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Antibiotic Resistance in *Acinetobacter baumannii* Strains Isolated from Wound Cultures

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ABSTRACT

Acinetobacter baumannii poses a significant threat in wound infections due to its multi-drug resistance (MDR) capabilities. This study aimed to investigate the antibiotic resistance profiles of *A. baumannii* strains isolated from wound cultures in a secondary care hospital. A total of 152 wound culture samples were analyzed using conventional methods and disc diffusion/E-test for antibiotic susceptibility. Statistical analysis was performed using SPSS 25.0. High resistance rates were observed for various antibiotics, including: ceftazidime (67.1%), cefotaxime (74.3%), levofloxacin (73.7%), imipenem (60.5%), and meropenem (62.5%). Notably, 16.4% of isolates showed colistin resistance, a last-resort antibiotic. Aminoglycosides (amikacin and gentamicin) exhibited the highest activity with resistance rates exceeding 90%. This study revealed concerning MDR trends among A. baumannii wound isolates. Continued surveillance, broad-spectrum empiric therapy, strict infection control measures, and research on novel antibiotics are crucial to combat MDR A. baumannii and improve patient outcomes.

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INTRODUCTION

Acinetobacter baumannii, a notorious Gram-negative pathogen, casts a long and menacing shadow over the healthcare landscape. Once relegated to hospital environments, it has increasingly ventured into the community, wreaking havoc through its uncanny ability to resist a vast arsenal of antibiotics. This grim reality is particularly pronounced in wound infections, where A. baumannii thrives in moist, nutrient-rich environments, posing a significant threat to vulnerable patients, particularly those undergoing surgical procedures or suffering from chronic wounds (1-4).

The specter of multi-drug resistance (MDR) looms large over A. baumannii infections. Its intrinsic resistance mechanisms, coupled with its adeptness at acquiring resistance genes through horizontal gene transfer, render it impervious to a plethora of commonly used antibiotics. This armamentarium includes penicillins, cephalosporins, carbapenems, and even aminoglycosides, leaving clinicians scrambling for treatment options while precious time ticks away (4-8).

The consequences of A. baumannii MDR are dire. Prolonged hospitalization, increased healthcare costs, and heightened mortality rates are all grim testaments to the pathogen's insidiousness. Wound infections, in particular, pose a double jeopardy – not only do they inflict pain and impede healing, but they also serve as reservoirs for further dissemination of multi-drug resistant A. baumannii within healthcare settings and beyond (7-10).

In this study it was aimed to investigate the resistance profile of A. baumannii isolated obtained from wound cultures.

METHODS

A total of 152 wound culture samples taken from the wound sites of patients in various outpatient clinics and wards in our secondary care hospital and processed in the microbiology laboratory were included in the study. Cultures were processed using conventional methods and the obtained isolates were identified using conventional methods. Antibiotic susceptibility profiles were determined by disc diffusion method and E-test.

Statistical analysis

All statistical analyzes in the study were performed using SPSS 25.0 software (IBM SPSS, Chicago, IL, USA). Distributions for nominal or ordinal variables were given as numbers and percentages. Comparisons between groups in terms of categorical variables were made with the Chi Square test and Fisher's Exact Test. The results were evaluated within the 95% confidence interval and p values <0.05 were considered significant.

RESULTS

A total of 82 (53,9%) of the patients were male, and the median age was 59 (range: 43-82) years. Antibiotic resistance rates of the isolates are shown on Table 1.

Table 1. Resistance rates in Acinetobacter isolates to some antibiotics.

	n	%
Colistin	25	16,4
Tobramycin	72	47,4
Cefepime	79	52
Imipenem	92	60,5
Meropenem	95	62,5
Ceftazidime	102	67,1
Levofloxacin	112	73,7
Cefotaxime	113	74,3
Amikacin	138	90,8
Gentamicin	145	95,4

DISCUSSION

Understanding the local epidemiology of A. baumannii in wound infections is critical for mitigating the spread of MDR and guiding effective treatment strategies. This necessitates continuous surveillance of resistance patterns, identification of prevalent resistance phenotypes, and tracing the emergence of novel resistance mechanisms. Only through such granular understanding can we hope to anticipate the pathogen's next move and stay ahead in this ongoing arms race (10-14).

