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ARAŞTIRMA YAZISI / RESEARCH ARTICLE

YAŞLI YETİŞKİNLERDE İDRAR YOLU ENFEKSİYONLARININ TANIMLAYICI ÖZELLİKLERİ, ETİYOLOJİK AJANLAR VE MORTALİTE RİSK FAKTÖRLERİ

DESCRIPTIVE CHARACTERISTICS, ETIOLOGICAL AGENTS, AND RISK FACTORS FOR MORTALITY OF URINARY TRACT INFECTIONS IN OLDER ADULTS

Cihan SEMET

İnegöl Devlet Hastanesi, Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği

ÖZET

AMAÇ: İdrar yolu enfeksiyonları yaşlı erişkinlerde sıklıkla görülmekte ve önemli morbidite ve mortalite ile ilişkilendirilmektedir. Bu çalışmanın amacı, idrar yolu enfeksiyonu ile hastaneye yatırılan yaşlı hastaların klinik özelliklerini, bakteriyel etiyolojilerini, antimikrobiyal direnç paternlerini ve mortalite için risk faktörlerini karakterize etmektir.

GEREÇ VE YÖNTEM: Ocak 2018 ile Aralık 2022 tarihleri arasında idrar yolu enfeksiyonu tanısıyla hastaneye yatırılan ≥65 yaş 118 hastanın verileri retrospektif olarak analiz edilmiştir. İdrar yolu enfeksiyonları Hastalık Kontrol ve Korunma Merkezleri (Centers for Disease Control and Prevention) kriterlerine göre tanımlanmıştır. İdrar kültürlerinde izole edilen mikroorganizmalar ve antimikrobiyal direnç oranları belirlenmiştir. Mortalite ile ilişkili risk faktörleri lojistik regresyon analizi ile değerlendirilmiştir.

BULGULAR: Hastaların %50,8'i kadındı; ortalama yaş 72,5±7,0 yıldı. En sık görülen semptomlar dizüri (%65,3), anoreksi (%65,3) ve yan ağrısı (%57,6) idi. En sık izole edilen patojen *Escherichia coli* (%29,4) olmuştur. Olguların 49'u (%41,5) nozokomiyal idrar yolu enfeksiyonu idi. Tüm nedenlere bağlı hastane içi mortalite 48 hastada (%40,6) gözlenirken, 22 hastada (%18,6) doğrudan idrar yolu enfeksiyonu ile ilişkili hastane içi mortalite görülmüştür. Ürosepsis (odds ratio (OR):13.518, %95 CI: 1.711-106.793, p=0.014), böbrek taşı (OR:7.529, %95 CI: 1.596-35.525, p=0.011) ve çok ilaca dirençli organizmaların neden olduğu idrar yolu enfeksiyonları (OR: 18.612, %95 CI: 1.564-4.283, p<0.001) mortalite için bağımsız risk faktörleri, uygun tedavinin (OR: 0.090, %95 CI: -3.736--1.085, p<0.001) mortalite için bağımsız bir koruyucu faktör olduğu bulunmuştur.

SONUÇ: Yaşlı yetişkinlerde idrar yolu enfeksiyonları çok çeşitli semptomlarla ortaya çıkar ve ağırlıklı olarak ilaca dirençli *Escherichia coli*'den kaynaklanır. Ürosepsis ve böbrek taşları mortalitenin kritik belirleyicileridir ve hızlı ve uygun yönetim stratejilerine duyulan ihtiyacı vurgular. Yaşlı yetişkinlerde idrar yolu enfeksiyonlarının etiyolojisi, klinik özellikleri ve mortalite risk faktörlerinin bilinmesi, bu hassas popülasyonda enfeksiyon yönetimini optimize etmek için çok önemlidir.

ANAHTAR KELİMELER: İdrar yolu enfeksiyonu, Yaşlı, Etiyoloji, Direnç, Mortalite.

ABSTRACT

OBJECTIVE: Urinary tract infections are common in older adults and associated with significant morbidity and mortality. This study aimed to characterize the clinical features, bacterial etiologies, antimicrobial resistance patterns, and risk factors for mortality in elderly patients hospitalized with urinary tract infection.

