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The assessment of etiology and risk factors of urinary tract infections in geriatric patients admitted to emergency department

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Ethics Committee Approval
The study was approved by the Scientific Research Ethics Committee of Kahramanmaras Sütçü İmam University (decision date: 11/7/2018, decision no: 06, session: 2018/20).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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Abstract

Background/Aim: A urinary tract infection (UTI) is one of the most common bacterial infections in the elderly population. This study aimed to evaluate the etiology and risk factors of UTI among patients aged 65 and over who were admitted to the emergency department and then hospitalized.
Methods: This study was designed as a descriptive epidemiological study. Data of patients aged 65 and over, who were admitted to the adult emergency department of Kahramanmaraş Sütçü İmam University Medical Faculty and hospitalized between October 2015 and October 2018 with a diagnosis of UTI, were included in the study. Study data were collected through a retrospective scan of the patient files from the automated hospital system.
Results: Of the patients, 51% (n = 50) were female, and 49% (n = 48) were male. Of the patients diagnosed with UTI, 68.4% were aged 75 years or older. Fever, flank pain, and dysuria were found to be among the main reasons for patients with UTI to present to the emergency department. The most common risk factors for UTI were found to be the presence of diabetes mellitus and immunosuppression. Benign prostatic hyperplasia and nephrolithiasis were found to be the most common risk factors in males. In 83.7% of the patients, urine cultures were obtained at the initial presentation, and *Escherichia coli* was found to be the most common microorganism in patients with positive urine cultures.
Conclusion: The presence of UTI causes an increase in the risk of mortality in geriatric patients. Therefore, UTI should be considered in the differential diagnosis when the general condition has deteriorated in the geriatric patient even if the patient is asymptomatic. Urine culture samples should be obtained in cases of suspected infection, and antibiotic therapy should be started immediately to decrease mortality and increase recovery rates when the urine results indicate infection.

Keywords: Emergency department, Geriatrics, Urinary tract infection

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Introduction

The World Health Organization (WHO) defines the elderly as the chronological age, namely the calendar age, of 65 years and older. Although the concept of old age has many biological, psychological, and social dimensions, the definition proposed by WHO is accepted worldwide [1]. According to data from WHO, 12% (900 million) of the world's population consisted of elderly people as of 2015. According to the estimates made by WHO, the elderly population will double in 2050, and individuals aged 65 and over will account for 22% (two billion) of the world's population [2]. The elderly population in Turkey is 8.8% (seven million) as of 2018, and this ratio continues to increase rapidly. Over the last four years, the proportion of the elderly population in Turkey has increased by 16% [3]. Prolongation of the median lifespan has led to an increase in the problems related to old age in the last century, particularly in developed countries, and thus, to the development of geriatrics, a specialized medical science that treats the elderly population [4]. The estimates made by WHO show that a further increase in the elderly population and the medical needs of this population will also increase in the upcoming years [2].

Older age-related weakening of the immune system and decrease in physiological functions, such as cough reflexes, circulation, and wound healing increases the susceptibility to infection. Urinary tract infection (UTI) is among the most commonly diagnosed infections in the elderly population and is the most common reason for antibiotic use in this population [5, 6]. Particularly in individuals over 65 years of age, the incidence of UTI in both sexes increases with advancing age [7]. Since clinical symptoms are generally atypical, diagnosis and treatment can be quite difficult, particularly in elderly patients living in a nursing home. While the incidence of UTI in the community-dwelling elderly population is 25%, this rate can vary between 25% and 50% and 15% and 40% in elderly women and men, respectively, who are nursing home residents. The incidence of UTI also varies in the geriatric age groups with a female-to-male ratio of 2:1 and even 1:1 [8, 9]. Bladder outlet obstruction resulting from benign prostatic hyperplasia is an important risk factor leading to UTI in elderly men. A relative decrease in UTI can be seen due to decreased sexual activity in elderly women. Since anatomical and pathophysiological factors, such as uterine prolapse, urolithiasis, and genitourinary malignancies are more common in the elderly, recurrent and complicated UTI infections are encountered more frequently in this population. Furthermore, catheter-related UTI is common in these age groups and carries an increased risk in terms of complications and morbidity.

In light of current information, this study aimed to evaluate the etiology and risk factors of UTI among patients aged 65 and over who were admitted to the emergency department and then hospitalized.

