Antibiotic Resistance in Escherichia coli Isolated from Patients with Urinary Tract Infections

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ABSTRACT

The aim is to investigate the bacterial etiology of urinary tract infections (UTIs) at Al-Rifai Teaching Hospital and to analyze the epidemiologic and microbiologic characteristics of Escherichia coli (E. coli) isolates from these infections. Bacterial identification was performed using standard culture methods and biochemical profiling, while antimicrobial susceptibility was assessed through the disk diffusion method. The findings indicated that E. coli was the predominant pathogen, accounting for the majority of UTI cases, with a higher incidence in women (65%) compared to men (35%). Antimicrobial susceptibility testing revealed that E. coli exhibited the lowest susceptibility rates to Cefepime (CIP), Cefixime (CFM), Ciprofloxacin (CRO), and Cefotaxime (CTX). In conclusion, this study underscores the importance of evaluating the etiology of urinary tract infections and their antimicrobial resistance patterns, particularly in regions like Al-Rifai, where antibiotic misuse is prevalent. Continuous monitoring of susceptibility profiles is essential to inform effective treatment protocols and mitigate the growing challenge of antibiotic resistance.

Keyword: - *Urinary tract infections, E. coli, Antibiotics and Resistance.*

1. Introduction

Urinary tract infections (UTIs) are one of the most common infectious diseases. [1], [2], [3]. Although different causative agents can be responsible for UTIs, bacteria are the major cause, being responsible for more than 95 % of UTI cases. [4], [5], [6]. *E. coli* causes 80 to 90 % of urinary tract infections in the world. Extraintestinal pathogenic strains of *E. coli* that cause urinary tract infections in humans are known as uropathogenic *E coli* [7]. Urinary tract infections (UTI) are the most common bacterial infections, which are characterized by bacterial colonization of the urinary system and often occur in women of all age groups [8], [9].

To reduce the course of the disease and stop the infection from spreading to the upper urinary tract, a precise and timely diagnosis is crucial. UTI treatment is frequently initiated experimentally. Antimicrobial susceptibility testing of the urinary pathogens forms the basis for antibiotic therapy, and UTIs are frequently treated with various broad-spectrum antibiotics when one with a narrow spectrum of activity may be appropriate due to concerns about infection with resistant organisms. To enhance recommendations for empirical antibiotic therapy, however, frequent monitoring of resistance trends is required due to the rise in bacterial resistance. [9], [10].

The prevalence of *E. coli* resistance to a variety of antibiotics, including penicillin, cephalosporins, and fluoroquinolones, has noticeably increased in recent decades. overuse and abuse of antibiotics, as well as spread of resistance genes among bacteria, are some of the causes of this resistance. In human or veterinary treatment, the overuse of antibiotics puts bacteria under selective pressure, which forces them to evolve resistance mechanisms to survive. Furthermore, development of resistances is accelerated by the abuse of antibiotics, such as not taking them as directed or using them without a prescription. [11], [12].

Spread of antibiotic resistance is also significantly influenced by the transfer of resistance genes between bacteria. Plasmids, which are tiny bits of DNA that can travel from one bacterium to another, even between different species, can be used to transfer resistance genes. genetic transfer can take place in a variety of settings, such as communities and hospitals, and it causes bacteria to become resistant quickly. has made treating UTIs brought on by antibiotic-resistant *E. coli* more difficult and frequently necessitates use of substitute medications, which may be less effective or more dangerous. [11], [12].

In light of this, current research attempts to identify the type of antibiotic resistance found in *E. coli* isolated from UTI patients. Investigations aim to detect resistant genotypes and phenotypes, evaluate frequency, and aid in the creation of more potent therapeutic approaches. Researchers can identify patterns in antibiotic resistance and direct

health policy toward more responsible antibiotic use by examining bacterial isolates from patients. helps to stop the spread of antibiotic resistance and enhances patient outcomes. [9], [10].

Antibiotic resistance in *E. coli* is a multifaceted issue that is influenced by environmental factors. For example, in developing countries, limited access to or misuse of appropriate antibiotics may be more common, leading to higher rates of resistance. In addition, the widespread use of antibiotics also contributes to increased bacterial resistance. Resistant bacteria can be transmitted from animals to humans through the food chain or direct contact, further complicating the issue and potentially affecting diseases [13], [14], [15], [16], [17].