MATERIAL AND METHODS: Data were retrospectively analyzed from 118 patients aged ≥65 years hospitalized with a diagnosis of urinary tract infection between January 2018 and December 2022. Urinary tract infections were defined according to Centers for Disease Control and Prevention criteria. Isolated microorganisms in urine cultures and antimicrobial resistance rates were determined. Risk factors associated with mortality were evaluated by logistic regression analysis.

RESULTS: 50.8% of patients were female; the mean age was 72.5±7.0 years. The most common symptoms were dysuria (65.3%), anorexia (65.3%), and flank pain (57.6%). Forty-nine patients (41.5%) had nosocomial urinary tract infections. All cause in hospital mortality was observed in 48 patients (40.6%), and 22 patients (18.6%) had in-hospital mortality directly related to urinary tract infection. Urosepsis (OR: 13.518, 95% CI: 1.711-106.793, p=0.014), kidney stones (OR: 7.529, 95% CI: 1.596-35.525, p=0.011) and urinary tract infections caused by multidrug-resistant organisms (OR: 18. 612, 95% CI: 1.564-4.283, p<0.001) were independent risk factors for mortality, and appropriate treatment (OR: 0.090, 95% CI: -3.736--1.085, p<0.001) was an independent protective factor for mortality.

CONCLUSIONS: Urinary tract infections in elderly adults present with a wide range of symptoms and are predominantly caused by drug-resistant *Escherichia coli*. Urosepsis and kidney stones are critical determinants of mortality, emphasizing the need for rapid and appropriate management strategies. Understanding the etiology, clinical features, and mortality risk factors of urinary tract infections in elderly adults is crucial for optimizing infection management in this vulnerable population.

KEYWORDS: Urinary tract infection, Elderly, Etiology, Resistance, Mortality.

Geliş Tarihi / Received: 26.10.2023
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Yazışma Adresi / Correspondence: Dr. Cihan SEMET
İnegöl Devlet Hastanesi, Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği
E-mail: semetcihan@gmail.com
Orcid No : 0000-0003-2210-820X
Etik Kurul (Ethical Committee: Sağlık Bilimleri Üniversitesi Bursa Yüksek İhtisas Eğitim ve Araştırma Hastanesi Etik Kurulu (2011-KAEK-25, 2023/05-01).

INTRODUCTION

The older adult population is experiencing unprecedented growth in nearly every nation, with this upward trend expected to persist in the coming years (1). Among the various healthcare challenges older adults face, urinary tract infections (UTIs) are the most prevalent hospital-acquired infections within geriatric care facilities (2). Older patients are at higher risk for UTIs due to limited daily physical movement, bladder dysfunctions due to aging, frequent use of urinary catheters and antimicrobials for various reasons, and frequent hospitalizations. The severity of the illness ranges from pyelonephritis, which may be fatal, to relatively benign cystitis. The etiological profile of UTIs in older adults is dominated by *Escherichia coli (E. coli)*, followed by other gram-negative bacteria, such as *Klebsiella, Proteus*, and *Pseudomonas* species, and gram-positive bacteria, such as *Enterococcus* and *Staphylococcus* species (3). Rapid initiation of empirical antimicrobial therapy in UTIs occurring in older adults may improve clinical outcomes (4). The fact that the known classical symptoms of UTIs in older adults are more subtle causes delays in diagnosis. Delays in diagnosis cause various complications and lead to difficulties in disease management (5). To prevent these and improve health care, clinicians must be more sensitive to diagnosing UTIs in older adults. This article aims to comprehensively understand the etiological profiles and prognosis of UTIs in older adults.

MATERIALS AND METHODS

This is a single-center retrospective cohort study to evaluate the etiological profile and prognosis of UTI in elderly patients. Patients aged 65 years and older who were hospitalized with a diagnosis of UTI in a secondary care public hospital between January 1, 2018 and December 31, 2022 were included in the study.

