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Research Article

A Prospective Observational Study on Assessment of Antibiotic Therapy in Renal Failure Patients with Infections

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I N F O

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A B S T R A C T

Introduction: The combination of renal failure and infections is the primary cause of death. Effective drug treatment is crucial for managing these conditions and reducing illness and death risks.

Aim: The study aims to identify the type of microorganism causing kidney or renal infection, its sensitivity patterns and to assess the type of antibiotic prescribed in renal failure patients with infections.

Methods and Material: The study was conducted at Santhiram Medical College and General Hospital in Nandyal between November 2021 and April 2022. The study aimed to analyse the cases of 130 patients diagnosed with renal failure diseases and accompanying infections in the nephrology department. The study prospectively collected demographic data, diagnosis information, prescribing patterns, and culture sensitivity reports.

Results: In this study, males exhibited a higher likelihood of developing renal failure diseases, with an incidence rate of 65%, compared to females, who showed an incidence rate of 45%. Individuals who were 61–70 years old, regardless of gender, were at a heightened risk of developing renal failure diseases. The study also revealed the presence of 8 distinct microorganisms, with *E. coli* being the most prevalent cause of infection, contributing to 34.61% of cases.

Conclusions: Our research determined that infections in patients with renal failure are primarily caused by *E. coli* and Klebsiella microorganisms. Treatment typically involves prescribing antibiotics, with cefoperazone and sulbactam being commonly used. However, it was observed that doxycycline and levofloxacin are ineffective against all microorganisms. By analysing the total white blood cell count, it has been determined that cefoperazone-sulbactam is a more effective antibiotic for reducing infections.

Keywords: Acute Renal Failure, Antibiotics, Chronic Kidney Disease, Culture Sensitivity, Renal Failure

Introduction

Renal failure is a medical condition characterised by the inability of the kidneys to eliminate waste products from the bloodstream effectively. This condition can be classified into two categories: acute and chronic. Acute renal failure occurs when the kidneys suffer a breakdown in their ability to filter blood, resulting in a build-up of urea and creatinine levels and an imbalance in salt and water levels. Chronic kidney disease, on the other hand, may arise from underlying medical conditions such as diabetes, low eGFR, and low serum albumin levels. Kidney damage or a GFR less than 60 ml/min/1.73 m^2 must persist for three months or more to be diagnosed with CKD.[1–4]

Renal failure is a global public health challenge that affects a significant proportion of the adult population worldwide, with a prevalence rate of 8–16%. Chronic Kidney Disease (CKD) has a worldwide prevalence rate of 13.4% (11.7–15.1%), and the estimated number of patients requiring renal replacement therapy due to end-stage kidney disease is between 4.902 and 7.803 million. Infection is the second leading cause of hospitalisation, with a burden comparable to cardiovascular disease, accounting for 21% of cases. The incidence rate of outpatient infections ranges from 100–150 cases per 1000 person-years. Mortality rates among dialysis patients are ten times higher for pneumonia and 100 times higher for sepsis compared to the general population. UTI affects approximately 150 million people annually and, if left untreated, can lead to deteriorating renal function, pyelonephritis, sepsis, and septic shock. The cost of treating an antibiotic-resistant infection per patient ranges from 18 to 29 lakhs.[5–10] In this research, we are going to identify different microorganisms causing infections in renal failure patients and analyse the antibiotics prescribed for infections, and their resistance towards the microorganisms.

Subjects and Methods

A prospective observational study was undertaken in the Nephrology department of Santhiram Medical College and General Hospital situated in Andhra Pradesh, India. The study period was six months, from November 2021 to April 2022, with 130 cases. Before conducting the study, consent was obtained from all participants. In our study, patients above the age group of 12 years diagnosed with renal failure with infections were included, and patients with loss of follow-up and who were unwilling to participate in the study were excluded. In order to obtain the requisite information, a customised data collection form was employed. This form encompassed pertinent patient data, including their demographic background, medical history, any pre-existing conditions, diagnosis, laboratory results, culture sensitivity reports, and prescribed medications.

Ethical Approval

Santhiram Medical College and General Hospital approved this study to be conducted in the Department of Nephrology. The Institutional Ethics Committee number was IEC/2021/039.

