ORIGINAL ARTICLE

ANALYSIS OF URINARY TRACT INFECTIONS IN GERIATRIC PATIENTS

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Abstract

Introduction: There are some differences in the clinical approach to urinary tract infections in geriatric patients. The aim of this study was to investigate the clinical characteristics of symptomatic urinary tract infections in geriatric patients in a tertiary care hospital and to determine the infectious agents and antibiotic susceptibilities.

Materials and Method: The study included geriatric patients (aged over 65) who were followed up for symptomatic urinary tract infection at Fırat University Medical Faculty Hospital between March and September 2023.

Results: The study included 258 patients, of whom 164 (63.6%) were male. Clinical analysis of the patients showed that 85.7% of the patients had complicated urinary tract infections, 51.2% had lower urinary tract infections and 61.6% had community-acquired urinary tract infections. A total of 274 isolates were identified, including two uropathogens in 16 patients. Of these, 70.8% belonged to *Enterobacterales* species and *E. coli* (42.7%) was the most common isolate. Extended-spectrum beta-lactamase production in *Enterobacterales* species was 50% in community-acquired strains and 68.9% in hospital-acquired strains. The ampicillin susceptibility of *Enterococcus* species was 72.7% for community-acquired isolates and 54.5% for hospital-acquired isolates. 68.8% of community-acquired *Staphylococcus spp.* and 68.8% of hospital-acquired *Staphylococcus spp.* isolates were methicillin-resistant.

Conclusion: In our study, the high prevalence of male patients with complicated urinary tract infections was notable. Furthermore, the antibiotic resistance profiles identified emphasise the need to update treatment strategies and maintain surveillance of resistance in geriatric patients. These findings highlight the importance of a multidisciplinary approach to managing UTIs in geriatric patients, with close collaboration between clinicians and microbiologists.

Keywords: Tertiary Care Centers; Community-Acquired Infections; Anti-Bacterial Agents; Methicillin Resistance; *Escherichia coli*; *Enterococcus*.

INTRODUCTION

Urinary tract infection (UTI) is caused by infection of the organs of the genitourinary system, such as the renal parenchyma, ureters, bladder and urethra. In geriatric patients, the presence of chronic genitourinary symptoms, the high frequency of asymptomatic bacteriuria and communication disorders (such as deafness, cognitive impairment, neurological diseases, etc.) make diagnosis more difficult in clinical practice. In addition, co-morbidities, residence in nursing homes, cognitive decline, physiological deterioration of the genitourinary system, and immunodeficiency contribute to UTI susceptibility and lead to more severe infections. Due to co-morbidities, hospital admission rates and the likelihood of hospital-acquired infections are higher compared to the adult age group. This factor should also be taken into account when choosing empirical treatment. Although there are some differences in the diagnosis and management of UTI in the geriatric population, there is no definitive protocol for the management of UTI in the elderly (1, 2).

The aim of this study is to investigate the epidemiology and clinical characteristics of UTI in geriatric patients in a tertiary hospital, and to determine the pathogens and antibiotic susceptibilities.

MATERIALS AND METHOD

Study Design, Setting, Participants and Clinical Assessment

In this study, geriatric patients (>65 years-old) diagnosed with UTI and being followed up at Firat University Faculty of Medicine Hospital between March 2023 and September 2023 were examined. Patients with symptomatic UTI, defined as pyuria, bacteriuria and genitourinary symptoms, were included in the study. Due to the prevalence of chronic genitourinary symptoms in the geriatric age group, acute or worsening genitourinary symptoms were included. Patients in intensive care were excluded.

Patients were evaluated for predisposing factors for UTI, origin of infection (community-acquired/hospital-acquired), upper/lower UTI, complicated/uncomplicated UTI, bacteraemia and final outcome (survival/mortality).

Definitions

Upper UTIs were classified as cases of bacteriuria accompanied by genitourinary symptoms, systemic signs (nausea, vomiting, fever, lateral pain and costovertebral angle tenderness, etc.) and systemic laboratory findings (elevated white blood cell count, C-reactive protein and erythrocyte sedimentation rate etc.) associated with UTIs.

Lower UTIs were classified as the presence of bacteriuria and genitourinary symptoms, in the absence of UTI-related systemic signs (nausea, vomiting, fever, lateral pain and costovertebral angle tenderness, etc.) and laboratory findings (elevated white blood cell count, C-reactive protein and erythrocyte sedimentation rate etc.).

