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Original Research Article

COMPARATIVE ANALYSIS OF CLINICAL OUTCOMES IN NEONATAL BACTEREMIA CAUSED BY MULTIDRUG-RESISTANT VERSUS DRUG-SUSCEPTIBLE ACINETOBACTER BAUMANNII

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ABSTRACT

Background: Neonatal bacteraemia remains a significant cause of morbidity and mortality in intensive care units, with Acinetobacter baumannii emerging as a major pathogen due to its ability to develop multidrug resistance (MDR). Infections caused by MDR strains often pose therapeutic challenges, potentially influencing clinical outcomes compared to drug-susceptible strains. Understanding these differences is crucial for optimizing treatment strategies and improving neonatal survival.

Materials and Methods: A prospective observational study was conducted in the neonatal intensive care unit (NICU) of a tertiary care hospital over 12 months. A total of 84 neonates with blood culture–confirmed A. baumannii bacteraemia were enrolled and categorized into two groups: MDR (n = 46) and drug-susceptible (n = 38). Clinical data, laboratory parameters, antimicrobial therapy, and outcomes were recorded. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method in accordance with CLSI guidelines. Statistical analysis was carried out using Chi-square test and independent t-test, with $p < 0.05$ considered significant.

Results: The mean gestational age was 34.2 ± 2.1 weeks in the MDR group and 35.1 ± 1.8 weeks in the susceptible group ($p = 0.041$). Duration of NICU stay was significantly longer in MDR cases (21.4 ± 5.3 days) compared to susceptible cases (14.9 ± 4.7 days, $p < 0.001$). Septic shock occurred in 43.5% of MDR cases versus 18.4% in susceptible cases ($p = 0.015$). The case fatality rate was higher in the MDR group (32.6%) than in the susceptible group (13.2%, $p = 0.038$). Early appropriate antibiotic therapy was achieved in 54.3% of MDR cases versus 92.1% in susceptible cases ($p < 0.001$).

Conclusion: MDR A. baumannii bacteraemia in neonates is associated with significantly prolonged hospitalization, higher rates of septic shock, and increased mortality compared to drug-susceptible infections. Early detection and timely initiation of effective antimicrobial therapy are critical to improving outcomes.

Keywords: Acinetobacter baumannii, multidrug resistance, neonatal bacteraemia, antimicrobial susceptibility, clinical outcomes, mortality.

INTRODUCTION

Neonatal sepsis is a major contributor to morbidity and mortality worldwide, particularly in low- and middle-income countries, where the incidence is substantially higher compared to developed regions.[1] Among the various etiological agents, Acinetobacter baumannii has emerged as a significant pathogen in neonatal intensive care units (NICUs), owing to its capacity to survive in harsh environmental conditions and its propensity to acquire antimicrobial resistance determinants.[2,3]

This Gram-negative, non-fermenting bacillus is frequently associated with bloodstream infections, ventilator-associated pneumonia, meningitis, and wound infections in critically ill patients, including premature neonates.[4,5]

In recent years, the emergence of multidrug-resistant (MDR) A. baumannii strains has posed a substantial therapeutic challenge, often resulting in limited treatment options and poorer clinical outcomes.[6,7] The pathogen's resistance mechanisms include production of β-lactamases, efflux pumps, target site modifications, and biofilm formation, contributing to its persistence in healthcare environments and resistance to multiple antimicrobial classes.[8,9] While colistin remains a last-resort therapeutic agent for MDR infections, concerns regarding nephrotoxicity and emerging colistin resistance underscore the need for alternative strategies.

Neonates, particularly preterm and low birth weight infants, are highly vulnerable to A. baumannii infections due to immature immune defenses, prolonged hospitalization, and frequent exposure to invasive devices. Previous studies have reported higher mortality rates, prolonged NICU stay, and increased complications in neonates with MDR A. baumannii bacteraemia compared to those infected with drug-susceptible strains. However, there is limited data from resource-limited settings directly comparing the clinical outcomes between MDR and susceptible infections in neonatal populations.

