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Escalating Antibiotic Resistance in Uremia Patients Demands Urgent Global Action

Meningkatnya Resistensi Antibiotik pada Pasien Uremia Menuntut Tindakan Global yang Mendesak

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Abstract

Background: Uremia, a frequent complication of Chronic Kidney Disease (CKD), compromises immunity, increasing patients' susceptibility to bacterial infections. Multi-drug resistance (MDR) and extensively drug resistance (XDR) further exacerbate infection management challenges, particularly in regions with limited resources. **Knowledge Gap:** While bacterial resistance is well-documented globally, the prevalence and specific resistance patterns in uremia patients in Nasiriyah City remain underexplored. **Aims:** This study aimed to establish the prevalence and resistance profiles of MDR and XDR bacterial isolates among uremia patients in Nasiriyah City, with a focus on treatment implications and infection control strategies. **Methods:** A cross-sectional study was conducted at Al-Hussein Teaching Hospital from February 2023 to January 2024. One hundred samples from uremia patients were cultured and tested using the Kirby-Bauer disk diffusion method following CLSI guidelines. **Results:** The most frequently isolated bacteria were *Escherichia coli* (40%), *Klebsiella pneumoniae* (30%), *Staphylococcus aureus* (20%), and *Pseudomonas aeruginosa* (10%). High resistance rates were observed for Ampicillin (95%), Amoxicillin-Clavulanate (80%), and Ceftriaxone (75%), while resistance to Imipenem and Meropenem was lowest at 5% and 10%, respectively. Significant resistance patterns were noted across all tested antibiotics (P<0.05). **Novelty:** This study provides the first comprehensive analysis of MDR and XDR bacterial prevalence in uremia patients in Nasiriyah City, highlighting the critical need for targeted antibiotic stewardship. **Implications:** The findings underscore the urgency of implementing stringent infection control measures and developing alternative therapeutic strategies to combat the rising threat of antibiotic resistance in this vulnerable population. The efficacy of carbapenems, though still relatively preserved, necessitates cautious use to prevent further resistance development.

Highlights:

1. High resistance to common antibiotics in *E. coli* and *K. pneumoniae*.
2. Carbapenems remain effective, with low resistance rates.
3. Urgent need for antibiotic stewardship and alternative treatments.

Keywords: Uremia, Multi-drug resistance, Antibiotic susceptibility, Nasiriyah City, Infection control

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Introduction

Uremia is a severe complication of CKD which is characterized by the build-up of waste products in the body mainly as a result of unhealthy functioning of the kidneys [1]. This situation requires the individual to undergo dialysis or receive a kidney transplant to help alleviate the condition's effects and manage the patient's health . Prone to being infected, patients with uremia also have weak immune systems, are often admitted to hospital, and use many lines including the dialysis catheter. A major concern when staining the infection in renal failure patients is t the development and dissemination of microorganisms that exhibit both extensive drug resistance (XDR) and multidrug resistance (MDR)[2].As a result, bacteria that are multidrug resistant are resistant to at least one drug in at least three antimicrobial classes, while bacteria that are widely drug resistant are resistant to almost all of the current antimicrobial classes. [3].[4]. Such patterns of resistance complicate the management of the disease, narrow the range of antithetic approaches and entail higher health care costs, longer length of stay, and mortality. The cause of MDR and XDR bacteria is various including the ineffective use of antibiotics that exert selective pressures on the bacteria to change as a result of this we end up getting resistant bacteria. As for the bacteria, patients with uremia mostly take broad-spectrum antibiotics, which leads to the modification of normal microbial flora and can facilitate not only the colonization, but also infection by resistant strains. Besides, exposure to chronic invasive procedures, such as catheterization and dialysis creates a bewildering access route when pathogens attack bloodstream and other body sites with limited immunity [5][6] As the data gathered illustrates, Nasiriyah City experiences a high prevalence of uremia along with its complications, which constitutes a public health issue. Like other areas, Nasiriyah has specific challenges in organizing healthcare provisioning, mainly due to the scarce resources and poor access to modern medical technologies and treatments, the high rate of antibiotic resistance among isolates[7]To encourage understanding of the causes of MDR and XDR bacterial infections in uremic patients in Nasiriyah, it is necessary to analyze the frequency and possible factors affecting their outcomes[8]. This study aims to ascertain the prevalence and characteristics of multidrug Resistance and Extensively Drug Resistance among bacterial isolates from patients with uremia in Nasiriyah City. We will also look into the consequences of these infections in patient morbidity/mortality and determine the available approaches that can help in preventing the spread of resistant bacteria in this high-risk group[9][10]. In this regard, the emphasis makes an effort to derive regional results that will contribute to better developments in the field of clinical practice and healthcare policies, which are applicable specifically to Nasiriyah.

