PREVALENCE OF URINARY TRACT INFECTIONS IN WOMEN WITH URINARY INCONTINENCE AND OTHER RISK FACTORS

İDRAR KAÇIRAN KADIN HASTALARDA İDRAR YOLU ENFEKSİYONU GÖRÜLME SIKLIĞI VE DİĞER RİSK FAKTÖRLERİ

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Öz

Giriş: Üriner sistem enfeksiyonlarının oluşumuna bir çok faktörün etki ettiği varsayılmaktadır. Postmenapozal vajinal ve üretral atrofi, üriner inkontinans, sistosel ve işeme sonrası rezidü volüm bu faktörlerden en önemli olanlarıdır. Bunların yanında diabetes mellitus, Parkinson hastalığı gibi bazı nörolojik hastalıklar, obezite, sigara içimi, multiparite ve zor doğum hikayesi de üriner sistem enfeksiyonu gelişiminde etkili faktörler olarak düşünülmektedir. Bu çalışmada kadınlarda üriner sistem enfeksiyonu gelişimine müdahil olan risk faktörlerini, özellikle üriner inkontinansın etkilerini, belirlemeyi amaçladık. Gereç ve Yöntem: 1060 kadın hastanın tıbbi kayıtları retrospektif olarak değerlendirildi. Yaş, üriner inkontinans tipi, parite, doğum hikayesi, histerektomi öyküsü, konstipasyon, postmenapozal semptomlar, obstrüktif üriner semptomlar, üriner sistem enfeksiyon hikayesi, mevcut sistemik hastalıklar ve sigara içimi hikayesi ile ilgili veriler hastaların tıbbi kayıtlarından derlendi. Bulgular: Univaryat analizlerde yaşlanma, yüksek işeme sonrası rezidü volüm, düşük Qmax, postmenapozal semptomlar, diabetes mellitus, nörolojik hastalıklar, vajinal-üretral atrofi ve üroflovmetre grafiğindeki anormallikler risk faktörleri olarak bulundu. Multivaryat analizde ise sadece diabetes mellitus istatistiksel anlamlı risk faktörü olarak bulundu. Tartışma: Çalışmamızın sonuçlarının ve literatür bilgilerinin ışığında bu faktörlerin tamamının üriner sistem enfeksiyon riskini arttırdığını iddia etmek yanlış olmayacaktır. Ancak kadınları global olarak etkileyen bu kronik hastalığın risk faktörlerini, oluşum mekanizmalarını ve önleme stratejilerini belirlemek için daha ileri çalışmaların yapılmasına ihtiyaç bulunmaktadır.

Anahtar Kelimeler

Üriner İnkontinans; Üriner Sistem Enfeksiyonu; Diabetes Mellitus

Abstract

Aim: Many factors are presumed to contribute to the development of urinary tract infections. The most significant of these factors are postmenopausal vaginal and urethral atrophy, urinary incontinence, cystocele, and postvoid residual urine. Diabetes mellitus; neurological disorders such as Parkinson's disease; obesity; smoking; multiparity; and hard delivery history are also considered influential factors for urinary tract infections. In this study, we aimed to determine the risk factors involved in urinary tract infections in women, especially focusing on the effects of urinary incontinence. Material and Method: Medical records of 1,060 female patients were examined retrospectively. Data about age, urinary incontinence types, parity, delivery history, hysterectomy history, constipation, postmenopausal symptoms, obstructive urinary symptoms, urinary tract infection history, presence of systemic diseases, and smoking history were obtained from the medical records of the patients. Results: In the univariate analysis, aging, higher post void residual urine, smaller Qmax, postmenopausal symptoms, diabetes mellitus, neurologic disorders, vaginal-urethral atrophy, and the abnormality of the uroflow graphic were found as the risk factors. In multivariate analysis only diabetes mellitus was found to be statistically meaningful. Discussion: In light of our results and the literature, it would not be incorrect to assert that all of these factors increase the risk of urinary tract infections. Certainly, supplementary studies are needed to further identify the risk factors, mechanisms, and prevention strategies for this prevalent and chronic disorder affecting many women globally.

Keywords

Urinary Incontinence; Urinary Tract Infection; Diabetes Mellitus

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Introduction

Urinary tract infections (UTI) are common diseases that account for substantial morbidity and financial expenditure worldwide [1]. Forty percent of women have had a UTI at least once during their life and 27% of these women have had recurrent UTIs in the 6-12 month period following their first UTI episode [2]. The prevalence of asymptomatic bacteriuria without UTI is high as well. Studies have shown the prevalence of asymptomatic bacteriuria as 3.5% [3]. UTIs affect people of all ages; occurrence frequency and risk factors vary with age [1].

