Content available at: https://www.ipinnovative.com/open-access-journals

Panacea Journal of Medical Sciences

Journal homepage: https://pjms.in/

Original Research Article

Evaluation of Acinetobacter baumannii antibiotic resistance from tertiary care hospital – Judging the silent storm

Bhabhor Ullas H[1], Patel Alpa S[2]*, Mullan Summaiya A[2]

[1]Dept. of Microbiology, Govt. Medical College, Bhavnagar, Gujarat, India
[2]Dept. of Microbiology, Govt. Medical College, Surat, Gujarat, India

Abstract

Introduction: Over the closing decades, Acinetobacter baumannii has globally emerged as an enormously troublesome nosocomial pathogen. Its scientific importance has been in large part pushed through a fantastic cap potential to collect or upregulate numerous resistance determinants, making it one of the maximum a success multidrug-resistant (MDR) organisms threatening modern-day antibiotic therapy. On pinnacle of such captivating resistance acquisition, A. baumannii is endowed with more than one mechanisms of survival below a huge variety of environments, potentiating capability for health facility spread. The attributable mortalities in patients with A. baumannii healthcare-related infections, of which ventilator-related pneumonia and bloodstream infections are the maximum common, can variety from 5% in widespread health facility wards to 54% with inside the in depth care unit (ICU), with growing reviews of community-received A.baumanni infections. Mounting proof of extensively drug-resistant (XDR) and pandrug-resistant (PDR) isolates of A. baumannii is likewise gathering in different countries. The World Health Organization (WHO) has assigned A. baumannii as a vital precedence pathogen posing a wonderful risk to human health, and toward which new antibiotics are urgently needed.
Aim & Objective: To evaluate various sample types from which Acinetobacter is isolated and evaluate antibiotic resistance pattern of Acinetobacter baumanii.
Materials and Methods: This retrospective observational study has taken the data from January 2021 to June 2022. The data collection was done in the month of May 2023 followed by data analysis in June 2023 to July 2023. A total of 1058 Acinetobacter baumanii were isolated from January 2021 to June 2022 from various sample that come to microbiology department, which includes tissue, sputum, Blood, pus, swab, CSF, ET Tube, urine, drain, CVP/DLC tip and body fluids. The data was entered into Microsoft Excel (Windows 10), and analysis was performed using Microsoft Excel, including frequency distribution and percentage.
Results: Out of 8226 (27.1%) positive culture 1058 (12.8%) were Acinetobacter baumannii isolates from various samples. highest resistance was seen with Ceftazidime (91.2%), followed by Piperacillin (88.5%), Ciprofloxacin (86.9%), Meropenem (82.6%), Imipenem (81.9%), Gentamicin (76.9%), Ampicillin-Sulbactam (68.6%), Amikacin (64.4%) and Tetracycline (57.5%). While Polymyxin B and Colistin was 100% sensitive.
Conclusions: Guarded use of all antimicrobials needs to be done. As in our study also shows resistant to at least one antibiotic in three groups or more of the isolates.

Keywords: Acinetobacter baumannii, Antibiotic, Resistance Multi drug resistant, Efflux pump.

Received: 15-04-2024; **Accepted:** 26-02-2025; **Available Online**: 19-08-2025

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution 4.0 International License which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Antimicrobial resistance (AMR), has become a significant and cost-increasing phenomenon for healthcare systems globally. Because of the extended duration of time, it has been linked in recent years to notable morbidity, mortality, and higher expense, admission and care in a hospital. Despite the addition of new antimicrobial medicines to our arsenal in recent decades, resistance appears to be a growing issue due to geometric evolution. The number of elderly patients with main or secondary immunodeficiencies is rising in tandem with the rise in community-acquired and nosocomial antimicrobial resistance (AMR), according to data from multicenter studies conducted in recent decades.[1,2]

Acinetobacter baumannii belongs to the Moraxellaceae family and is a Gram-negative bacterium that predominantly causes nosocomial infections. These infections are diverse

*Corresponding author: Patel Alpa S
Email: dralpain1@gmail.com

https://doi.org/10.18231/pjms.v.15.i.2.337-340
© 2025 The Author(s), Published by Innovative Publications.

and may include hospital-acquired and ventilator-associated pneumonia (HAP, VAP), urinary tract infections, meningitis, bacteremia, and gastrointestinal and skin/wound infections.[3-7]

A. baumannii is one of the ESKAPE organisms (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, A. baumannii, Pseudomonas aeruginosa, and Enterobacter spp.), that pose a global threat to human health and a therapeutic challenge due to emerging and constantly in- creasing resistance.[8] Mechanisms of antibiotic resistance can be categorized into three groups. First, resistance can be achieved by reducing membrane permeability or increasing efflux of the antibiotic and thus preventing access to the target. Second, bacteria can protect the antibiotic target through genetic mutation or post-translational modification, and last, antibiotics can be directly inactivated by hydrolysis or modification.[9]