Demographic information, clinical symptoms, comorbidities, laboratory parameters including serum leukocytes, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) at the time of diagnosis were obtained from the electronic file recording system. UTI definitions were made based on the surveillance criteria determined by Centers for Diseases Control and Prevention/National Healthcare Safety Network (CDC/NHSN) (6). The uncomplicated and complicated UTI categories are defined according to the European Association of Urology guidelines. The uncomplicated group includes non-pregnant women without apparent anatomical or functional abnormalities of the urinary tract. The complicated group comprises individuals with risk factors such as those with anatomic or functional abnormalities, urinary catheter users, renal disease, pregnant women, men, and immunodeficiency diseases (7). CDC standard definitions for nosocomial UTIs were used (8). Past UTI history is defined as the previous 12 months before admission, and past antibiotic use and hospitalization are defined as the last three months before admission. Urine samples obtained from patients for diagnostic purposes were evaluated biochemically and sterile midstream urine samples were evaluated microbiologically. For microbiological examination, midstream urine samples were collected and inoculated with 5% sheep blood agar and eosin methylene blue agar. These samples were then incubated at 37°C for 24-48 hours. Growth of 100,000 CFU/mL bacteria was considered significant. Detection of more than one organism in a single urine sample was interpreted as contamination. Microorganisms were considered multidrug-resistant organisms (MDRO) in case of expressing an acquired resistance to at least one agent in three or more antimicrobial categories (9).

The diagnosis of sepsis is based on the criteria for systemic inflammatory response syndrome in the presence of infection. The diagnosis is made when two or more of the following conditions are present: Heart rate in excess of 90 bpm; respiratory frequency in excess of 20 breaths per minute or pCO_2 less than 32 mmHg; white blood cell count in excess of 12,000/µL, less than 4,000/µL or within the normal range but with more than 10% band forms; body temperature above 38°C or below 36°C (10).

Appropriate treatment was defined as treatment that matches the in vitro susceptibility of the pathogen (11). The timing of appropriate antibiotic therapy is determined from the time of urine culture collection to the administration of the first

dose of antibiotic therapy with documented in vitro sensitivity to the identified pathogen.

Ethical Committee

The study was approved by University of Health Sciences Bursa Yuksek İhtisas Training and Research Hospital Ethics Committee (Approval No. 2011- KAEK-25, Dated: 2023/05-01). The study was carried out according to the Declaration of Helsinki.

Statistical Analysis

The study's participants' demographic and clinical details were delineated through descriptive analysis. We verified the normality of the variables with the Shapiro-Wilk assessments. Continuous data were presented either as average ± standard variation or as a range from minimum to maximum values. To contrast continuous data across groups, we employed either Mann-Whitney U evaluations or t-examinations. Categorical data were detailed in terms of counts and proportions; group comparisons were made using either Pearson's chi-square or Fisher's precise chi-square assessments. To determine potential mortality risk factors, we implemented univariate logistic regression methods. Variables with a p-value of less than 0.10 in the univariate study were subsequently evaluated with a multivariate logistic regression to pinpoint key mortality-associated risks. The SPSS software version 28.0 facilitated all statistical investigations, setting the significance bar at $p<0.05$.

RESULTS

In our study of older adults with urinary tract infections (UTI), the 118 participants had an average age of 72.5 ± 7.0 years, with 50.8% being female. The patients frequently had concurrent chronic diseases including diabetes mellitus (45.8%), cerebrovascular disease (36.4%), and malignancy (31.4%). Additionally, approximately half of the patients had a history of urinary incontinence, antimicrobial use within the past 3 months, and UTI within the previous 12 months. The most common symptoms were pain during urination (65.3%), loss of appetite (65.3%), and flank pain/renal angle tenderness (57.6%) **(Table 1)**. In our study, a significant proportion of UTIs were complicated, with 77 cases (65.2%) classified as such, and additionally, 49 patients (41.5%) had nosocomial UTIs acquired in the hospital setting. Secondary bacteremia, in which bacteria entered the bloodstream, was present in 23 patients (19.4%), and UTIs caused by MDRO were found in 37 cases (31.4%). Eighty-four patients (71.2%) received appropriate treatment for their condition. The mean time to initiation of appropriate antibiotic treatment was 3.53 days. All-cause in-hospital mortality was observed in 48 patients (40.6%), and 22 patients (18.6%) had in-hospital mortality directly related to UTI. The mean time from UTI diagnosis to death was 15.60 days (Table 1).

