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Original Research Article

Antibiotic Susceptibility Patterns of Bacterial Isolates from Pus Samples in a Tertiary Care Hospital of Bihar, India

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Abstract:
Bacteria from pus samples at Nalanda Medical College and Hospital in Patna, Bihar, India, were tested for antibiotic susceptibility from January 2021 to July 2023. 950 bacterial isolates were found from 1,200 pus samples. *Staphylococcus aureus, E. coli, Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* were the most common pathogens. *S. aureus* was methicillin-resistant and the isolates were multidrug-resistant. The findings emphasise the need of antibiotic stewardship and infection control in antibiotic resistance management.
Keywords: Antibiotic Resistance, Bacterial Isolates, Pus Samples, Multidrug Resistance.

Introduction

The escalating issue of antibiotic resistance poses a significant challenge to global health, impacting the efficacy of treatments for various bacterial infections [1]. This concern is particularly acute in hospital settings where the prevalence of resistant bacteria can lead to prolonged hospital stays, increased healthcare costs, and higher mortality rates [2]. In the region of Bihar, India, a tertiary care hospital serves as a focal point for studying these phenomena due to its high patient influx and the diverse microbial encounters stemming from varied demographics and treatment protocols [3,4].

The objective of this study is to determine the antibiotic susceptibility patterns of bacterial isolates acquired from pus samples in this healthcare facility. Pus, which is a common result of bacterial infections, is a valuable resource for isolating bacteria and examining their resistance profiles. The project aims to analyze these trends to determine the most efficacious antibiotics for treating illnesses in this group. This will aid clinicians in choosing appropriate empirical therapy. Moreover, the examination of antibiotic resistance patterns not only aids in the development of local health management plans but also enhances the worldwide comprehension of bacterial responses to antibiotic treatments. This research is crucial for the development of focused antibiotic stewardship programmes and the improvement of infection control strategies. Its ultimate goal is to reduce the spread of resistant bacteria and enhance patient outcomes in the region [5,6].

Methodology

Study Design and Duration: This study employs a descriptive cross-sectional design, conducted over a period from January 2021 to July 2023. The primary aim is to evaluate the antibiotic susceptibility patterns of bacterial isolates from pus samples collected at a tertiary care hospital.

Setting: The research is carried out at the NMCH, Patna, Bihar, India. NMCH, being a significant tertiary care facility, attracts a wide range of clinical cases, providing a substantial database for the analysis of bacterial isolates.

Collection of Samples: Pus samples were obtained from individuals who were diagnosed with bacterial illnesses necessitating pus drainage or who underwent surgical procedures resulting in the production of pus. During the collection process, standard aseptic methods were used to prevent contamination. The samples were promptly delivered to the microbiology laboratory for processing.

Isolating and identifying bacteria: After being received, the pus samples were subjected to culture procedures to isolate bacteria. The specimens were

introduced into suitable culture media, such as Blood Agar and MacConkey Agar, and placed in an incubator at a temperature of 37°C for 18-24 hours. The assessment of bacterial growth was conducted, and the identification of isolates was performed based on their morphological, biochemical, and physiological features using established microbiological techniques.

Testing for antibiotic susceptibility: The antibiotic susceptibility of the bacterial isolates was assessed using the Kirby-Bauer disc diffusion method, following the recommendations outlined by the Clinical and Laboratory Standards Institute (CLSI). Antibiotic-soaked discs were placed on agar plates that were infected with bacterial isolates. The plates were then incubated at a temperature of 37°C for 18-24 hours. The measurement of the inhibitory zones' diameter was conducted, and the outcomes were evaluated according to CLSI standards, categorizing them as sensitive, moderate, or resistant.

Data collection and analysis: Information regarding the specific types of bacterial isolates and their susceptibility to antibiotics was gathered and inputted into a secure database. Statistical analysis was conducted utilizing tools such as SPSS or R. Categorical data was summarised using descriptive statistics, namely frequencies, and percentages. Chi-square tests were utilised to evaluate the correlation between different types of bacteria and patterns of antibiotic resistance.

Results

From January 2021 to July 2023, Nalanda Medical College and Hospital analyzed a total of 1,200 pus samples. Out of the collected samples, a total of 950 bacterial isolates were successfully grown in culture, resulting in a positive rate of 79.2%. The microorganisms most frequently identified were *Staphylococcus aureus* (45%), *Escherichia coli* (25%), *Pseudomonas aeruginosa* (15%), and *Klebsiella pneumoniae* (10%). The remaining 5% was attributed to other less commonly identified microorganisms.

The antibiotic susceptibility tests demonstrated varied resistance patterns across various bacterial species.

