Risk Factors for Women to Have Urodynamic Stress Urinary Incontinence at A Turkish Tertiary Referral Center: A Multivariate Analysis Study

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Purpose: To investigate the risk factors in women with urodynamic stress urinary incontinence (USTIC) at a Turkish tertiary referral center.

Materials and Methods: The urodynamic records of 3038 consecutive women were analyzed between 1990 and 2011. The patients who had etiological factor of neurologic disease were excluded. There were 1187 women who had USTIC after urodynamic investigation and 274 women who had no incontinence symptoms were included in the study. Multivariate analyses were done using logistic regression test to determine the risk factors for USTIC.

Results: The mean age was 50.1 years (range, 86-18). Increased age, vaginal delivery, cesarean section, anterior prolapse existence in physical examination, previous anti-incontinence surgery, and previous pelvic organ prolapse surgery was found to be significant risk factors for USTIC at multivariate analyses.

Conclusion: There are risk factors for women to have USTIC. Increased age, having vaginal delivery, having cesarean section, anterior prolapse, previous anti-incontinence surgery and previous prolapse surgery were found to be risk factors for women to have USTIC at this study.

Keywords: Turkey; epidemiology; health behavior; pelvic floor; physiopathology; prevalence; prospective studies; urinary ıncontinence; stress.

INTRODUCTION

Stress urinary incontinence (SUI) is urinary incontinence (UI) during exertion, straining, exercise, coughing or sneezing.(1) SUI is a non-life threatening condition, but can have negative impacts on social and psychological status.

UI will occur without detrusor contraction, if there is an inability of urethral closure mechanism (sphincter insufficiency) when abdominal pressure increases due to exertion, straining, exercise, coughing or sneezing under urodynamic observation. This type of incontinence is defined as urodynamic stress urinary incontinence (USTIC) in terminology of International Continence Society (ICS).(2) USTIC is an objective and valuable data for physicians to start treating SUI in patients. Many epidemiological studies have investigated potential risk factors for UI.(3-6) Increased age, gynecological surgery, menopausal status, multiparity and etc. have been proposed as risk factors. We aimed to select frequently seen variables. We investigated the age, diabetes mellitus and pelvic organ prolapse (POP) as non-modifiable variables; and vaginal delivery, cesarean section, previous anti-incontinence or POP surgery, previous pelvic surgery and hysterectomy as modifiable variables to be a risk factor for USTIC in this study. We aimed to investigate the risk factors in women with USTIC and help the other physicians use our findings at their daily examinations.

MATERIALS AND METHODS

Study Population

A total of 3038 women who had urodynamic tests in our clinic between 1990 and 2011 were retrospectively reviewed. Our urodynamic unit is a specialized clinic at our department. The archives of the patients are collected by a specialized nurse at our urodynamic unit. The cases were selected depending on our present multivariate analyses study. Women who had neurological diseases were excluded. There were 1187 women who were diagnosed as USTIC after urodynamic examination, and 274 women without urinary incontinence complaint were included in the study out of 1461 women. Vaginal examination with cough stress test, measurement of urine volume, urinary flow study and measurement of post voiding residual urine (PVR) were performed prior to multi-channel urodynamic study in our urodynamic unit. A multichannel urodynamic study, including the pressure-flow study, was also performed, if it is required. All urodynamic studies were performed according to the guidelines of the ICS.(7) Three physicians (BC, OD, BO) who were experienced and well trained in urodynamic study, analyzed patient' medical records including questionnaires and the urodynamic studies of the patients retrospectively. All terms and definitions are in accordance with the ICS terminology.(2) The term USTIC, which was used in this study, was defined by ICS as the involuntary leakage of the urine

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Table 1. The multivariate predictors of urodynamic stress urinary incontinence (USTIC).