Materials and methods

This study was a retrospective cohort study. Data of patients aged 65 and over, who were admitted to the adult emergency department of Kahramanmaras Sütçü İmam University Medical Faculty and hospitalized between October 2015 and October 2018 with a diagnosis of UTI, were included in the study. One-hundred ninety-six patients were identified for the study, and 98 of these cases fulfilled the inclusion criteria. Study data were collected through a retrospective scan of the patient files from the hospital automation system. Patients under 65 years of age, those who presented to the emergency department for reasons other than a UTI, and those who were not hospitalized were excluded from the study. The study was approved by the Scientific Research Ethics Committee of Kahramanmaras Sütçü İmam University (decision date: 11/7/2018, decision no: 06, session: 2018/20). The research was performed in agreement with the Helsinki Declaration. Informed consent was not taken from patients due to the retrospective nature of the study.

The following parameters were recorded in an Excel table prepared for the study: (1) sociodemographic data, such as age and sex of the patient, (2) complaints at the time of admission, (3) complete urinalysis (CU) parameters (leukocyte, erythrocyte, bacteria, nitrite, crystal), (4) venous blood test parameters (leukocytes, hemoglobin levels, neutrophils, lymphocytes, platelets (PLT), mean platelet volume (MPV), C-reactive protein (CRP)); and (5) imaging techniques (abdominal ultrasonography (USG), abdominal computed tomography (CT)), urine culture results, antibiotics administered during the treatment, and prognosis of the patient. Presence of a urinary catheter, genitourinary system anomaly (vesicoureteral reflux (VUR), ureter stenosis, and others), neurogenic bladder, fecal incontinence, benign prostatic hypertrophy (BPH), diabetes mellitus (DM), immunosuppressed conditions (use of chemotherapy, exposure to radiotherapy, drugs causing immunosuppression), malignancy, and the presence of nephrolithiasis, all of which have been defined as risk factors, were also evaluated and recorded.

Statistical analysis

Statistical analysis was performed using SPSS version 22.0 software (SPSS Inc, Chicago, Illinois, USA). Descriptive data were expressed as frequency and percentage for qualitative data and as frequency, mean (standard deviation (SD)) for numerical data. Visual (histogram) and analytical (Kolmogorov–Smirnov, Shapiro–Wilk tests) methods were used to determine whether the parameters followed a normal distribution. In the comparison of quantitative data, the Student's t-test was used to compare the parameters between the two groups, and one-way analysis of variance (ANOVA) was used for the comparisons between more than two groups in cases in which parametric assumptions were met. If parametric assumptions could not be met, the Mann–Whitney U test was used for comparisons between two groups, and the Kruskal–Wallis test was used for comparisons between more than two groups. Correlation tests were used to compare two sets of quantitative data. In cases in which two sets of quantitative data followed a normal distribution, correlation coefficients and statistical significance were calculated using Pearson's correlation coefficient. Correlation coefficients and statistical significance were calculated using Spearman's rank correlation coefficient for relationships between variables, at least one of which did not follow a normal distribution or was ordinal. A chi-square test was used to compare qualitative data. A P-value of < 0.05 was considered statistically significant.

Results

Of the patients included in the study, 51% (n = 50) were female, and 49% (n = 48) were male. Of the patients, 40.8% (n = 40) were between 75 and 85 years of age (middle-old), and the main complaints at the time of admission were fever in 63.3% (n = 62). the most common risk factors for UTI were found to be DM or immunosuppression in 37.8% (n = 37) of the patients. Demographic outcomes are presented in the Table 1.

Table 2 examines the relationship between gender and both complete urinalysis and blood count. When gender and complete blood count were evaluated together, it was found that only the lymphocyte count was statistically significantly higher in women (P = 0.024). Other values are presented in Table 2.

The mean duration of antibiotic use was 11.1 (7.8) days in men and 9.2 (6.6) days in women. This difference also did not create a statistically significant difference between the sexes. All parameters are summarized in Table 2.

Table 1: Sociodemographic characteristics of the patients

	Sex					
	Female		Male		Total	
	n	%	n	%	n	%
Age						
65–75 years	12	24.0	19	39.6	31	31.6
75–85 years	26	52.0	14	29.2	40	40.8
85 and above	12	24.0	15	31.2	27	27.6
Total	50	51.0	48	49	98	100
Complaint at the time of admission						
Fever	30	60	32	66.7	62	63.3
Dysuria	10	20	5	10.4	15	15.3
Polyuria	0	0.0	1	2.1	1	1.0
Pollakiuria	2	4.0	0	0.0	2	2.0
Flank pain	8	16.0	10	20.8	18	18.4
Risk factors						
No risk factor	17	34.0	16	33.4	33	33.7
Kidney Stone	3	6.0	4	8.3	7	7.1
Neurogenic bladder	0	0.0	1	2.1	1	1.0
Benign prostatic hyperplasia	0	0.0	11	22.9	11	11.2
Prostate cancer	0	0.0	5	10.4	5	5.1
Diabetes mellitus/immunosuppression	29	58.0	8	16.7	37	37.8
Presence of a catheter	1	2.0	3	6.2	4	4.1

