Section: Microbiology

Original Research Article

PREVALENCE AND ANTIBIOGRAM OF *ACINETOBACTER BAUMANNII* COMPLEX ISOLATED FROM VARIOUS CLINICAL SPECIMENS

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Received : 04/11/2023
Received in revised form : 27/12/2023
Accepted : 13/01/2024

Keywords:
Antibiogram, Acinetobacter, nosocomial infections, opportunistic pathogens, community-acquired infections

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DOI: 10.47009/jamp.2024.6.1.107

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 541-545

Abstract

Background: Members of the Acinetobacter genus are widespread, independent, small aerobic Gram-negative cocco-bacilli that thrive in moist environments and can readily be found in soil, water, food, and sewage. Generally classified as opportunistic pathogens, they have recently been implicated in numerous outbreaks of nosocomial infections among hospitalized patients, causing conditions such as septicemia, pneumonia, wound sepsis, endocarditis, meningitis, and urinary tract infections (UTIs). **Materials and Methods:** This study was conducted jointly in the Departments of Microbiology at ESI-PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata. The duration of study was over a period of two years. A total of 490 samples from various clinical departments received in the microbiology laboratory were selected for processing on a random basis. Culture identification and antimicrobial susceptibility testing were performed using standard manual methods. **Results:** Of the 490 cases, 60.4% yielded positive culture results, while the remaining cases were negative. Amongst the 296 cases with positive cultures, 116 were identified as Acinetobacter baumannii, with the rest attributed to other organisms. The antibiotic susceptibility pattern revealed high resistance rates with 96.5% of isolates resistant to ticarcillin-clavulanate and ceftazidime, followed by piperacillin-tazobactam (93.1%), ceftriaxone (90.5%), gentamicin (87.9%) etc. **Conclusion:** Acinetobacter baumannii has become a significant nosocomial pathogen, demonstrating a high level of resistance to numerous antibiotics. Reports routinely highlight the presence of multi-drug resistant (MDR) isolates, with a surge in pan-drug resistant isolates. Newer drugs like tigecycline and colistin are frequently employed against these drug-resistant isolates but their use should be limited due to associated toxicity and the emerging global resistance against these drugs.

INTRODUCTION

Members of the *Acinetobacter* genus are widespread, independent, small aerobic Gram-negative cocco-bacilli that thrive in moist environments and can readily be found in soil, water, food, and sewage.[1] Generally classified as opportunistic pathogens, they have recently been implicated in numerous outbreaks of nosocomial infections among hospitalized patients, causing conditions such as septicemia, pneumonia, wound sepsis, endocarditis, meningitis, and urinary tract infections (UTIs).[2,3] Despite being recognized as opportunistic in hospital settings, there are reports of community-acquired infections, and these bacteria can induce suppurative infections in nearly every organ system.[4] Assessing the significance of isolates from clinical specimens proves challenging due to the widespread presence of *Acinetobacter* in nature and its ability to colonize both healthy and damaged tissues.[5] Up to 25% of healthy, ambulatory adults exhibit cutaneous colonization, making them the most prevalent Gram-negative bacilli on the skin of healthcare personnel.[6]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In the recent decades, the clinical significance of *Acinetobacter* has grown due to its capacity to acquire antimicrobial resistance factors.[7,8] This occurs through the transfer of plasmids or transposons containing antimicrobial resistant genes, particularly in hospital settings where extensive antibiotic use creates selective pressure.[9,10] Multidrug-resistant (MDR) *Acinetobacter* species are characterized by their resistance to the three major classes of antimicrobial agents which are all penicillins and cephalosporins (including inhibitor combinations), fluoroquinolones, and aminoglycosides.[11,12] These strains are implicated in severe infections such as ventilator-associated pneumonia (VAP), urinary tract infections, bloodstream infections, surgical site infections, and infections linked to medical devices, especially in intensive care unit patients. Furthermore, a noteworthy association between biofilm formation and multidrug resistance underscores the threat posed by *Acinetobacter* to the current era of antibiotic treatment. [13]

Identifying multidrug-resistant *Acinetobacter* infections poses a significant challenge due to the diverse distribution of species concerning the infection type, their antimicrobial characteristics, and biofilm-forming behavior. Therefore, for effective management and infection control, it is imperative to minimize the risks associated with *Acinetobacter* infections within healthcare settings.

MATERIALS AND METHODS

Study Area: This study was conducted jointly in the Departments of Microbiology at ESI PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata.

Study population: A total of 490 samples from various clinical departments received in the microbiology laboratory were selected for processing on a random basis.

Study duration: The duration of study was over a period of two years.