Many factors are presumed to contribute to the development of UTIs. The most significant of these factors are postmenopausal vaginal and urethral atrophy, urinary incontinence (UI), cystocele, and postvoid residual urine (PVR) [4]. Diabetes mellitus (DM); neurological disorders such as Parkinson's disease; obesity; smoking; multiparity; and hard delivery history are also considered influential factors for UTIs. DM and obesity are serious public health problems, and they interact with each other; some studies assert that these two pathological conditions substantially increase the prevalence of UI and UTI in women [5].

UI, described as involuntary urine leakage causing social and/or hygiene problems by the International Continence Society (ICS), is a significant public health problem that affects 200 billion people around the world every year. The overall prevalence of UI is 30% in the female population; however, this rate increases to 50% in elderly women [6]. UI has profound consequences on quality of life, including social isolation, depression, and the end of independent living for some elderly women [7]. Costs for incontinence may be as high as $30 billion per year in the United States, greater than the annual costs for breast, ovarian, cervical, and uterine cancers combined [8].

In this study, we aimed to determine the risk factors involved in UTIs, especially focusing on the effects of UI on UTIs.

Material And Method

Medical records of 1,060 female patients who applied to the women's urology department of Gazi University, School of Medicine, Urology Department between September 2002 and January 2010 were examined retrospectively; 979 patients with UI were included in the study. Patients with positive urine cultures were classified as Group A (72 patients), and patients with negative urine cultures were classified as Group B (907 patients).

Data regarding age, stress UI, urge UI, mixed UI, parity, type of delivery, hard delivery history, hysterectomy history, constipation, postmenopausal symptoms (PMS), obstructive urinary symptoms, UTI history, presence of systemic diseases (DM, neurological disorders), and smoking history were obtained from the medical records of the patients. Moreover, information obtained from urogenital examinations, that included body mass index (BMI), vaginal-urethral atrophy, cystocele grade, and rectocele grade, was evaluated. Physical examinations of the patients were performed in classical gynecological position with full bladders, and stress UI evaluation was performed via the coughing or straining of the patients. We used the criteria of ICS for definitions of stress, urge, and mix UI. [9]. Pelvic organ prolapse of the patients was evaluated according to the pelvic organ prolapse quantification (POP-Q) classification system, and pelvic organ prolapse was recorded as either positive or negative [10]. Recurrent UTI was defined as recurrent UTIs 6-12 months after the first infection.

Data of uroflowmetry (Medical Measurement System, Solar®, The Netherlands) and PVR results evaluated with Bladderscan® (Verathon, BVI-6100, USA) were included in the study. Also, data gained from the forms of the Urogenital Distress Inventory (UDI-6-short form) and Incontinence Impact Questionnaire (IIQ-7-short form), filled out by patients, were entered into the study [11,12]. The patients' uroflow charts were objectively evaluated by one researcher (A.F.B, M.D.) as normal or abnormal. Intermittent and/or obstructive patterns of voidings were classified as abnormal.

Type of delivery was classified as no parity, vaginal delivery, cesarean section delivery, or both vaginal and cesarean section delivery. The designation of hard delivery included the presence of at least one of the following situations: longer labor period, use of forceps and/or vacuum during labor, and/or high birth weight (4000 grams and higher).

Student's t-test and Pearson's chi-squared test were used for statistical analysis. In the statistical analysis, data found to be meaningful from univariate analysis were placed into a multivariate logistic regression analysis model. As a result, variables were evaluated as risk factors in terms of causation for UTI by the multivariate analysis model.

Results

The mean age of the women in Group A was calculated as 56.42±15.09 and in Group B, 50.14±12.53; the difference was statistically significant (p=0.001). Urine culture results showed that the 72 patients in Group A (7.4%) had positive urine cultures, and the 907 in Group B had negative urine cultures (92.6%). Infections for Group A were caused by Escherichia coli (26 patients, or 36.1%), Klebsiella series (40 patients, or 55.6%), Proteus species (2 patients, or 2.8%), or Enterococcus (4 patients, or 5.6%). The number of the patients having recurrent UTIs was calculated as 11, constituting 1.1% of all of the patients and 15.3% of the UTI patients.

