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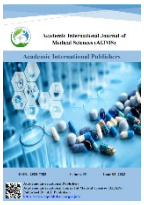

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Urinary Tract Infections in Karbala Population: Epidemiology, Causes and Treatment Options

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Abstract

Aim of study: To identify the etiological agent of urinary tract infections and test the sensitivity of microorganisms that caused UTIs to antibiotics. The study also aims to find the appropriate treatment that bacteria cannot resist or to find an alternative to it in treating urinary tract infections.
Methods: This was conducted at the microbiology department of the Al-Imam Al-Hussein Medical City in Karbala. Urine samples were collected from patients of different ages and sex. Bacterial culture and antibiotic susceptibility were performed in the laboratory. Many symptoms diagnose urinary tract infections (UTIs) by examining urine samples and bacterial growth on Petri dishes. There is a significant risk because of the increase in protract infections and the growing antibiotic resistance leading to the increase of the economic burden of these illnesses.
Results: UTI cultured samples included 30 males (26.5%) and 83 females (73.5%), with patient ages ranging from 18 to 90. Among 113 individuals with uropathogens, *Escherichia coli* in 49 patients (55.37%), followed by *Staphylococcus* bacteria detected in 38 patients (42.94%). *Klebsiella pneumonia* was detected in only 9 patients (10.17%), while other types of bacteria were detected in 17 (19%). Various antimicrobial agents were employed on the isolated bacteria; the highest sensitivity was observed for meropenem (79.5%), while the lowest sensitivity was noted for ampicillin (21.2%). **Conclusion:** Early diagnosis and treatment of UTI is very important to minimise medical

complications and decrease financial outcomes; this is achieved by isolating the causative pathogens and testing for suitable antimicrobial drugs.

1. Introduction

A significant number of individuals in the United States and globally suffer urinary tract infections (UTIs), a prevalent medical disease [1-3,27]. They can result in severe consequences and provide treatment challenges due to variables such as antibiotic resistance [4]. Understanding the various elements of UTIs, their classifications, and related risk factors is essential. Urinary tract infections (UTIs) are primarily classified into two categories: simple and complicated [5,6]: [1)] Uncomplicated UTIs: These infections are frequently defined by community-onset cystitis and usually arise in outpatient environments. Uncomplicated urinary tract infections occur in generally healthy persons without structural or neurological problems in their urinary systems. While these infections are predominantly observed in females across all age demographics [7], they may also manifest in specific male subsets, including infant boys and older adult men [8]. [2)] Complicated UTIs: These infections are connected with patient-level variables that can affect the normal urodynamics or host defences of the urinary tract. Indwelling or intermittent urine catheterisation is one of the variables that can contribute to the development of severe urinary tract infections (UTIs). Catheters have the potential to transfer germs into the urinary system, which is a common risk factor for severe urinary tract infections (UTIs) [9]. People with weakened immune systems are more susceptible to UTIs. Pregnant women are more prone to UTIs due to changes in the urinary tract during pregnancy [10]. Urinary stones can lead to obstruction and increase the risk of UTIs. Individuals with kidney dysfunction are at a higher risk of UTIs. Patients who have undergone kidney transplantation may be more susceptible to UTIs.

These complicated UTIs can lead to severe complications, such as recurrent infections, pyelonephritis (kidney infection) with sepsis, renal damage, and other problems resulting from the frequent use of antibiotics, including the development of multi-class antibiotic resistance and Clostridium difficile colitis [11]. Efforts to understand the pathophysiology of UTIs and develop more efficient and antibiotic-sparing therapies are essential to combat the persistent problem of UTIs, especially in cases of complicated UTIs [12]. Uncomplicated urinary tract infections (UTIs) are often caused by uropathogenic Escherichia coli (UPEC) and Klebsiella pneumoniae. These pathogens have evolved specific virulence mechanisms to facilitate their recognition, adherence, invasion, replication, and persistence within the urothelial cells [13]. Virulence mechanisms in uncomplicated UTIs caused by these bacteria: [1)] Adherence and Invasion, [2)] Intracellular Bacterial Communities (IBCs), [3)] Bacterial Dispersion and Host Cell Re-invasion, [4)] Toxins and Immune Evasion [14]. Currently, UTI is mostly managed without urine culture, which may lead to the frequent misuse of antibiotics. The use of antibiotics for microorganisms causing urinary tract infections is variable and depends on times and locations. Most common UTIs are treated according to antimicrobial drug selection criteria that should be decided on the basis of the most likely microorganism and its expected resistance pattern in that geographic area [15].