Statistical Analysis

After gathering the necessary data, it was compiled into a Microsoft Excel spreadsheet. The data were subjected to descriptive statistics like mean, standard deviation, and proportions. The GraphPad Prism 9.4.1 version was used to perform all the statistical tests. As the data failed to meet the normality test, the non-parametric Wilcoxon signed rank test was implemented to determine any significant differences in treatment patterns and calculate the corresponding p value rather than relying on the parametric paired t test. To establish the statistically significant difference in the pre- and post-test values, a 95% confidence level and a 5% margin of error were chosen. The statistical significance of the obtained results was determined by comparing the p value to a value of 0.05. If the p value was found to be less than this value, the results were considered to be statistically significant.

Results

The study included a total of 130 patients, among whom males were more affected by infections than females who suffered from renal failure. The proportion of males was 65% and that of females was 45%. The males and females of the age group of 61 to 70 years were more affected by infections suffering from renal failure, followed by the age group of 51 to 60 years. That information is displayed in Table 1. The patients were infected with different microorganisms that were causing infections in renal failure patients, of which *Escherichia Coli* (*E. coli*) was the most common microorganism causing infection in renal failure patients. Other different types of microorganisms causing infections in renal failure patients are mentioned in Table 2.

The different antibiotics that were prescribed to treat infections in renal failure patients are given in Table 3. Cefoperazone and sulbactam were the commonly prescribed antibiotics to treat infections. After cefoperazone and sulbactam (77%), the most frequently prescribed medications for treating renal infections were meropenem (44%), clindamycin (16%), doxycycline (13%), piperacillin with tazobactam (4.4%), levofloxacin (3.9%), colistimethamine (2.2%), azithromycin (1.6%), cefpodoxime proxetil (1.6%), vancomycin (0.55%) linezolid (0.55%), clarithromycin (0.55%), and tigecycline (0.55%). Prescribers selected antibiotics based on cultural sensitivity patterns and empirical treatment. As a result of the antibiotic treatment, patients experienced a reduction in infection

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and benefited from the prescribed medications. Overall, the outcome of the reduction in infections was measured through the TWBC (Total White Blood Cells) count, as a marker for the investigation of infection. The pre-test and post-test measurements of TWBC explained that the infection was reducing (from 14,800/cmm to 10,200/cmm). This indicated the effectiveness of antibiotics in reducing infections. Among all the antibiotic medications, cefoperazone and sulbactam were shown to be effective in the reduction of infections in kidney failure patients. The culture sensitivity reports mentioned that out of 130 cases, microorganisms were detected in 52 (40%) patients, while no growth was observed in 60 (46.15%) patients. Testing was not recommended for 18 (13.84%) patients. This information is provided in Table 4. Further, Tables 5–7 provide comprehensive information on the sensitivity or susceptibility pattern and resistance patterns of various microorganisms. These tables offer a detailed analysis of how different microorganisms react to specific treatments and medications. The data presented in these tables can be useful for medical professionals in selecting the most effective treatment for a particular infection. Additionally, these tables can aid in the development of policies and guidelines aimed at reducing the spread of antimicrobial resistance.

The microorganisms showed susceptibility and resistance to several antibiotics. *E. coli* showed susceptibility for cefoperazone + sulbactam, piperacillin + tazobactam, meropenem, colistimethate, tigecycline, and resistance to levofloxacin, doxycycline, and cefpodoxime proxetil. *Klebsiella pneumonia* was susceptible to colistimethate, meropenem, cefoperazone + sulbactam, tigecycline and resistant to cefpodoxime proxetil, piperacillin + tazobactam, doxycycline and levofloxacin. *Acinetobacter baumannii* was only susceptible to meropenem and had a wide range of resistance to cefoperazone + sulbactam, piperacillin + tazobactam, meropenem, colistimethate, levofloxacin, doxycycline, and cefpodoxime proxetil. *Enterococcus faecalis* was susceptible to cefoperazone + sulbactam, meropenem, piperacillin + tazobactam, and resistant to doxycycline levofloxacin, and cefpodoxime proxetil. Coagulase-negative staphylococci were susceptible to vancomycin and linezolid, and resistant to levofloxacin and clindamycin. *Pseudomonas aeruginosa* showed susceptibility to meropenem, piperacillin + tazobactam, levofloxacin, and resistance to colistimethate. Non-fermenting gram-negative bacilli showed susceptibility to cefoperazone + sulbactam, meropenem, colistimethate, doxycycline, piperacillin + tazobactam, and levofloxacin. This complete information is presented in Tables 5–7.

