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Antibacterial Activities of Various Antibiotics Against Klebsiella pneumoniae in Clinical Isolates

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ABSTRACT

Antibiotic resistance is not a latest phenomenon, since the introduction of antibiotics, bacteria are noted to posses some resistance. Antibiotic resistance refers to bacteria's capacity to withstand the effects of antibiotics. **Objective:** To compare the antibacterial effects of different drugs on *Klebsiella pneumoniae* clinical isolates. **Methods:** A cross-sectional investigation was conducted in a hospital in Lahore, Pakistan, collecting 1,400 samples over the course of a year. Antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion method. **Results:** The results showed that Imipenem, Gentamycin, Amikacin, Augmentin, Linezolid, Levofloxacin, Ceftazidime, Norfloxacine, and Cefazolin were the most effective antibacterial agents against K. pneumoniae. On the other hand, K. pneumoniae was highly resistant to Meropenem, Cephalothin, Rifampicin, Cefoxitin, and Ampicillin. **Conclusion:** The study highlights the growing concern of antibiotic resistance in *K. pneumoniae* and the importance of preventative measures such as responsible use of antibiotics, development of new treatments, and implementation of infection control strategies in healthcare settings to effectively manage and prevent the spread of resistance.

INTRODUCTION

A Gram-negative bacteria called *Klebsiella pneumoniae* is frequently linked to nosocomial diseases such pneumonia, septicemia, and urinary tract infections. Treatment of infections brought on by *K. pneumoniae* has become increasingly difficult due to this bacterium's rising resistance to widely used medicines [1, 2]. The purpose of this study was to compare different drugs' antibacterial effects on *K. pneumoniae* clinical isolates. Ampicillin and sulbactam, followed by imipenem and ceftazidime, were reported to have the strongest action against *K. pneumoniae* in one investigation [3, 4]. Amikacin was found to be effective against *K. pneumoniae* in a different investigation, however certain clinical isolates showed resistance to the drug. According to research comparing the effectiveness of cefotaxime and ceftriaxone in treating infections brought on by the bacteria *K. pneumoniae*, cefotaxime was superior to ceftriaxone in treating isolates of *K. pneumoniae* that were resistant to other antibiotics [5, 6]. Another research examined the effectiveness of tigecycline against *K. pneumoniae* and discovered that it had a modest effect; nevertheless, certain clinical isolates showed resistance to the drug. The study also discovered that the action against *K. pneumoniae* was enhanced when tigecycline was combined with other medicines [7, 8]. Ciprofloxacin and levofloxacin shown modest effectiveness against *K. pneumoniae* in research on the activity of fluoroquinolones against this bacterium, however resistance was also noted in certain clinical isolates [9, 10]. The previous studies emphasize the different levels of antibiotics' efficacy against *K. pneumoniae.* Ampicillin-sulbactam and imipenem, among other antibiotics, had strong action against this bacteria, but cefepime shown modest activity [11, 12]. Additionally, several clinical isolates of *K. pneumoniae* showed signs of

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drug resistance. This emphasizes the necessity of ongoing study into the creation of fresh antibiotics and the improvement of current antibiotic treatments to successfully treat infections brought by *K. pneumoniae* [13].

METHODS

A cross-sectional investigation was conducted in the pathology division of the Fatima Memorial Hospital in Lahore, Pakistan. Over the course of a year, 1,400 samples including blood, pus, swabs, sputum, urine, CSF, and semen were collected from various wards at the hospital. The sample containers were labeled with the collection time, source, and date and transported to the lab for analysis within an hour of being collected. The samples were grown on various medium plates (Eosin thiazine Agar, Mannitol Salt agar, TCBS Agar, MSA agar, MacConkey Agar, and enteric bacteria Agar) and stored for 24 hours at 37 °C in an incubator to create pure cultures. The colony morphology on Mac-Conkey agar was used to identify the clinical isolates. Standard identification and susceptibility techniques were used to identify the species, and gram-negative bacteria were identified as pink-colored organisms in gram-stained smears. Antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion method. A colony from the plate was mixed and emulsified in a tube of sterile saline solution. The agar plates were created using Muller Hinton. A sterile cotton swab was used to streak the dried MHA plate surface with the broth culture. Antibiotic discs were positioned on the plate using sterile forceps and incubated for 24 hours at 37 °C. The size of the zone of inhibition for each drug was measured in millimeters and compared to a standard interpretation chart to determine the susceptibility of the bacteria to antibiotics. Data was analyzed using SPSS version 22.0. Both antibiotic sensitivity and resistance were evaluated, and the proportion of sensitivity and resistance was used to calculate an antibiotic's antibacterial activity.