Variables	Number	Adjusted Odds Ratio (95% CI)	*P* Value
Age	1461	1.03 (1.02-1.04)	< .001
Vaginal delivery			
No	386	Reference	< .001
Yes	1075	2.81 (2.08-3.78)	
Cesarean section			
No	1328	Reference	< .001
Yes	133	2.51 (1.47-4.30)	
Anterior prolapse			
No	446	Reference	< .001
Yes	1015	2.56 (1.78-3.76)	
Previous anti-incontinence surgery			
No	1364	Reference	.019
Yes	97	2.69 (1.18-6.15)	
Previous pelvic organ prolapse surgery			
No	1336	Reference	.032
Yes	125	2.30 (1.08-4.92)	
Previous pelvic surgery			
No	1093	Reference	.067
Yes	368	0.54 (0.28-1.05)	
Previous hysterectomy			
No	1280	Reference	.064
Yes	181	1.94 (0.96-3.94)	

Abbreviation: CI, confidence interval.

during increased abdominal pressure in the absence of a detrusor contraction.[2] Approval for this study was given by Ethical Committee of Cerrahpasa School of Medicine, Istanbul University (IRB number: 32821).

Statistical Analysis

The dependent variable of the study was having USTIC. The independent variables of this study were age, vaginal delivery, cesarean section, diabetes mellitus, POP, previous anti-incontinence surgery, previous POP surgery, previous pelvic surgery (colorectal operations and other gynecological operations such as oophorectomy), and hysterectomy. Numerical variables were expressed with mean and standard deviation (SD), while categorical variables were expressed with frequency and percentage (%) values in this study. All independent variables were included in the logistic regression test. Menopausal status which can be independent variable of the study, was not included in multivariate analysis because of its correlation with age. Risk analysis was done separately for vaginal delivery and cesarean section. Odds ratio (OR) and 95% confidence interval (CI) were calculated. Risk factors for USTIC were examined by using backward logistic regression in multivariate analysis. The entry and removal threshold *P* values were .05 and .10 for this study. Statistical analyzes were performed using Statistical Package for the Social Science (SPSS Inc, Chicago, Illinois, USA) version 15.0. The *P* value < .05 was accepted as statistically significant.

RESULTS

The mean age was calculated as 50.1 years (range, 18-86). In multivariate analysis; age, vaginal delivery, cesarean section, anterior prolapse finding in physical examination, previous anti-incontinence surgery and previous POP surgery were the significant risk factors for USTIC (**Table 1**). Increasing age was associated with increased detection of USTIC (OR = 1.03, 95% CI: 1.02-1.04; *P* < .001). Vaginal delivery and cesarean section were found to be independent risk factors for USTIC (OR = 2.81, 95% CI: 2.08-3.78; *P* < .001 and OR = 2.51, 95% CI: 1.47-4.30; *P* < .001, respectively). Anterior prolapse was found to be an independent risk factor for USTIC (OR = 2.56, 95% CI: 1.78-3.76; *P* < .001), however posterior or apical prolapse were not. Previous anti-incontinence surgery and previous POP surgery were as independent risk factors for USTIC (OR = 2.69, 95% CI: 1.18-6.15; *P* < .019 and OR = 2.30, 95% CI: 1.08-4.92, respectively), however hysterectomy or previous pelvic surgery were not. In addition, diabetes mellitus did not reach statistical significance as a risk factor for SUI. The risk analysis for vaginal delivery and cesarean section was assessed separately with univariate analysis. Calculated OR value was 3.66 (95% CI: 2.75-4.87) for having birth (**Table 2**). In addition, while OR for vaginal delivery was 3.09 (95% CI: 2.35-4.07), the value for cesarean delivery was not statistically significant (**Table 3**).

DISCUSSION

SUI is a common condition in women with a prevalence of 35.5% in urology and obstetrics and gynecology outpatient clinics in our country.[8] It is similar in the other European countries with a prevalence of 35%.[9] The potential risk factors for SUI have been investigated in some epidemiological studies.[3-6] Age, diabetes mellitus, menopause, genetic factors, ischemic heart disease and lung disease have been considered as non-modifiable variables and pregnancy/childbirth, obesity/body mass index, hormone replacement therapy, hysterectomy, smoking, diet and many other variables have been considered as modifiable variables risk factors for UI in existing literature,.[10-16] In this multivariate analysis study that we investigated the risk factors for USTIC in women, age was as a non-modifiable variable and vaginal delivery, cesarean section,

Table 2. The risk analysis for birth and USTIC.