The distribution according to UI patterns was 2 stress UI (18.2%), 3 urge UI (27.3%), and 6 mix UI (54.5%). In women with stress UI, the number of positive urine cultures was 9 (12.5%), whereas, in women without stress UI, the positives totaled 63 (87.5%). Similarly, in women with urge UI, positive urine cultures occurred in 18 (25%) patients but, without urge UI, this number was 54 (75%). Positive urine cultures in women with and without mix UI were 45 (62.5%) and 27 (37.5%), respectively. The difference between the UI patterns in terms of positive urine cultures was statistically insignificant (p=0.150).

The parity was 3.21±2.05 for Group A and 2.96±2.04 for Group B (p=0.317). When the delivery type, presence of hard delivery, and presence of constipation were evaluated as risk factors for UTI development, these factors were found statistically insignificant. On the other hand, the presence of PMS was found to be a statistically significant risk factor for UTI (p=0.002). Similarly, the presence of DM and neurological disorders were found to be statistically significant risk factors in univariate analysis (Table 1).

Positive urine cultures were found in patients with and without smoking as 11 (6.7%) and 61 (7.5%), respectively. Smoking was

Table 1. Univariate analysis with selected variables of Age, Qmax, and PVR

Variable	Group A	Group B	P -value
Age	22.04±11.24	28.70±14.22	0.001
Qmax	56,42±15,09	50,14±12,53	0,001
PVR	35.71±64.89	13.77±45.10	0.004

Group A: Positive urine culture group
Group B: Negative urine culture group
Qmax, maximum urinary flow rate; PVR, post void residual urine.

assessed as a statistically insignificant factor (p=0.734). Positive urine cultures were found with and without hysterectomy history as 11 (7.3%) and 61 (7.4%), respectively (p=0.973). Mean BMI value was 28.07±6.13 for Group A and 28.37±14.21 for Group B, and the difference was statistically insignificant (p=0.738).

The presence of vaginal-urethral atrophy, which has been mentioned as a strong risk factor for UTIs in previous reports, was also found statistically significant in our results. Positive urine cultures with and without the presence of vaginal-urethral atrophy were 21 (13.5%) and 42 (6.3%), respectively (p=0.003) (Table 1). When pelvic organ prolapse was evaluated, presenting as cystocele, positive urine cultures with and without its presence were 21 (5.2%) and 14 (4.6%), respectively, and the difference was statistically insignificant (p=0.959). Positive urine cultures with and without the presence of rectocele were 14 (5.3%) and 20 (5.5%), respectively, and the difference was statistically insignificant (p=0.596).

According to uroflow charts, positive urine cultures were found in 33 (6.7%) patients who scored normal and 17 (13.2%) who scored abnormal, and the difference was calculated as statistically significant (p=0.016) (Table 1). Mean Qmax value was 22.04±11.24 for Group A and 28.70±14.22 for Group B. The difference calculated was significant (p=0.001). Similarly, the mean PVR value was 35.71±64.89 for Group A and 13.77±45.10 for Group B, and the difference was statistically significant (p=0.004) (Table 2). When the responses on the UDI-6 and IIQ-7 forms were evaluated for increased risk for UTIs, the mean values were found to be statistically insignificant. Mean values of UDI-6 and IIQ-7 were calculated in Group A and Group B as 10.43±4.19, 10.15±4.03 (p=0.697) and 13.08±9.78, 11.39±8.57 (p=0.255), respectively.

Only DM was found to have a statistically significant relationship with increased risk of UTI when the variables of age (OR, 1014; 95% CI, 0.978-1.052), PMS (OR, 1005; 95% CI, 0.998-1.011), DM (OR, 2424; 95% CI, 1.025-5.732), neurological disorders (OR, 1530; 95% CI, 0.434-5.388), Qmax (OR, 0.989; 95% CI, 0.958-1.020), PVR (OR, 1234; 95% CI, 0.497-3.063), vaginal-urethral atrophy (OR, 0.901; 95% CI, 0.344-2.359), and uroflow charts, that had been found statistically significant in univariate analysis models, were placed into the multivariate regression analysis model (Table 3).

Table 2. Univariate analysis with selected variables of DM, Neurologic Disease, PMS, Vaginal- Urethral Atrophy, and Uroflow Chart

Variable		Group A (n,%)	Grup B (n,%)	Number of Patients		P-value
DM	+	19(%14.4)	113(%85.6)	132	976	0.001
	-	53(%6.3)	791(%93.7)	844		
Neurologic Disease	+	12(%14.5)	71(%85.5)	83	976	0.001
	-	60(%6.7)	833(%93.3)	904		
PMS	+	37(%10.6)	311(%89.4)	348	915	0.002
	-	29(%5.1)	538(%94.9)	567		
Vaginal - Urethral Atrophy	+	21(%13.5)	135(%86.5)	156	821	0.003
	-	42(%6.3)	623(%93.7)	665		
Üroflow Chart	Normal	33(%6.7)	459(%93.3)	492	621	0.016
	Abnormal	17(%13.2)	112(%86.8)	129		

Group A: Positive urine culture group
Group B: Negative urine culture group
DM, diabetes mellitus; PMS, postmenopausal symptoms.

