ORIGINAL ARTICLE ÖZGÜN ARAŞTIRMA

# *Acinetobacter baumannii* Infections in the Neonatal Intensive Care Unit: A Five-year Single-center Experience

## Yenidoğan Yoğun Bakım Ünitesinde *Acinetobacter Baumannii* Enfeksiyonları: Beş Yıllık Tek Merkez Deneyimi

*Betül Türen (0000-0001-7011-0246), *Bayram Ali Dorum (0000-0002-2823-8454), **Şefika Elmas Bozdemir (0000-0003-1058-0320), **Deniz Camcı Erten (0000-0001-5124-2323), *Erbu Yarcı (0000-0003-4434-0958)

**University of Health Sciences Türkiye, Bursa City Hospital, Department of Pediatrics, Division of Neonatology, Bursa, Türkiye*
***University of Health Sciences Türkiye, Bursa City Hospital, Department of Pediatrics, Division of Pediatric Infectious Diseases, Bursa City Hospital, Bursa, Türkiye*

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### Abstract

**Introduction:** *Acinetobacter baumannii* is a major nosocomial pathogen associated with high antibiotic resistance rates and significant mortality. This study aimed to evaluate the demographic, clinical, and microbiological characteristics of neonates with *A. baumannii* isolates in a tertiary Neonatal Intensive Care Unit (NICU) over a five-year period.

**Materials and Methods:** Between January 2021 and June 2025, a total of 1,759 neonates admitted to the a tertiary-level NICU were retrospectively reviewed. Nineteen neonates with *A. baumannii* positive cultures were included. Demographic data, history of invasive procedures, laboratory findings, antibiotic usage, culture results, and antimicrobial susceptibility patterns were analyzed.

**Results:** The median gestational age was 28 weeks (22–40) and the median birth weight was 950 g (450–3630 g). Of the cases, 68.4% were <29 weeks and 63.1% had a birth weight <1000 g. The majority of cultures (71.7%) were obtained from tracheal aspirates. The most frequent abnormal laboratory findings were elevated CRP (68%) and thrombocytopenia (42%). Antimicrobial susceptibility tests showed that 92.3% of *A. baumannii* isolates were susceptible to colistin. The overall mortality rate was 42.1%.

**Conclusion:** *A. baumannii* infections are associated with high mortality, particularly in extremely preterm and very low birth weight neonates. The high rate of carbapenem resistance and limited therapeutic options highlight the crucial importance of strict infection control measures and rational antibiotic use. Colistin remains the most effective agent, but should be used with caution due to potential toxicity, requiring close monitoring.

**Keywords**
Newborn, Acinetobacter baumannii, antibiotic resistance, sepsis, colistin, prematurity, mortality

### Öz

**Giriş:** *Acinetobacter baumannii*, yüksek antibiyotik direnç oranları ve anlamlı mortalite ile ilişkili önemli bir nozokomiyal patojendir. Bu çalışmanın amacı, üçüncü basamak bir Yenidoğan Yoğun Bakım Ünitesi'nde (YYBÜ) beş yıllık dönemde *A. baumannii* izolatı saptanan yenidoğanların demografik, klinik ve mikrobiyolojik özelliklerini değerlendirmektir.

**Gereç ve Yöntem:** Ocak 2021–Haziran 2025 tarihleri arasında 3. basamak YYBÜ'ne yatırılan toplam 1.759 yenidoğan retrospektif olarak incelendi. Kültürlerinde *A. baumannii* üremesi saptanan 19 yenidoğan çalışmaya dahil edildi. Olguların demografik verileri, invaziv girişim öyküsü, laboratuvar bulguları, antibiyotik kullanımı, kültür sonuçları ve antimikrobiyal duyarlılık paternleri analiz edildi.