Complicated UTIs were classified in the presence of predisposing factors such as structural or functional abnormalities of the urinary tract, urinary catheterization, urinary tract obstruction, or chronic systemic conditions that impair immune function.

Hospital-acquired UTIs are classified as infections that develop between 48 and 72 hours after admission to hospital, or within 10 days of discharge (1, 2). In addition, infections that occur within 10 days of a urological intervention (urodynamic test, etc.) performed in an outpatient setting were also considered nosocomial infections.

Data Sources

The hospital information system and laboratory information system were searched retrospectively, and patients' electronic records were accessed. Demographic data (age and sex), co-morbidities,

clinical features of UTI, treatment setting (outpatient/clinic), treatment history (UTI in the past 12 months, antibiotic use in the past 3 months and hospitalisation history), microorganisms grown in urine culture and antibiotic susceptibilities were recorded.

Microbiological studies

Urine samples received by our laboratory were inoculated onto EMB (eosin methylene blue) and blood agar media and incubated in an incubator. When evaluating urine cultures, identification and antibiotic susceptibility testing were performed for uropathogens forming ≥104 cfu/ml in the presence of ≤2 uropathogens and ≥105 cfu/ml in the presence of ≥3 uropathogens in non-invasive specimens (midstream urine, foley catheter, etc.). For invasive specimens (direct catheterisation, nephrostomy, cystoscopy, etc.), identification and antibiotic susceptibility tests were performed for uropathogens forming ≥103 cfu/ml in the presence of ≤2 uropathogens, or ≥104 cfu/ml in the presence of ≥3 uropathogens.

Identification and antibiotic susceptibility of microorganisms grown on the media were evaluated using a fully automated bacterial identification and susceptibility system (Phoenix™, BD, USA). The disk diffusion method with cefoxitin was used to determine methicillin resistance in *S. aureus* isolates. Carbapenem resistance in Gram-negative bacteria and vancomycin resistance in enterococci, as detected by the automated system, were confirmed by the reference disk diffusion method. Test results were interpreted according to the criteria of the European Committee on Antimicrobial Susceptibility Testing (EUCAST). The antibiotics used in the study were selected according to the recommendations of the Turkish Society of Microbiology Standardisation of Antibiotic Susceptibility Testing working group.

In line with EUCAST recommendations, the presence of extended-spectrum beta-lactamases (ESBLs) was investigated in isolates exhibiting a minimum inhibitory concentration (MIC) of greater than or equal to 1 µg/mL for ceftriaxone, cefotaxime, or ceftazidime. The presence of ESBLs was determined using either the double-disk synergy test or the combined disk method.

Statistical Analysis

IBM SPSS Statistics version 23 package (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The Shapiro-Wilk test was used to analyse the normality of quantitative data. Mean ± standard deviation was used for normally distributed continuous variables. For continuous variables that are not normally distributed, median and 1st Quarter (Q1) - 3rd Quarter (Q3) are used. Classified data were presented as frequencies and percentages.

Compliance with Ethical Standards

This study was conducted in accordance with the tenets of the Declaration of Helsinki and approved by the Non-Interventional Ethics Committee of Firat University Faculty of Medicine (decision no. 2024/12-27 dated 11.09.2024).

RESULTS

A total of 258 patients, 164 (63.6%) male and 94 (36.4%) female, were included in the study. The mean age was 75.55±7.45 years. Of the patients, 159 (61.6%) were classified as having community-acquired infections, and 99 as having hospital-acquired infections. A total of 221 patients (85.7%) were diagnosed with complicated infections, while 37 (14.3%) had uncomplicated infections. In addition, 132 patients (51.2%) were identified as having lower urinary tract infections (UTIs), and 126 (48.8%) as having upper UTIs. The clinical characteristics of the patients are shown in Table 1. Results of urine microscopy are presented in Table 2. None of the patients lived in a nursing home. Bacteraemia was observed in 12 (4.7%) of the patients, all of whom