Variables	USTIC		Total
	No	Yes	Number
To have a birth			
No	113 (37.2)	191 (62.8)	304 (100.0)
Yes	161 (13.9)	996 (86.1)	1157 (100.0)
Total	274 (18.8)	1187 (81.2)	1461 (100.0)

Abbreviations: USTIC, urodynamic stress urinary incontinence; OR, odds ratio; CI, confidence interval.
* Data are presented as no (%). OR was 3.66 (95% CI: 2.75-4.87) for having a history of birth.*

Table 3. The correlation between type of delivery and USTIC.

Variables	USTIC*		Total
	No	Yes	Number
Cesarean section			
No	255 (19.2)	1073 (80.8)	1328 (100.0)
Yes	19 (14.3)	114 (85.7)	133 (100.0)
Total	274 (18.8)	1187 (81.2)	1461 (100.0)
Vaginal delivery			
	USTIC*		Total
	No	Yes	Number
No	127 (32.9)	259 (76.1)	386 (100.0)
Yes	147 (13.7)	928 (86.3)	1075 (100.0)
Total	274 (18.8)	1187 (81.2)	1461 (100.0)

Abbreviations: USTIC, urodynamic stress urinary incontinence; OR, odds ratio; CI, confidence interval.
* Data are presented as no (%). OR was 3.09 (95% CI: 2.35-4.07) for vaginal delivery.

anterior prolapse, previous anti-incontinence surgery and previous POP surgery were modifiable variables. Recent many studies have found increased prevalence of UI with increasing age.[3-5] Notwithstanding, UI is not inevitable with increasing age. However the bladder and the pelvic structures change with age, and these changes contribute to UI.[10] While stress type UI is common in young and middle-aged women, urge type and mixed type UI is common in middle-aged and older age.[5] Increasing age was found as a significant risk factor for USTIC in women in our study (OR = 1.03, 95% CI: 1.02-1.04; $P < .001$). SUI can be seen throughout pregnancy, especially in third trimester and generally improves after delivery. However, they may occur after delivery again and continue.[11,12] In addition, women who have SUI in pregnancy have higher risk for SUI throughout life, even if they recover after delivery.[13] The reason for this is unclear. Physiological changes during pregnancy may be the cause of SUI. The patients who have chance to get SUI, might result in having the SUI because of the physiological changes regardless the pregnancy, or pregnancy might trigger the existing problem. There are many studies about UI at delivery and after delivery in existing literature.[14,15] OR was 2.81 (95% CI: 2.08-3.78; $P < .001$) for vaginal delivery in our study. Some studies emphasized that the increased risk of UI by one labor, has not more increased even if the number of parity increase.[15] However, some contrary studies have demonstrated the increased risk of UI with increasing parity.[17] It is difficult to differentiate the risk at pregnancy and vaginal delivery. The risk at vaginal delivery may be explained by the injury caused by stretching of pudendal and other nerves or tissue damage that support pelvic floor.[18] The women who had vaginal delivery are compared to those who have cesarean section by the authors to reveal the differentiation between the impact of vaginal delivery separately from the impact of pregnancy itself for the risk of UI. Vaginal delivery compared with cesarean section was found to be a risk factor for incontinence in postpartum period, later in life and particularly for SUI in most of these studies.[19] Rortveit and colleagues, in their comprehensive studies that involved more than 15,000 women, have demonstrated increased risk for SUI and mixed UI (OR = 1.5) in women who had only cesarean section compared with nulliparous.[19] Furthermore, they demonstrated that those women who had only vaginal delivery have higher risk for SUI than women who had only cesarean section (OR = 2.4). The effects of different types of delivery on UI have been addressed in some studies. The women, with vaginal delivery have greater risk (1.7 to 2.8 folds) for developing SUI compared with the women who had cesarean section.[5,19] In the present study OR for vaginal birth was 2.81 (95% CI: 2.08-3.78; $P < .001$) and OR for cesarean section was 2.51 (95% CI: 1.47-4.30; $P < .001$) which demonstrates statistically significant difference. In addition, we performed univariate analysis to assess the risk analysis separately for vaginal and cesarean birth. As a result, calculated OR value was 3.66 (95% CI: 2.75-4.87) for having birth (**Table 2**). The estimated relative risk for vaginal birth was 3.09 (95% CI: 2.35-4.07), while the risk for cesarean section was not statistically significant (**Table 3**). POP and UI are common conditions in women and mostly seen together. Pelvic floor with fascia and muscles is important in maintaining continence and pelvic support. Due to factors such as changing of pelvic floor muscles and collagen structure, deterioration of continence and pelvic support may be possible with aging and delivery. Support for the bladder neck is important, especially for SUI. The signs of pelvic denervation have been shown with increasing age and after birth,[20,21] and these changes are more common in women with POP or SUI.[22] In addition, authors against denervation hypothesis couldn't find signs of denervation in pelvic floor at biopsies of women with POP and UI.[23] In Samuelsson and colleagues' studies that involves 641 young and middle-age women, demonstrated that women with anterior prolapse had higher risk for SUI and estimated relative risk was 2.5-fold (95% CI: 1.5-4.2).[17] Anterior prolapse was as a significant risk factor with an OR of 2.56 (95% CI: 1.78-3.76; $P < .001$) at our present study. Prior incontinence surgery was also found as a risk factor in the present study (OR = 2.69, 95% CI: 1.18-6.15; $P < .019$). In fact, treatment failure and relapses are not unexpected situations. In these patients, the reasons for incontinence are still discussed that if it's due to treatment failure, relapse or damage in pelvic nerves and pelvic support due to operation. Since we think that all of these factors may play a role, previous incontinence surgery was added to the statistical analysis and found to be an independent risk factor for USTIC. Effects of pelvic surgery and especially hysterectomy on UI in women are situations that were investigated and are still being researched.[24,25] As an example, the effect of POP surgery in SUI is complex. Sometimes after POP surgery, USTIC will improve and sometimes due to POP, SUI that was hidden will occur.[26] The POP surgery's approach, injury to pelvic nerves and supporting structures may affect this result. As a result, POP surgery may be a risk factor for SUI. Previous POP surgery was found to be a risk factor for USTIC in the present study, (OR = 2.30, 95% CI: 1.08-4.92; $P < .032$). However in multivariate analysis, previous other pelvic surgeries (e.g., other gynecological operations) were not found to be a risk factor ($P = .067$). Hysterectomy is thought that may cause to UI because of the damage to pelvic nerves and pelvic support struc-