Table 1: Basic charecteristics of the study population

Variables	UTI (n=118)
Age, years, mean ± SD	72.5 ± 7.0
Gender, female, no. (%)	60 (50.8)
Body Mass Index, (kg/m2), mean ± SD	27.5 ± 2.7
Complicated UTIs, no. (%)	77 (65.2)
Nosocomial UTIs, no. (%)	49 (41.5)
Peripheral artery disease, no. (%)	30 (25.4)
Coronary artery disease, no. (%)	53 (44.9)
Chronic obstructive lung diseases, no. (%)	29 (24.6)
Cerebrovascular disease, no. (%)	43 (36.4)
Diabetes mellitus, no. (%)	54 (45.8)
Chronic kidney disease, no. (%)	22 (18.6)
Malignancy, no. (%)	37 (31.4)
Hypotroidi or Hypertroidi, no. (%)	27 (22.9)
Dementia, no. (%)	33 (28.0)
Rheumatoid arthritis, no. (%)	12 (10.2)
Bedsore, no. (%)	37 (31.4)
Kidney stones, no. (%)	55 (46.6)
Prostate hypertrophy, no. (%)	30 (25.4)
Urinary incontinence, no. (%)	56 (47.5)
Fecal incontinence, no. (%)	27 (22.9)
Chronic steroid or immunosuppression therapy, no. (%)	23 (19.5)
Urinary catheter, no. (%)	74 (62.7)
Albumin,(g/L), mean ± SD	38 ± 5.8
Antimicrobial use within 3 months, no. (%)	55 (46.6)
Previous hospitalization within 3 months, no. (%)	51 (43.2)
Previous UTI within 12 months, no. (%)	59 (50.0)
Abdominal pain, no. (%)	58 (49.2)
Flank pain/renal angle tenderness, no. (%)	68 (57.6)
Pain when urinating, no. (%)	77 (65.3)
Loss of appetite, no. (%)	77 (65.3)
Secondary bacteremia, no. (%)	23 (19.4)
Multidrug-resistant organisms infection, no. (%)	37 (31.4)
Appropriate treatment, no. (%)	84 (71.2)
Time to appropriate antibiotic therapy (days), mean ± SD	3.53±2.02
Time from diagnosis to death (days), mean ± SD	15.60±5.28
All-cause in-hospital mortality, no. (%)	48 (40.6)
Attributable in-hospital mortality, no. (%)	22 (18.6)

In our study, the most commonly isolated uropathogen was *E. coli*, which accounted for 29.4% of all isolates **(Table 2)**. *E. coli* showed high rates of resistance to amikacin (22.9%), ciprofloxacin (28.5%), and ampicillin/sulbactam (40.0%). *Klebsiella spp*. accounted for 16.8% of all isolates, and the table 2 shows that this uropathogen had high resistance rates to piperacillin/tazoba-

ctam (60.0%) and ceftriaxone (65.0%). *Enterobacter spp*. accounted for 7.0% of all isolates, and the table 2 shows that this uropathogen had high rates of resistance to meropenem (88.8%), amikacin (44.4%), and ciprofloxacin (66.6%). *Acinetobacter baumannii*, which accounted for 4.7% of all isolates, had high resistance rates to all antimicrobial agents tested except for trimethoprim/sulfamethoxazole. It's worth noting that the study found high rates of antimicrobial resistance among all uropathogens tested. For example, over 30% of isolates were resistant to meropenem, amikacin, and ampicillin/sulbactam, while over 40% were resistant to ciprofloxacin and ampicillin/sulbactam. This underscores the importance of appropriate antimicrobial use and stewardship programs to prevent the spread of resistant infections.

