure greater than the urethral pressure without increased activity in the detrusor muscle (3). Urge urinary incontinence (UUI) is a urinary incontinence circumstance that accompanies a strong urge to urinate (4).

Among the types of incontinence, SUI patients are the patient group that can benefit most from surgery among the treatment options, and surgical treatment is often required. Many surgical techniques have been developed, vaginally and abdominally (5). Tension-free vaginal tape (TVT) surgery that was defined by Ulmsten in 1996, and Trans obturator tape (TOT) technique that was defined by Delorme in 2001 (6,7,).

Complications of TVT and TOT operations include bladder perforation, mesh erosion, bleeding, soft tissue infections, urinary tract infections, bowel injury, ureteral injuries, vaginal lacerations, and postoperative voiding disorders. The rate of voiding dysfunction after surgery ranges from 7.8% to 84%. This is associated with prolonged postoperative catheterization, increased urinary tract infections, the need for a second operation, higher healthcare costs, and reduced patient satisfaction. It will be helpful to state the risk factors correlated with postoperative voiding dysfunction in order to provide information to the surgeon in the preoperative period and appropriate counseling to patients who will undergo mid-urethral sling (MUS) operations (8). Thus, the purpose of the study is to determine the risk factors that contribute to postoperative voiding dysfunction in patients who have undergone TVT or TOT procedures.

2. Materials and Methods

This retrospective-case-control study was managed to patients who were diagnosed with SUI and underwent TVT or TOT operation from January 2013 to December 2016 in the gynecology department at a tertiary hospital. After obtaining ethical approval from Research Ethical Committee, the files of the patients who were operated on within the study period were

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reviewed from the hospital's archive (Approval number: 13.02.2017-21). This research complies with privacy legislation and follows the Helsinki Declaration.

The clinical, and sociodemographic data, laboratory findings, gynecological examination, and urodynamic examination results of each patient were recorded. Abstracted data contained age, menopausal status, obstetric history, body mass index (BMI), chronic systemic diseases, medications, and previous pelvic and urogynecological surgery history. Pelvic organ prolapse (POP) grading of the patients was done according to the Baden-Walker classification (9). In the preoperative evaluation, postvoiding residual urine volume was determined by applying a urinary catheter. A preoperative urodynamic evalutaion was applied according to ICS standards (10). The urinary incontinence kind of all patients was confirmed by urodynamic examination. Anesthesia type and duration of the patients' operations, MUS type, other accompanying surgical procedures (anterior colporrhaphy, posterior colporrhaphy, and vaginal hysterectomy), and the presence of complications were noted. TOT and TVT operations were applied to the patients as MUS operations. The TOT operation was performed by the same experienced team as described by Delorme and the TVT operation by Ulmsten, using the same type of mesh material (1.1 cm x 40 cm, polypropylene, monofilament braided) (6,7). The patients were followed up with urinary catheterization for 24 hours postoperatively, and then the catheter was removed. After catheter removal, the residual urine volume was measured. When the residual urine volume was above 150 ml or in the presence of voiding difficulty, urinary catheterization was applied again for 3 days. In case of residual urine excess or voiding difficulty despite this additional 3 days of catheterization, the mesh material placed during the MUS operation was surgically loosened for the patients. Patients who underwent mesh loosening were identified as patients who developed postoperative voiding dysfunction and constituted the case group in our study. The patients who were discharged without any problem after the operation constituted the control group. Patients with preoperative voiding dysfunction, neurological disease, or drug use that may cause urinary retention, intraoperative complications, postoperative urinary tract infection, and insufficient data were excluded.

2.1. Statistical Analysis

Statistical analysis was performed using IBM SPSS for Windows, Version 25.0 software. The distributions of the data were checked by the Kolmogorov-Smirnov test. In the case of normally distributed variables, parametric methods were applied, whereas in the case of non-normally distributed variables, nonparametric methods were applied. Normally distributed continuous variables were evaluated with the Independent Student's T-test. In order to determine the difference between categorical variables, we used the Chi-square test. Continuous variables were reported as mean±standard deviation, and categorical variables as numbers (n) and percentages (%). The multiple effects of possible risk factors for postoperative voiding dysfunction were evaluated by logistic regression analysis. A p-value less than 0.05 was deemed significant.

3. Results

Medical records of 338 patients were reviewed, of which 171 patients were excluded. The final analysis included 167 patients, 29 of whom developed voiding dysfunction after MUS surgery, and 138 were discharged without any problems. There was a statistically significant difference between the mean age of the patients in the case and control groups (54.44±11.54 vs. 49.36±8.55, p=0.007). It was also found that 21 (72.4%) of the patients in the case group and 45 (32.6%) of the patients in the control group were in menopause, and a statistically significant difference was found between the two groups (p<0.001). A statistically significant difference was not found between the two groups in terms of gravida-parity numbers, BMI, history of chronic diseases, a history of macrosomic birth, and previous urogynecological or pelvic surgery history (Table 1).