Methods: Direct microscopy from the specimen was done by Gram staining technique for presumptive identification. Further processing was done by plating the specimen on various culture media like blood agar, MacConkey's agar, chocolate agar, CLED agar and Brain heart infusion agar depending upon the specimen and the plates where then incubated at 37 degree Celsius for 18-24 hours. The organisms isolated were identified using an array of biochemical tests like oxidase test, indole test, citrate test, urease test, triple sugar iron agar and oxidation-fermentation media. Antibiotic susceptibility testing for all the isolates where done on Mueller-Hinton agar by Kirby-Bauer disc diffusion method following CLSI guidelines 2019.

Data Analysis: Analysis of data was done using Microsoft excel.

RESULTS

Of the 490 cases, 60.4% yielded positive culture results, while the remaining cases were negative. Within the 296 cases with positive cultures, 116 were identified as *Acinetobacter baumannii*, with the rest being other organisms. Among these 116 cases, males predominated over females. The majority of cases belonged to the 51-60 year age group, followed by other age groups.

The study found that *Acinetobacter baumannii* was isolated from the various clinical samples as follows: 48.2% from endotracheal (ET) tubes, 23.2% from sputum, 12.1% from blood, 9.4% from urine, 5.1% from pus, and 1.7% from tissue samples. The antibiotic susceptibility pattern revealed high resistance rates with 96.5% of isolates resistant to ticarcillin-clavulanate and ceftazidime, followed by piperacillin-tazobactam (93.1%), ceftriaxone (90.5%), gentamicin (87.9%), ofloxacin (89.6%), tobramycin (82.7%), piperacillin (82.7%), imipenem (82.7%), ciprofloxacin (79.3%), sulfamethoxazole-trimethoprim (75.8%), doxycycline (72.4%), levofloxacin (71.5%), tetracycline (68.9%), meropenem (65.5%), and Ampicillin-sulbactam (25.8%).

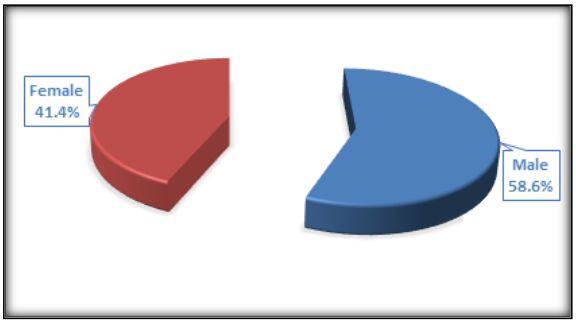

Figure 1: Gender distribution

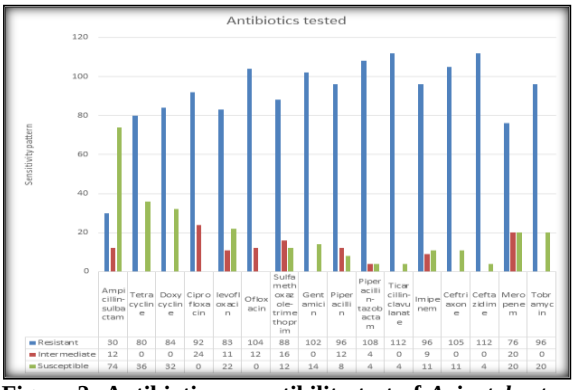

Figure 2: Antibiotic susceptibility test of *Acinetobacter baumannii*

Table 1: Total cases according to positive and negative culture

Culture results	Number of samples	%

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Positive Culture	296	60.4
Negative culture	194	39.6
Total	490	100

Table 2: Distribution of cases according to organism

Organism	Number of isolates	%
Acinetobacter baumannii	116	39.2
Other organisms	180	60.8
Total	296	100

Table 3: Age distribution

Age (years)	Number of cases.	%
< 10	9	7.8
11-20	14	12.1
21-30	16	13.7
31-40	15	12.9
41-50	19	16.3
51-60	29	25.0
> 60	14	12.1
Total	116	100

Table 4: Distribution of cases according to specimens

Specimens	Number of cases.	%
ET tube	56	48.2
Pus	6	5.1
Urine	11	9.4
Sputum	27	23.2
Blood	14	12.1
Tissue	2	1.7
Total	116	100

DISCUSSION

The escalating antimicrobial resistance in *Acinetobacter baumannii* has garnered significant scientific concern. This resistance contributes to heightened mortality rates, presenting a substantial challenge for physicians and healthcare professionals in combating both hospital and community-based infections. The emergence of strains resistant to antimicrobial agents poses a particularly severe threat in the intensive care unit (ICU) setting. Additionally, the increasing resistance to carbapenems, which serve as crucial antibiotics in treating infections caused by multidrug-resistant Gram-negative bacteria, is a major worry. Carbapenem-resistant *A. baumannii* (CR-Ab) has become a global issue, as these strains often exhibit resistance to all other commonly used antibiotics. Consequently, infections associated with pathogenic multidrug-resistant *A. baumannii* (MDR-Ab) become increasingly challenging to eliminate.