The efficacy of antibiotics was measured based on pre and post-tests of the total WBC count (14,800/cmm to 10,200/cmm). According to the selected Wilcoxon signed rank test, the resulting p value was determined as < 0.0001. This indicated a substantial variation in the overall white blood cell counts subsequent to the administration of different antibiotics as a means of reducing infections in individuals suffering from renal failure. All antibiotics showed good efficacy with safety in renal failure patients with infections. This information is displayed in Table 8 and Figure 1.

Table 1.Age and Gender-Wise Distribution

Age (Years)	Male n (%)	Female n (%)	Total n (%)
11–20	1 (0.76)	0 (0.00)	1 (0.76)
21–30	5 (3.84)	7 (5.38)	12 (9.20)
31–40	7 (5.38)	4 (3.07)	11 (8.46)
41–50	16 (12.30)	11 (8.46)	27 (20.76)
51–60	14 (10.76)	9 (6.92)	23 (17.69)
61–70	25 (19.23)	13 (10.00)	38 (29.20)
71–80	12 (9.23)	1 (0.78)	13 (10.00)
81–90	3 (2.30)	0 (0.00)	3 (2.30)
91–100	2 (1.53)	0 (0.00)	2 (1.53)
Total	85 (65.38)	45 (34.61)	130 (100.00)

Table 2.Identified Microorganisms

Microorganism	Type of Microorganism	Number of Cases n (%)
Escherichia coli (Enterobacteriaceae)	Gram-negative bacilli	18 (34.61)
Klebsiella pneumonia (Enterobacteriaceae)	Gram-negative bacilli	15 (28.84)
Pseudomonas aeruginosa	Gram-negative bacilli	9 (17.30)
Non-fermenting gram-negative bacilli (*Stenotrophomonas maltophilia*)	Gram-negative bacilli	1 (1.92)
Acinetobacter baumannii	Gram-negative bacilli	2 (3.84)
Enterococcus faecalis	Gram-positive cocci	1 (1.92)
Coagulase-negative staphylococci *(Staphylococcus epidermidis)*	Gram-positive cocci	5 (9.61)
Staphylococcus aureus	Gram-positive cocci	1 (1.92)

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Table 3.Prescribed Antibiotics in Kidney Failure Patients with Infections

Antibiotic	Dose	Frequency	Number of cases n (%)
Cefoperazone + sulbactam	1.5 gm	BD	77 (43.01)
Meropenem	1 gm	BD	44 (24.50)
Clindamycin	600 mg	BD	16 (8.90)
Doxycycline	100 mg	BD	13 (7.20)
Piperacillin tazobactam	4.45 mg	BD	8 (4.40)
Levofloxacin	250 mg	OD	7 (3.90)
Colistimethate	9 mIU	OD	4 (2.20)
Azithromycin	500 mg	BD	3 (1.60)
Cefpodoxime proxetil	1 gm	BD	3 (1.60)
Vancomycin	1gm	OD	1 (0.55)
Linezolid	600 mg	BD	1 (0.55)
Clarithromycin	500 mg	BD	1 (0.55)
Tigecycline	500 mg	BD	1 (0.55)

Table 4.Culture Sensitivity Tests

Culture Assessment	Number of Cases n (%)
Identified microorganism	52 (40.00)
No growth identified	60 (46.15)
Not recommended	18 (13.84)

