Original Research Article

ANTIBIOTIC RESISTANCES PATTERN OF ACINETOBACTER BAUMANNII ISOLATES FROM VARIOUS CLINICAL SPECIMENS
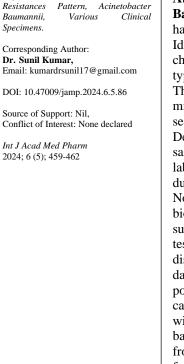
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Abstract

Background: In the recent decades, the clinical significance of Acinetobacter has grown due to its capacity to acquire antimicrobial resistance factors. 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:** This study was conducted jointly in the Departments of Microbiology, SKMCH Muzaffarpur, Bihar. A total of 245 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 from December 2021 to November 2023. 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. Data Analysis: Analysis of data was done using Microsoft excel. **Result:** Of the 245 cases, 60.4% yielded positive culture results, while the remaining cases were negative. Within the 148 cases with positive cultures, 58 were identified as Acinetobacter baumannii, with the rest being other organisms. The study found that Acinetobacter baumannii was isolated from the various clinical samples as follows: 48.2% from endotracheal (ET) tubes, 24.13% from sputum, 12.1% from blood, 8.6% from urine, 5.1% from pus, and 1.7% from tissue samples. The antibiotic susceptibility pattern revealed high resistance rates with 96.5%. **Conclusion:** Acinetobacter baumannii has become a significant nosocomial pathogen, demonstrating a high level of resistance to numerous antibiotics. While newer drugs like tigecycline and colistin are frequently employed against these drugs.

INTRODUCTION

Members of the Acinetobacter genus are widespread, independent, small aerobic Gramnegative coccobacilli 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] 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

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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

This study was conducted jointly in the Departments of Microbiology, SKMCH Muzaffarpur, Bihar. A total of 245 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 from December 2021 to November 2023. 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. Data Analysis: Analysis of data was done using Microsoft excel.

RESULTS

Of the 245 cases, 60.4% yielded positive culture results, while the remaining cases were negative. Within the 148 cases with positive cultures, 58 were identified as Acinetobacter baumannii, with the rest being other organisms. Among these 58 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, 24.13% from sputum, 12.1% from blood, 8.6% 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%).

Table 1: Total cases according to positive and negative culture

Culture results	Number of sample	Percentage
Positive culture	148	60.4
Negative culture	97	39.6
Total	245	100

Table 2: Distribution of cases according to organism

Organisms	Number of cases	Percentage
Acinetobacter baumannii	58	39.2
Other organisms	90	60.8
Total	148	100

Table 3: Age distribution.

Age	Number of cases	Percentage
<10	5	8.62
11-20	7	12.1
21-30	8	13.7
31-40	8	13.7
41-50	9	15.5
51-60	14	24.13
>60	7	12.1
Total	58	100

Table 4: Distribution of cases according to specimens

Specimens	No. of cases	Percentage
ET tube	28	48.2

Pus	3	5.1
Urine	5	8.6
Sputum	14	24.13
Blood	7	12.1
Tissue	1	1.7
Total	58	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 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, 59.6% of the patients were males, while 40.4% 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]

n the β-lactam and β-lactamase inhibitor category, our study revealed a high resistance rate to piperacillin–tazobactam (93.1%) and ticarcillinclavulanate (96.5%), in contrast to ampicillinsulbactam, 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 multidrugresistant 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

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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 drugs.

Resistant isolates, their use should be limited due to associated toxicity and the emerging global resistance against these drugs.