Table 1. Comparison of Study Groups by Demographic Characteristics (n=167)

	Case group (n=29)	Control group (n=138)	p
Age (years)	54.44±11.54	49.36±8.55	0.007
Gravida	4.34±1.67	4.47±1.34	0.798
Parity	3.24±0.83	3.08±1.01	0.575
BMI (kg/m^2)	30.49±3.88	29.67±3.76	0.291
Menopause status	21 (72.4)	45 (32.6)	<0.001
Diabetes mellitus status	4 (13.8)	13 (9.4)	0.479
Hypertension status	9 (31.0)	29 (21.0)	0.242
Asthma status	4 (13.8)	18 (13.0)	0.914
History of macrosomic birth	6 (20.7)	29 (21.0)	0.969
History of urogynecological surgery	2 (6.9)	4 (2.9)	0.293
History of pelvic laparotomy	5 (17.2)	26 (18.8)	0.840

Data are shown as Mean±Standard Deviation and number (n) and percentages (%). BMI: Body Mass Index p<0.05 was considered statistically significant.

Regarding accompanying POP, no significant difference was observed between groups, except POP grade 3 and above (p=0.004). In both groups, statistically significant differences were observed regarding valsalva leak point pressure (VLPP) (p=0.018), however, no differences were observed regarding detrusor overactivity, bladder capacity, or maximum urethral

closure pressure (MUCP) (Table 2).

Table 2. Comparison of Urogynecological Evaluation Results of Study Groups (n=167)

	Case group (n=29)	Control group (n=138)	p
Overactive bladder symptoms			
Urgency	12 (41.4)	46 (33.3)	0.408
Frequency	5 (17.2)	18 (13.0)	0.551
Nocturia	6 (20.7)	19 (13.8)	0.342
≥Grade 2, presence of POP	24 (82.8)	108 (78.3)	0.589
≥Grade 3, presence of POP	13 (44.8)	27 (19.6)	0.004
Bladder capacity (ml)	453.52±54.34	457.02±49.78	0.735
Presence of detrusor overactivity	10 (34.5)	33 (23.9)	0.237
VLPP (cm H_2O)	70.55±34.86	54.92±31.49	0.018
MUCP (cm H_2O)	63.34±23.75	67.96±24.72	0.329
Type of incontinence			
SUI	19 (65.5)	105 (76.1)	0.237
SUI+UUI	10 (34.5)	33 (23.9)	

Data are shown as mean±standard deviation and number (n) and percentages (%). POP: Pelvic Organ Prolapse VLPP: Valsalva leak point pressure MUCP: Maximum Urethral Closure Pressure SUI: Stress Urinary Incontinence UUI: Urge Urinary Incontinence p<0.05 was considered statistically significant.

The frequency of TVT and anterior colporrhaphy accompanying MUS operation was significantly higher in the case group than the control group (p<0.001; p=0.024) (Table 3). Factors that may be effective in the postoperative voiding dysfunction were investigated by multiple regression analysis. Age (p=0.487), VLPP value (p=0.15), presence of ≥G3 POP (p=0.253), and vaginal hysterectomy (p=0.452) were not detected to be significant factors for postoperative voiding dysfunction. Moreover, the presence of menopause (Wald=6.20, OR=4.59, 95% CI=1.38-14.73 P=0.013), TVT (Wald=15.77, OR=16.26, 95% CI=4.12-64.37 P<0.001) and anterior colporrhaphy (Wald=4.10, OR=4.51, 95% CI=1.05-20.05 P=0.043) were detected to be significant independent variables (Table 4).

Table 3. Comparison of Study Groups by Intraoperative Characteristics (n=167)

	Case group (n=29)	Control group (n=138)	p
Type of anesthesia			0.949
General	9 (31.0)	42 (30.4)	
Regional	20 (69.0)	96 (69.6)	
Anesthesia time (min)	102.93±35.34	100.04±37.06	0.497
MUS type			<0.001
TVT	26 (89.7)	50 (36.2)	
TOT	3 (10.3)	88 (63.8)	
Concomitant operations			
Anterior colporrhaphy	20 (69.0)	68 (49.3)	0.024
Posterior colporrhaphy	14 (48.3)	60 (43.5)	0.816
Vaginal hysterectomy	6 (20.7)	12 (8.7)	0.058

Data are shown as mean±standard deviation and number (%). MUS: Mid-urethral Sling TVT: Tension-free Vaginal Tape TOT: Trans Obturator Tape p<0.05 was considered statistically significant.