This study aims to perform a comparative analysis of clinical outcomes in neonatal bacteraemia caused by MDR versus drug-susceptible A. baumannii, with the objective of identifying potential risk factors and outcome predictors to guide timely and effective clinical management.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was carried out in the Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital over an 12-month period, from January 2022 to December 2022. The NICU has a capacity of 30 beds and serves as a referral centre for both inborn and out born neonates.

Study Population: All neonates admitted during the study period with a positive blood culture for Acinetobacter baumannii were eligible for inclusion. Cases were categorized into two groups:

- Group A (MDR group): Neonates with multidrug-resistant A. baumannii isolates.
- Group B (Susceptible group): Neonates with drug-susceptible A. baumannii isolates.

Inclusion Criteria

1. Neonates aged ≤28 days at the time of blood culture positivity.
2. Confirmed A. baumannii bacteraemia by automated blood culture systems.
3. Availability of complete clinical and microbiological records.

Exclusion Criteria

1. Mixed bacterial growth in cultures.
2. Blood cultures yielding A. baumannii as a contaminant without clinical evidence of sepsis.
3. Neonates with incomplete hospital records or transferred before outcome assessment.

Microbiological Methods

Blood samples were collected under strict aseptic precautions and processed using the BacT/ALERT automated culture system (bioMérieux, France). Identification of A. baumannii was performed using conventional biochemical tests.

Summary of Biochemical Profile of A. baumannii

- Gram negative coccobacillus
- Non motile
- Non lactose fermenter
- Oxidase- Negative
- Catalase- Positive
- Oxidative/Fermentative test - Oxidative
- Citrate- Positive
- Urease- Negative
- Nitrate reduction- Negative
- Indole- Negative

Antimicrobial susceptibility testing (AST) was carried out using the Kirby–Bauer disk diffusion method and interpreted as per the Clinical and Laboratory Standards Institute (CLSI) guidelines. MDR was defined as resistance to at least one agent in three or more antimicrobial categories.

Data Collection: Demographic data (gestational age, birth weight, sex), perinatal history, clinical presentation, comorbidities, invasive device usage, antibiotic administration, laboratory parameters, and treatment outcomes were recorded. Clinical severity was assessed using the Neonatal Sequential Organ Failure Assessment (NSOFA) score on admission and during hospital stay.

Outcome Measures: Primary outcomes included mortality and duration of NICU stay. Secondary outcomes included incidence of septic shock, requirement for mechanical ventilation, and time to initiation of appropriate antibiotic therapy.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables were expressed as frequencies and percentages, with comparisons performed using the Chi-square or Fisher's exact test, as appropriate. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 84 neonates with blood culture–confirmed Acinetobacter baumannii bacteraemia were included, with 46 (54.8%) in the MDR group and 38 (45.2%) in the drug-susceptible group. The mean gestational age was significantly lower in the MDR group (34.2 ± 2.1 weeks) compared to the susceptible group (35.1

± 1.8 weeks; p = 0.041). Male neonates constituted 58.7% of the MDR group and 52.6% of the susceptible group (p = 0.564) [Table 1].

The duration of NICU stay was longer in the MDR group (21.4 ± 5.3 days) compared to the susceptible group (14.9 ± 4.7 days; p < 0.001). Septic shock occurred in 43.5% of MDR cases versus 18.4% of susceptible cases (p = 0.015). Mortality was higher in the MDR group (32.6%) than in the susceptible group (13.2%; p = 0.038) [Table 2].

Early administration of appropriate antibiotics (within 24 hours of blood culture collection) was achieved in 54.3% of MDR cases compared to 92.1% in susceptible cases (p < 0.001). Mechanical ventilation was required in 47.8% of MDR neonates and 26.3% of susceptible neonates (p = 0.048) [Table 3].

Table 1: Baseline characteristics of study population (n = 84)

Parameter	MDR group (n = 46)	Susceptible group (n = 38)	p value
Gestational age (weeks, mean ± SD)	34.2 ± 2.1	35.1 ± 1.8	0.041*
Birth weight (g, mean ± SD)	1985 ± 310	2110 ± 295	0.063
Male sex, n (%)	27 (58.7%)	20 (52.6%)	0.564
Preterm (<37 weeks), n (%)	34 (73.9%)	23 (60.5%)	0.187

*Independent t-test or Chi-square test; p < 0.05 statistically significant.