Table 1. Clinical Characteristics of the Patients

Parameters	**Total** n=258	**Community-acquired UTI** n=159	**Hospital-acquired UTI** N=99	**Complicated UTI** n=221	**Uncomplicated UTI** n=37	**Lower UTI** n=132	**Upper UTI** n=126
Gender n (%)							
Male	164 (63.6)	96 (60.4)	68 (68.7)	164 (74.2)	-	80 (60.6)	84 (66.7)
Female	94 (36.4)	63 (39.6)	31 (31.3)	57 (25.8)	37 (100)	52 (39.4)	42 (33.3)
Age Mean±standard deviation	75.55±7.45	75.72±7.46	75.29 ±7.45	75.72±7.50	77.62±7.07	75.92±7.00	75.16±7.89
Co-morbidities n (%)							
Hypertension	116 (45)	66 (41.5)	50 (50.5)	100 (45.2)	16 (43.2)	67 (50.8)	49 (38.9)
Chronic heart disease	95 (36.8)	55 (34.6)	30 (30.3)	78 (35.3)	17 (45.9)	60 (45.5)	35 (27.8)
Diabetes mellitus	82 (31.8)	54 (34)	28 (28.3)	82 (37.1)	-	39 (29.5)	43 (34.1)
Chronic renal failure	30 (11.6)	14 (8.8)	16 (16.2)	24 (10.9)	6 (16.2)	19 (14.4)	11 (8.7)
Other neurological diseases	23 (8.9)	17 (10.7)	6 (6.1)	19 (8.6)	4 (10.8)	11 (8.3)	12 (9.5)
Chronic obstructive pulmonary disease	20 (7.8)	13 (8.2)	7 (7.1)	17 (7.7)	3 (8.1)	11 (8.3)	9 (7.1)
Delirium and dementia	18 (7)	17 (10.7)	1 (1)	10 (4.5)	8 (21.6)	8 (6.1)	10 (7.9)
Non-urinary malignancy	10 (3.9)	4 (2.5)	6 (6.1)	10 (4.5)	-	8 (6.1)	2 (1.6)
Rheumatological diseases	9 (3.5)	5 (3.1)	4 (4)	5 (2.3)	4 (10.8)	7 (5.3)	2 (1.6)
Presence of at least one chronic disease	183 (70.9)	113 (71.1)	70 (70.7)	157 (71)	26 (70.3)	104 (78.8)	79 (62.7)
Predisposing factors n (%)							
Benign prostatic hyperplasia	86 (33.3)	48 (30.2)	38 (38.4)	86 (38.9)	-	47 (35.6)	39 (31)
History of urinary intervention	50 (19.4)	-	50 (31.4)	50 (22.6)	-	20 (15.2)	30 (23.8)
Urological malignancy	44 (17.1)	22 (13.8)	22 (22.2)	44 (19.9)	-	18 (13.6)	26 (20.6)
Nephrolithiasis	35 (13.6)	21 (13.2)	14 (14.1)	35 (15.8)	-	5 (3.8)	30 (23.8)
Urological instrumentation	40 (15.5)	19 (13.2)	21 (21.2)	40 (18.1)	-	20 (15.2)	20 (15.8)
Urostomy or nephrostomy	5 (2)	2 (1.3)	3 (3)	5 (2.3)	-	-	5 (4)
Urethral stricture	5 (1.9)	-	5 (5.1)	5 (2.3)	-	2 (1.5)	3 (2.4)

Table 1. Continued...							
Symptoms and signs n (%)							
Dysuria	225 (87.2)	140 (88.1)	85 (85.9)	192 (86.9)	33 (89.2)	114 (86.4)	111 (88.1)
Increased urinary frequency	123 (47.7)	72 (45.3)	51 (51.5)	103 (46.6)	20 (54.1)	66 (50)	57 (45.2)
Suprapubic tenderness	123 (47.7)	72 (45.3)	51 (51.5)	111 (50.2)	12 (32.4)	45 (34.1)	78 (61.9)
Lateral pain and costovertebral angle tenderness	122 (47.3)	77 (48.4)	45 (45.5)	122 (55.2)	-	-	122 (96.8)
Urgency	56 (21.7)	29 (18.2)	27 (27.3)	49 (22.2)	7 (18.9)	37 (%28)	19 (15.1)
Nausea and vomiting	40 (15.5)			40 (18.1)	-	-	40 (31.7)
Fever	30 (11.6)	19 (11.9)	11 (11.1)	30 (13.6)	-	-	30 (23.8)
Treatment background n (%)							
History of UTI in the past twelve months	127 (29.2)	64 (40.3)	63 (63.6)	114 (51.6)	13 (35.1)	60 (45.5)	67 (53.2)
History of antibiotic use in the past three months	126 (48.8)	56 (35.2)	70 (70.7)	112 (50.7)	14 (37.8)	64 (48.5)	62 (49.2)
History of hospitalisation in the past three months	74 (28.7)	8 (5)	66 (66.7)	68 (30.8)	6 (16.2)	36 (27.3)	38 (30.2)
Treatment setting n (%)							
Polyclinic	192 (74.4)	129 (81.1)	63 (63.6)	164 (74.2)	28 (75.7)	102 (77.3)	90 (71.4)
Clinic	66 (25.6)	30 (18.9)	36 (36.4)	57 (25.8)	9 (24.3)	30 (22.7)	36 (28.6)

