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Short Communication

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Prevalence and Antibiotic Resistance of *Enterobacteriaceae* in Urinary Tract Infections: A Retrospective Study at Secondary Healthcare Center-Tripoli, Libya

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ABSTRACT

Urinary tract infections (UTIs) are prevalent bacterial infections that affect millions globally and lead to significant morbidity. UTIs are classified as uncomplicated or complicated, with various risk factors and causative agents, primarily uropathogenic *Escherichia coli* (UPEC).

This study aims to determine the prevalence and antibiotic resistance patterns of Enterobacteriaceae in UTI patients at AL-Nokhba Medical Clinic, Tripoli, Libya.

A retrospective, observational study was conducted from September 2021 to September 2023, including patients with positive urine cultures. Antibiotic susceptibility was tested using the disc diffusion method.

Out of 220 positive urine cultures with significant bacterial growth, 191 samples were identified as Enterobacteriaceae. The most common pathogens were *Klebsiella spp. (62.3%) and Escherichia coli* (33.5%). Multidrug-resistant Enterobacteriaceae (MDRE) constituted 16.75% of the samples. MDRE showed a high resistance rate to amoxicillin-clavulanic acid and third-generation cephalosporins, compared to carbapenems and fosfomycin.

The study highlights the prevalence of Enterobacteriaceae in UTIs and the significant antibiotic resistance, emphasizing the need for appropriate empirical therapy based on local antibiogram data. Regular surveillance of microbial prevalence and resistance patterns is crucial for guiding effective treatment.

Keywords- *Antibiotic Resistance*; *Escherichia coli*; *Al-Nokhba Medical Clinic*.

INTRODUCTION

Urinary tract infections (UTIs) are among the most prevalent bacterial infections globally, affecting approximately 150 million individuals annually.[1] They pose a significant health burden across various demographics, including infant boys, older men, and females of all ages.[2,3] UTIs can lead to severe complications such as recurrent infections, pyelonephritis with sepsis, and renal damage in young children.[2,4] Additionally, the frequent use of antimicrobials to treat UTIs can result in high-level antibiotic resistance and *Clostridium difficile* colitis.[5]

Clinically, UTIs are classified as either uncomplicated or complicated. Uncomplicated UTIs occur in otherwise healthy individuals without structural or neurological abnormalities of the urinary tract.[2,4] In contrast, complicated UTIs are associated with factors that compromise the urinary tract or host defenses. The primary causative agent for both UTIs is uropathogenic *Escherichia coli* (UPEC), followed by other bacteria such as *Klebsiella pneumonia* and *Staphylococcus saprophyticus*.[6]

The treatment of symptomatic UTIs typically involves antibiotics, which can disrupt the normal microbiota and promote the development of multidrug-resistant microorganisms.[7] This study aims to determine the prevalence and antibiotic resistance patterns of Enterobacteriaceae in UTI patients, providing insights into appropriate empiric therapy.

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MATERIALS AND METHODS

This study is an observational retrospective study, designed to assess the prevalence of Enterobacteriaceae infections in UTI patients and their antibiotic resistance patterns. The study population comprised both inpatients and outpatients, at AL-Nokhba Medical Clinic from September 2021 to September 2023, who had positive urine cultures. Patient identification was conducted through a review of urine specimen records sent to the microbiology laboratory during the study period.

Urine cultures were performed for patients suspected of having a UTI or those with positive urinalysis for leukocyte esterase and/or nitrite. Patients with significant Enterobacteriaceae growth on CLED culture media were included in the study. Antibiotic susceptibility testing was carried out using the disc diffusion method. Data from the microbiology laboratory, including patient demographics, isolated Enterobacteriaceae species, and antibiotic sensitivity results, were collected and analyzed using SPSS version 20. The study received approval from the lab board of AL-Nokhba Clinic.

RESULTS

The data available showed that a total of 741 samples were investigated, of which 220 showed significant bacterial growth. Among these, 29 (13.18%) samples contained non-Enterobacteriaceae bacteria, and 191 (86.82%) samples showed Enterobacteriaceae bacteria growth. The results analyzed below were based on the Enterobacteriaceae bacteria contained samples.

Table 1: Distribution of the samples with and without MDRE.

Enterobacteriaceae bacteria	All isolates	MDR isolates	Non-MDR isolates
Escherichia coli	64	11	53
Klebsiella spp	119	17	102
Enterobacter spp.	8	4	4
Total	191	32	159
Percentage	100%	16.7%	83.3%

The majority of uropathogens identified (Table 1) were *Klebsiella spp*. (119, 62.3%), *Escherichia coli* (64, 33.5%), and *Enterobacter spp*. (8, 4.2%). MDRE (multi-drug resistant Enterobacteriaceae) isolates were defined as those resistant or intermediately susceptible to three of the following antimicrobial categories: (1) penicillins ± beta-lactamase inhibitors, (2) cephalosporins (either ceftriaxone, cefotaxime, or cefixime), (3) carbapenems (either imipenem or meropenem), and (4) gentamicin or amikacin.[8]

Enterobacteriaceae isolates that did not meet these criteria were considered non-MDRE. Out of the 191 samples tested, 32 (16.75%) were identified as MDRE .

All MDRE isolates were resistant to both amoxicillin + clavulanic acid and third-generation cephalosporins. In contrast, non-MDRE showed resistance rates of 61.8% to amoxicillin + clavulanic acid and 23.5% to third-generation cephalosporins. Carbapenems demonstrated fairly good efficacy against MDRE and excellent efficacy against non-MDRE, with resistance rates of 38.7% for MDRE and 2.6% for non-MDRE (Figure 1).

