Original
ISSN 2413-0516

Antibiotic Resistance of Bacteria Isolated in Urinary Tract Infections

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(Submitted: 17 February 2024 – Revised version received: 03 March 2024 – Accepted: 25 March 2024 – Published online: 26 April 2024)

Abstract

Objectives: This study aimed to examine the relationships between isolated bacterial agents, age, and gender, as well as antibiotic resistance of UTI isolates, in addition to investigate the antibiotic resistance in a section of Iraqi patients with UTI.

Methods: Isolates (885) from patients and outpatients with symptomatic urinary tract infections at Al-Sadder teaching hospital in Basra province, southern Iraq, from January to August 2022.

Results: The results of patient specimens cultured on appropriate culture media indicate that the number of negative cultures was 528 while the number of positive cultures was 357; females are more susceptible to UTIs than males (170). The age category 60 years had the highest infection rate (31%), followed by 20–29 years (19.3%). The most prevalent etiological agent was *Escherichia coli* (28.3%), followed by *Staphylococcus spp*. (19.3%), *Candida albicans* (14.9%), and *Klebsiella pneumonia* (14.9%).

Conclusion: The results demonstrate that various bacteria exhibit variable degrees of sensitivity to different antibiotics, with the significant finding that the majority of urinary isolates were highly resistant to commonly used antibiotics.

Keywords: Antibiotic resistance pattern, antimicrobial susceptibility, *Escherichia coli*, urinary tract infection

Introduction

When a pathogen colonized any area along the urinary tract, including the kidney, ureter, bladder, and urethra, a UTI resulted. Despite the fact that parasites, fungi, and viruses can also cause urinary tract infections, the majority of UTI instances are brought on by bacteria, which also often causes infections in women's faeces and perineum when it colonizes the intestine as part of the normal flora.[1-3] While UTIs occasionally go unnoticed, they frequently come with clinical signs and symptoms like dysuria, increased nocturnal and daytime urinary frequency, reduced urine flow, difficulty starting to urinate, intermittent urination, lower abdominal pain, various urinary incontinence symptoms, and odorous, cloudy or bloody urine in addition to postvertebral angle pain and fever. UTIs can be categorized as pyelonephritis, cystitis, or urethritis depending on where the infection is located inside the urinary system. Urinary tract infections (UTIs) are a frequent and significant clinical issue that can cause renal damage and systemic disease in the near term. Repeated infections can also cause renal scarring, hypertension, and end-stage renal dysfunction.[3] Urinary tract infections caused by bacteria are a common reason for both nosocomial infections and outpatient visits. In the population, urinary tract infections (UTIs) are a relatively frequent illness. One of the most common bacterial illnesses with a high frequency worldwide is UTIs. The range of etiologic agents that cause urinary tract infections and their pattern of antibiotic resistance have been evolving throughout time. Almost always, especially in the outpatient situation, therapy must begin before definitive bacteriological results are available.[2,4] Significant morbidity, such as renal scarring, hypertension, and reduced renal function, may result from delayed identification and treatment. In youngsters, classifying UTI as a first infection, vs recurring infection is a simpler and more useful technique. These protected locations are frequently anatomic abnormalities, such as diseased urinary calculi, necrotic papillae, or foreign objects, such as indwelling ureteral stents or urethral catheters, which are not always sterilizable after becoming infected.[5,6] It is crucial to identify the anatomic anomaly since the infection's source may need to be removed surgically (by extirpation). Unresolved bacteriuria, bacterial persistence, and reinfection are other categories of recurrent infections. Bacteria that can also exist in the digestive system, in the vagina, or along the urethra frequently enter the urethra and rise to the bladder, kidneys, and prostate (in males), and are typically eliminated by our bodies without causing any symptoms.[2,6] Antibiotic resistance may result from natural selection acting on random mutations, but it may also be obtained by applying an evolutionary stressor population, as is the case with UTI treatment, which is frequently started therapy and empirically.[7] In the developing world, where there is not only a high level of poverty, ignorance, and poor hygienic practices, but also a high prevalence of fake and spurious drugs of questionable quality in circulation, the emergence of antibiotic resistance in the management of UTIs is a serious public health issue. The proper empirical treatment may be selected by doctors with the use of studies designed to learn more about the bacteria that cause UTIs and their susceptibility patterns.[8] The current study's objectives are to identify the most prevalent bacterial causes of UTIs and the extent of the spread of antibiotic resistance within the Basra province community. Another objective is to evaluate the viability of urine culture and sensitivity tests that physicians request in order to identify the causing agent of urinary tract infections.