UTI: Urinary tract infection

Table 2. Results of urine microscopy

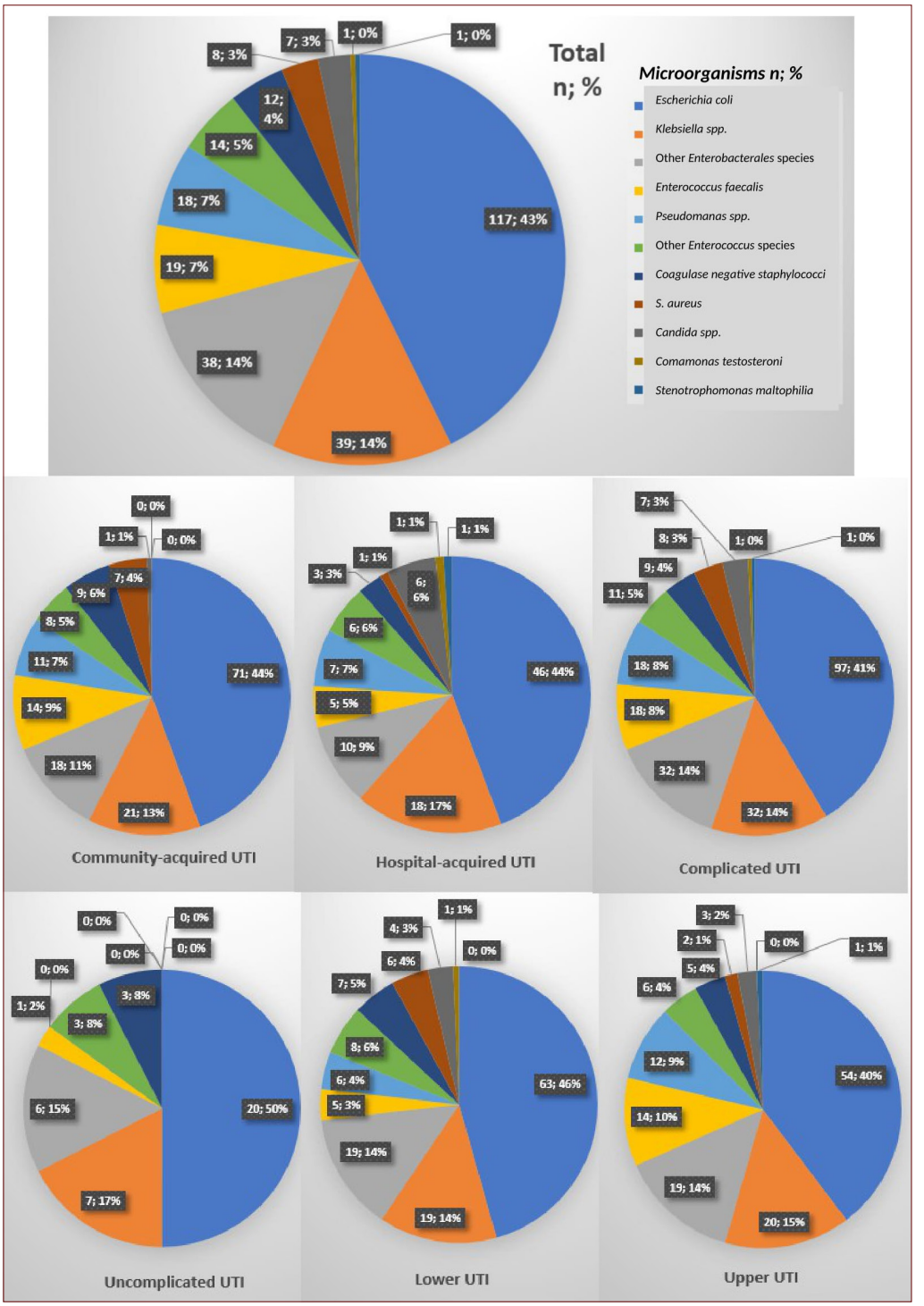
Parameters Median (Q1-Q3)	**Total** n=240	**Community-acquired UTI** n=148	**Hospital-acquired UTI** n=92	**Complicated UTI** n=207	**Uncomplicated UTI** n=33	**Lower UTI** n=125	**Upper UTI** n=115
White blood cell/HPF Median (Q1-Q3)	106.5 (33-542)	87 (33-420)	127 (36-743)	108 (33-554)	57 (14-455)	87 (30-547)	155 (43-480)
Red blood cell/HPF Median (Q1-Q3)	32 (6.5-136)	23 (6-77)	61 (7-222)	33 (7-139)	14 (4-122)	33.5 (6-136)	30 (8-129.5)
Pyuria* n (%)	234 (97.3)	143 (96.8)	90 (98.2)	202 (97.8)	31 (93.3)	121 (96.8)	112 (97.7)
Hematuria** n (%)	216 (90)	131 (88.4)	85 (92.7)	187 (90.4)	29 (86.7)	119 (95.2)	99 (86.4)