2. Materials and methods

2. 1. Materials: Mannitol salt agar (MSA), MacConkey media, Nutrient agar, Blood agar, petri dish, autoclave, incubator, refrigerator, distilled water, burner, continuers, pipette, ethanol, microscope, slides.

2.2. Patient Recruitment and Data Collection

This study was conducted in the microbiology section of the general laboratory department of the Al-Imam Al-Hussein Medical City from September 2023 to December 2023

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2.3. Sample size: The study targeted all patients attending outpatient clinics with any symptoms; a total of 113 samples were collected from both male and female patients of age (18-90) years. Patient age, sex, and the causative microorganism were recorded, and the antimicrobial susceptibility was done.

2.4. Culture and identification: The eurine sample was collected by a sterile wide-mouth plastic container as per standard operating procedure; these specimens were plated using a calibrated wire loop (0.001ml) on MacConkey agar and the blood agar, then incubated aerobically at 37° for 24 hours, according to the standard operating procedures, we isolate from the positive cultures those having a colony count $\geq 10^5$ CFU/ml.

Antibiotic susceptibility tests: They were done using either the disc diffusion method or the VITEK® 2 COMPACT System for ampicillin, ciprofloxacin, vancomycin trimethoprim-sulfamethoxazole, amikacin, Gentamycin, meropenem, Rifampicin, piperacillin-tazobactam, imipenem, and levofloxacin.

2.5. Statistical analysis: Data analysis was performed using the SPSS Windows version 14.0 software. Descriptive statistics (median, mean + SD, percentages) were used for patients' socio-demographic characteristics.

Ethical considerations were obtained from the training and human development centre in Karbala and Imam Hussain Medical City Hospital; written consent from the participants was not required because the study involved data collection from laboratory records.

3. Results

The 113 positive samples of UTI cultured included 30 males (26.5%) and 83 females (73.5%) (Table 1), with ages ranging from 18 to 90 (mean age 44.54) (Table 2). Of these patients, 24 (21.2%) were diabetic patients on oral hypoglycemic treatment, 89 (78.8%) were non-diabetic patients, 26 patients (23%) were hypertensive patients on regular treatment, and 87 (77%) were normotensive people.

Table (1): distributions of patient's gender:

gender	Frequency	Percent%
Male	30	26.5
Female	83	73.5
Total	113	100

Table (2): Distributions of Patient's ages.

	Minimum-Maximum	Mean	Std. Deviation
Age	18- 90	44.54	18.718
Age group	Frequency	Per cent	
18-27	26	23	
28-37	15	13	
38-47	24	21.2	
48-57	18	15.9	
58-67	16	14.2	
More than 68	14	12.4	
Total	113	100	

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Many types of bacteria were isolated in this study, as shown in **Figure (1)**:

1. *Escherichia coli* in 49 patients (55.37%).
2. Different species of *Staphylococcus* bacteria were detected in 38 patients (42.94%).
3. *Klebsiella pneumonia* was detected in only 9 patients (10.17%).
4. Others 17 (19%).

