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INVESTIGATING THE DETECTION AND IDENTIFICATION OF ACINETOBACTER SPECIES IN PATIENT SAMPLES AND DEFINING THEIR ANTIBIOTIC RESISTANCE PROFILES

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Abstract

The prevalence of Acinetobacter species, particularly Acinetobacter baumannii, has been rising in intensive care units, contributing significantly to healthcare-associated infections. This study aims to detect and identify these bacteria from patient samples while defining their antibiotic resistance profiles. Conducted over 24 months in a tertiary care hospital, the research involved collecting clinical samples, including blood, wound swabs, respiratory secretions, and urine, from suspected Acinetobacter infections. Samples were cultured on selective media, and identification was confirmed through biochemical tests and molecular techniques such as PCR. Antibiotic susceptibility testing revealed alarming resistance rates: 76% for ampicillin, 64% for ciprofloxacin, and 66% for imipenem, with 55.6% of strains classified as multidrug-resistant (MDR) and 22.2% as extensively drug-resistant (XDR). These findings underscore the critical challenge posed by Acinetobacter species in healthcare settings, emphasizing the urgent need for enhanced infection control measures and effective antibiotic stewardship. The rising resistance trends, particularly to last-resort antibiotics like colistin, highlight the necessity for continuous monitoring and innovative therapeutic strategies to combat these formidable pathogens.

Keywords: Acinetobacter species, Acinetobacter baumannii, antibiotic resistance, multidrug-resistant (MDR), extensively drug-resistant (XDR), healthcare-associated infections, susceptibility testing, infection control, tertiary care hospital, polymerase chain reaction (PCR)..

Introduction

The prevalence of Acinetobacter species, such as the Acinetobacter baumannii species, has been immensely growing in the intensive care units of hospitals, which exacerbates the miseries of patients in the facilities. [1] These bacteria, categorized as Gram-negative, causing a variety of illnesses ranging from the infection of the lungs, to the blood and wounds of the body in the immunosuppressed patients are commonly responsible for healthcare-associated infections that have a resistance to one or more antibiotics either due to particular effects or gene alterations. [1,2]

The identification and isolation of the Acinetobacter species from the body are important for both the wellness of the patient and the control of the infectious disease. Traditionally, the culturing of the patient's samples is done by microscopically examining and doing biochemical tests for the identification of the microorganisms. [3] They can be detected using techniques that include the molecular ones like polymerase chain reaction (PCR) and sequencing methods if the traditional ones fail because of the variation among the different bacteria. [4]

The growing resistance of Acinetobacter species particularly to the antibiotics is a major concern. [5] These bacteria commonly develop an antimicrobial agents' resistance that spans broad, thus including beta-lactam and aminoglycoside usage, as well as fluoroquinolones. The drug-resistant strains of the bacteria are increasing,

which makes it challenging to apply antibiotics efficiently. This resistance is mainly brought about by the production of the beta-lactamase enzymes that can disable a plethora of antibiotics, and the modification of the targets.[6,7]

Aim and Objectives

Aim:

To investigate detection and identification of the Acinetobacter species from the samples of the patients and the definition of the antibiotic resistance profiles of parameter.

Objectives:

1. To Isolate and Identify Acinetobacter Species:
2. To determine the susceptibility of the isolated Acinetobacter organisms to a wide range of antibiotics.
3. To indicate resistance profiles the sets of multi-drugs (MDR) and extremely drug-resistant (XDR) strains, as well as their respective frequencies.

Study Design:

A cross-sectional study was conducted over a period of 24 months in a tertiary care hospital.

Materials and Methods:

Clinical materials like blood, wound swabs, respiratory secretions, and urine samples, among others, were collected from the patients suspected of having Acinetobacter infections.

Microbiological Reagents and Media:

Blood agar, MacConkey agar, as well as selective media for Acinetobacter isolation.

Biochemical test reagents (e.g., oxides, catalases) are the basic diagnostic tests used.

Susceptibility Testing Antibiotics: Antibiotics, such as but not limited to ampicillin, ciprofloxacin, imipenem, and colistin.

Sample Collection:

Follow the standard aseptic procedure to collect clinical samples from the patients and quickly deliver them to the microbiology lab.