Regarding aminoglycosides, MDRE isolates exhibited a high resistance rate of 88.5%, whereas non-MDRE showed a lower resistance rate of 17.6%. Additionally, 65.6% of MDRE were resistant to fluoroquinolones, and 40% were resistant to fosfomycin. Non-MDRE exhibited low resistance rates to fluoroquinolones (15.7%) and fosfomycin (12.2%).

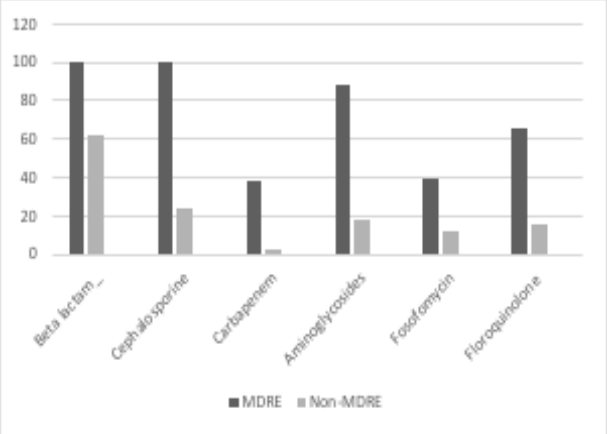

Figure 1: Resistance rate of uropathogenic Enterobacteriaceae**.**

The prevalence of MDRE was 16.7%, which is significantly lower compared to the 60% reported in Saudi Arabia. A high prevalence of drug-resistant Enterobacteriaceae infections was associated with serious sequelae.[9]

Among non-MDRE UTIs, all tested antibiotics, except penicillin plus beta-lactam inhibitors, were suitable for empiric treatment: cephalosporins (76.8% susceptible), carbapenems (97.4% susceptible), aminoglycosides (82.4% susceptible), fluoroquinolones (84.3% susceptible), and fosfomycin (87.8% susceptible). In contrast, the susceptibility of MDRE was limited to carbapenems (61.3% susceptible), fosfomycin (60% susceptible), and fluoroquinolones (34.4% susceptible).

Fosfomycin demonstrated the highest susceptibility rate among the tested antibiotics (60% susceptible), making it a good choice for treating both MDRE and non-MDRE due to its convenient dosing regimen. Additionally, fosfomycin is a promising option as it is active against ESBLs and is well-tolerated with excellent urinary penetration. However, this study found that cefixime, another once-daily antibiotic commonly used to treat UTIs, cannot be recommended for the treatment of MDRE due to the high rate of resistance (100%). Carbapenems

showed good in vitro susceptibility and could be used for short-course empiric therapy while awaiting urine culture results.

DISCUSSION

This study focuses exclusively on significant positive urine cultures, identifying *Klebsiella pneumoniae* as the most prevalent pathogen among both multidrug-resistant (MDR) and non-MDR organisms. It is strongly recommended to implement appropriate screening for MDR organisms to prevent patient-to-patient transmission. The prevalence of MDR organisms among uropathogens in this study was 16.7%, which is notably lower than the 60% reported in Saudi Arabia.[9] High rates of drug-resistant Enterobacteriaceae infections are associated with serious complications.

In cases of non-MDR urinary tract infections (UTIs), all tested antibiotics except for penicillin combined with beta-lactam inhibitors were deemed suitable for empirical treatment. Specifically, susceptibility rates were as follows: Cephalosporins (76.8%), Carbapenems (97.4%), Aminoglycosides (82.4%), Fluoroquinolones (84.3%), and Fosfomycin (87.8%). In contrast, the susceptibility of MDR organisms was limited, with rates of 61.3% for Carbapenems, 60% for Fosfomycin, and only 34.4% for Fluoroquinolones. Notably, Fosfomycin exhibited the highest susceptibility rate (60%) among the tested antibiotics, making it a promising choice for treating both MDR and non-MDR infections due to its convenient dosing regimen. Furthermore, Fosfomycin is effective against extended-spectrum beta-lactamases (ESBLs) and is well-tolerated with excellent urinary penetration.[10]

This study suggests that cefixime, a commonly used once-daily antibiotic for UTI treatment, is not suitable for MDR cases due to a resistance rate of 100%. Carbapenems demonstrated a favorable *in vitro* susceptibility profile and could be considered for short-course empirical therapy while awaiting urine culture results. Unfortunately, there are limited oral treatment options for MDR infections, and oral antibiotic therapy should be guided by formal susceptibility results from urine cultures.

Risk factors for recurrent UTIs, such as urological procedures and obstructive uropathy, likely contribute to multiple antibiotic exposures, explaining the increased prevalence of MDR isolates. Our findings indicate an alarming rate of resistance to fluoroquinolones among MDR organisms. Although fluoroquinolones have been recommended for empirical therapy of complicated UTIs by urologists due to historically low resistance rates, our data suggest they are not suitable for empirical treatment in MDR cases.

Additionally, this study underscores the importance of assessing local antibiotic resistance patterns to guide appropriate therapy. Limitations include the limited number of tested antibiotics and the fact that the study was conducted at a single healthcare center. Moreover, it was not designed to evaluate clinical and microbiological outcomes in patients receiving antibiotic therapy. Nonetheless, these findings highlight the need for further research on uropathogen susceptibility patterns to inform individual treatment plans. Regular updates on local microbial prevalence and resistance patterns are essential for guiding empirical therapy for UTIs.

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