UTI: Urinary tract infection, Q1: 1st Quarter. Q3: 3rd Quarter

HPF: High Power Field

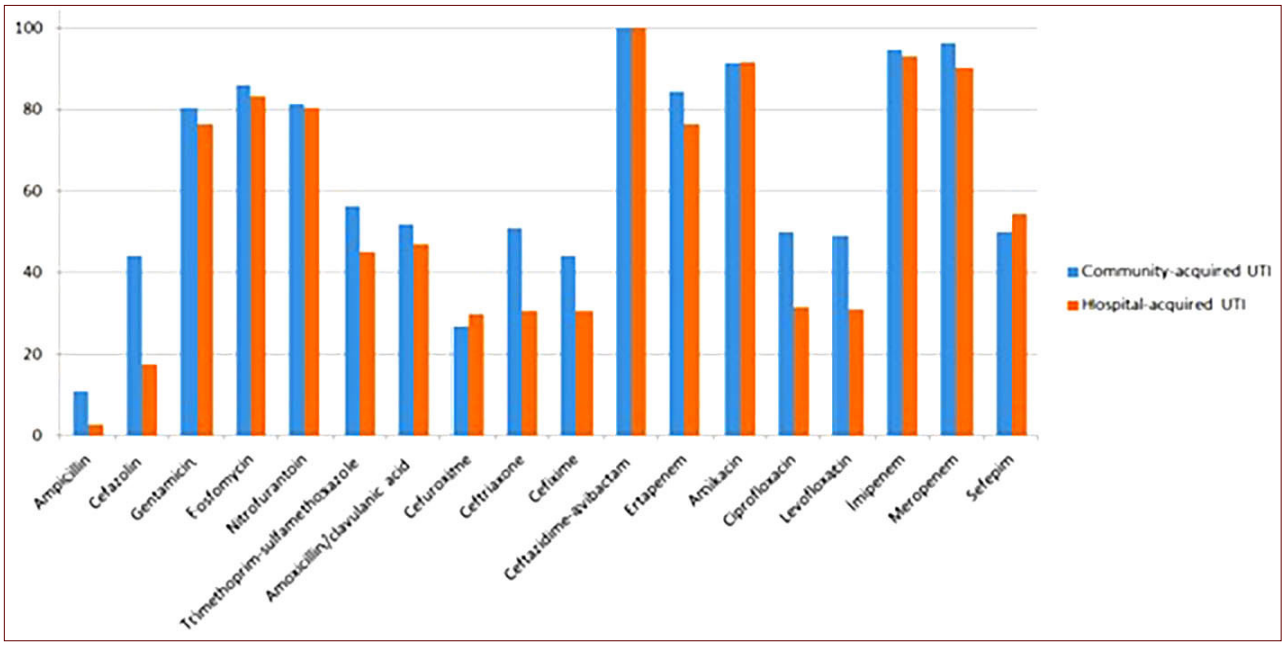
* Pyuria: ≥ 5 White blood cell/HPF

** Hematuria: ≥ 3 Red blood cell/HPF



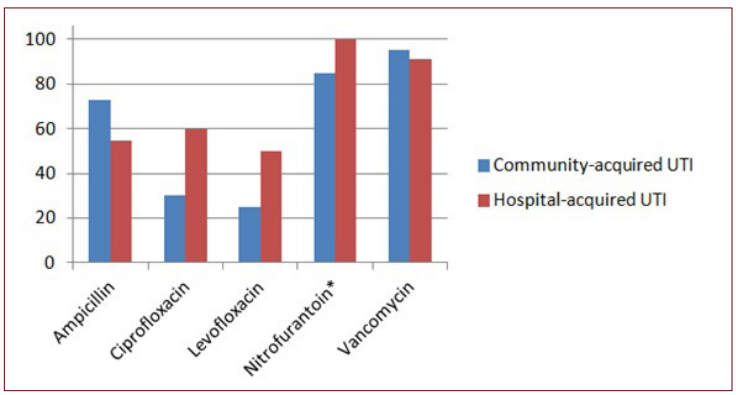
UTI: Urinary tract infection

Figure 1. Distribution of microorganisms grown in urine culture



UTI: Urinary tract infection

Figure 2. Antibiotic susceptibility percentages of *Enterobacterales* species



UTI: Urinary tract infection

Figure 3. Susceptibility percentages of *Enterococcus spp.* isolates
*Only *Enterococcus faecalis* isolates were included.

were followed up as inpatients. Two (0.8%) of the patients died.

Two different microorganisms were found in urine cultures of 16 (6.2%) patients. The colony count was 104-105 cfu/ml in 38 (13.9%) isolates and >105 cfu/ml in 236 (86.1%) isolates. Of the 274 isolates, 214 (78.1%) were gram-negative, 53 (19.3%) were gram-positive and 7 (2.6%) were yeast-type fungi. The distribution of microorganisms grown in urine culture is shown in Figure 1. ESBL production was detected in 60 of 120 (50%) community-acquired *Enterobacterales* isolates and in 51 of 74 (68.9%) hospital-acquired isolates. The antibiotic susceptibility percentages of *Enterobacterales* species are shown in Figure 2. Antibiotic susceptibility percentages of *Enterococcus* spp. isolates are shown in Figure 3. Of the *S. aureus*

isolates, one was hospital-acquired and seven were community-acquired. The hospital-acquired isolate and three (42.8%) of the community-acquired isolates were resistant to methicillin.

DISCUSSION

The number of elderly people worldwide is increasing every day. In Türkiye, 10.2% of the population will be over 65 years of age by 2023 (3). UTI occurs in both sexes and all age groups and is the most common bacterial infection in geriatric patients. UTIs are more common in women due to anatomical structure, but studies have reported that men are more common in geriatric patients (4). In our study, the sex distribution was 63.6% male and 36.4% female. This may be associated with the fact that female patients with uncomplicated UTI received treatment by referring to primary and secondary healthcare institutions and referred less to tertiary hospitals where our study was conducted.