The current investigation was conducted jointly at ESI PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata, in their Departments of Microbiology. The primary objectives were to assess the prevalence of *Acinetobacter baumannii* across diverse clinical specimens and to analyze the antibiotic susceptibility pattern of the isolated *Acinetobacter baumannii* strains. The age range of the patients included in the study spanned from one day to 72 years, with a notable concentration observed in the 40 to 60 years age group, followed by other age categories.

In the current study, 58.6% of the patients were males, while 41.4% were females. The majority of isolated *Acinetobacter baumannii* strains were found in pulmonary samples, with endotracheal aspirates accounting for 48.2% and sputum for 23.2%. This finding aligns with the results reported by Ben Haj Khalifa and Khedher, who identified the airway as the primary isolation site for this species. Additionally, Delbos noted that hospital-acquired pneumonia remains the most common infection caused by *A. baumannii*. The study also revealed the presence of *A. baumannii* in 5.1% of pus samples, a slightly higher percentage compared to 3.8% reported by Sileem et al. and 32.5% found in the study conducted by Falagas et al. [14-17]

Multidrug-resistant *Acinetobacter baumannii* (MDRAB) is characterized by its resistance to more than three classes of antibiotics. This study observed the presence of MDRAB in various clinical samples, a finding consistent with the research conducted by Dent et al. [18]

The antibiotic susceptibility pattern revealed a notably high resistance rate for cephalosporins, aligning with findings from studies conducted by Omer MI et al and Chakraverti et al, where similarly elevated resistance to cephalosporins was observed. In our study, a significantly high resistance rate to piperacillin was noted at 82.7%, surpassing the rates reported by Tewari et al (68.9%) and Nazmul et al. (77.5%) but falling below the 100% resistance documented by Shakibaie et al. in their study on piperacillin.[19-23]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In the β-lactam and β-lactamase inhibitor category, our study revealed a high resistance rate to piperacillin–tazobactam (93.1%) and ticarcillin-clavulanate (96.5%), in contrast to ampicillin-sulbactam, which showed a lower resistance rate of 25.8%. This aligns with the findings of Jingyi Shi et al who emphasized the superior in vitro activities of sulbactam compared to clavulanic acid and tazobactam. [24] Sulbactam demonstrated good intrinsic antimicrobial activity against multidrug-resistant *Acinetobacter* strains at concentrations achievable in human serum. Several studies have underscored the importance of sulbactam-containing regimens, which appeared comparable to regimens involving other agents when the infecting organisms were susceptible to sulbactam, particularly in patients with *A. baumannii* pneumonia and bloodstream infections.[25-27] The efficacy of sulbactam in treating *A. baumannii* meningitis has yielded mixed results, possibly related to impaired drug penetration. Determining whether higher dosages are more effective, reduce the risk of resistance, or whether ampicillin-sulbactam should be combined with other agents remains to be established.

Tetracyclines are not commonly prescribed for treating *A. baumannii* infections. However, recent practices involve administering doxycycline and minocycline in combination with other antibiotics to enhance clinical effectiveness in eradicating *A. baumannii* infections. Despite this, the present study indicates a resistance rate of 68.9% for tetracycline and 72.4% for doxycycline compared to other antibiotic groups. Beheshti Maryam et al demonstrated a high susceptibility rate of 96.93% to doxycycline and 43.87% to tetracycline. [28] The current study revealed adequate in vitro activity of doxycycline and minocycline in burned patients, and only doxycycline in ventilator-associated pneumonia (VAP), suggesting promising clinical and microbiological effectiveness of tetracyclines either as monotherapy or in combination with other agents for treating A. baumannii infections. Maleki et al in their study, reported a resistance rate of 18% to doxycycline, while 80% of isolates showed resistance to tetracycline. [29]

CONCLUSION

Acinetobacter baumannii has become a significant nosocomial pathogen, demonstrating a high level of resistance to numerous antibiotics. This resistance may be attributed, in part, to the bacterium's capability to acquire resistance genes through horizontal gene transfer and its adaptability to the nosocomial environment, allowing it to withstand adverse environmental challenges. Reports routinely highlight the presence of multi-drug resistant (MDR) isolates, with a surge in pan-drug resistant isolates. While newer drugs like tigecycline and colistin are frequently employed against these drug-resistant isolates, their use should be limited due to associated toxicity and the emerging global resistance against these drugs.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556