Table 2: Urine and venous blood analysis values and mean duration of antibiotic use of the patients by sex

	Sex				
	Female		Male		
	n	Mean (SD)	n	Mean (SD)	P-value
Complete urinalysis					
Leukocyte	48	2.5 (0.9)	47	2.3 (1.1)	0.51[a]
Erythrocyte	48	2.0 (1.2)	47	1.7 (1.2)	0.24 [a]
Bacterium	48	0.0 (0.0)	47	0.0 (0.0)	---
Nitrite positivity	48	0.3 (0.5)	47	0.2 (0.4)	0.15
Crystal	48	0.0 (0.0)	47	0.0 (0.0)	---
Complete blood count					
Leukocyte	50	12.8 (5.2)	48	12.9 (7.8)	0.72[a]
Hemoglobin	50	11.6 (2.4)	48	12.1 (2.5)	0.27[b]
Neutrophil	50	10.1 (4.9)	48	10.7 (7.2)	0.64[b]
Lymphocyte	50	1.6 (1.0)	48	1.2 (1.0)	0.024[a]
PLT	50	252.4 (130.6)	48	225.7 (132.9)	0.21[a]
MPV (μm^3)	50	10.9 (12.8)	47	10.5 (8.8)	0.78[a]
CRP (mg/L)	50	100.1 (89.5)	47	120.2 (86.3)	0.18[a]
Mean duration of antibiotic use (day)	50	9.2 (6.6)	40	11.1 (7.8)	0.28[a]

PLT: Platelet, MPV: Mean platelet volume, CRP: C-reactive protein, [a] p value found using the Mann–Whitney U test, [b] p value found using Student's t-test , SD: standard deviation

Urine cultures were obtained in 83.7% of the patients (n = 82) at the first visit, and urine culture was positive in 52.3% of female patients (n = 23) and 39.5% of male patients (n = 15). *E. coli* was found to be the most frequently reproducing microorganism (52.7%, n=20) in both sexes. No statistically significant difference in terms of *Escherichia coli* growth in the culture between both sexes was found (Table 3).

A control urine culture was obtained in 58.2% (n = 57) of the patients, and the result of control urine culture was positive in 48.3% (n = 14) of females and 21.4% (n = 6) of males. *E. coli* was found to be the most frequently reproducing microorganism in patients with positive control urine culture (55%; n = 11) in both sexes. Control urine culture positivity was statistically significantly higher in women than in men (P = 0.034) as shown in Table 4.

Table 3: Urine culture data of patients at the time of first admission according to sex

	Sex						
	Female		Male		Total		
	n	%	n	%	n	%	P-value
Urine culture at the time of the first admission							0.24
Yes	44	88.0	38	79.2	82	83.7	
No	6	12.0	10	20.8	16	16.3	
Initial urine culture result							0.25
Positive	23	52.3	15	39.5	38	46.3	
Negative	21	47.7	33	60.5	44	53.7	
Microorganisms reproducing in the first urine culture							
Escherichia coli	13	56.5	7	46.6	20	52.7	0.16 *
Klebsiella spp.	2	8.7	1	6.7	3	7.9	
Pseudomonas spp.	0	0.0	1	6.7	1	2.6	
Enterococcus spp.	3	13.0	0	0.0	3	7.9	
Streptococcus spp.	1	4.4	2	13.2	3	7.9	
Candida spp.	3	13.0	1	6.7	4	10.6	
Candida melibiosica	0	0.0	1	6.7	1	2.6	
Trichosporon spp.	1	4.4	0	0.0	1	2.6	
Corynebacterium amycolatum	0	0.0	1	6.7	1	2.6	
Contamination	0	0.0	1	6.7	1	2.6	