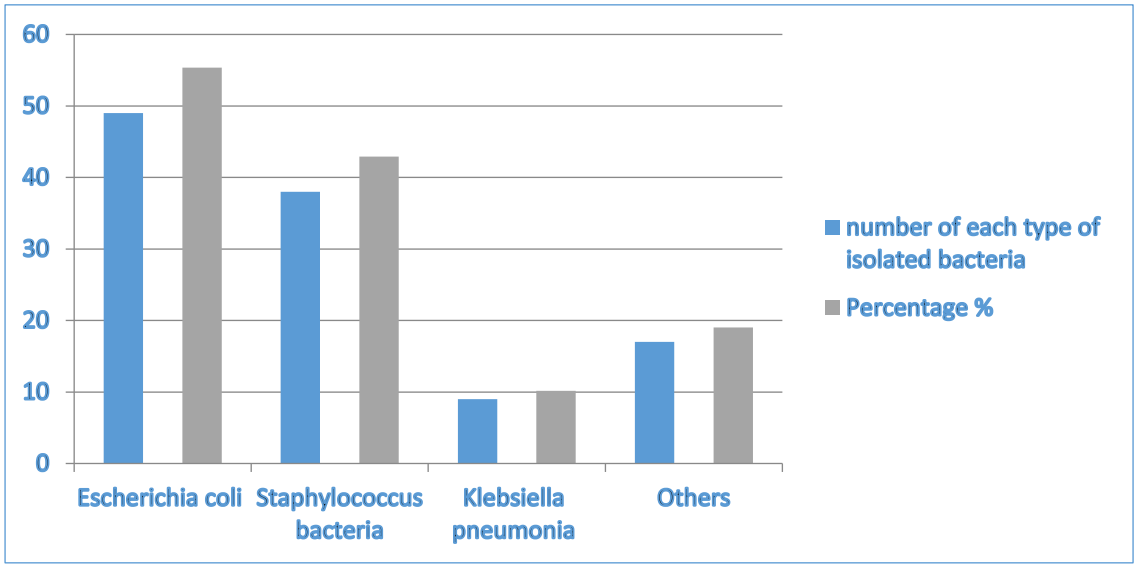

Figure (1): Frequency of Causative microorganisms in study patients

Different antimicrobial drugs were used, and they had different effects on the isolated bacteria. As shown in Figure **(2)**, the sensitivity for Meropenem was the highest (79.5%), and the lowest sensitivity was recorded toward ampicillin (21.2%).

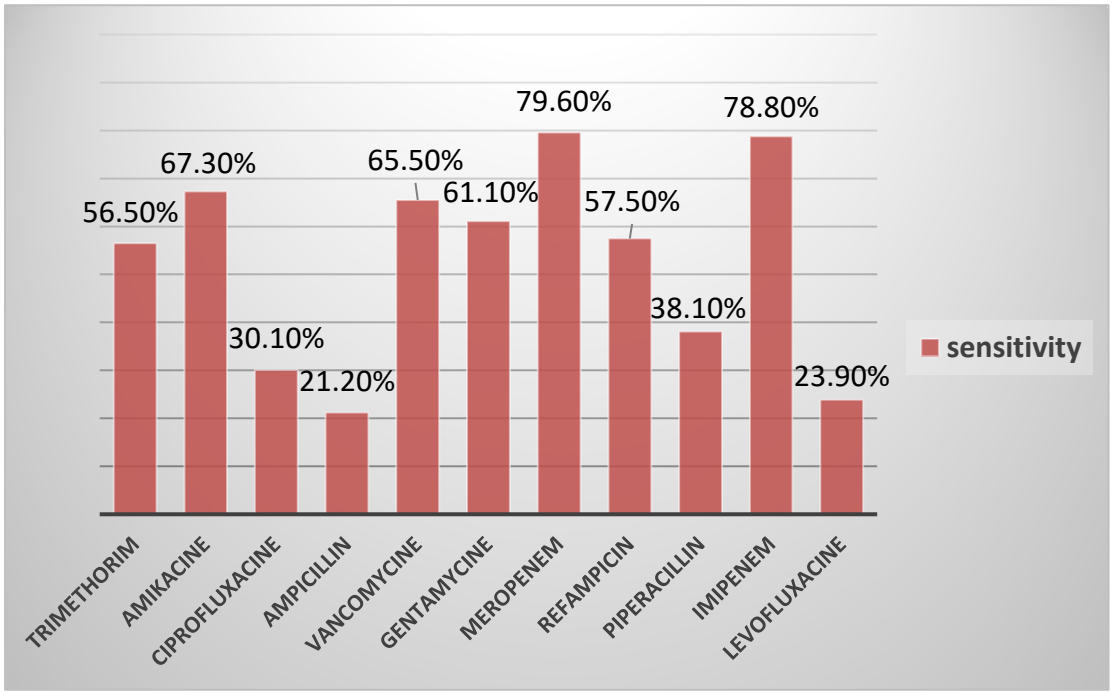

Figure (2): Antimicrobial susceptibility pattern of isolated organism.