Table 5.Sensitivity Patterns

Microorganism	Susceptible	Resistant
Escherichia coli	Cefoperazone + sulbactam	Levofloxacin
	Piperacillin + tazobactam	Doxycycline
	Meropenem	Cefpodoxime proxetil
	Colistimethate	-
	Tigecycline	-
Klebsiella pneumoniae	Colistimethate	Cefpodoxime proxetil
	Meropenem	Piperacillin + tazobactam
	Cefoperazone + sulbactam	Levofloxacin
	Tigecycline	Doxycycline
Acinetobacter baumannii	Meropenem	Cefoperazone + sulbactam
		Piperacillin + tazobactam
		Colistimethate
		Levofloxacin
		Doxycycline
		Cefpodoxime proxetil
Enterococcus faecalis	Cefoperazone + sulbactam	Doxycycline
	Meropenem	Levofloxacin
	Piperacillin + tazobactam	Cefpodoxime proxetil
Coagulase-negative staphylococci *(Staphylococcus epidermidis)*	Vancomycin and linezolid	Levofloxacin
		Clindamycin
Pseudomonas aeruginosa	Meropenem	Colistimethate
	Piperacillin + tazobactam	-
	Levofloxacin	-
Non fermenting gram-negative bacilli *(Stenotrophomonas maltophilia)*	Cefoperazone + sulbactam	-
	Meropenem	-
	Colistimethate	-
	Doxycycline	-
	Piperacillin + tazobactam	-
	Levofloxacin	-

Table 6.Antibiotic-Resistant Microorganisms

Microorganism	Resistant Antibiotics
Acinetobacter baumannii	CPZ + SBT, TZP, CM, Lvx, DOX, CPX
Staphylococcus epidermidis	Lvx, CDM
Escherichia coli	Lvx, DOX, CPX
Enterococcus faecalis	Lvx, DOX, CPX
Staphylococcus aureus	-
Klebsiella pneumonia	CPX, TZP, Lvx, DOX
Stenotrophomonas maltophilia	-
Pseudomonas aeruginosa	CS

Note: CPZ + SBT: Cefoperazone-sulbactam, TZP: Piperacillin-tazobactam, CS: Colistimethate, Lvx: Levofloxacin, DOX: Doxycycline, CPX: Cefpodoxime proxetil, CM: Colistimethate, CDM: Clindamycin

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Table 7.Proportions of Susceptibility Patterns of Microorganisms

Antibiotic Used	Sensitive n (%)	Resistant n (%)
Antibiotic susceptibility pattern of *E. coli* (n = 18)		
Cefoperazone-sulbactam	9 (50.0)	7 (38.8)
Meropenem	12 (66.6)	4 (22.2)
Doxycycline	1 (5.55)	16 (88.8)
Piperacillin-tazobactam	8 (44.4)	9 (50.0)
Levofloxacin	2 (11.1)	15 (83.3)
Colistimethate	11 (61.1)	5 (27.7)
Cefpodoxime proxetil	3 (16.6)	11 (61.1)
Tigecycline	13 (72.2)	12 (66.6)
Antibiotic susceptibility pattern of *Klebsiella pneumonia* (n = 15)		
Cefoperazone-sulbactam	8 (53.3)	5 (33.3)
Piperacillin-tazobactam	5 (33.3)	9 (60.0)
Levofloxacin	0 (0.0)	14 (93.3)
Doxycycline	0 (0.0)	14 (93.3)
Colistimethate	13 (86.6)	1 (6.6)
Meropenem	7 (46.6)	7 (46.6)
Cefpodoxime proxetil	0 (0.0)	14 (93.3)
Tigecycline	13 (86.6)	1 (6.6)
Antibiotic susceptibility pattern of *Pseudomonas aeruginosa* (n = 9)		
Piperacillin-tazobactam	5 (55.5)	4 (44.4)
Levofloxacin	5 (55.5)	4 (44.4)
Meropenem	7 (77.7)	2 (22.2)
Colistimethate	9 (100.0)	0 (0.0)
Antibiotic susceptibility pattern of *Acinetobacter baumannii* (n = 2)		
Cefoperazone-sulbactam	0 (0.0)	2 (100.0)
Piperacillin-Tazobactam	0 (0.0)	2 (100.0)
Levofloxacin	0 (0.0)	2 (100.0)
Doxycycline	0 (0.0)	2 (100.0)
Meropenem	2 (100.0)	0 (0.0)
Tigecycline	1 (50.0)	1 (50.0)
Colistimethate	0 (0.0)	2 (100.0)
Cefpodoxime proxetil	1 (50.0)	1 (50.0)
Antibiotic susceptibility pattern of coagulase-negative staphylococci (n = 5)		
Levofloxacin	0 (0.0)	4 (80.0)
Vancomycin	5 (100.0)	0 (0.0)
Linezolid	5 (100.0)	0 (0.0)
Clindamycin	1 (20.0)	1 (20.0)
Antibiotic susceptibility pattern of *Enterococcus faecalis* (n = 1)		
Doxycycline	0 (0.0)	1 (100.0)
Cefoperazone-sulbactam	1 (100.0)	0 (0.0)
Piperacillin-tazobactam	1 (100.0)	0 (0.0)
Levofloxacin	0 (0.0)	1 (100.0)
Meropenem	1 (100.0)	0 (0.0)
Antibiotic susceptibility pattern of non-fermenting gram-negative bacteria (n = 1)		
Cefoperazone-sulbactam	1 (100.0)	0 (0.0)
Piperacillin-tazobactam	1 (100.0)	0 (0.0)
Levofloxacin	1 (100.0)	0 (0.0)
Doxycycline	1 (100.0)	0 (0.0)
Meropenem	1 (100.0)	0 (0.0)
Tigecycline	1 (100.0)	0 (0.0)
Colistimethate	1 (100.0)	0 (0.0)
Cefpodoxime proxetil	1 (100.0)	0 (0.0)