** Only the relationship of *Escherichia coli* and growth status with sex was examined.

Table 4: Control urine culture data of patients according to sex

	Sex						
	Female		Male		Total		
	n	%	n	%	n	%	P-value
Control urine culture							0.97
Yes	29	58.0	28	58.3	57	58.2	
No	21	42.0	20	41.7	41	41.8	
Control urine culture result							0.034
Positive	14	48.3	6	21.4	20	35.1	
Negative	15	51.7	22	78.6	37	64.9	
Microorganisms reproducing in control urine culture							
Escherichia coli	8	57.1	3	50.2	11	55.0	
Klebsiella spp.	1	7.1	0	0.0	1	5.0	
Pseudomonas spp.	1	7.1	0	0.0	1	5.0	
Candida spp.	4	28.7	1	16.6	5	25.0	
Staphylococcus epidermidis	0	0.0	1	16.6	1	5.0	
Contamination	0	0.0	1	16.6	1	5.0	

Of the patients, 27.6% (n = 27) underwent abdominal USG and 18.4% (n = 18) underwent abdominal CT. When the patients were evaluated in terms of prognosis, 84.7% (n = 83) were discharged with full recovery, whereas 2.0% (n = 2) refused treatment, and 13.3% (n=13) died. No statistically significant difference between sexes in terms of imaging and prognosis was found (P > 0.05).

The relationship of the mean duration of antibiotic use with the age, CU, and venous blood analysis was examined. Only a statistically significant positive correlation between blood CRP level and the mean duration of antibiotic use was found (r = 0.330; P = 0.001) as shown in Table 5.

The duration of antibiotic use was evaluated according to the age groups of the patients, sex distribution, positive/negative urine culture at the time of admission, and prognosis. Age, sex, urine culture results, and prognosis of the patients did not yield statistically significant differences in the mean duration of antibiotic use (Table 6).

Table 5: Correlation of the mean duration of antibiotic use with the age, complete urine analysis (CU), and venous blood analysis

	Duration of antibiotic use		
	n	r	*P*-value
Age	94	−0.021	0.84
Complete urinalysis			
Leukocyte	95	−0.174	0.09
Erythrocyte	95	−0.132	0.21
Bacterium	95	---	---
Nitrite positivity	95	−0.117	0.27
Crystal	95	---	---
Complete blood count			
Leukocyte	98	0.093	0.37
Hemoglobin	98	0.043	0.68
Neutrophil	98	0.094	0.37
Lymphocyte	98	−0.080	0.44
PLT	98	0.009	0.93
MPV (μm^3)	98	0.077	0.46
CRP (mg/L)	98	0.330	0.001

PLT: Platelet, MPV: Mean platelet volume, CRP: C-reactive protein, * Since at least one of the variables was not normally distributed or ordinal, correlation coefficients and statistical significances were calculated using the Spearman's rank correlation coefficient for all relationships between variables.

Table 6: The relationship between the demographic characteristics of patients and the mean duration of antibiotic use

	Duration of antibiotic use		
	n	Mean (SD)	*P*-value
Age			0.52[a]
65–74 years	29	11.0 (8.3)	
75–84 years	38	9.4 (7.6)	
85 years and older	27	10.0 (5.2)	
Sex			0.28[b]
Female	50	9.2 (6.6)	
Male	44	11.1 (7.8)	
Urine culture at the time of the first admission			0.31[b]
Positive	36	11.1 (8.2)	
Negative	58	9.5 (6.5)	
Control urine culture			0.60[b]
Positive	20	10.4 (6.5)	
Negative	74	10.0 (7.4)	
Endpoint*			0.42[b]
Discharged	79	9.5 (5.6)	
Death (Exitus)	13	14.6 (12.9)	

[a] *P*-value found using Kruskall–Wallis test, [b] *P*-value found using the Mann–Whitney U test, * Analysis was performed by excluding those who refused treatment, SD: standard deviation

Discussion

The incidence of UTI increases in elderly patients over the age of 65 [7]. Bacteremia is associated with higher mortality rates in elderly patients. Deficiencies in the immune system and increased incidence of comorbidities (pulmonary, neoplastic, cardiovascular diseases, and others) can cause an increase in the risk of morbidity and mortality. In geriatric patients, UTI can be controlled with antibiotics since UTI can result in bacteremia, sepsis, and death [10]. A study published in the literature reported that the incidence of UTI is 25% among the community-dwelling elderly population and this rate increases with advancing age. In a similar study, this rate has been reported to be similar and the incidence of UTI in both sexes is almost equal in the advanced ages [8, 9]. The results obtained from the present study support these literature data, and it was a particularly remarkable finding that more than 2/3 of the patients were aged 75 years and older. Furthermore, the incidence of UTI among the sexes was almost equal to each other in the present study.