Materials and Methods

During the time period of January through August (2022), symptomatic UTI cases from patients and outpatients of Al-Sadder teaching hospital (in Basra province, south of Iraq) provided a total of 885 isolates that were collected. Isolates were analysed using both traditional techniques and the VITEK identification card system to determine their identities. The disc diffusion technique was used for assessing the antimicrobial susceptibility of Gram-positive organisms, whereas an automated VITEK 2 machine was used for testing the susceptibility of Gram-negative organisms.

Results

UTI is a prevalent bacterial infection that affects a significant number of individuals globally. Timely identification and proper treatment are crucial to avoid complications and enhance patients' overall well-being. Figure 1 shows the results of specimen cultured on appropriate culture media of all patients who included within the present study, negative urine cultures in patients with symptoms of UTI can pose a diagnostic challenge, as it is often difficult to determine whether the symptoms are truly caused by a UTI or by other conditions. According to several studies, negative urine culture results are more common than positive results in patients with suspected UTIs. One possible explanation for the high rate of negative urine cultures is that some cases of UTI are caused by non-bacterial pathogens such as fungi or viruses, which are not detected by routine urine culture methods that only identify bacterial pathogens. Additionally, the use of antibiotics prior to urine collection can also lead to false-negative results, as well as inadequate urine sampling techniques and suboptimal transport and storage conditions; what is found by the present study in the subject of the results of urine culture on media is agreed with what had seen by other studies.[9,10] It is worth noting that negative urine cultures do not necessarily rule out a UTI, and clinicians should consider the patient's symptoms and risk factors in addition to culture results when making a diagnosis. Furthermore, clinicians should also consider the possibility of other conditions that can mimic UTI symptoms, such as interstitial cystitis or sexually transmitted infections.[11] In spite of infection of the urinary tract is one of the most common infectious diseases and it would affect all age groups of people including men, women, and children in worldwide , the median of age patients aged in (Figure 2) is 45 ± 33.9 years, individuals who have this age in Iraqi society. They are often the primary breadwinners for their families and are overburdened with work responsibilities, leaving them with little time to care for their personal hygiene, the purity of their potable water, and even their food. There are also other factors, such as changes in the urinary tract, that can increase the risk of UTIs. For instance, the bladder may become less elastic and the urethra may shorten, making it easier for bacteria to enter the urinary tract and cause infections, hormonal changes, prostate enlargement, a weakened immune system, and chronic health conditions such as diabetes or kidney disease.[12]

Table 1 provides the bacterial frequencies identified in the results of urine culture. The most common microorganism identified in urine culture is *E. coli*, which accounts for 28.346% of the total bacterial isolates. *E. coli* is a Gram-negative bacterium and is a common cause of UTIs, especially in women.[13] *Candida albicans* and *Klebsiella pneumoniae* are the second most frequently isolated microorganisms, accounting for 14.961% each. *C. albicans* is a fungus that can cause urinary tract infections in patients with predisposing factors such as diabetes, pregnancy, or use of antibiotics.[14] *K. pneumoniae* is a Gram-negative bacterium that is associated with hospital-acquired infections and is often resistant to multiple antibiotics.[15] *Staphylococcus saprophyticus* accounts for 11.024% of the total bacterial isolates and is a Gram-positive bacterium that is a common cause of UTIs in young women.[16]

The results of an antibiotic sensitivity test for bacterial isolates from urinary tract infections are presented in Table 2.