Table 3. Multivariable logistic regression model with selected variables for urinary tract infection

	Beta	P	OR (95% CI)
Age	0,014	0,444	1,014(0.978-1.052)
DM	0,885	0,044	1.00*
			2,424(1.025-5.732)
Neurologic Disease	0,425	0,508	1.00*
			1,530(0.434-5.388)
Vaginal – Urethral Atrophy	-0,105	0,831	1.00*
			,901(0.344-2.359)
QMAX	-0,011	0,479	,989(0.958-1.020)
PVR	0,210	0,650	1,234(0.497-3.063)
PMS	0,005	0,154	1.00*
			1,005(0.998-1.011)

*Reference group

CI, confidence interval; OR, odds ratio; DM, diabetes mellitus; Qmax, maximum urinary flow rate; PVR, Post void residual urine; PMS, postmenopausal symptoms.

Discussion

While variables of age, PMS, DM, neurological disorders, Qmax, PVR, vaginal-urethral atrophy, and uroflow charts were found statistically significant for increased risk of UTI development in univariate analysis models, only DM was found statistically significant in multivariate regression models (p=0.044). Similar results exist in other studies in the literature [13].

UI is clearly a risk factor for UTI, according to studies conducted in the elderly population. Although there are limited numbers of studies evaluating the effect of urine amount on UTI, Hu et al. concluded that both UI and urine amount could result in increased UTI risk in double mass analysis, but multivariate regression models revealed only UI as a significant risk factor in their study [14]. Our research also revealed UI as a risk factor for UTI. We evaluated the effects of UI types separately, and our statistical analysis revealed that there is no significant difference between UI types. The pathophysiology of UI as a risk factor for UTI is a multifactorial issue that is still under review. Brostrøm et al. found that stress UI, especially, develops at statistically higher rates in patients who have pelvic organ prolapse, such as cystocele and rectocele [15]. Moreover, these organ prolapses, especially cystocele, have been shown to cause voiding dysfunction [16]. It is a well-known fact that risk of UTI development increases in the presence of both voiding dysfunction and UI. Therefore, it would make sense that multiparity, hard and vaginal delivery history, and cystocele and/or recto-

cele presence increase the tendency for development of UTIs. In this study, we evaluated these factors as independent variables, but multiparity, history of vaginal and/or hard delivery, and cystocele and rectocele presence were found to be statistically insignificant. Nonetheless, further research is needed to make a definitive judgment.

Another controversy among these risk factors is the effect of accompanying systemic illnesses. Two such systemic diseases were investigated: DM and neurological disorders. Boyko et al. revealed that DM is an important risk factor in UTI development, particularly in postmenopausal women [13]. Asymptomatic bacteriuria was twice as likely to occur in DM patients than in those without DM. Also, it is claimed that asymptomatic bacteriuria leads to pyelonephritis, which eventually results in decreased kidney function in type I DM patients [2]. Strikingly, these kinds of serious morbidities resulting from asymptomatic bacteriuria are not an expected outcome in healthy, non-pregnant women with normally functioning urinary systems, alhough asymptomatic bacteriuria could cause pyelonephritis or premature labor in pregnant women [17]. Aside from these complications, DM seems to worsen the probability of UTIs.

Emphysematous cystitis and pyelonephritis, abscess formation, renal papillary necrosis, and xanthogranulomatous glomerulonephritis could be designated uncommon conditions of UTI related to DM. The exact pathophysiological mechanism of the effects of DM on the tendency for UTIs is unknown, but weakness of glycemic control, leukocyte malfunction due to hyperglycemia, recurrent vaginitis, and anatomical and functional changes in the urinary tract are some proposed theories. The anatomical and functional changes in the urinary tract related to DM are listed as neuromuscular malfunction of bladder due to peripheric neuropathy, bladder outlet obstruction, incontinence, and increased PVR [2]. Both univariate and multivariate analysis in our study showed that DM is a statistically significant risk factor for UTI development. Importantly, DM was the only significant factor when placed into the multivariate regression models.