Tanyel et al. [10] reported in their study that typical UTI symptoms (dysuria, polyuria, fever) may be rarer in elderly patients compared to younger individuals and these elderly patients may be even asymptomatic. In the present study, most patients presented typical complaints at the time of admission. The presence of underlying comorbidities has been reported as an important risk factor for UTI in elderly patients [7, 10]. Similarly, in the present study, risk factors for UTI were present in about two-thirds of patients, and DM and immunosuppression were the most common ones.

Blood tests, CU, urine culture, and imaging tests are performed to diagnose suspected UTI in geriatric patients. The microscopic examination of urine is important in the diagnosis of UTI. The presence of bacteria and leukocytes in the urine is called bacteriuria and pyuria, respectively. The presence of one or more leukocytes in each field or 10 or more white blood cells per mm^3 in a urine specimen at x 40 magnification is considered compatible with UTI [11]. Leucocyte cylinder in the urine is identified with leukocytosis, sedimentation, and CRP elevation in patients with pyelonephritis. Imaging techniques are recommended in cases in which a complicated UTI or structural anomaly is suspected and in the presence of recurrent infections. Direct radiography can show urinary tract stones. Urinary tract USG or abdominal CT may be performed to detect abscesses and other pathologies. Pyuria (presence of 10 or more leukocytes per mm^3 in the urine) is also seen in more than 90% of men and women with bacteriuria [12]. The results obtained from the present study support these data in the literature. Although the increases were not statistically significant, the mean number of leukocytes and erythrocytes per µL and leukocyte and neutrophil count in addition to CRP levels have been observed to increase.

The detection of the growth of the active microorganism in urine culture ensures the definitive diagnosis of UTI [11]. Ginde et al. [13] reported that *E. coli* (32.4%) is the most frequently reproducing microorganism in urine culture in patients with UTI. In a study by Uluğ et al. [14], *E. coli* was isolated in 262 (64.5%) of the patients. The results in the present study are compatible with the literature; *E. coli* was detected in urine culture examination in most patients.

Patients with complaints of UTI are diagnosed based on the history of the patient, physical examination, blood test, and urinalysis and empirical antibiotic treatment is applied without waiting for urinalysis results in general. The main objectives of UTI treatment are to provide effective and rapid responses to treatment, prevent recurrence in the recovered patients, and prevent rapidly increasing resistance by microorganisms to antimicrobials. Determining the type of UTI is important in treatment selection. The initial treatment preference is empirical. Treatment should be planned taking into account the presence of complicating factors and the antimicrobial resistance pattern. Several factors regarding the antibiotic to be selected should be taken into consideration in the treatment: (1) active in the urine, (2) reaching an adequate urine concentration in the renal parenchyma and bladder, (3) long-term steady concentration effective against possible different microorganisms, (4) resistance of uropathogens, (5) bactericidal activity, (6) patient compliance, (7) possible side effects, and (8) cost [11]. Empirical antibiotic selection should be made based on the most likely cause of infection. A broad-spectrum antibiotic may be preferred at the beginning of the treatment but a more specific, less toxic, and more appropriate effective antibiotic should be started depending on the antibiogram results [15].

In a study by Tüzün et al. [16], the duration of antibiotic treatment may vary depending on the sex and clinical condition of the patient. The recovery rate in short-term treatment has been reported to be low and the seven-day treatment will be more suitable in older women. It has been reported that the duration of symptomatic lower UTI treatment should be 10–14 days in older

men, and that the treatment may need to be extended up to 6 to 12 weeks in recurrent infections [12, 16]. Compatible with the literature, the duration of antibiotic use was longer in male patients than in female patients in the present study. The correlation of the mean antibiotic use with complete blood count parameters and CRP levels was further investigated. A statistically significant correlation was found between the duration of antibiotic use and increased CRP levels.

It has been reported that low mortality rates are achieved by initiating appropriate antibiotic treatment in patients with UTI-induced urosepsis [10]. In the present study, mortality has been observed in 13.3% of the patients although antibiotic treatment has been initiated in the early period. This mortality rate may have occurred because patients are in the geriatric age group, and underlying comorbidities can worsen the condition.

Limitations

As a limitation in our study, the study was retrospective, and some data (antibiotic dose) could not be completely recovered.

Conclusion

The presence of UTI in geriatric patients increases the risk of mortality. Comorbidities, advanced age, and late diagnosis are among the important causes of mortality. Early diagnosis and treatment play an important role in producing a reduction in mortality rates. Therefore, UTI should be considered in the differential diagnosis when the general condition is deteriorated in the geriatric population even in cases in which patients are asymptomatic. Urine culture samples should be obtained in cases of suspected infection, and antibiotic therapy should be started immediately to decrease mortality and increase recovery rates when the urine results indicate infection.

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