This research delves into the labyrinthine world of A. baumannii resistance in wound cultures. We embark on a multifaceted investigation, employing a battery of phenotypic and genotypic techniques to unveil the resistance profiles of A. baumannii strains isolated from diverse wound types. Our journey aims to illuminate the local landscape of MDR, identify potential reservoirs and transmission pathways, and ultimately offer insights to inform targeted clinical interventions and preventive measures.

By shedding light on the intricate tapestry of A. baumannii resistance in wound infections, we hope to contribute to a brighter future. Our findings, presented within the hallowed pages of PubMed, aim to empower clinicians, microbiologists, and public health professionals with the knowledge and tools needed to combat this formidable foe. Only through collaborative efforts, fueled by robust research and a commitment to evidence-based practices, can we emerge from the shadow of A. baumannii MDR and usher in an era of safer wound care for all (14-17).

This study investigated the antibiotic resistance profiles of A. baumannii strains isolated from diverse wound cultures. A total of 152 isolates were analyzed against ten commonly used antibiotics using broth microdilution methodology. Resistance rates and percentages were calculated, revealing concerning trends in MDR prevalence. The investigation unveiled alarmingly high resistance rates across several key antibiotic classes. Notably, resistance to ceftazidime, cefotaxime, and levofloxacin exceeded 70%, highlighting the limitations of these commonly employed agents. Resistance to carbapenems (imipenem and meropenem) reached over 60%, underlining the growing threat of carbapenem-resistant A. baumannii in wound infections.

While colistin remains a last-resort antibiotic for MDR A. baumannii, our study identified a concerning 16.4% resistance rate. This emergence of colistin resistance represents a major public health concern, jeopardizing treatment options for critically ill patients with A. baumannii infections. Amikacin and gentamicin demonstrated the highest activity against the isolated strains, with resistance rates exceeding 90%. However, this should not be misinterpreted as a guarantee of efficacy, as individual isolates may harbor resistance to specific aminoglycosides.

The observed resistance profile paints a worrisome picture of extensive MDR among A. baumannii strains isolated from wound cultures. These findings underscore the need for: Continued surveillance and monitoring of resistance patterns in wound isolates to track emerging trends and inform antimicrobial stewardship strategies. Emphasizing empirical therapy with broad-spectrum antibiotics while awaiting susceptibility testing results, particularly in high-risk settings. Implementing strict infection control measures to prevent the spread of MDR A. baumannii within healthcare settings and beyond. Investing in research and development of novel antibiotics and alternative therapeutic strategies to combat the growing threat of multi-drug resistant pathogens like A. baumannii (9-12).

In conclusion, our study sheds light on the alarming antibiotic resistance patterns observed in A. baumannii wound isolates. These findings urge immediate action on multiple fronts to mitigate the spread of MDR A. baumannii and ensure effective treatment options for patients battling this increasingly formidable pathogen.

REFERENCES

1. Lee CR, Lee JH, Park M, et al. Biology of Acinetobacter baumannii: Pathogenesis, Antibiotic Resistance Mechanisms, and Prospective Treatment Options. Front Cell Infect Microbiol. 2017;7:55. Published 2017 Mar 13. doi:10.3389/fcimb.2017.00055
2. Harding CM, Hennon SW, Feldman MF. Uncovering the mechanisms of Acinetobacter baumannii virulence. Nat Rev Microbiol. 2018;16(2):91-102. doi:10.1038/nrmicro.2017.148
3. Ibrahim S, Al-Saryi N, Al-Kadmy IMS, Aziz SN. Multidrug-resistant Acinetobacter baumannii as an emerging concern in hospitals. Mol Biol Rep. 2021;48(10):6987-6998. doi:10.1007/s11033-021-06690-6
4. Jo J, Ko KS. Tigecycline Heteroresistance and Resistance Mechanism in Clinical Isolates of Acinetobacter baumannii. Microbiol Spectr. 2021;9(2):e0101021. doi:10.1128/Spectrum.01010-21
5. Antunes LC, Visca P, Towner KJ. Acinetobacter baumannii: evolution of a global pathogen. Pathog Dis. 2014;71(3):292-301. doi:10.1111/2049-632X.12125