Healthcare costs are high in the geriatric population due to the high incidence of chronic diseases (1, 2). In our study, 70.9% of patients had at least one chronic disease. In an Indian study, diabetes mellitus (63.3%), chronic renal failure (21.6%) and cerebrovascular events (14.1%) were the most common, whereas in a Greek study, dementia (34.3%), diabetes mellitus (25%) and cerebrovascular disease (21.6%) were the most common (4, 5). In our study, hypertension (45%), chronic heart disease (36.8%) and diabetes mellitus (31.8%) were the most common. This may be due to the fact that co-morbidities vary from country to country and region to region.

In geriatric patients; weakening of the immune system, use of urological catheters, decreased water consumption, cognitive disorders, structural and functional abnormalities of the urinary system causing urinary retention are common predisposing factors for UTI (1, 2). Benign prostatic hyperplasia, which causes urinary retention and provides a favourable environment for bacterial growth, was the most common predisposing factor in our study and was found in more than half of the men. The second most common predisposing factor was a history of urinary intervention, which may be related to the fact that our study was conducted in a tertiary care hospital where interventional procedures such as transurethral prostate resection and urodynamic testing are frequently performed.

Chronic infections causing immune deficiency or presence of predisposing factors are classified as complicated UTI (1, 2). In our study, diabetes mellitus and malignancy were observed in 31.8% and 21%, respectively. Uncomplicated infections are usually observed in young women. In the elderly population, factors that predispose individuals to UTIs, such as structural or functional abnormalities of the urinary tract, urinary catheterisation, urinary tract obstruction and chronic systemic conditions that impair immune function, are more common. Therefore, complicated UTIs are more frequent in this population than in other age groups (1, 6). In our study, complicated UTIs also predominated, accounting for 85% of cases.

Although invasive methods are mentioned for the differentiation of upper/lower UTI, it is very important in clinical practice to start appropriate antibiotic treatment without delay. Therefore, the distinction is usually made on the basis of symptoms. According to the traditional symptomatic distinction, the presence of symptoms such as flank pain, nausea-vomiting, fever, etc. indicates an upper *UTI*. Symptoms such as dysuria, increased urinary frequency, urgency and suprapubic tenderness indicate lower *UTI* (1, 6). In our study, symptoms of lower *UTI* were present in more than half of the patients.