REFERENCES

1. Gerner-Smidt P. Taxonomy and epidemiology of Acinetobacter infections. Rev Med Microbiol. 1995;6:186–197.
2. Towner KJ. Clinical importance and antibiotic resistance of Acinetobacter spp. J Med Microbiol. 1997;46:721–746.
3. Levi I, Rubinstein E. Acinetobacter infections-overview of clinical features. In: Bergogne-Berezin I, Joly-Guilloo MI, Towner KJ, editors. Acinetobacter: microbiology, epidemiology, infections, management. CRC Press; Boca Raton: 1996. pp. 101–115.
4. Glew RH, Moellering RC, Kunz LJ. Infections with Acinetobacter calcoaeceticus (Herelleavaginicola): Clinical and laboratory studies. Medicine. 1997;56:79–97.
5. Henricksen SD. Moraxella, Acinetobacter and Mimae. Bacterial Rev. 1973;37:522–561.
6. Mandell G, Bennett JE, Dolin R. 5th ed. Vol. 2. Churchill Livingstone; 2000. pp. 239–241. (Principles and practice of infectious diseases).
7. Kishk R., Soliman N., Nemr N., et al. Prevalence of aminoglycoside resistance and aminoglycoside modifying enzymes in Acinetobacter baumannii among intensive care unit patients, ismailia, Egypt. Infection and Drug Resistance .2021;14:143–150.
8. Ranjbar R., Farahani A. Study of genetic diversity, biofilm formation, and detection of Carbapenemase, MBL, ESBL, and tetracycline resistance genes in multidrug-resistant Acinetobacter baumannii isolated from burn wound infections in Iran. Antimicrobial Resistance and Infection Control . 2019;8:p. 172.
9. Mohajeri P., Farahani A., Feizabadi M. M., Norozi B. Clonal evolution multi-drug resistant Acinetobacter baumannii by pulsed-field gel electrophoresis. Indian Journal of Medical Microbiology . 2015;33(1):87–91.
10. Mohajeri P., Sharbati S., Farahani A., Rezaei Z. Evaluate the frequency distribution of nonadhesive virulence factors in carbapenemase-producing Acinetobacter baumannii isolated from clinical samples in Kermanshah. Journal of Natural Science, Biology and Medicine. 2016;7(1):58–61.
11. Manchanda V., Sanchaita S., Singh N. P. Multidrug resistant acinetobacter. Journal of Global Infectious Diseases. 2010;2(3):291–304.
12. Akbar F., Eghbalimoghadam M., Farahani A., Mohajeri P. Frequency of class 1 integron and genetic diversity of Acinetobacter baumannii isolated from medical centers in kermanshah. Journal of Natural Science, Biology and Medicine. 2017;8(2):193–198.
13. Badave G. K., Kulkarni D. Biofilm producing multidrug resistant Acinetobacter baumannii: an emerging challenge. Journal of Clinical and Diagnostic Research. 2015;9(1):DC08–DC10.
14. Ben Haj Khalifa, A.; Khedher, M.: Profil de sensibilitéauxantibiotiquesdessouches d'Acinetobacter baumannii isoléesdans la région de Mahdia. Med. Mal. Infect. 40, 126–128 (2010)
15. Delbos, V.: Manifestations cliniques et traitement des infections à Acinetobacter baumannii. RFL 441, 59–65 (2012)
16. Falagas, E.M.; Vardakas, Z.K.; Kapaskelis, A.; Triarides, A.N.; Roussos, N.: Tetracycline for multidrug-résistant Acinetobacter Baumannii infections. Int. J. Antimicrob. Agents 14, 252–258 (2015)
17. Sileem, A.E.; Said, A.M.; Meleha, M.S.: Acinetobacter baumannii in ICU patients: A prospective study highlighting their incidence, antibiotic sensitivity pattern and impact on ICU stay and mortality. Egypt J. Chest Dis. Tuberc. 66, 693–698 (2017)
18. Dent et al., Multidrug resistant Acinetobacter baumannii: a descriptive study in a city hospital BMC Infectious Diseases 2010, 10:196
19. Omer MI, Gumaa SA, Hassan AA, Idris KH, Ali OA, Osman MM, et al. Prevalence and resistance profile of Acinetobacter baumannii clinical isolates from a private hospital in Khartoum, Sudan. Am J Microbiol Res., 2015; 3(2):76–9.
20. Chakraverti TK, Tripathi PC. Pattern of antibiotic susceptibility of common isolates in ICU of a tertiary care hospital: 2 years study. Int J Clin Biomed Res. 2015;1(2):79–86.
21. Tewari R, Chopra D, Wazahat R, Dhingra S, Dudeja M. Antimicrobial susceptibility patterns of an emerging multidrug resistant nosocomial pathogen: Acinetobacter baumannii. Malays J Med Sci. 2018;25(3):129– 134.
22. Nazmul MHM, Jamal H, Fazlul MKK. Acinetobacter species-associated infections and their antibiotic susceptibility profiles in Malaysia. Biomed Res-India. 2012;23(4):571–575.
23. Shakibaie MR, Adeli S, Salehi MH. Antibiotic resistance patterns and extended spectrum b-lactamase production among Acinetobacter spp. isolated from an intensive care unit of a hospital in Kerman, Iran. Antimicrob Resist Infect Control. 2012;1:1.
24. Shi et al. Multidrug resistant and extensively drug resistant Acinetobacter baumannii hospital infection associated with high mortality: a retrospective study in the pediatric intensive care unit. BMC Infectious Diseases (2020) 20:597
25. Wood GC, Hanes SD, Croce MA, Fabian TC, Boucher BA. Comparison of ampicillin-sulbactam and imipenem-cilastatin for the treatment of acinetobacter ventilator-associated pneumonia. Clin Infect Dis 2002; 34(11):1425–1430.
26. Oliveira MS, Prado GV, Costa SF, Grinbaum RS, Levin AS. Ampicillin/ sulbactam compared with polymyxins for the treatment of infections caused by carbapenem-resistant Acinetobacter spp. J AntimicrobChemother 2008; 61(6):1369–1375.
27. Jellison TK, Mckinnon PS, Rybak MJ. Epidemiology, resistance, and outcomes of Acinetobacter baumannii bacteremia treated with imipenem-cilastatin or ampicillinsulbactam. Pharmacotherapy 2022; 21(2): 142–48.
28. Beheshti, Maryam et al. Tetracycline resistance mediated by tet efflux pumps in clinical isolates of Acinetobacter baumannii. Revista do Instituto de Medicina Tropical de São Paulo [online]. 2023, v. 62 [Accessed 25 May 2022] ,
29. Maleki MH, Sekawi Z, Soroush S, Azizi-Jalilian F, Asadollahi K, Mohammadi S, et al. Phenotypic and genotypic characteristics of tetracycline resistant Acinetobacter baumannii isolates from nosocomial infections at Tehran hospitals. Iran J Basic Med Sci. 2024;17:21-6

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