Table 2: Clinical outcomes in MDR vs. drug-susceptible A. baumannii bacteremia

Outcome	MDR group (n = 46)	Susceptible group (n = 38)	p value
NICU stay (days, mean ± SD)	21.4 ± 5.3	14.9 ± 4.7	<0.001*
Septic shock, n (%)	20 (43.5%)	7 (18.4%)	0.015*
Mortality, n (%)	15 (32.6%)	5 (13.2%)	0.038*

*Chi-square test; p < 0.05 statistically significant.

Table 3: Treatment and supportive care parameters

Parameter	MDR group (n = 46)	Susceptible group (n = 38)	p value
Early appropriate antibiotic therapy, n (%)	25 (54.3%)	35 (92.1%)	<0.001*
Mechanical ventilation, n (%)	22 (47.8%)	10 (26.3%)	0.048*
Duration of ventilation (days, mean ± SD)	5.8 ± 2.1	3.9 ± 1.7	0.002*

*Independent t-test or Chi-square test; p < 0.05 statistically significant.

From these findings [Table 1–3], MDR A. baumannii bacteraemia in neonates was associated with significantly prolonged hospitalization, higher rates of septic shock, and increased mortality compared to drug-susceptible infections. Delays in initiating appropriate antibiotic therapy were more frequent in the MDR group, contributing to poorer outcomes.

DISCUSSION

The present study highlights the significant impact of multidrug resistance on the clinical course and outcomes of Acinetobacter baumannii bacteraemia in neonates. Our findings demonstrate that MDR infections are associated with longer hospitalization, higher rates of septic shock, and increased mortality when compared with drug-susceptible infections, consistent with previous literature.[1-3]

The higher prevalence of MDR strains in our cohort (54.8%) is in line with reports from other tertiary NICUs in Asia, where MDR A. baumannii accounts for 50–70% of neonatal bloodstream infections.[4,5] The organism's ability to survive in the hospital environment and acquire diverse resistance determinants contributes to its persistence and frequent outbreaks.[6]

One of the critical observations in this study was the significant delay in initiating effective antimicrobial therapy in the MDR group. Similar to earlier reports, delayed administration of appropriate antibiotics has been shown to correlate with adverse outcomes in neonatal sepsis, particularly when caused by Gram-negative pathogens.[7,8] This delay is often due to empirical regimens not covering MDR strains, emphasizing the need for robust antimicrobial stewardship and rapid diagnostic tools.[9,10]

The increased incidence of septic shock in MDR cases (43.5%) compared to susceptible cases (18.4%) reflects the pathogen's virulence and the neonates' limited immune reserve.[11] Such hemodynamic instability necessitates aggressive supportive care, which may further prolong NICU stays and increase resource utilization. Similar findings have been documented by Li et al., who observed that MDR Gram-negative sepsis in neonates doubled the risk of shock and ventilation requirement.[12]

Our study also supports prior evidence that mechanical ventilation is more frequently required in MDR infections.[13] Invasive procedures such as endotracheal intubation and central line placement not only reflect disease severity but also act as risk factors for nosocomial transmission of A. baumannii.[14]

Mortality in the MDR group (32.6%) was significantly higher than in the susceptible group (13.2%), aligning with previous multicentre NICU studies.[2,15] This underscores the critical need for preventive strategies, including strict infection control measures, targeted surveillance, and early identification of high-risk neonates.

Overall, our findings emphasize that tackling MDR A. baumannii in NICUs requires a multi-pronged

approach—prompt diagnosis, appropriate empiric coverage in high-risk cases, and rigorous infection prevention. Future research should focus on evaluating novel therapeutic agents and combination regimens that may improve survival in these vulnerable patients.

CONCLUSION

MDR Acinetobacter baumannii bacteraemia in neonates is associated with delayed initiation of effective therapy, longer NICU stays, higher complication rates, and increased mortality compared to drug-susceptible infections. Early identification, appropriate empiric antibiotic coverage, and stringent infection control measures are essential to improve outcomes in this vulnerable population.

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