Table 4. Multiple Regression Analysis Results of Factors That May Be Effective in the Development of Postoperative Voiding Dysfunction

	Wald	P	OR	95% CI
Age	0.48	0.487	0.97	0.90-1.05
VLPP	2.07	0.150	1.01	1.00-1.03
Menopause status	6.20	0.013	4.59	1.38-14,73
≥Grade3, presence of POP	1.31	0.253	2.11	0.59-7.64
TVT	15.77	<0.001	16.26	4.12-64.37
Anterior colporrhaphy	4.10	0.043	4.51	1.05-20.05
Vaginal hysterectomy	0.57	0.452	0.53	0.10-2.74

OR: Odds Ratio, CI: Confidence Interval POP: Pelvic Organ Prolapse VLPP: Valsalva leak point pressure TVT: Tension-free Vaginal Tape p<0.05 was considered statistically significant.

4. Discussion

Although UI is a common health concern that reduces the quality of life and negatively affects social life (10). Therefore, UI should be considered as a health problem, regardless of the age of the patient. An accurate diagnosis is critical and patients should be directed to appropriate treatment. Patients with SUI can benefit most from surgery among the treatment options (5). MUS operations can be applied and voiding dysfunction may occur after these operations.

The incidence of postoperative voiding dysfunction ranges

from 7.8% to 84% (8). In our study, this rate was 17.4%. The difference between studies can be attributed to patient characteristics, the use of different surgical techniques, and the use of different standard definitions of voiding dysfunction among different teams. According to Groutz et al. (11) and Ambroise et al., (12) a postoperative residual urine volume of 100 ml and above was considered the lower limit for the development of voiding dysfunction; this limit was 200 ml according to Stanton et al. (13) and Chang et al. (14) By applying ICS standards in our study, we defined the presence of residual urine excess or voiding difficulty despite 3-day urinary catheterization as postoperative voiding dysfunction when the postvoid residual urine volume is above 150 ml or voiding difficulty (10). We considered that this describtion is helpful for standardizing the describtion of postoperative voiding dysfunction.

Salin et al. (12) and Mutone et al. (15) demonstrated that aging is a critical risk factor for postoperative voiding dysfunction. Similarly, Vervest et al. (16) showed that concomitant menopause with increasing age is a significant risk factor for developing postoperative voiding dysfunction. In our study, the case group was older and menopausal compared to the control group. We assumed that advanced age and the presence of menopause may be risk factors for postoperative voiding dysfunction. As age advances, bladder capacity, compliance, and urinary flow rate decrease, and post-void residual urine volume increases. In addition, MUCP and functional urethral length decrease with age (17). Aging patients may experience an increase in symptoms associated with the lower urinary system due to anatomical and physiological changes (18). Vaginal atrophy that occurs with menopause causes frequent urination, dysuria, urinary incontinence, and difficulty in urination. Studies have shown that vaginal estrogen therapy improves lower urinary tract symptoms in postmenopausal women (19). In patients with voiding dysfunction following MUS surgery who are in menopause, we may consider vaginal estrogen therapy as a treatment option.

Previous studies found that low BMI in addition to increasing age was a risk factor for postoperative voiding dysfunction (20,21). However, we found no difference in BMI in our study. Similar to our study, Dawson et al. (22) and Park et al. (23) did not detect a relationship between BMI and voiding dysfunction. Therefore, in our opinion, studies with larger patient populations are needed to determine the definitive effect of BMI on voiding dysfunction. In line with our study results, Dawson et al. (22) and Karin et al. (24) could not find a relationship between parity and the development of voiding dysfunction.

In previous studies, it was stated that there was a statistically significant difference between mean bladder capacity (25). Even though the authors have suggested that having a high bladder capacity in the preoperative period is a protective factor with reference to the risk of postoperative voiding dysfunction, they emphasized that it was important to work with a much more patient population in the conclusion of their study, since the total number of patients was 100. Despite a larger number of patients included in this research, mean bladder capacity of the case group was greater than the control group, but there was no statistically significant difference between the two groups. Chang et al. (14) showed that the presence of detrusor overactivity among the preoperative urodynamic findings was significantly higher in the case group than the control group. In our study, however, there was no difference in terms of the presence of detrusor overactivity. Because this study was limited to patients who developed voiding dysfunction after TOT operation. Also, Chang et al. (14) defined preoperative voiding difficulty and a history of urinary retention as independent risk factors for postoperative voiding dysfunction. In our study, however, preoperative voiding dysfunction or urinary retention were among the exclusion criteria. Previous studies indicated that the risk of developing voiding dysfunction increases in patients with postoperative urinary tract infections in the early postoperative period.[26] In our study, urinary tract infection is among the exclusion criteria as it may cause the development of voiding dysfunction independent of the operation.