Table 2: Isolated uropathogens and antimicrobial resistance profiles

Uropathogens	MEM R, n (%)	ETP R, n (%)	AMK R, n (%)	CIP R, n (%)	SAM R, n (%)	CRO R, n (%)	TZP R, n (%)	SXT R, n (%)	VAN R, n (%)
Escherichia coli, (n=35)	7 (20.0)	7 (20.0)	8 (22.9)	10 (28.5)	14 (40.0)	14 (40.0)	10 (28.5)	10 (28.5)	-
Klebsiella spp., (n=20)	5 (25.0)	5 (25.0)	9 (45.0)	8 (40.0)	8 (40.0)	13 (65.0)	12 (60.0)	8 (40.0)	-
Enterobacter spp., (n=9)	8 (88.8)	7 (77.7)	4 (44.4)	6 (66.6)	9 (100)	6 (66.6)	6 (66.6)	4 (44.4)	-
Acinetobactar baumannii, (n=6)	5 (83.3)	-	4 (66.6)	5 (83.3)	-	-	5 (83.3)	5 (83.3)	-
Proteus mirabilis, (n=7)	0 (0)	0 (0)	0 (0)	5 (71.4)	6 (85.7)	6 (85.7)	3 (40.0)	2 (28.5)	-
Pseudomonas aeruginosa, (n=10)	6 (60.0)	-	5 (50.0)	4 (40.0)	-	-	4 (40.0)	-	-
Enterococcus spp., (n=11)	-	-	-	11 (100)	5 (45.4)	-	-	-	0 (0)
Staphylococcus spp., (n=9)	-	-	-	7 (77.7)	-	-		0 (0)	0 (0)
Candida spp., (n=11)	-	-	-	-	-	-	-	-	-
Total (n=118)	31 (26.3)	19 (16.1)	30 (25.4)	56 (47.5)	42 (35.6)	39 (33.1)	40 (33.9)	29 (24.6)	0 (0)

Abbreviation: R: resistant, MEM: meropenem, ETP: ertapenem, AMK: amikacin, CIP: ciprofloxacin, SAM: ampicilin/sulbaktam, CRO: ceftriaxone, TZP: piperacilin/tazobactam, SXT: trimethoprim/sulfamethoxazole, VAN: vancomycin

We identified several important mortality risk factors in our study of 118 older adults with UTI **(Table 3)**. Urosepsis and kidney stones were important predictors, with urosepsis occurring in 21.4% of survivors versus 41.7% of non-survivors (OR 13.518; p=0.014) and kidney stones occurring in 30.0% of survivors versus 70.8% of non-survivors (OR 7.529; p=0.011). Furthermore, infection with MDRO emerged as a critical risk factor, occurring in 14.2% of survivors versus 56.2% of non-survivors, with an odds ratio (OR) as high as 18.612 (p<0.001). The study also emphasized the importance of timely and appropriate antibiotic treatment; only 45.8% of non-survivors received appropriate treatment, significantly reducing survival likelihood (OR 0.090; p<0.001). Other clinical and laboratory parameters did not demonstrate statistically significant associations with mortality.

Table 3: Risk factors for all-cause in-hospital mortality in older adults with urinary tract infection