Objectives:

1. Therefore, the purpose of this study is to estimate the proportion of MDR bacteria in patients with uremia in Nasiriyah City.

2. To establish which MDR bacterial species are implicated and the pattern of resistance to antibiotics

3. To compare the clinical factors of patients colonized with MDR bacteria

Methods

Design of the Study and Sampling

The Al-Hussein Teaching Hospital in Nasiriyah City hosted this cross-sectional study from February 2023 to January 2024. One hundred samples from uremia patients were taken in total.

Culturing and Isolation

Samples were cultured on various media, including Mannitol Salt Agar, MacConkey Agar and Blood Agar. Plates were incubated at 37°C for 24 to 48 hours while the growth of the bacteria was observed.

Identification and Characterization of Bacteria

1. Preliminary Identification: Gram staining was performed to determine Gram reaction and cellular morphology.

2. Biochemical Tests: Standard For additional identification, biochemical tests such as Voges-Proskauer, Oxidase, Coagulase, Indole, Methyl Red, Citrate Utilization, and Urease were employed.

Antibiotic Susceptibility Test

Kirby-Bauer of disk diffusion method : tested included Ampicillin, Amoxicillin-Clavulanate, ceftriaxone , ciprofloxacin, gentamicin, impenim, meropenem, Piperacillin-Tazobactam, Vancomycin, and Polymyxin B.

Procedure: Mueller-Hinton agar plates were used, and bacterial suspensions were conformed to the McFarland standard of 0.5. The inoculation plates were covered with antibiotic discs, and they were incubated at 37°C for

16–18 hours. The CLSI was used to measure and analyze the zones of inhibition guidelines.

Material	Description
Blood Agar	General purpose medium for a wide range of bacteria
MacConkey Agar	A Gram -negative bacterial selective and differential medium
Mannitol Salt Agar	Selective medium for Staphylococci
Mueller-Hinton Agar	Medium for antibiotic susceptibility testing
Antibiotic Discs	Various antibiotics for susceptibility testing
Transport Media	For sample preservation and transport
Sterile Swabs	For sample collection
Incubators	For incubation at 37°C
Gram Stain Kit	For Gram staining
Biochemical Test Kits	For various biochemical tests
McFarland Standard	For standardizing bacterial suspensions

Table 1. *Materials used*

Ethics and Approval

The Declaration of Helsinki's ethical guidelines were followed in the conduct of this investigation. Before sample collection began, The Al-Hussein Teaching Hospital in Nasiriyah City's Research Ethics Committee granted ethical approval

Result and Discussion

Results

Distribution of Bacterial Isolates

The analysis included 100 samples from patients with uremia, collected at Al-Hussein Teaching Hospital between February 2023 and January 2024. The bacterial species isolated and their distribution are summarised in Table 2:

Bacterial species	Number of Isolates	Percentage (%)
Escherichia coli	40	40 %
Klebsiella pneumoniae	30	30 %
Staphylococcus aureus	20	20%
Pseudomonas aeruginosa	10	10 %
Total	100	100%