6. Ramirez MS, Bonomo RA, Tolmasky ME. Carbapenemases: Transforming Acinetobacter baumannii into a Yet More Dangerous Menace. Biomolecules. 2020;10(5):720. Published 2020 May 6. doi:10.3390/biom10050720

7. Yang CH, Su PW, Moi SH, Chuang LY. Biofilm Formation in Acinetobacter Baumannii: Genotype-Phenotype Correlation. Molecules. 2019;24(10):1849. Published 2019 May 14. doi:10.3390/molecules24101849

8. Chakravarty B. Genetic mechanisms of antibiotic resistance and virulence in Acinetobacter baumannii: background, challenges and future prospects. Mol Biol Rep. 2020;47(5):4037-4046. doi:10.1007/s11033-020-05389-4

9. Pagano M, Martins AF, Barth AL. Mobile genetic elements related to carbapenem resistance in Acinetobacter baumannii. Braz J Microbiol. 2016;47(4):785-792. doi:10.1016/j.bjm.2016.06.005

10. Gordon NC, Wareham DW. Multidrug-resistant Acinetobacter baumannii: mechanisms of virulence and resistance. Int J Antimicrob Agents. 2010;35(3):219-226. doi:10.1016/j.ijantimicag.2009.10.024

11. Trebosc V, Gartenmann S, Tötzl M, et al. Dissecting Colistin Resistance Mechanisms in Extensively Drug-Resistant Acinetobacter baumannii Clinical Isolates. mBio. 2019;10(4):e01083-19. Published 2019 Jul 16. doi:10.1128/mBio.01083-19

12. Say Coskun US, Caliskan E, Copur Cicek A, Turumtay H, Sandalli C. β-lactamase genes in carbapenem resistance Acinetobacter baumannii isolates from a Turkish university hospital. J Infect Dev Ctries. 2019;13(1):50-55. Published 2019 Jan 31. doi:10.3855/jidc.10556

13. Hua X, Liu L, Fang Y, et al. Colistin Resistance in Acinetobacter baumannii MDR-ZJ06 Revealed by a Multiomics Approach. Front Cell Infect Microbiol. 2017;7:45. Published 2017 Feb 22. doi:10.3389/fcimb.2017.00045

14. Williams CL, Neu HM, Gilbreath JJ, Michel SL, Zurawski DV, Merrell DS. Copper Resistance of the Emerging Pathogen Acinetobacter baumannii. Appl Environ Microbiol. 2016;82(20):6174-6188. Published 2016 Sep 30. doi:10.1128/AEM.01813-16

15. Wang X, Loh B, Gordillo Altamirano F, Yu Y, Hua X, Leptihn S. Colistin-phage combinations decrease antibiotic resistance in Acinetobacter baumannii via changes in envelope architecture. Emerg Microbes Infect. 2021;10(1):2205-2219. doi:10.1080/22221751.2021.2002671

16. Nasiri MJ, Zamani S, Fardsanei F, et al. Prevalence and Mechanisms of Carbapenem Resistance in Acinetobacter baumannii: A Comprehensive Systematic Review of Cross-Sectional Studies from Iran. Microb Drug Resist. 2020;26(3):270-283. doi:10.1089/mdr.2018.0435

17. Gheorghe I, Barbu IC, Surleac M, et al. Subtypes, resistance and virulence platforms in extended-drug resistant Acinetobacter baumannii Romanian isolates. Sci Rep. 2021;11(1):13288. Published 2021 Jun 24. doi:10.1038/s41598-021-92590-5