Therefore, understanding the mechanisms of *E. coli* antibiotic resistance requires a multidisciplinary approach encompassing microbiology, genetics, epidemiology, and health policy. By studying the genetic factors that confer antibiotic resistance to bacteria, researchers can develop new diagnostic tools that allow for the rapid detection of resistant bacteria, aiding in the selection of appropriate treatments for patients. Furthermore, understanding the spread of resistant bacteria in hospitals and communities can help design infection prevention and control strategies.

The present study analyses the infectious epidemiology of UTIs in Al-Rifai hospital. In addition, it examines the susceptibility profiles of *E. coli* for 2024.

2. 2. Material and Methods

2.1. Study Design

This is a study conducted at the Microbiology section of Al-Rifai Teaching Hospital. Included 100 samples, all patients with documented UTI. There were samples from female patients and from male patients. Adult patients were sampled by clean catch midstream urine, only a single positive culture per patient was included in the analysis within 6 months.

2.2. Isolation and Identification of Organisms

Urine cultures were examined within 30 minutes of the sample being taken. Both blood agar and Mac Conkey agar were used to inoculate all samples, which were then incubated for 24 hours at 37°C and 48 hours in the case of negative results. Based on the number of colonies that were produced (≥105 cfu/mL) and the urine's cytology, which detected bacteriuria and PMNs under a microscope (≥8 leukocytes/mm3), a specimen was deemed positive for UTI. Nonetheless, the clinical picture and the patient's immunological condition were taken into consideration when analyzing reduced colony counts linked to significant pyuria or low PMN counts linked to significant colony counts. The biochemical properties of the isolates and the standard culture were used to identify the bacteria. Standard biochemical techniques were used to identify gram-negative bacteria.

2.3. Susceptibility Testing

E. Coli's antimicrobial susceptibility was assessed using the Mueller-Hinton agar and the disk diffusion method by CLSI guidelines. Cefepime CIP, Cefixime (CFM), Ciprofloxacin (CRO), and Cefotaxime (CTX) were the antimicrobial drugs that were tested. On Mueller-Hinton agar plates, the isolates were obtained using the disk diffusion method. The Clinical & Laboratory Standard Institute's (CLSI) standards were used to interpret the findings of susceptibility tests.

3. Results

The presence of bacteria causing urinary tract infections was investigated in 100 urine samples from patients with UTI. The number of samples that gave a positive result for bacterial culture was 92 samples, while 8 samples gave a negative result for bacterial culture. Based on the results of the morphological and microscopic diagnosis, Biochemical tests, As expected, E. coli was the most frequent isolate throughout the 6 months, 60 (65.2 %) samples were diagnosed as E. coli and 32 (34.8 %) as other types The results showed that the bacteria were Fermented for sugar, it produced pink, smooth, thiny colonies with a sharp edge on the middle of the Maconcay agar Figure 4.1, E. coli is the predominant isolated pathogen from both sexes, it occurred more frequently in women 39 (65 %) of these

samples were female and 21 (35 %) were male. The woman is more than a man due to their anatomy and reproductive physiology.

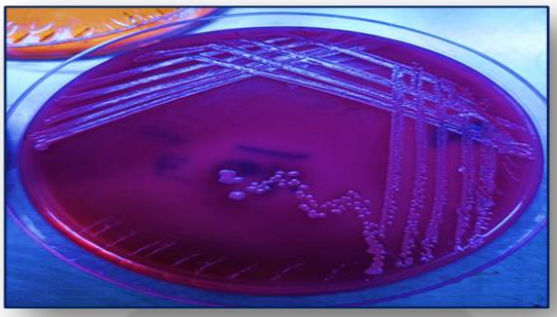

Figure 1: *E Coli* in MacConkey agar

The percentages of susceptibility (and subsequently of nonsusceptibility including both resistant) of *E. coli* isolates to the panel of antibiotics which are commonly used to treat *Escherichia* infections are shown in **Table 1**. The lowest percentage of susceptibility was manifested against Cefixime CFM 15 (25 %) followed by Cefotaxime CTX 20 (33%), Ciprofloxacin CRO 24 (40%) while high sensitivity was observed with Cefepim CIP 26 (43%). In general, the urinary isolates showed a slightly better susceptibility profile in comparison to the other hospital isolates of *E. coli*.