One of the most important weapons in the armory of Acinetobacter is its impressive genetic plasticity, facilitating rapid genetic mutations and rearrangements as well as integration of foreign determinants carried by mobile genetic elements. Of these, insertion sequences are considered one of the key forces shaping bacterial genomes and ultimately evolution.[1,2] Additionally, A. baumannii can form biofilms and thus prolong its survival on medical devices, such as ventilators in intensive care units (ICUs).[10] However, the relationship between biofilm formation and antibiotic resistance still remains un- clear.[11,12] In the present review, we report data on A. baummannii mechanisms of resistance to different classes of antibiotics.

2. Materials and Methods

This laboratory-based retrospective observational study was conducted between January 2021 to June 2022. The data collection was done in the month of May 2023 followed by data analysis in June 2023 to July 2023. The study was conducted after obtaining ethical clearance from the institutional ethics committee, with HREC No. GMCS/STU/ETHICS- 3/ Approval/10640/23. Inclusion criteria: Various bacteriological sampled received in to microbiology department from January 2021 to June 2022would be included, irrespective of age and sex. Exclusion criteria: Repeat sample, multiple organism Samples would be excluded**.**

Patients and sampling: A total of 30295 samples were received to bacteriology laboratory during the study period, out of that 8226 were positive culture. Total Acinetobacter isolates were 1058. Samples such as swabs, tissues, skin scrapings, CSF, sputum, pus, and drain samples from different wards, were received for bacteriological culture at the Microbiology Department. Samples are cultured on culture media according to sample type and were incubated for 24 h at 37 °C. Conventional biochemical methods such as oxidase, citrate, urea urease, oxidation and fermentation of sugars, motility, and indole production were done to identify A. baumannii.

Antimicrobial susceptibility test : This test was performed using the Kirby Bauer method using disks including Piperacillin (100ug), Ampicillin/sulbactam (10/10ug), Piperacilline/ tazobactam (100/10ug), Ticarcilline/clavulanic acid (75/10ug), Cefepime (30ug), Ceftriaxone (30ug), Cefotaxime (30ug), Ceftazidime (30ug), Imipenem(10ug), Meropenem (10ug), Tetracycline (30ug), Doxycycline (30ug), Minocycline (30ug), Ciprofloxacin (5ug), Levofloxacin (5ug), Gentamycin (10 ug), Tobramycin (10 ug), Amikacin (30 ug), Netilmycin, Trimethoprim-sulfamethoxazole (1.25/23.75 ug). The 2022-23 CLSI was used for interpretation. The Acinetobacter baumanii ATCC19606 was used as quality control for this test. Data analysis of antibiotic resistant pattern, evaluation of it. The results of culture and antibiotic susceptibility were recorded. Statistical Analysis: The data was entered into Microsoft Excel (Windows 10), and analysis was performed using Microsoft Excel, including frequency distribution and percentage.

3. Results

A total of 8226 positive samples, 1058 (13%) were Acinetobacter baumanii spp. Samples from all age groups and both genders were included in the study. In terms of age-wise distribution, all age groups were affected, but the highest number of cases 233 (22 %) were observed in the 30-39 years age group. The number of male cases were higher than female cases [**Table 1**].

Table 1: Demographic details

Age (yrs)	Total in Numbers (%)
0-9	90(8.5%)
10−19	55(5.1%)
20−29	184(17.3%)
30-39	233(22%)
40-49	177(16.7%)
50-59	158(14.9%)
≥ 60	161(15.2%)
Gender-wise distribution	
Male	767(72.4%)
Female	291(27.5%)

Table 2 displays the different sample types received and their corresponding culture positive data. The samples included blood culture, E.T (Endotracheal secretion), Urine, CVP tip, DLC tip, CSF, drain, Scrapping material, high vaginal swab, secretion tip, pus, scraping material, sputum, swab, and tissue samples. Among these sample types, pus/swab/tissue samples demonstrated the highest culture positivity, with 626 (59.1%) samples yielding positive results followed by E.t secretion accounted for 157 (14.8%) and blood culture accounted for 93 (8.7%).

Table 2: Sample wise distribution

Sample	Total number (%)
blood culture	93(8.7%)
drain	19(1.7%)
E.T	157(14.8%)
Fluid	56(5.2%)
pus/ swab/ tissue	626(59.1%)
sputum	11(1%)
urine	56(5.2%)
CVP tip/DLC tip	19(1.7%)
scrapping material	1(0.09%)
csf	10(0.9%)
secreation tip	5(0.4%)
high vaginal swab	5(0.4%)

Antibiogram results by agar disc diffusion method Out of 1058 A. baumannii isolates, 91.2% were resistant to Ceftazidime and this rate was as follows in other antibiotics: 88.5% Piperacillin, Ciprofloxacin 86.9 %, Meropenem 82.6%, Imipenem 81.9%, Gentamicin 76.9%, Ampicillin-Sulbactam 68.6%, Amikacin 64.4%, Tetracycline 57.5 % and, which had the considerable effect and Ceftazidime and Piperacillin showed the most resistance levels [**Table 3**].