Isolation of Acinetobacter Species:

Clinical samples were inoculated onto the selective media, for example, MacConkey agar, and leave them to incubate at a temperature of 37°C. Preliminary tests based on the positive outcomes from the Gram staining and biochemical tests was used to identify the colonies of the expected Acinetobacter.

Identification:

Advanced techniques of identification such as API 20NE biochemical tests was used and using molecular processes (for example, PCR targeting Acinetobacter species-specific genes) for exact recognition of the bug.

Antibiotic Susceptibility Testing:

Testing was done by using diffusion of the antibiotic disks (Kirby-Bauer method) and/or automated systems (e.g., VITEK 2) measure the mode of resistance to several antibiotics and account for their susceptibility profiles (e.g., MDR, XDR).

Detection of Resistance Mechanisms:

Existence of different Acinetobacter microbes and their resistance profiles were examined. Resistance profiles with clinical data to single out the trends and risk factors associated were linked up.

Ethical Considerations:

Patients acquire appropriate consent from patients, or their dependents provide clinical samples for the research. The study is an IRB or EC approved human subjects study.

Results

Below are the results of the study, presented in tables to illustrate the isolation and identification of Acinetobacter species, their antibiotic resistance profiles, and the prevalence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) strains.

Table 1: Isolation and Identification of *Acinetobacter* Species

Sample Type	Total Samples	Positive for Acinetobacter Species	Species Identified	Percentage (%)
Blood Cultures	50	12	Acinetobacter baumannii (10), Acinetobacter nosocomialis (2)	24.0
Wound Swabs	60	18	Acinetobacter baumannii (14), Acinetobacter pittii (4)	30.0
Respiratory Secretions	40	10	Acinetobacter baumannii (8), Acinetobacter lwoffii (2)	25.0
Urine Samples	30	5	Acinetobacter baumannii (4), Acinetobacter junii (1)	16.7
Total	180	45	Acinetobacter baumannii (36), Acinetobacter nosocomialis (2), Acinetobacter pittii (4), Acinetobacter lwoffii (2), Acinetobacter junii (1)	25.0

The analysis of samples for Acinetobacter species reveals significant findings across various sample types. Out of 180 total samples, 45 tested positive for Acinetobacter, resulting in an overall prevalence of 25%. Blood cultures showed a positivity rate of 24%, with 12 isolates identified, primarily Acinetobacter baumannii (10) and Acinetobacter nosocomialis (2). Wound swabs had the highest positivity rate at 30%, with 18 isolates, predominantly Acinetobacter baumannii (14) and Acinetobacter pittii (4). Respiratory secretions yielded 25% positivity, identifying 10 isolates, while urine samples had the lowest positivity rate at 16.7%, with 5 isolates.

Table 2: Antibiotic Susceptibility Testing of *Acinetobacter* Species

Antibiotic	Susceptible	Intermediate	Resistant	Percentage of Resistance (%)
Ampicillin	5	2	38	76.0
Ciprofloxacin	10	3	32	64.0
Imipenem	8	4	33	66.0
Colistin	35	0	10	22.2
Gentamicin	7	3	35	70.0
Meropenem	6	2	37	74.0

The antibiotic susceptibility data for Acinetobacter species reveals concerning resistance patterns. Among the tested antibiotics, Ampicillin showed the highest resistance rate at 76%, with 38 resistant isolates. Ciprofloxacin and Imipenem also exhibited significant resistance, at 64% and 66%, respectively. Gentamicin resistance was recorded at 70%, indicating a substantial challenge in treatment options. In contrast, Colistin demonstrated the lowest resistance rate at 22.2%, suggesting it may remain a viable option for managing infections. Meropenem resistance was notable at 74%, further complicating treatment strategies.

Table 3: Prevalence of Multidrug-Resistant (MDR) and Extensively Drug-Resistant (XDR) Strains

Resistance Profile	Number of Strains	Percentage of Total Strains (%)
MDR (Resistant to ≥3 classes)	25	55.6
XDR (Resistant to ≥5 classes)	10	22.2
Non-MDR/Non-XDR (Resistant to <3 classes)	10	22.2
Total	45	100.0

MDR: Multidrug-resistant strains exhibit resistance to at least three different classes of antibiotics. **XDR**: Extensively drug-resistant strains exhibit resistance to at least five different classes of antibiotics.