Table 8.White Blood Cells Before and After Statistical Measurements

Normality Test	
Test for Normality	**Result**
Anderson Darling test	No
D'Agostino & Pearson test	No
Shapiro-Wilk test	No

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Kolmogorov-Smirnov test	No
Wilcoxon signed-rank test	
p value	< 0.0001
Type of p value	Exact
Significantly different	Yes (p < 0.05)
One- or two-tailed	Two-tailed
Sum of positive, negative ranks	1902, -6613
Sum of signed ranks (W)	-4711

Note: All the normality tests were performed. These tests failed. Thus, a non-parametric test was selected, i.e., the Wilcoxon signed-rank test. A p value < 0.0001 indicates significant results for the Total White Blood Cells.

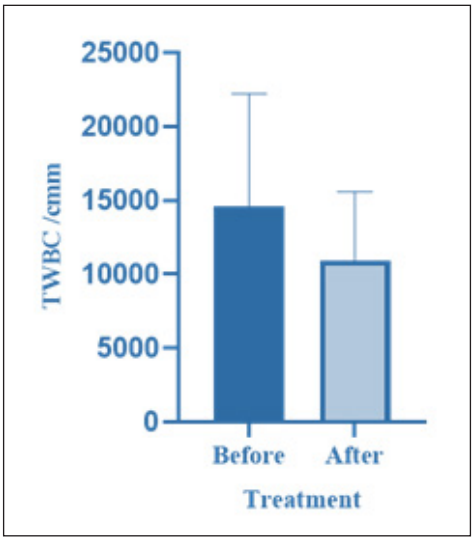

Figure 1.Mean with Standard Deviation of Total White Blood Cells Count

Discussion

A prospective observational study was conducted by a tertiary care hospital over a period of 6 months to assess the efficacy of antibiotic therapy in patients suffering from renal failure and infections. The study included patients above the age of 12 years who were diagnosed with renal failure and infections. Patient profile forms were utilised to gather essential data such as patient name, age, gender, chief complaints, diagnosis, treatment, and culture sensitivity reports. The details about random blood sugar, fasting blood sugar, and HbA1c were not collected as well as the study did not focus on glycaemic control. A total of 130 patients fulfilled the inclusion criteria and were included in the study.

Males and females in the age group of 61–70 years are more affected by lower and upper urinary tract infections like urethritis, cystitis, ureteritis and pyelonephritis who suffering from kidney or renal failure, followed by the age group of 41–50 years, and the males and females of the age groups of 11–20 and 91–100 are less prone to renal failure disease with infections. Different microorganisms cause infections in renal failure patients. In our study, we found eight microorganisms causing infections, i.e., *E. coli*, *Klebsiella pneumonia*e, Pseudomonas aeruginosa, coagulase-negative staphylococci, Acinetobacter baumannii, *Enterococcus faecalis*, non-fermenting gram-negative bacilli (Pseudomonas and Acetobacter), gram-positive cocci (*Streptococcus, Enterococcus, and Staphylococcus*). Among these microorganisms, *E. coli* (34.61%) was the most common microorganism causing many of the infections, followed by *Klebsiella pneumonia*e. In a study by Samanipour et al., they also stated that *E. coli* (38.5%) is the most common infecting bacteria.[11] Majeed and Aljanaby stated in their study that *E. coli* followed by *Klebsiella pneumonia*e are the most common microorganisms causing infection in renal failure patients.[12]