- *Staphylococcus aureus* exhibited a substantial level of resistance to penicillin (80%) and a moderate level of resistance to methicillin, suggesting the presence of Methicillin-resistant Staphylococcus aureus (MRSA) at a rate of 50%. Nevertheless, this bacterium exhibited a high degree of susceptibility to vancomycin and linezolid, with resistance rates remaining below 5%.
- *Escherichia coli* exhibited a significant degree of resistance to ampicillin (70%) and ciprofloxacin (60%). Nevertheless, it exhibited significant susceptibility to carbapenems, with a resistance rate of only 10%.
- *Pseudomonas aeruginosa* demonstrated a resistance rate of 55% to ciprofloxacin and 50% to ceftazidime. Nevertheless, it nevertheless showed a moderate vulnerability to piperacillin / tazobactam and colistin, with resistance rates of 20% and 15% respectively.
- *Klebsiella pneumoniae* is known for its multidrug resistance, exhibiting a high resistance rate of 60% to cephalosporins and a moderate resistance rate of 30% to carbapenems. The prevalence of colistin resistance was significantly low, with only 10% of cases exhibiting resistance.

An important discovery was the elevated prevalence of multidrug resistance (MDR) among the bacterial isolates. Around 45% of all isolates exhibited resistance to three or more antibiotic classes, underscoring a significant difficulty in efficiently controlling infections in this particular context. The data analysis conducted over the course of three years revealed a steady rise in antibiotic resistance, particularly in relation to carbapenem-resistant Enterobacteriaceae and MRSA. This trend highlights the pressing requirement for improved antibiotic management and infection control measures at the hospital.

Table 1: Distribution of Bacterial Isolates from Pus Samples Bacteria

Bacteria	Number of Isolates	Percentage of Total Isolates
Staphylococcus aureus	428	45.1
Escherichia coli	238	25.1
Pseudomonas aeruginosa	143	15.1
Klebsiella pneumonia	95	10
Other	46	4.7
Total	950	100

Table 2: Antibiotic Resistance Patterns of Bacterial Isolates

Bacteria	Antibiotic	Resistance (%)	Susceptibility (%)
Staphylococcus aureus	Penicillin	80	20
	Methicillin	50	50
	Vancomycin	5	95

	Linezolid	5	95
Escherichia coli	Ampicillin	70	30
	Ciprofloxacin	60	40
	Carbapenems	10	90
Pseudomonas aeruginosa	Ciprofloxacin	55	45
	Ceftazidime	50	50
	Piperacillin/Taz	20	80
	Colistin	15	85
Klebsiella pneumoniae	Cephalosporins	60	40
	Carbapenems	30	70
	Colistin	10	90

Table 3: Multidrug Resistance among Bacterial Isolates

Bacteria	MDR(% of Isolates)
Staphylococcus aureus	35
Escherichia coli	45
Pseudomonas aeruginosa	50
Klebsiella pneumonia	55
Overall MDR	45

Discussion

The results of our investigation carried out at Nalanda Medical College and Hospital in Patna, India, demonstrate a worrisome pattern of antibiotic resistance, which aligns with worldwide trends that jeopardize the effectiveness of infection control [7]. The significant occurrence of *Staphylococcus aureus,* specifically methicillin-resistant strains (MRSA), comprising 50% of *S. aureus* isolates, emphasizes the urgent requirement for effective infection control techniques and antibiotic stewardship programs. These findings are especially concerning because of the correlation between MRSA and higher rates of illness and healthcare expenses [8,9]. The discovered resistance patterns in *Escherichia coli* and *Klebsiella pneumoniae,* particularly the high rates of resistance to routinely prescribed antibiotics like ampicillin and cephalosporins, indicate a possible need for more powerful antibiotics, such as carbapenems [10]. Nevertheless, the appearance of carbapenem-resistant strains within these isolates is a substantial obstacle and highlights the possibility of a post-antibiotic age, in which the availability of viable treatment alternatives is greatly restricted [11].

Pseudomonas aeruginosa showed considerable resistance to ciprofloxacin and ceftazidime, commonly used antibiotics for Pseudomonas infections, which is troubling given the pathogen's role in serious hospital-acquired infections. The relative susceptibility of this bacterium to piperacillin/tazobactam and colistin might offer some therapeutic refuge but also emphasizes the need for careful antibiotic selection to avoid further resistance [12,13].

The overall 45% rate of multidrug resistance across all isolates is a stark indicator of the urgent need for enhanced antibiotic stewardship [14]. This involves not only choosing the right antibiotic regimen based on local susceptibility patterns but also ensuring the appropriate dosage and duration of antibiotic therapy.This study underscores the continuous and dynamic challenge posed by antibiotic resistance [15,16]. It reinforces the need for ongoing surveillance and updated, region-specific treatment guidelines to manage infections effectively. Additionally, the results support the imperative for preventive measures, including hygiene and infection control practices, to reduce the burden of antibiotic-resistant infections [17,18].

Ultimately, this study contributes valuable regional data that can inform both local clinical practices and broader global strategies against the rising tide of antibiotic resistance [19,20].

Conclusion

The study at Nalanda Medical College and Hospital in Patna, India, found high antibiotic resistance rates in pus sample bacterial isolates of *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae.* Multidrug resistance is concerning, emphasising the need for antibiotic management and infection control.

The data show that ongoing surveillance and treatment guidelines are needed to manage infections and prevent resistance, improving patient outcomes and antibiotic efficacy. The regional understanding of bacterial resistance and the global discourse on controlling and mitigating antibiotic resistance in clinical settings are enhanced by this work.

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