Table 3: Antibiotic susceptibility of Acinetobacter baumanii

Antibiotic	Resistant N (%)	Intermediate N (%)	Susceptible N (%)
Ceftazidime (30ug)	965(91.2)	36(3.4)	57(5.3)
Piperacillin (100ug)	937(88.5)	35(3.3)	86(8.1)
Ciprofloxacin (5ug)	920(86.9)	28(2.6)	110(10.3)
Meropenem (10ug)	874(82.6)	27(2.5)	157(14.8)
Imipenem (10ug)	867(81.9)	32(3.0)	159(15.0)
Gentamycin (10 ug)	814(76.9)	63(5.9)	181(17.1)
Ampicillin/ sulbactam (10/10ug)	726(68.6)	115(10.8)	217(20.5)
Amikacin (30 ug)	682(64.4)	77(7.2)	299(28.2)
Tetracycline (30ug)	609(57.5)	60(5.6)	389(36.7)
Polymyxin B	0(0)	0(0)	1058(100)
Colistin	0(0)	0(0)	1058(100)

4. Discussion

The most common cause of nosocomial infections is Gram-negative bacteria. Numerous nosocomial infections are caused by the opportunistic hospital bacterium Acinetobacter baumannii. We are seeing a rise in antibiotic resistance brought on by people using broad-spectrum antibiotics carelessly. This bacterium's high level of antibiotic resistance is linked to the spread of several antibiotic resistance genes. Acinetobacter baumannii is resistant to the majority of beta lactam antibiotics, quinolones, and aminoglycosides, and this resistance is growing, according to several studies. In our study Amikacin and Tetracycline are most effective antibiotics used against Acinetobacter baumannii, which had 64.4% and 57.5% resistance respectively. While the highest resistance was seen with Ceftazidime (91.2%), Piperacillin (88.5%), Ciprofloxacin (86.9%), Meropenem (82.6%), Imipenem (81.9%), Gentamicin (76.9%), Ampicillin-Sulbactam (68.6%).

Acinetobacter baumannii was found to be resistant to at least one antibiotic in three groups or more of the isolates in the current investigation. Acinetobacter baumannii isolates had a 100% rate of multi-drug resistance; however, other investigations found that the incidence of multiple resistance in Acinetobacter baumannii varied between 50% and 100%.[13] High MDR levels in Acinetobacter baumannii studied in Farsiani et al. Studies in Iran and Rynga et al. In India were reported to be 97% and 85%, respectively,[14,15] which could be due to abuse of antibiotics. In the Noori et al. study, All isolates had 100% resistance to Ceftazidime, Ciprofoxacin, and Piperacillin.[16]

Research by Rahbarnia et al. Found that the resistance to Ciprofoxacin was 95%, Imipenem 82%, and Gentamicin 35%. Also, the prevalence of MDR and XDR in the studied strains was 76% and 30%, respectively, which compared to the present study, higher resistance to Ciprofoxacin and Imipenem has been reported.[17] One of the resistance mechanisms in the Acinetobacter baumanii is the presence of efflux pumps. These pumps cause the leakage of antibiotics and a wide range of substances out of the bacteria, creating multidrug resistance. Although high levels of resistance do not occur only as a result of multi-drug efflux pumps, the expression of their genes among isolates with high antibiotic resistance cannot be ignored. Therefore, it is necessary to identify resistance systems, including efflux pumps.[18]

The reason for the differences in different studies could be due to differences in the patterns of antibiotic use, the type of clinical sample, the number of samples studied, sampling method, environmental factors and the different geographical distribution of these genes. As such polymxin B and colistin shows 100% sensitive results, which are last resource in case of extremely resistant organisms.

5. Conclusion

A significant increase in antibiotic resistance is one of the main problems in the treatment of infections caused by Acinetobacter baumannii. A. baumannii may acquire antibiotic resistance through several distinct mechanisms: by altering the antibiotic target site, by controlling the passage of antibiotics through its membranes, and by enzymatic modification of antibiotics, rendering them neutralized. As most of the antimicrobial drugs are resistant in our study in higher or lower percentage. Usage of antimicrobial needs guarded approach.

6. Limitation

Our limitation in this research was we haven't done gene level research. Which will be our further step in investigation.

7. Source of Funding

None.

8. Conflicts of Interest

None.