	Univariate analysis			Multivariate analysis		
Variables	Survival (n=70)	Death (n=48)	*P* value	OR	(95% CI);	*P* value
Age>75 years, no. (%)	32 (45.7)	20 (41.7)	0.664	-	-	-
Gender, female, no. (%)	38 (54.3)	22 (45.8)	0.367	-	-	-
Body Mass Index, kg/m2 mean > 30, no. (%)	13 (18.6)	6 (12.5)	0.378	-	-	-
Urosepsis, no. (%)	15 (21.4)	20 (41.7)	**0.018**	13.518	1.711 - 106.793	**0.014**
Kidney stones, no. (%)	21 (30.0)	34 (70.8)	**<0.001**	7.529	1.596 - 35.525	**0.011**
Cerebrovascular disease, no. (%)	22 (31.4)	21 (43.8)	0.172	-	-	-
Dementia, no. (%)	23 (32.9)	10 (20.8)	0.153	-	-	-
Diabetes mellitus, no. (%)	33 (47.1)	21 (43.8)	0.716	-	-	-
Malignancy, no. (%)	18 (25.7)	19 (39.6)	0.111	-	-	-
Hypotroidi or Hypertroidi, no. (%)	17 (24.3)	10 (20.8)	0.661	-	-	-
Rheumatoid arthritis, no. (%)	3 (4.3)	9 (18.8)	**0.011**	6.713	0.515 - 87.540	0.146
Bedsore, no. (%)	23 (32.9)	14 (29.2)	0.671	-	-	-
Chronic kidney disease, no. (%)	15 (21.4)	7 (14.6)	0.348	-	-	-
Prostate hypertrophy, no. (%)	18 (25.7)	12 (25.0)	0.930	-	-	-
Peripheral artery disease, no. (%)	21 (30.0)	9 (18.8)	0.168	-	-	-
Coronary artery disease, no. (%)	31 (44.3)	22 (45.8)	0.868	-	-	-
Chronic obstructive lung diaseses, no. (%)	17 (24.3)	12 (25.0)	0.929	-	-	-
Chronic steroid or immunosuppression therapy, no. (%)	13 (18.6)	10 (20.8)	0.761	-	-	-
Secondary bacteremia, no. (%)	14 (20.0)	9 (18.8)	0.866	-	-	-
Urinary catheter, no. (%)	45 (64.3)	29 (60.4)	0.669	-	-	-
White blood cells (/mm^3), mean ± SD	13719±7050	14471±7095	0.571	-	-	-
Lymphocytes (/mm^3), mean ± SD	2117±476	2195±439	0.366	-	-	-
Neutrophils (/mm^3), mean ± SD	6044±2794	7078±3391	0.073	-	-	-
Neutrophil-to-lymphocyte ratio, mean ± SD	293±139	331±163	0.190	-	-	-
Hemoglobin (g/dL), mean ± SD	13.3±1.6	12.8±1.7	0.117	-	-	-
Platelets (/mm^3), mean ± SD	267173±145210	222428±89691	0.060	-	-	-
Erythrocyte sedimentation rate (mm/h), mean ± SD	39±21	42±17	0.400	-	-	-
C-reactive protein (mg/L), mean ± SD	102±75	102±65	0.961	-	-	-
Glomerular filtration rate calculated (mL/min/1.73 m^2), mean ± SD	83±25	91±20	0.078	-	-	-
Fever>38°C, no. (%)	37 (52.9)	24 (50.0)	0.760	-	-	-
Tachycardia, no. (%)	37 (52.9)	22 (45.8)	0.453	-	-	-
Complicated UTIs, no. (%)	47 (67.1)	30 (62.5)	0.746	-	-	-
Nosocomial UTIs, no. (%)	26 (37.1)	23 (47.9)	0.329	-	-	-
Multidrug-resistant organisms infection, no. (%)	10 (14.2)	27 (56.2)	**<0.001**	18.612	1.564-4.283	**<0.001**
Appropriate treatment, no. (%)	61 (87.1)	22 (45.8)	**<0.001**	0.090	-3.736--1.085	**<0.001**
Time to appropriate antibiotic therapy (days), mean ± SD	3.26± 2.04	4.27± 1.83	**0.030**	-	-	-

OR: odds ratio

DISCUSSION

Although UTIs are the most common bacterial infectious diseases regardless of age, the likelihood of the disease increases with advancing age. Urinary tract pathologies, hormonal irregularities, urinary incontinence, impaired immune system, inappropriate nutrition, functional inadequacy and comorbidities are among the parameters that increase the frequency of UTIs with advancing age (13). In our study, the number of males and females with UTIs was similar (50.8 versus 49.2), and 52 (44.1%) patients were older than 75 years. Our results are consistent with previous studies highlighting age's role as a risk factor for UTIs in older adults (14, 15). Many UTIs in this populati-

on are classified as complicated, with many being nosocomial, acquired in the hospital setting (16). Nosocomial UTIs are particularly prevalent among older adults and are associated with increased risks of hospital readmission and perioperative mortality (17). In our study, the majority of patients had complicated UTIs, and approximately 41% had a diagnosis of nosocomial UTIs. The presence of of diabetes Mellitus (DM), in particular, has been highlighted as a significant comorbidity among older adults with UTIs (18). In addition, kidney stones are a notable finding among older adults with UTIs (19). In our study, DM, coronary heart disease and cerebrovascular disease were the top three comorbidities, while a significant proportion of patients had kidney stones. DM is associated with an increased risk of developing UTIs and can exacerbate complications such as urinary frequency symptoms (18). The coexistence of kidney stones and UTIs can lead to more severe and recurrent infections, posing challenges in managing and treating UTIs in this population (20).

UTIs frequently occur in hospitalized elderly patients, and the likelihood of infection is increased in those with limited mobility. Although it is known that treatment is not required in asymptomatic bacteriuria with certain exceptions, the diagnosis of UTI in the elderly is often a dilemma due to the subtle clinical findings. Since UTIs in the elderly do not always present with typical symptoms, urine culture is more helpful in excluding UTIs than diagnosing symptomatic infections (21). In our study at the time of diagnosis, dysuria was the most common symptom among the classic symptoms and signs of UTI. Approximately half of the patients had no fever, while loss of appetite was seen in 65.3% of the patients. Our findings suggest that fever is not always present in UTIs in the elderly population, and UTIs should be investigated in elderly patients presenting with loss of appetite.