Table 1: Result of antibiotic susceptibility test for the different antibiotics, R (resistance), S (sensitive)

Antibiotic	S	R
CTX	20 (33%)	40 (67%)
CFM	15 (25 %)	45 (75 %)
CIP	26 (43%)	34 (57 %)
CRO	24 (40%)	36 (60 %)

4. Discussion

This study was conducted among patients of urinary tract infection attending Refaei Hospital, it occurred more frequently in women, 39 (65 %) of these samples were female and 21 (35 %) were male. The woman is more than a man due to their anatomy and reproductive physiology. This is for reason A woman's urethra is shorter than a man's, which means that bacteria have to travel a shorter distance before reaching the woman's bladder, which increases her risk of disease. [18].

E. coli isolates were initially identified based on phenotypic characteristics after growing them on the MacConkey agar and the blood agar. The results showed that the bacteria were fermented for sugar, and it produced pink, smooth, thin colonies with a sharp edge on the middle of the MacConkey agar [19].

The differential substance present in MacConkey agar, such as bile salts and crystal violet dye, which allows Gram-negative bacteria to grow, Gram-negative bacteria, including Enterobacteriaceae, inhibit the growth of Gram-positive bacteria. [20]

The sensitivity of the bacterial isolates to four different antibiotics was tested. The lowest percentage of susceptibility was manifested against Cefixime CFM 15 (25 %) followed by Cefotaxime CTX 20 (33%), Ciprofloxacin CRO 24 (40%) while high sensitivity was observed with Cefepim CIP 26 (43%).

In the final *E. coli* appeared resistant to this antibiotic as all bacterial isolates were multi-resistant to antibiotics. Multi-drug resistance (MDR) with what was stated [21] .

4. CONCLUSIONS

Study confirms that Escherichia coli (*E. coli*) is the predominant cause of urinary tract infections (UTIs) at Al-Rifai Teaching Hospital, with a significant predominance among female patients, who accounted for 65% of the cases compared to 35% in males. Gender disparity is consistent with global trends and is largely attributed to anatomical and physiological factors, such as the shorter female urethra, which facilitates bacterial entry into the urinary tract. Findings underscore the importance of targeted public health interventions to raise awareness about preventive measures, particularly among women, who are at a higher risk of developing UTIs.

One of the most concerning outcomes of study is the high level of antibiotic resistance observed among *E. coli* isolates. Susceptibility testing revealed alarmingly low sensitivity rates to commonly used antibiotics, with only 25% of isolates susceptible to Cefixime (CFM), 33% to Cefotaxime (CTX), and 40% to Ciprofloxacin (CRO). In contrast, Cefepime (CIP) showed a slightly higher susceptibility rate of 43%. Results reflect a growing trend of antibiotic resistance, which is likely exacerbated by overuse and misuse of antibiotics in both clinical and community settings. Factors such as self-medication, incomplete adherence to prescribed regimens, and widespread availability of antibiotics without prescription have contributed to the selection and proliferation of resistant strains.

Multidrug resistance (MDR) observed *in E. coli* isolates is particularly troubling, as it severely limits treatment options and complicates clinical management of UTIs. Ability of *E. coli* to transfer resistance genes via plasmids further aggravates the problem, enabling rapid spread of resistance not only within the species but also across different bacterial populations. Phenomenon highlights the need for a comprehensive approach to address antibiotic resistance, encompassing both clinical and public health strategies. To combat this growing public health challenge, it is imperative to strengthen antimicrobial stewardship programs that promote the rational use of antibiotics. Programs should focus on educating healthcare providers and public about dangers of antibiotic misuse and importance of adhering to prescribed treatment regimens. Additionally, enhancing infection prevention and control measures, such as improving hygiene practices and implementing stricter protocols in healthcare settings, can help reduce the incidence of UTIs and the spread of resistant bacteria. Regular surveillance of antibiotic resistance patterns is also crucial to inform empirical treatment guidelines and ensure patients receive effective therapy. By monitoring resistance trends, healthcare systems can adapt their treatment protocols to reflect current susceptibility profiles of bacterial pathogens, thereby minimizing the risk of treatment failure and the further emergence of resistance.

Furthermore, promoting research into alternative treatment options, such as development of new antibiotics, phage therapy, and immunotherapies, is essential to address limitations posed by existing treatments. A multidisciplinary approach that integrates clinical, epidemiological, and microbiological insights is vital to understanding mechanisms of resistance and developing innovative solutions to combat resistant infections.

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