References

1. Ayoub Moubareck C, Hammoudi Halat D. Insights into Acinetobacter baumannii: A Review of Microbiological, Virulence, and Resistance Traits in a Threatening Nosocomial Pathogen. *Antibiotics*. 2020;9(3):119.
2. Vrancianu CO, Gheorghe I, Czobor IB, Chifiriuc MC. Antibiotic resistance profiles, molecular mechanisms and innovative treatment strategies of acinetobacter baumannii. *Microorganisms*. 2020;8(6):935.
3. Peleg AY, Seifert H, Paterson DL. Acinetobacter baumannii: Emergence of a successful pathogen. *Clin Microbiol Rev*. 2008;21(3):538–82.
4. Levy-Blitchtein S, Roca I, Plasencia-Rebata S, Vicente-Taboada W, Velásquez-Pomar J, Muñoz L, et al. Emergence and spread of carbapenem-resistant Acinetobacter baumannii international clones II and III in Lima, Peru article. *Emerg Microbes Infect*. 2018;7(1):119.
5. Nasr P. Genetics, epidemiology, and clinical manifestations of multidrugresistant Acinetobacter baumannii. *J Hosp Infect*. 2020;104:4–11.
6. Doi Y, Murray GL, Peleg AY. Acinetobacter baumannii: Evolution of antimicrobial resistance-treatment options. *Semin Respir Crit Care Med*. 2015;36(1):85–98.
7. Kyriakidis I, Palabougiouki M, Vasileiou E, Tragiannidis A, Stamou M, Moudiou T, et al. Candidemia complicating biliary atresia in an infant with hemoglobinopathy. *Turk Pediatri Ars*. 2019;54(2):129–32.
8. Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet DL, et al. Discovery, research, and development of new antibiotics: The WHO priority list of antibiotic-resistant bacteria and tuberculosis. *Lancet Infect Dis*. 2018;18(3):318–27.
9. Blair JMA, Webber MA, Baylay AJ, Ogbolu DO, Piddock LJV. Molecular mechanisms of antibiotic resistance. *Nat Rev Microbiol*. 2015;13(1):42–51.
10. Pakharukova N., Tuittila M., Paavilainen S., Malmi H., Parilova O., Teneberg S., Knight S.D., Zavialov A.V. Structural basis for Acinetobacter baumannii biofilm formation. *Proc Natl Acad Sci USA*. 2018;115(21):5558–63.
11. Yang CH, Su PW, Moi SH, Chuang LY. Biofilm formation in Acinetobacter baumannii: Genotype-phenotype correlation. *Molecules*. 2019;24(10):1849.
12. Krzyściak P., Chmielarczyk A., Pobiega M., Romaniszyn D., Wójkowska-Mach J. Acinetobacter baumannii isolated from hospital-acquired infection: Biofilm production and drug susceptibility. *APMIS*. 2017;125(11):1017–26.
13. Jia W, Li C, Zhang H, Li G, Liu X, Wei J. Prevalence of genes of OXA-23 carbapenemase and AdeABC efux pump associated with multidrug resistance of Acinetobacter baumannii isolates in the ICU of a compre- hensive hospital of northwestern China. *Int J Environ Res Public Health*. 2015;12(8):10079–92.
14. Farsiani H, Mosavat A, Soleimanpour S, Nasab MN, Salimizand H, Jameh- dar SA, et al. Limited genetic diversity and extensive antimicrobial resist- ance in clinical isolates of Acinetobacter baumannii in north-east Iran. *J Med Microbiol*. 2015;64(7):767–73.
15. Rynga D, Sharif M, Deb M. Phenotypic and molecular characterization of clinical isolates of Acinetobacter baumannii isolated from Delhi, India. *Ann Clin Microbiol Antimicrob*. 2015;14(1):40.
16. Noori M, Mohsenzadeh B, Bahramian A, Shahi F, Mirzaei H, Khoshnood S. Characterization and frequency of antibiotic resistance related to membrane porin and efux pump genes among Acinetobacter baumannii strains obtained from burn patients in Tehran, Iran. *J Acute Dis*. 2019;8(2):63.
17. Rahbarnia L, Farajnia S, Khaneshi H, Farajnia H, Naghili B, Tanomand A. Detection of blaOXA-23 and blaNDM-1 carbapenemase among clinical isolates of A. baumannii in Tabriz, north-west of Iran. *Gene Rep*. 2019;18(4):100555.
18. Cortez-Cordova J, Kumar A. Activity of the efux pump inhibitor phenylalanine-arginine β-naphthylamide against the AdeFGH pump of Acinetobacter baumannii. *Int J Antimicrob Agents*. 2011;37(5):420–4.

Cite this article: Bhabhor Ullas H, Patel Alpa S, Mullan Summaiya A. Evaluation of Acinetobacter baumannii antibiotic resistance from tertiary care hospital – Judging the silent storm. *Panacea J Med Sci*. 2025;15(2):337-340.