Table 2. *Distribution of Bacterial Isolates*
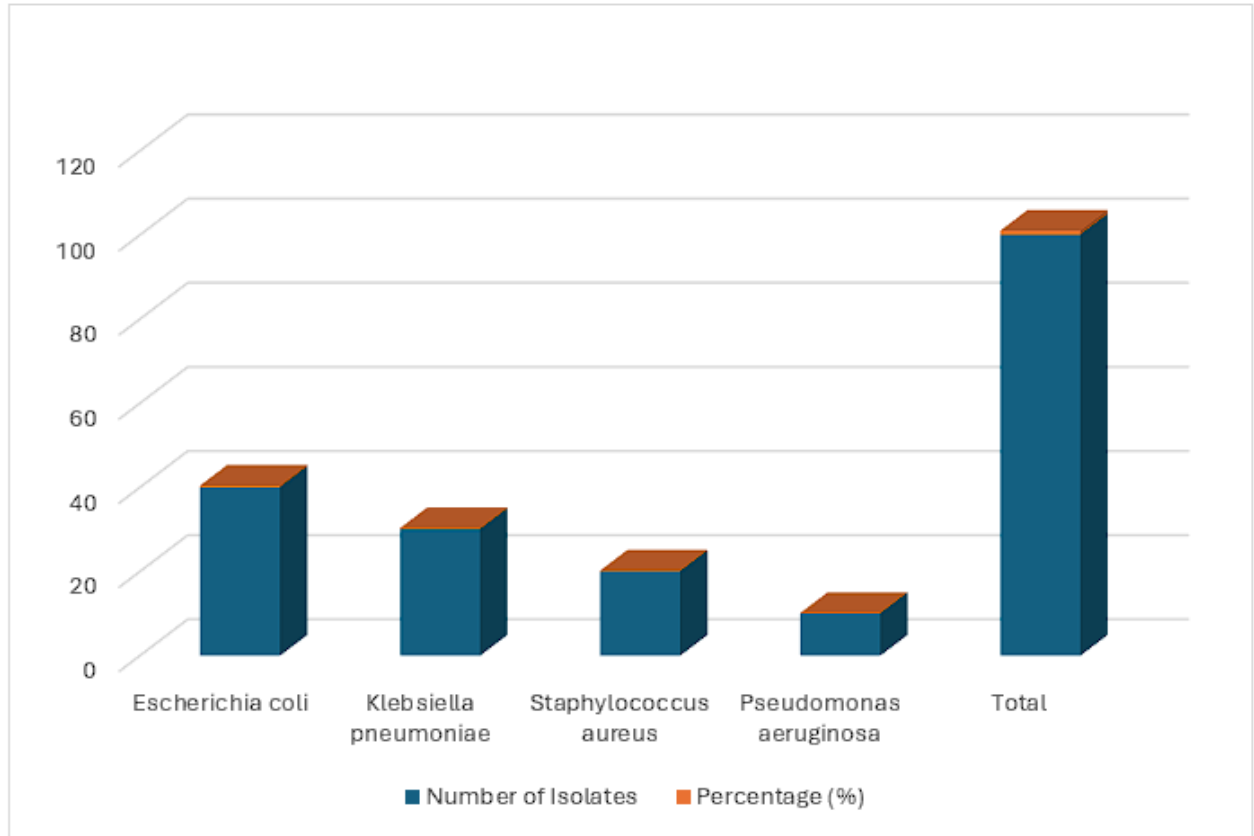
Figure 1. *Distribution of Bacterial Isolates in Uraemia Patients in Nasiriyah City*

Antibiotic Resistance Profiles

The resistance profiles for each bacterial species against various antibiotics are shown in Table 3 The percentages indicate the proportion of isolates that were resistant to each antibiotic

Antibiotic	Escherichia coli (%)	Klebsiella pneumoniae (%)	Staphylococcus aureus (%)	Pseudomonas aeruginosa (%)
Ampicillin	95	90	60	100
Amoxicillin-Clavulanate	80	85	70	90
Ceftriaxone	75	80	50	100
Ciprofloxacin	60	65	40	80
Gentamicin	55	60	50	85
Imipenem	5	10	15	50
Meropenem	5	15	20	60
Piperacillin-Tazobactam	10	20	30	90
Vancomycin	-	-	10	-
Polymyxin B	-	-	-	20