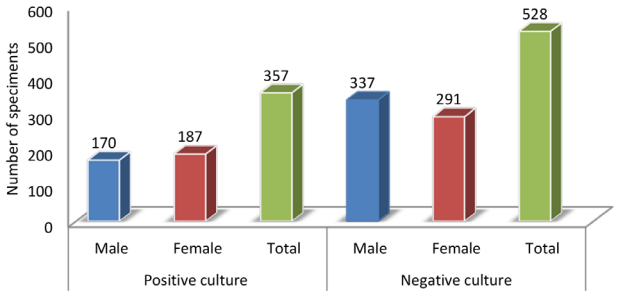

Fig. 1 **Frequency of positive cultures among males and females as comparison with negative cultures.**

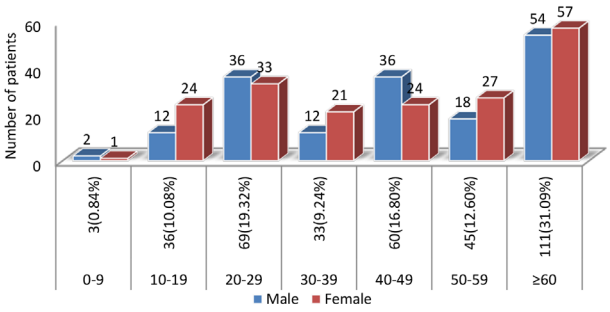

Fig. 2 **Distribution of patients having positive urine culture by age group (N = 357).**

Table 1. **Frequencies and percentages of microbial types**

Microorganism	Frequency	Percentage (%)
Escherichia coli	108	28.346
Candida albicans	57	14.961
Klebsiella pneumoniae	57	14.961
Staphylococcus saprophyticus	42	11.024
Enterococcus fecalis	24	6.2992
pseudomonas aeruginosa	21	5.5118
Staphylococcus aureus	15	3.937
Proteus mirabilus	9	2.3622
Staphylococcus haemolyticus	9	2.3622
Streptococcus pneumoniae	9	2.3622
Burkholderia cepacia	3	0.7874
Corynebacterium diphtheriae	3	0.7874
Enterobacter cloacae	3	0.7874
Enterococcus hermannii	3	0.7874
Klyvora intermedia	3	0.7874
Morganella morganii	3	0.7874
Mycobacterium tuberculosis	3	0.7874
Staphylococcus epidermidis	3	0.7874
Staphylococcus hominis	3	0.7874
Staphylococcus lentus	3	0.7874
Total	381	100

Testing for antibiotic sensitivity is essential for determining the most effective antibiotic to treat a bacterial infection. The test involves subjecting bacteria to various antibiotics and assessing their ability to proliferate in the presence of each antibiotic, as opposed to employing the VITEK 2 automated procedure. The results indicate that distinct bacteria are sensitive to different antibiotics to variable degrees. *E. coli*, for example, is susceptible to amikacin, ciprofloxacin, levofloxacin, and norfloxacin but resistant to aztreonam and erythromycin. Amikacin, ciprofloxacin, levofloxacin, and meropenem are effective against *P. aeruginosa*, whereas amoxicillin and erythromycin are ineffective. However, *S. aureus* is resistant to amoxicillin and nalidixic acid. Noting that the sensitivity of bacteria to antibiotics can vary regionally and over time is essential. Therefore, it is essential to continuously monitor patterns of bacterial resistance and adapt antibiotic prescribing practises accordingly.

Conclusion

This investigation sheds light on the prevalence of UTIs and the distribution of microbial types among Iraqi patients.

Table 2. **Antibiotics sensitivity test for bacteria isolated from urinary tract infection**