The fact that culture and antibiotic susceptibility testing takes at least two days has made the use of empirical treatment mandatory. The most appropriate antibiotic treatment should be decided

by asking about the medical history (history of UTI, previous UTI agent and antibiotic susceptibility, history of hospitalisation for any reason and antibiotic use), predisposing factors for UTI and co-morbidities (complicated/uncomplicated UTI). In addition, it should be determined whether the UTI is of community or hospital origin. A study of geriatric patients with UTI in Greece reported that 18.1% of patients had UTI in the past 12 months, 30.4% had used antibiotics in the past 3 months and 42.2% had been hospitalised (5). In a study of adult patients in Germany, hospital-acquired UTI was found to be 50.6%, and hospital-acquired UTI was found to be higher than community-acquired UTI only in intensive care units and surgical wards (7). When we compared the data from our study with these studies, we found a higher rate of UTI (29.2%) and antibiotic use (48.8%) and a lower rate of hospitalisation (28.7%). In addition, the rate of hospital-acquired UTI (38.4%) was lower in our study, probably due to the exclusion of intensive care patients.

A study analysing the adult age group admitted to the emergency department in our country reported that 9% of patients diagnosed with UTI were admitted to hospital (8). In our study, this rate was 25.6%, which is an expected result due to other co-morbidities apart from UTI and the more severe course of UTI in geriatric patients.

Although hematuria can be observed in UTIs, it is not specific to them. It may also occur in conditions such as urinary tract stones, trauma, tumors, glomerular diseases and anticoagulant use. Similarly, pyuria can be detected in the absence of a UTI in cases involving inflammation due to stones, tumors or catheterisation. Therefore, urinalysis findings should always be interpreted alongside the patient's clinical presentation (6). In a study investigating UTIs in elderly patients, haematuria was reported in 15.8% of cases and pyuria in 10.0% (4). Another study reported these rates as 77% and 94%, respectively (9). Hematuria is more commonly observed in lower UTIs than in upper UTIs, whereas pyuria is more commonly observed in upper UTIs than in lower UTIs (2, 6). Our findings were consistent with those of previous studies.

Residence in a nursing home has been identified as a predisposing factor for UTI due to poor hygiene and the frequent use of urological catheters. UTI is the most common cause of bacteraemia in nursing home residents and the mortality rate is lower than other bacteraemia-causing infections (pneumonia, etc.). In a study conducted in Pittsburgh, Pennsylvania, 55% of bacteraemia cases were caused by UTI. The mortality rates were 15.5% for UTI-associated bacteraemia and 50% for pneumonia (10). Residence in a nursing home is rare in Türkiye (0.36%) compared to Western countries (11). There were no nursing home residents in our study. In a study of geriatric patients hospitalised for UTI in Türkiye, bacteraemia was reported in 29% of patients and 2.5% of patients died (12). In a study conducted in Spain, bacteraemia was reported in 16.3% of patients and 10.3% of patients died (13). In our study, bacteraemia was seen in 4.7% of patients and 0.8% of patients died. The fact that our data are lower than previous studies is related to the inclusion of outpatients in the study. This is also supported by the fact that all patients with bacteraemia in our study were hospital patients.

In our study, the colony count was 10^4-10^5 cfu/ml in 38 patients (13.9%) and $\geq 10^5$ cfu/ml in the rest (14). Polymicrobial UTI is more common in geriatric patients, those with chronic infections leading to immunodeficiency, those with indwelling catheters and those in intensive care (15). Although polymicrobial UTI was not mentioned in some studies of geriatric patients, a study of inpatients in Spain reported 9.2% polymicrobial UTI. In our study, the rate of polymicrobial UTI was 6.2% (13). It is an expected finding that the rate was lower due to the exclusion of ICU patients and inclusion of outpatients.

As in other age groups, ***E. coli*** was the most common organism found in UTI in geriatric patients (5, 9, 12). However, it has been reported that ***E. coli*** is less common and ***Klebsiella spp.***, ***Proteus spp.*** and ***Pseudomonas aeruginosa*** are more common in the geriatric age group compared to other age groups (16). The second most common organism in geriatric UTIs was ***Klebsiella pneumoniae***, and Gram-negative bacteria accounted for more than 75%. Among gram-positive bacteria, enterococci were the most common (5, 9, 12). ***Staphylococcus*** species, accepted as causative agents in symptomatic patients, are rare uropathogens (17, 18). Studies have reported that more than 65% of ***Staphylococcus*** species are coagulase positive (*S. aureus*) (19, 20). The distribution of bacteria identified in our study was consistent with previous research, and the three most common microorganisms remained consistent across subgroups of *UTI*s. In addition, ***Comamonas testosteroni***, detected in one patient in our study, has been associated with many hospital-acquired infections, including a *UTI*, and its prevalence has been reported to be increasing (21).