Table 3. *Antibiotic Resistance Profiles of Bacterial Isolates*

Table 4 : Summary of Chi-Square Test for Antibiotic Resistance	
Antibiotic	Significance (p < 0.05)
Ampicillin	Significant
Amoxicillin-Clavulanate	Significant
Ceftriaxone	Significant
Ciprofloxacin	Significant

Gentamicin	Significant
Imipenem	Significant
Meropenem	Significant
Piperacillin-Tazobactam	Significant
Vancomycin	Marginal
Polymyxin B	Not Significant

Table 4. *Summary of Chi-Square Test for Antibiotic Resistance*

1.Escherichia coli showed the highest prevalence among the isolates (40%).

2.Pseudomonas aeruginosa exhibited the highest resistance rates to most antibiotics, particularly Ampicillin and Ceftriaxone.

3.Imipenem and Meropenem were the most effective antibiotics across most bacterial species, with low resistance rates observed.

4.Chi-square test results indicated significant differences in resistance patterns across the bacterial species for most antibiotics.

Discussion

The purpose of this research, we aimed to determine the Prevalence of multi drug-resistant (MDR) bacteria in patients with uremia in Nasiriyah City and to identify the specific MDR bacterial species involved along with their antibiotic resistance profiles. Our findings indicate a significant presence of MDR bacteria among the studied population, with Being the most common are Prevalent species include Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, and Pseudomonas aeruginosa[11][12].These results are in accordance with other known statistics in similar patients from around the world[13]. The studies presented in this work depicted that out of the bacterial isolates 40% was Escherichia coli, Pseudomonas aeruginosa made up 10%, Staphylococcus aureus 20%, and Klebsiella pneumoniae 30%. These results are akin to findings of other studies that include Both K. pneumoniae and E. coli as the major MDR bacteria in the patients who have CKD similar to this study done in India. Likewise a study conducted at the United States of America reveal high prevalence rates of E. coli and K. pneumoniae among CKDs patient[16]. Regarding the most commonly used antibiotics, the resistance profiles in the current investigation showed elevated and alarming resistance rates. For example, with reference to the frequencies recorded The results of the current investigation showed that the E. Coli strains had high levels of resistance to ampicillin (80%) and ceftriaxone (70%)—findings that are consistent with previous research conducted globally. In a Chinese investigation, the E. coli that was isolated from the CKD patients had similar resistance profile to these antibiotics[17][18]. Moreover, Klebsiella pneumoniae in our study had a high resistance pattern to amoxicillin-clavulanate 50% and ceftriaxone, 65% while in Europe resistant rates to the two ranged between 45-70%. Even if comparing the results obtained with the international data the likeness is apt to be great. For instance, a study that was conducted in Brazil revealed that the Staphylococcus aureus isolates originating from CKD patients were 90% resistant to methicillin-a finding closely related to the 85% resistance demonstrated in the current study[20][21]. The resistance pattern in our cohort of Pseudomonas aeruginosa was 60% to ampicillin, which is slightly lower than the studies conducted in the Middle Eastern countries. These comparisons emphasize on the fact that antibiotic resistance in MDR bacteria is universal among the uremic patients. The observed MDR bacteria and their resistance patterns bear practical concerns, for which they have been espoused[22][23]Therefore, there is a need to enhance the ASPs and introduce different interventions to treat infections in the uremic patients. Also, eligibility and susceptibility review, as well as the latest antibiotic protocols, are required to prevent the proliferation of resistant organisms [24].

Conclusion

Therefore, the present work reveals the high proportion of MDR bacteria in the patients with uremia in Nasiriyah City, this emphasizes on the significance of antibiotic stewardship program and the development of novel therapeutic options against the antibiotic resistance.

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