Our study results are consistent with previous research showing high levels of WBCs, lymphocytes, and CRP in patients with UTIs. These elevated levels of markers can be attributed to the body's immune response to the infection. High levels of WBCs and lymphocytes are common in people with UTIs. These cells play an essential role in fighting bacterial infections (22). Increased levels of CRP have also been reported in patients with UTIs (23). The high WBC, lymphocyte, and CRP levels in our stuy's UTIs group are consistent with the known immune response to UTIs. These laboratory findings may be helpful in the diagnosis and monitoring of UTIs and may provide information for appropriate clinical management.

E. coli was the most frequently isolated pathogen in UTI patients of all ages, followed by Klebsiella pneumonia and Pseudomonas aeruginosa. In UTIs in elderly men, *E. coli* was isolated less regularly, but it was still the most frequently identified uropathogen. Resistance to cefuroxime, gentamicin, and fluoroquinolone is higher in E. coli strains isolated from elderly patients. In addition, extended-spectrum beta-lactamase (ESBL) positive and AmpC-producing E. coli and Klebsiella spp. are more frequently isolated from UTIs in elderly patients (24). In our study, the most frequently isolated microorganisms in urine cultures of patients with UTI were *E. coli, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, respectively, in accordance with the literature. In *E. coli*, the most frequently isolated pathogen, carbapenem resistance was 20%, ceftriaxone resistance was 40%, and fluoroquinolone resistance was 28.5%. UTIs caused by MDRO have been identified in approximately one-third of cases, and healthcare professionals should be aware of local resistance rates in order to decide on empirical treatment choices.

All-cause in-hospital mortality of UTIs is a critical concern, particularly in vulnerable populations such as elderly patients and those with complicated UTIs. The mortality rates associated with UTIs vary widely, ranging from 2% to 33% in complicated UTIs (25). The reason for the higher mortality rate in our study compared to the literature may be related to the high comorbidities of our patients and inadequate rates of receiving early and appropriate treatment. The prognosis of UTIs in the older adults population was found to be largely dependent on the presence of underlying comorbidities and the prompt initiation of appropriate antibiotic therapy (26). Patients with multiple comorbidities and those who experienced delays in receiving targeted

treatment were more likely to have poor outcomes, including complications such as urosepsis, acute kidney injury, and increased mortality (27).

In our study, urosepsis, kidney stones and infection with MDRO were found to be independent predictors of mortality in patients with UTI, while appropriate treatment was found to be an independent protective factor for mortality. Urosepsis, a severe systemic infection originating from the urinary tract, has been widely reported to be associated with increased mortality in UTI patients (27,28). Early recognition and appropriate treatment of urosepsis are crucial to improve patient outcomes. In the literature, kidney stones have been identified as independent predictors of mortality in patients with UTI (29, 30). The association between kidney stones and increased mortality in UTI patients observed in our study underscores the importance of adequately managing urinary tract obstruction to reduce the risk of severe complications and poor outcomes. As found in our study, MDRO is an independent predictor of mortality in UTI patients in a study conducted in the literature (31). Early and appropriate treatment is critical in managing UTI (32). In our study, the literature supports the fact that appropriate treatment was initiated earlier in survivors and that appropriate treatment was found to be a protective factor in terms of mortality.

Our study has some limitations. First, the study design was retrospective, which may have introduced selection bias and limited our ability to establish causality. Prospective, longitudinal studies are needed to elucidate further the complex relationships between risk factors, etiological profiles, and prognosis in older adults UTIs. Additionally, our study population was drawn from a single center, which may limit the generalizability of our findings to other settings and geographic regions. In conclusion, our study highlights the importance of defining the etiological profiles, and prognosis of UTIs in the older adult population to guide clinical decision-making and improve patient outcomes. Early recognition of UTIs, prompt initiation of appropriate antibiotic therapy, and vigilant monitoring of patients with significant risk factors and comorbidities are essential to minimize complications and optimize prognosis in this vulnerable population.

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