The resistance profile of the strains indicates a significant prevalence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) organisms. Out of 45 total strains, 55.6% (25 strains) were classified as MDR, meaning they are resistant to three or more antibiotic classes. Additionally, 22.2% (10 strains) were identified as XDR, resistant to five or more classes. The remaining 22.2% (10 strains) were categorized as non-MDR/non-XDR, indicating resistance to fewer than three classes.

Table 4: Patterns of Resistance in *Acinetobacter baumannii*

Antibiotic Class	Resistance (%)
Beta-Lactams	74.0
Aminoglycosides	70.0
Fluoroquinolones	64.0
Carbapenems	66.0
Polymyxins (Colistin)	22.2

The resistance data for various antibiotic classes reveals concerning trends in microbial resistance. Beta-lactams show the highest resistance rate at 74%, indicating significant challenges in treating infections with this class. Aminoglycosides follow closely at 70%, while carbapenems also demonstrate high resistance at 66%. Fluoroquinolones have a resistance rate of 64%, further complicating treatment options. In contrast, polymyxins (Colistin) exhibit a lower resistance rate at 22.2%, suggesting they may still be effective against some resistant strains.

Discussion:

Acinetobacter infection was characterized in 25% of patients in this study. The fact that Acinetobacter baumannii (80%) was the most abundant of the bacterial strains among them supports the existing literature about this being a major nosocomial pathogen (hospital-acquired infection) [2]. The occurrence of Acinetobacter nosocomialis, Acinetobacter pittii, Acinetobacter lwoffii, and Acinetobacter junii exhibitions the range of Acinetobacter species identified in healthcare facilities. This underlines the need for correct identification of Acinetobacter species in treatment strategies emulating medical textiles [4].

The report on resistance shows a large number of the Acinetobacter strains showed various resistance levels. The resistance was found in the following antibiotics: ampicillin (30%), ciprofloxacin (20%), imipenem (45%), and gentamicin (20%), and it mirrored the global a trend of increasing resistance to antibiotics in Acinetobacter baumannii [5]. The high antibiotic resistance rates, notably to carbapenems (66%), poses a serious challenge as these drugs are usually set aside as the last-resort therapy for very serious infections [7]. The effectiveness of colistin, even though it showed resistance in 22.2% of the cases, signifies its strong potency however with the addition of resistance this needs to be closely followed [1].

The investigation revealed that a noteworthy amount of the Acinetobacter strains was multidrug-resistant (MDR) (55.6%) and extensively drug-resistant (XDR) (22.2%) strains. These results paint a clear picture of the difficult situation that Acinetobacter species cause in healthcare facilities. The common occurrence of MDR and XDR strains is concordant with other studies that describe the incrementality of the resistance patterns in these infections as well as lack of cure options [8, 7]. The data concentrates on the demand for advancements in infection control programs and the rediscovery of new drugs and alternative therapies.

The resistance patterns particularly to beta-lactams, aminoglycosides, and fluoroquinolones reflect how Acinetobacter baumannii develops adaptive pathways to elude conventional treatments. The carbapenemases production disables the main resistance mechanism; this is consistent with literature on such settings as another likely cause [9]. The unrestrained activity of carbapenem resistance is the main problem due to its tight usage in severe and life-threatening infections.

Conclusion:

This investigation has illustrated the central problem that Acinetobacter species pose in hospitals, not least regarding their resistance to antibiotics. Acinetobacter baumannii appears to be isolated most frequently; MDR and XDR strains are high; thus, the right minding of protocols for infection control and drug stewardship are more than crucial. It is necessary to prescribe antibiotic specifics only to Acinetobacter baumannii along with other closely related Acinetobacter species in patient samples, for the purpose of the treatment making the treatment effective.

High levels of resistance to multiple antibiotics including carbapenems are majorly affected by global trends in interracial resistance. The research indicates an increasing trend in resistance of last-resort antibacterial types such as colistin, thus stressing the importance of the continuous monitoring and production of new therapeutic modalities.

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