A study by Park et al. (23) examined the urodynamics of patients in the preoperative period and reported that the mean VLPP and MUCP values did not differ between the groups. In this study, a difference in mean VLPP and MUCP measurements between the case and control groups was not demonstrated. These results reflect those of Ripperda et al. (8) who also did not find any significant differences in preoperative urodynamic examination findings. It can thus be suggested that preoperative urodynamic parameters do not play a defining role in postoperative voiding dysfunction.

A recent study reported a higher rate of voiding dysfunction after MUS operation in patients previously operated for POP (26). The main weakness in their study is that they overlooked the effect of the presence of POP accompanying existing urinary incontinence on the development of voiding dysfunction after MUS operation. An even greater source of the issue was that no classification was used for the grading of POP. Our results differed slightly from those of Hayser et al.'s study findings. Our analysis showed significant differences between the case and control groups in the presence of POPs accompanied by grade 3 and higher. However, not with an accompanying POP grade 2 or higher.

In the current study, evaluating anesthesia types and average anesthesia duration did not demonstrate any difference between the two groups. Although there has been no study of the literature concerning anesthesia types and durations of the cases in detail, Risperda et al. (8) stated that spinal anesthesia and Chang et al. (14) general anesthesia might increase the risk for postoperative voiding dysfunction. Regression analysis in

these studies, however, was also statistically insignificant.

A study emphasized that the rate of development of voiding dysfunction after the TVT operation was higher than after the TOT operation (TVT 18.3%, 11.0% after TOT, $p < 0.05$) (27). This finding was also reported by Tahseen et al. (28) and Jeffry et al. (29). In our study, the prevalence of TVT was higher in the case group than in the control group. It can thus be suggested that it may cause more post-operative voiding dysfunction since the sling in TVT is more upright and stronger than in TOT. In their multicenter case-control study, Molden et al. noted that the presence of simultaneous surgery accompanying the MUS operation increased the risk of developing postoperative voiding dysfunction. However, they did not differentiate between the types of accompanying operations (30).

In the present study, the incidence of anterior colporrhaphy accompanying MUS operation was higher in the case group. On the other hand, no significant difference was found in postoperative voiding dysfunction in posterior colporrhaphy or vaginal hysterectomy accompanying MUS operation. This can be explained by the fact that anterior colporrhaphy causes a wider incision, more local edema and local inflammation, and more fibrosis development after the surgery.

Retrospective design was the main weakness of our study. As anticipated, it was not possible to assess conditions such as race, ethnicity, and genetic factors that may cause voiding dysfunction due to the study design. On the other hand, it was an advantage in terms of the correct interpretation of the study results, that there are more study groups compared to similar studies in the literature and that the applied procedures were performed by the same team with the same standards.

Postoperative voiding dysfunction was associated with prolonged postoperative catheterization, increased urinary tract infections, the need for a second operation, and decreased patient satisfaction. In our study, performing a TVT operation, the presence of a simultaneous anterior colporrhaphy procedure, and being in the postmenopausal period were significant risk factors for the development of postoperative voiding dysfunction. Therefore, patients who are scheduled for a MUS operation due to incontinence are in the postmenopausal period or who will undergo a TVT operation or simultaneous anterior colporrhaphy operation, may have prior knowledge of voiding dysfunction that may develop after the operation. In addition, it provides an advantage for the surgeon to apply the necessary preventive approaches against this complication that may occur. As a result, determining which patient will develop postoperative voiding dysfunction will help the surgeon to provide appropriate counseling to the patients in the preoperative period.

Conflict of interest

The authors declared no conflict of interest.

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Authors' contributions

Concept: U.K.O., E.K., C.M.A., M.K.K., O.S.A., Design: U.K.O., E.K., C.M.A., M.K.K., O.S.A.., Data Collection or Processing: U.K.O., E.K., C.M.A., M.K.K., O.S.A. Analysis or Interpretation: U.K.O., M.K.K., O.S.A., Literature Search: U.K.O., E.K., C.M.A., M.K.K., O.S.A, Writing: U.K.O., E.K., C.M.A., M.K.K., O.S.A

Ethical Statement

Approval was obtained from Health Sciences University Zekai Tahir Burak Women and Children Diseases Training and Research Hospital Ethics Committee, the study started. The ethics committee decision date is 13/02/2017 and the number of ethical committee decisions is 21.

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