The effects of neurological disorders, especially Parkinson's disease, on the lower urinary system are well-known. Lower urinary system symptoms such as urge, frequency, pollakuria, and urge UI have been described in different studies with rates of frequency varying between 50 and 75% [18]. Detrusor overactivity is the most common urodynamic abnormality in this group of patients. Therefore, storage and voiding malfunction due to Parkinson's disease leads to a higher tendency for UTI development than in the normal population. In this study, we investigated the effects of any neurological disease on UTI, and they were found to be a significant factor in univariate analysis. However, our evaluation of the effects of neurological diseases as simply in terms of their presence or absence is one of the limits of this study.

The effect of smoking on UTI development is currently unknown, but Parazzini et al. stated that smoking could have an effect on UI risk in their epidemiologic studies [19]. Our study found no relationship between smoking and UTI development.

History of hysterectomy has been implicated as a risk factor for lower urinary system dysfunction and, indirectly, a factor in development of UTIs in some studies [20]. Also, some recent studies have concluded that urge UI and stress UI could develop after a hysterectomy [21]. The effects of hysterectomy on UTI development could be attributed to the modification of the pelvic organ anatomy and functions [22]. We evaluated the effect of hysterectomy on UTI development and could not reach any significant result.

Epidemiologic studies have shown that obesity is a strong and independent risk factor for UTI. Many research studies have concluded that every five units of increase in BMI lead to a 20% to 70% increase in UI, varying in proportion. Subak et al. stated that obesity could increase the tendency to develop stress UI and overactive bladder in their study of 6,424 obese female patients [23]. Obesity and abdominal fat may induce UI by increasing pressure on the bladder and straining the muscles and connective tissues that support the urethra [24]. Also, the strong positive correlation between obesity and insulin resistance suggests several potential mechanisms linking obesity and incontinence [25]. Improving blood glucose control and promoting weight loss have both been identified as potential targets for interventions to prevent or treat UI in women with DM. In contrast, we could not find a statistically significant link between BMI and UTI development.

The three interdependent factors that have been proven to have effects on UTI development are aging, menopause status, and the presence of vaginal-urethral atrophy. Especially, age has been identified as an independent factor by causing voiding dysfunction in the geriatric population. In an editorial review, Cho stated that older age is related to UI, overactive bladder, and lower urinary tract symptoms [26]. In most studies, postmenopausal symptoms and presence of vaginal atrophy are evaluated together. Some studies investigating the effects of intravaginal estrogen therapy revealed a statistically significant decreased risk of recurrent UTIs [27]. Moreover, epidemiologic studies have confirmed that stress UI appears at higher rates during the menopause development period. In the light of this data, lack of estrogen could lead to UI, in addition to the vaginal-urethral atrophy premise [28]. In this study, we found a significantly higher UTI risk with the presence of vaginal-urethral atrophy and postmenopausal symptoms in univariate analysis; as with other factors except DM, these factors were found insignificant in multivariate regression models.

Markedly elevated PVR volumes, abnormal uroflow charts, and decreased Qmax scores are defined risk factors for UTI development in women. The common effect mechanism of these factors is to increase PVR's facilitation of bacteria reproduction. It has been propounded that 30 ml or more of increased PVR volume could result in increased UTI prevalence [29]. In our study, we calculated PVR as a significant risk factor in univariate analysis. We evaluated the effect of PVR by measuring the amount of residual urine. Since bladder capacity varies from woman to woman, however, PVR volumes should be evaluated individually. In addition, abnormal uroflow charts, such as obstructive or intermittent patterns, and decreased Qmax values were statistically significant as risk factors. The mechanisms leading to UTIs could be the developments of sacculations, diverticules, and/or stones in high pressure bladders [30].

To the best of our knowledge, no studies exist to date on the effects of UDI-6 and IIQ-7 forms on UTI risk. In this study, when

evaluated individually, the results of these forms had no effect on UTI development risk, statistically.

In this study, we evaluated most of the factors that are presumed to contribute to the development of UTIs. Even though many of these factors were considered significant in univariate analysis, only DM was determined a significant factor in the multivariate regression model. In light of our results and the literature, it would not be incorrect to assert that all of these factors increase the risk of UTIs. The aim of this research was to discuss the risk factors of UTI and, especially, to understand the effects of UI, with its subtypes, as risk factors for UTIs. Certainly, supplementary studies are needed to further identify the risk factors, mechanisms, and treatments and also prevention strategies for this prevalent and chronic disorder affecting many women globally.

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Competing interests

The authors declare that they have no competing interests.

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