Antibiotics	*E. coli*		*K. pneumonia*		*P. aeruginosa*		*S. aureus*		*S. saprophyticus*		*Enterococcus fecalis*		*S. haemolyticus*	
	R	S	R	S	R	S	R	S	R	S	R	S	R	S
AFM	102	6	–	–	–	–	–	–	–	–	–	–	–	–
AMIKACIN	9	99	18	39	6	15	9	6	36	6	21	3	6	3
AMC	–	–	51	6	–	–	–	–	–	–	24	0	–	–
AML	96	12	–	–	–	–	–	–	–	–	–	–	–	–
Aztreonam	–	–	45	12	12	9	15	0	39	3	–	–	9	0
Azithromycin	81	27	39	18	–	–	–	–	39	3	–	–	9	0
Chloramphenicol	72	36	6	51	–	–	0	15	3	11	–	–	9	0
Ceftazidime	96	12	45	12	21	0	15	0	–	–	18	6	–	–
Ciprofloxacin	75	33	36	21	9	12	0	15	27	15	24	0	9	0
Cefalexin	21	87	24	33	3	18	6	9	18	24	–	–	0	9
Clarithromycin	–	–	–	–	–	–	–	–	–	–	21	3	9	0
Ceftriaxone	78	30	51	6	–	–	15	0	39	3	–	–	–	–
Cefotaxime	90	18	48	9	–	–	15	0	–	–	–	–	9	0
Cefuroxime	87	21	51	6	–	–	–	–	–	–	–	–	–	–
Clindamycin	–	–	–	–	–	–	–	–	27	15	21	3	6	3
Doxycycline	87	21	42	15	–	–	6	9	15	27	–	–	3	6
Erythromycin	–	–	–	–	–	–	–	–	33	9	24	0	9	0
Cefepime	69	39	45	12	9	12	15	0	–	–	15	9	–	–
Cefoxitin	72	36	45	12	–	–	3	12	33	9	–	–	9	0
Imipenem	6	102	15	42	3	18	9	6	30	12	–	–	–	–
Levofloxacin	75	33	45	12	6	15	3	12	–	–	21	3	3	6
Meropenem	15	93	15	42	3	18	12	3	–	–	–	–	–	–
Nalidixic acid	96	12	51	6	–	–	–	–	–	–	–	–	–	–
Netilmicin	66	42	36	21	6	15	6	9	21	21	–	–	0	9
Norfloxacine	99	9	48	9	–	–	–	–	–	–	–	–	–	–
Ofloxacin	87	21	39	18	6	15	6	9	30	12	21	3	–	–
Piperacillin	87	21	48	9	9	12			–	–	–	–	–	–
Rifampicin	35	1	51	6	–	–	15	0	39	3	–	–	–	–
SXT	57	51	36	21	18	3	3	12	27	15	–	–	3	6
Tetracycline	84	24	30	27	–	–	3	12	27	15	12	12	6	3
Tigecyclin	–	–	–	–	–	–	–	–	–	–	18	6	6	3
Tobramycin	27	81	27	30	0	21	15	0	–	–	–	–	–	–
TZP	33	75	24	33	12	9	15	0	–	–	24	0	–	–

AFM: amoxicillin + fosfomycin + metronidazole; AMC: amoxicillin + clavulanic acid; SXT: Trimethoprim/sulfamethoxazole; TZP: piperacillin + tazobactam.

UTIs continue to be a significant public health concern afflicting men, women, and children of all ages. The study emphasizes the difficulties posed by negative urine cultures in patients with UTI symptoms, which can be attributed to a variety of factors, such as non-bacterial pathogens, prior antibiotic use, suboptimal sampling methodologies, and storage conditions. The most prevalent microorganism isolated from urine cultures was E. coli, followed by *C. albicans* and *K. pneumoniae*. *E. coli* is a common cause of urinary tract infections in women. This study highlights the significance of timely and accurate diagnosis of UTIs, taking into account both the patient's symptoms and risk factors in addition to culture results. When developing treatment strategies, clinicians should remain vigilant for potential mimicking conditions and consider regional and temporal variations in bacterial resistance patterns. To enhance UTI management and reduce the prevalence of infections, efforts should center on increasing public awareness. Moreover, promoting the consumption of clean water and addressing risk factors such as hormonal changes, prostate enlargement, weakened immune systems, and chronic health conditions can play a significant role in UTI prevention. This study contributes to the comprehension of UTIs in Iraqi society by casting light on the prevalence of various microorganisms and their antibiotic susceptibilities.

Acknowledgments

We deeply appreciate the staff of the laboratory of Microbiology at Al-Sadder teaching hospital for their unreserved support.

Conflicts of Interest

The authors have no conflicts of interest to declare for this study.

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