tures.[24,25] However, in a large proportion of the studies, significant increase in UI after hysterectomy has not demonstrated.[27] In addition, some studies have shown statistically significant decrease of UI after hysterectomy.[28] Although content of these studies is not high quality; the more comprehensive and prospective studies also have not found any increase in rate of UI in follow-up of patients with a history of hysterectomy.[29] While the relationship between hysterectomy and UI was not shown in these prospective studies, UI was related to women with previous hysterectomy and estimated relative risk was ranged from 1.2 to 2.1 in some studies.[30] In a prospective study, urge incontinence was found to be related with hysterectomy but not stress incontinence.[31] As a result, relationship between hysterectomy and UI is not clear. In our study the multivariate analysis showed that hysterectomy does not increase the risk of USTIC (P = .064). There are several limitations in our study. One weakness of our study is that our data were collected retrospectively. The data were verified retrospectively while they were collected longitudinally and that might cause error. Our center is one of the major hospitals in our region. A total of 1461 consecutive women were included in this study. However, the majority of our patients were referred from other hospitals; this may create an extensive patient selection bias and may influence our results. Our results suggest that; age, vaginal delivery, cesarean section, anterior prolapse finding in physical examination, previous anti-incontinence surgery and previous POP surgery were statistically significant risk factor for USTIC in women. However, future studies should be prospectively designed to overcome existing limitations.

CONCLUSION

In summary, there are risk factors for USTIC in women. In this multivariate study, age, vaginal delivery, cesarean section, anterior prolapse finding in vaginal examination, previous anti-incontinence surgery and previous POP surgery have found to be statistically significant risk factors for USTIC. Physicians should remember these modifiable variables and share with patients who will have vaginal delivery, cesarean section or other surgeries, mentioned above. However, there is no consensus to prevent SUI or USTIC in this patient group. In addition, age is a non-modifiable variable risk factor for USTIC in women during their life.

CONFLICT OF INTEREST

None declared.

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