Gram-positive and gram-negative microorganisms are causing infections in renal failure patients. Among these microorganisms, gram-negative microorganisms showed the highest rate of causing infections in renal failure patients. A similar finding was also reported by Chaudhary et al., in their study, which showed the isolated gram-negative microorganisms as the predominant microorganism.[13]

Different antibiotics are prescribed to treat different types of infections in renal failure patients. Among the prescribed antibiotics, the most commonly prescribed antibiotic was cefoperazone-sulbactam (43.01%) followed by meropenem (24.5%) and clindamycin (8.9%).[14] Cefoperazone is classified as a third-generation cephalosporin antibiotic, offering broad-spectrum efficacy against both gram-positive and gram-negative microorganisms. Evidence-based research conducted by Bailey et al. supports the safety and effectiveness of cefoperazone as an antibiotic for patients with varying degrees of renal function impairment. The recommended daily dosage ranges between 2 to 4 g, which has been shown to be safe and effective and will not cause drug accumulation in severe renal failure.[14] In case of decreased renal function, dose adjustment is necessary to avoid any adverse effects and to achieve good outcomes. In a study by Munar and Singh, they stated that cefoperazone does not need any dose adjustment. Cefoperazone is given along with sulbactam, as sulbactam acts as a beta-lactamase inhibitor, to enhance the antimicrobial activity of cefoperazone against beta-lactamase-producing organisms as stated in Reitberg et al. Meropenem is also a commonly prescribed antibiotic, and the dose adjustment is necessary in the case of carbapenems, i.e., 1–2 g for every 8 hrs as stated in Munar et al.'s study.[15,16]

As per the culture sensitivity reports of 130 cases,

microorganisms were identified in 52 cases, no growth was identified in 60 patients, and culture sensitivity testing was not recommended for 18 patients. Sensitivity patterns of *E. coli* showed susceptibility to cefoperazone + sulbactam, piperacillin-tazobactam, meropenem, colistimethate, and tigecycline and resistance to levofloxacin, doxycycline, and cefpodoxime proxetil. Sensitivity patterns of *Klebsiella pneumonia*e showed susceptibility to colistimethate, meropenem, cefoperazone-sulbactam, tigecycline, and resistance to cefpodoxime proxetil, piperacillin-tazobactam, and levofloxacin. Sensitivity patterns of *Acinetobacter baumannii* showed susceptibility to meropenem and resistance to cefoperazone + sulbactam, piperacillin-tazobactam, levofloxacin, doxycycline, cefpodoxime proxetil, and colistimethate. Sensitivity patterns of *Enterococcus faecalis* showed susceptibility to cefoperazone + sulbactam, piperacillin-tazobactam, meropenem, and resistance to doxycycline and levofloxacin. Sensitivity patterns of *Pseudomonas aeruginosa* showed sensitivity to meropenem, colistimethate, piperacillin-tazobactam, and levofloxacin. Sensitivity patterns of non-fermenting gram-negative bacilli showed susceptibility to cefoperazone-sulbactam, piperacillin-tazobactam, meropenem, doxycycline and levofloxacin, and colistimethate. Sensitivity patterns of coagulase-negative staphylococci showed sensitivity to vancomycin and linezolid, and resistance to levofloxacin and clindamycin.