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4. Discussion

Among the diseases most common globally, urinary tract infections are among the most common. The selection of the appropriate antimicrobial drug is vital for their treatment; the introduction of a new medication has made it simpler to maintain control. Antimicrobial medication resistance, on the other hand, affects the treatment being administered for these conditions. The prevalence of UTI was found to be higher in females (73.5%) than in males (26.5%), which correlates with findings from other studies that revealed that the frequency of UTI is greater in females when compared to males [16,17]. Many factors contribute to a medical condition in females, likely urinary tract infections (UTIs) or pelvic floor disorders; the relatively shorter urethra (which is anatomically close to the anus); the impact of sexual activity; complications arising from repeated pregnancies; and pelvic floor changes such as incontinence [16].

In this study, Gram-negative bacteria accounted for 66.3% of the total bacterial isolates, while Gram-positive cocci represented 33.7%. Escherichia coli was the predominant pathogen, accounting for 43.4% of cases associated with urinary tract infections. Numerous studies [19, 20, 21, 22, and 23] consistently identified *E. coli* as the most frequent bacterium responsible for UTIs.

Various kinds of *Staphylococcus aureus* were identified in 33.7% of cases. Al Mohajer et al. [24] observed a reduced percentage; nonetheless, a symmetrical occurrence was identified among young married women.

Klebsiella pneumonia was the third most frequently identified bacterium in UTI cases in this study, accounting for 8%; this finding aligns with the results of Devanand et al. [17], Mulugeta et al. [20], and Ahmed et al. [23].

Other types were *P. aeruginosa* (1.8%), *Proteus mirabilis* (0.9%) and *Enterobacter spp.* (5.3%). The higher incidence of gram-negative bacteria causing UTI may be related to the factors responsible for their attachment to the uroepithelium, such as their ability to colonize the urogenital mucosa by fimbriae, pili or adhesins.

The most efficacious antibiotics identified in the new study were Meropenem, Imipenem, Amikacin, and Vancomycin. The percentage susceptibility was 79.6%, 78.8%, 67.3%, and 65.5%, respectively (Fig. 2), as acknowledged by Claudine et al. [25] and Muktikesh et al. [26], who see amikacin as a more effective antibiotic. A study conducted by Ahmed Naeem et al. [23] indicated the maximum sensitivity to Gentamicin (92.3%), followed by Imipenem (90.2%), with reduced sensitivity observed for Cefotaxime.

Higher resistance was observed for Ampicillin and Fluoroquinolones (ciprofloxacin and levofloxacin), exhibiting susceptibility percentages of 21.2%, 30.1%, and 23.9%, respectively, corroborating the findings of Arghya Das et al [22].

A significant observation indicated that various species of the isolated bacteria exhibit differing susceptibilities to the tested antibiotics. In contrast, the isolated E. coli (43.4%) demonstrated resistance to routinely utilized antibiotics, including ampicillin. Meropenem had the maximum sensitivity at 79.6%, while Imipenem followed with 87.8% sensitivity. Staphylococcus species have increased resistance to ampicillin and levofloxacin.

Conclusion:

Early diagnosis and treatment of UTIs are very important to minimize medical complications and to decrease financial outcomes; this is achieved by isolating the causative pathogens and testing for suitable antimicrobial drugs, antibiotic resistance should be minimized, physicians should be updated about the empirical treatment of UTIs, which should be based on the knowledge of the local prevalence of causative micro-organisms and their suitable antimicrobial treatment not on universal guidelines.

Recommendation:

1- Future studies should be conducted over a longer time span, including all seasons.

2- Collect samples for a longer period and compare the results between the collected samples and other periods during the year's seasons.

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