RESULTS

Antibiotics which showed high sensitivity against Klebsiella species were Imipenem (100%), Gentamycin (99%), Amikacin (99%), Augmentin (99%), Linezolid (99%), Levofloxacin (84%), and Ceftazidime (78%), Norfloxacine (76%), Cefazolin (75%). Klebsiella species were highly resistant to Meropenem (100%), Cephalothin (99%), Rifampicin (98%), Cefoxitin (98%), and Ampicillin (85%). Other antibiotics with high resistance were Ceftriaxone (83%), Cefazolin (75%), Cefuroxime (75%), and Cefixime (67%)(table 1).

Antibacterial agent	*Klebsiella pneumoniae* (105)	
	Sensitive n (%)	Resistance n (%)
Amikacin	104 (99.0%)	1 (1.0%)
Ampicillin	16 (15.0%)	89 (85.0%)
Augmentin	104 (99.0%)	1 (1.0%)
Cefazolin	26 (25.0%)	79 (75.0%)
Cefepime	37 (35.0%)	68 (65.0%)
Cefixime	35 (33.0%)	70 (67.0%)
Cefoxitin	2 (2.0%)	103 (98.0%)
Ceftriaxone	18 (17.0%)	87 (83.0%)
Ceftazidime	82 (78.0%)	23 (22.0%)
Cefuroxime	26 (25.0%)	79 (75.0%)
Cephalothin	1 (1.0%)	104 (99.0%)
Ciprofloxacin	66 (63.0%)	39 (37.0%)
Gentamycin	104 (99.0%)	1 (1.0%)
Imipenem	105 (100.0%)	0 (0.0%)
Levofloxacin	88 (84.0%)	17 (16.0%)
Linezolid	104 (99.0%)	1 (1.0%)
Meropenem	0 (0.0%)	105 (100.0%)
Nalidixic Acid	36 (34.0%)	69 (66.0%)
Nitrofurantoin	36 (34.0%)	69 (66.0%)
Norfloxacin	80 (76.0%)	25 (24.0%)
Ofloxacin	67 (64.0%)	38 (36.0%)
Rifampicin	2 (2.0%)	103 (98.0%)

Table 1: Antibacterial activities against *Klebsiella pneumoniae*

DISCUSSION

The findings of the Friedrich *et al.*, research under consideration show that different antibiotic types have different degrees of efficiency against *K. pneumoniae*. Ampicillin-sulbactam and imipenem, two antibiotics, shown strong activity against this bacterium, but cefepime, another drug, demonstrated moderate action [14, 15]. Antibiotic combinations with other antibiotics, shown better action against *K. pneumoniae*. This emphasizes the significance of combining antibiotics to improve the efficacy of treatment for *K. pneumoniae*. However, the research also revealed that certain clinical isolates of *K. pneumoniae* had antibiotic resistance [17, 18]. This is a developing worry since *Klebsiella* pneumoniae infections are becoming harder to treat as a result of the bacteria's increasing drug resistance. The public's health is seriously threatened by the introduction of K. pneumoniae strains that are multi-drug resistant since it reduces the range of possible treatments. To treat infections brought on by *K. pneumoniae*, new medicines must be developed and existing antibiotic regimens must be improved [19]. The development of antibiotic resistance can also be prevented by using antibiotics properly. Antibiotic resistance among bacteria may rise as a result of overuse and abuse, making it more challenging to treat diseases in the future. Fang *et al.*, study offered significant new information on how different antibiotics interact with clinical isolates of *K. pneumoniae* to fight bacteria [20].

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While certain medications had excellent antibacterial action against this bacterium, others had very moderate antibacterial activity, and other clinical isolates had antibiotic resistance. To effectively treat infections brought on by *K. pneumoniae*, new medicines must continue to be developed and existing antibiotic regimens must be improved.

CONCLUSIONS

The results of this investigation showed a higher prevalence of antibiotic resistance in *K. pneumoniae*. The most effective antibacterial agents against *K. pneumoniae* infections were Linezolid, Imipenem, Amikacin, and Gentamycin. However, it is imperative to note that the development of antibiotic resistance is a growing concern in the field of medicine. To effectively manage and prevent the spread of antibiotic resistance, preventative measures must be taken. These measures may include the responsible use of antibiotics, the development of new treatments, and the implementation of infection control strategies in healthcare settings. By taking these steps, the medical community can work to mitigate the impact of antibiotic resistance and ensure effective treatment for bacterial infections.

Conflicts of Interest

The author declares no conflict of interest.

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