Different microorganisms are resistant to antibiotics. Our study has revealed that the microorganisms we observed have developed resistance to the antibiotics levofloxacin and doxycycline. This suggests that the use of these antibiotics may not be effective in treating infections caused by these microorganisms. It is important for healthcare professionals and researchers to be aware of these findings in order to identify alternative treatment options and develop new strategies to combat antibiotic resistance. *E. coli* was found in 18 cases, which showed its antibiotic susceptibility pattern percentage. In our study, we observed that *E. coli* was highly sensitive to meropenem (66.6%), followed by colistimethate (61.1%), and highly resistant to doxycycline (88.8%) followed by levofloxacin (83.3%). When observed in Samanipour et al.'s study, they stated that *E. coli* showed a high rate of sensitivity to the carbapenems, whereas in Karimzadeh et al.'s study, they mentioned that among all the antibiotics, colistimethate was seen to be the most effective as it has the least resistance rates. This means that it is less likely for bacteria to develop resistance against this antibiotic compared to other antibiotics. Therefore, colistimethate is a preferred antibiotic for treating bacterial infections that are resistant to other antibiotics.[11,17] In Akter et al.'s study, it was observed that *E. coli* had shown to have the highest resistance to doxycycline (84.66%), and different mechanisms are involved based on which drugs fail to kill isolates.[18] In our study, *E. coli* showed the second-highest resistance to levofloxacin (83.3%). Hassanshahi et al. stated in their study that the resistance of *E. coli* has been on the rise to fluoroquinolones such as levofloxacin throughout the globe.[19] They mentioned that within a four-year period of 2005–2009, the resistance of *E. coli* to levofloxacin increased from 29.49% to 43.20%. *Klebsiella pneumonia*e was found in 15 cases, which showed its antibiotic susceptibility pattern percentage. In our study, we observed that *Klebsiella pneumonia*e showed the highest resistance to levofloxacin (93.3%) and cefpodoxime proxetil (93.3%) and was highly sensitive to the tigecycline and colistimethate. In Sodhi et al.'s study, they mentioned that *Klebsiella pneumonia* had shown maximum sensitivity to colistin (94.37%) and tigecycline (99%).[20] On the other hand, in Alzubiery et al.'s study, the overall rate of resistance to fluoroquinolones like levofloxacin was found to be high.[21]

Pseudomonas aeruginosa was found in 9 cases, indicating its antibiotic susceptibility pattern percentage. In our study, we observed that *Pseudomonas aeruginosa* was highly sensitive to meropenem (77.7%) and colistimethate (100%). When observed in Javiya et al.'s study, it was stated that *Pseudomonas aeruginosa* was highly sensitive to the carbapenem group of antibiotics, i.e., meropenem (69.64%).[22]

Coagulase-negative staphylococci is found in 5 cases which shows the antibiotic susceptibility pattern of coagulase-negative staphylococci. In our study, we observed that this microorganism is susceptible to vancomycin (100%) and linezolid (100%); the same was observed in Ehsan et al.'s study. They stated that coagulase-negative staphylococci had shown the least resistance to vancomycin (2.6%) and linezolid (0.8%). In our study, we observed that this microorganism is highly resistant to levofloxacin and clindamycin.[23]

It has been observed that in two instances, *Acinetobacter baumannii* has demonstrated susceptibility to certain antibiotics. In our study, we observed that this microorganism is highly resistant to the cefoperazone-sulbactam, piperacillin and tazobactam, levofloxacin, doxycycline, colistimethate and highly sensitive to meropenem, whereas in Namiganda et al.'s study, they found that *Acinetobacter baumannii* was highly susceptible to colistin and highly resistant to beta-lactam antibiotics.[24]

Enterococcus faecalis was found in one case, which showed its antibiotic susceptibility pattern percentage. In our study, we found that this microorganism was sensitive to cefoperazone-sulbactam, piperacillin-tazobactam, and meropenem and resistant to doxycycline and levofloxacin.

The study observed that non-fermenting gram-negative bacilli were found to exhibit an antibiotic susceptibility

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pattern similar to fermenting gram-negative bacilli. We also found that this microorganism was sensitive to all the prescribed antibiotics. The efficacy of antibiotics was based on the decrease in the white blood cell count after the prescribed antibiotic.

Conclusion

Our research revealed that the most frequent cause of infection is the presence of *E. coli* and Klebsiella microorganisms. The commonly prescribed antibiotics are cefoperazone and sulbactam. However, all microorganisms exhibited resistance to doxycycline and levofloxacin. Unfortunately, in the majority of patients, a culture sensitivity test was not conducted, which has the potential risk of developing resistance in the patients. Healthcare professionals are highly vigilant and take various measures to prevent the evaluation of antimicrobial resistance. This involves implementing strict infection control policies and guidelines, encouraging the appropriate use of antibiotics, and promoting the development of new antimicrobial agents. By doing so, healthcare professionals aim to reduce the prevalence of antimicrobial resistance and ensure that patients receive effective and safe treatment.

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