Bacteria producing broad-spectrum beta-lactamase are resistant to penicillin, cephalosporins and azithromycin, limiting treatment options. ESBL prevalence is high in Mediterranean countries where ***Enterobacterales*** species are common. However, it varies from country to country depending on many factors such as geographical location, population density, hygiene and antibiotic use. According to the European Centre for Disease Prevention and Control (ECDC) 2023 report, resistance to third-generation cephalosporins in ***E. coli*** and ***Klebsiella spp.*** isolates from invasive samples in Türkiye in 2021 was reported to be 49.6% and 92.3%, respectively (22). In a study conducted in our country analysing geriatric *UTI*s, the frequency of ESBL was reported to be 56.0% in ***E. coli*** and 40.0% in *K. pneumoniae* (12). In our study, ESBL production was found in more than 50% of both community-acquired and hospital-acquired ***Enterobacterales*** isolates. Due to genetic proximity, ESBL production may be associated with quinolone, TMP/SMX and aminoglycoside resistance (23). In our study, although similar susceptibility rates to TMP/SMX and quinolone were found, high susceptibility rates to gentamicin and amikacin were detected among the aminoglycosides.

Enterococci have become more common in both hospital-acquired and community-acquired *UTI*s in recent years due to their ever-increasing pathogenicity, such as biofilm formation. Ampicillin is a good option for the treatment of enterococci because it reaches high concentrations in the urinary system (24). In our study, ampicillin susceptibility was found to be 72.7% in community-acquired isolates and 54.5% in hospital-acquired isolates. Although nitrofurantoin has been shown to be effective in the treatment of UTI caused by *E. faecium*, EUCAST has recommended that it only be used for uncomplicated UTI caused by *E. faecalis* (25). Quinolones are used orally or intravenously in complicated and uncomplicated UTIs (24). In our study, high sensitivity rates (90%) were found for nitrofurantoin and low rates (33.3%-40%) for quinolones. *E. gallinarum* and *E. casseliflavus/* flavescens are naturally resistant to vancomycin and are rare. Acquired vancomycin resistance is most commonly observed in al-acquired *E. faecium* isolates (24). In our study, one of the two isolates with vancomycin resistance was *E. gallinarum* and the other was hospital-acquired *E. faecium*, in line with the literature.

Staphylococcus species are increasingly isolated from *UTI*s. Uropathogenic ***Staphylococcus*** species have virulence factors such as biofilm formation, which makes the bacteria more resistant to antibiotics (20). In our country, methicillin resistance was found in ***S. aureus*** isolates from invasive isolates at a rate of 25.8%-33.4% between 2017 and 2021, while 68.8% of community-acquired ***Staphylococcus spp.*** isolates and all hospital-acquired ***Staphylococcus spp***. isolates were methicillin-resistant in our study

(22). The high rate of methicillin resistance in our study may be related to the higher incidence of hospital-acquired methicillin-resistant pathogens in the geriatric age group and the high antibiotic resistance of uropathogenic *Staphylococcus* isolates. The high antibiotic resistance of uropathogenic *Staphylococcus* isolates should be taken into account in clinical practice.

As our study was retrospective, this represents a significant limitation. There is a possibility that patient records may contain missing or inaccurate data. Additionally, since laboratory tests related to UTIs were not performed for all patients, there are missing data in this regard. Another limitation is that the clinical presentation of UTIs in geriatric patients may not be fully elucidated due to communication difficulties, comorbidities, and polypharmacy. Furthermore, the single-centre nature of the study and the absence of follow-up data should also be considered as limitations.

In our study, the high prevalence of male patients with complicated *UTI*s was notable. The high rate of ESBL production in *Enterobacterales* species, the presence of ampicillin- and vancomycin-resistant *Enterococcus* species, and the high prevalence of methicillin-resistant *Staphylococcus* species underscore the need to update treatment strategies and maintain surveillance of antimicrobial resistance in geriatric patients. These findings highlight the importance of a multidisciplinary approach to managing UTIs in geriatric patients, with close collaboration between clinicians and microbiologists.

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