**Anahtar kelimeler**
Yenidoğan, Acinetobacter baumannii, antibiyotik direnci, sepsis, kolistin, prematürite, mortalite

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**Address for Correspondence/Yazışma Adresi:** Betül Türen, University of Health Sciences Türkiye, Bursa City Hospital, Department of Pediatrics, Division of Neonatology, Bursa, Türkiye
**E-mail:** dr.betul.turen@gmail.com

**Bulgular:** Olguların medyan gebelik haftası 28 hafta (22–40), medyan doğum ağırlığı ise 950 g (450–3630 g) idi. Vakaların %68,4'ü <29 gebelik haftasında, %63,1'i ise <1000 g doğum ağırlığında idi. Kültürlerin büyük çoğunluğu (%71,7) trakeal aspirat örneklerinden elde edildi. En sık saptanan anormal laboratuvar bulguları CRP yüksekliği (%68) ve trombositopeni (%42) idi. Antimikrobiyal duyarlılık testlerinde *A. baumannii* izolatlarının %92,3'ünün kolistine duyarlı olduğu belirlendi. Genel mortalite oranı %42,1 olarak saptandı.
**Sonuç:** *A. baumannii* enfeksiyonları, özellikle aşırı prematüre ve çok düşük doğum ağırlıklı yenidoğanlarda yüksek mortalite ile ilişkilidir. Yüksek karbapenem direnci oranları ve sınırlı tedavi seçenekleri, sıkı enfeksiyon kontrol önlemleri ve akılcı antibiyotik kullanımının önemini ortaya koymaktadır. Kolistin en etkili ajan olarak görünmekle birlikte, potansiyel toksisite riski nedeniyle yakın izlem eşliğinde dikkatli kullanılmalıdır.

## Introduction

*Acinetobacter baumannii* is an aerobic, Gram-negative bacillus that has emerged as a prominent cause of hospital-acquired infections, particularly in intensive care units, due to its remarkable capacity to develop resistance to nearly all classes of antibiotics (1). It is most commonly associated with nosocomial infections such as urinary tract infections, sepsis, meningitis, lower respiratory tract infections, and wound infections (2-4).

Neonates hospitalized in the neonatal intensive care unit (NICU) are especially vulnerable to these infections because of their immature immune systems and frequent exposure to invasive procedures (5-7). Preterm infants; those with low birth weight; those receiving parenteral nutrition or broad-spectrum antibiotic therapy; and those undergoing invasive interventions such as endotracheal intubation and intravascular catheterization, particularly during prolonged hospital stays, are at increased risk of *A. baumannii* infection (8-10). Reported mortality rates range from 20% to 60%, and *A. baumannii* infections play a significant role, particularly in cases of ventilator-associated pneumonia and sepsis (11).

In this study, we evaluated the demographic and microbiological characteristics, associated risk factors, and clinical outcomes of neonates with *Acinetobacter baumannii* growth identified over a five-year period in a tertiary-level Neonatal Intensive Care Unit.

## Materials and Methods

This study was designed as a retrospective case series conducted in a tertiary-level Neonatal Intensive Care Unit. Medical records of neonates hospitalized between January 2021 and June 2025 were retrospectively reviewed. Nineteen neonates with *Acinetobacter baumannii* growth in culture specimens accompanied by clinical signs of sepsis were included in the study. Culture results considered to represent colonization based on clinical evaluation were excluded. A total of 39 culture samples obtained from the included cases were analyzed. Demographic characteristics, laboratory findings, history of invasive procedures, antibiotic use, culture results, and antimicrobial susceptibility profiles were retrospectively collected using standardized chart review forms.

Neonates hospitalized in the neonatal intensive care unit during the study period with growth of *Acinetobacter baumannii* in at least one clinical culture specimen (blood, urine, or tracheal aspirate) accompanied by clinical findings compatible with sepsis or healthcare-associated infection were included in the study. Neonates with culture positivity considered to represent colonization in the absence of clinical or laboratory evidence of infection, duplicate culture samples obtained during the same infectious episode, and patients with incomplete medical records were excluded from the study.

The distinction between infection and colonization was established according to clinical evaluation and standardized healthcare-associated infection criteria based on CDC/NHSN definitions. Colonization was defined as the isolation of *Acinetobacter baumannii* from clinical specimens in the absence of clinical signs of infection, laboratory evidence of inflammation, or requirement for targeted antimicrobial therapy. Infection was defined as the isolation of *Acinetobacter baumannii* from a clinical specimen accompanied by compatible clinical findings and laboratory abnormalities suggestive of sepsis or healthcare-associated infection requiring antimicrobial treatment.

The diagnosis of neonatal sepsis was established based on combined clinical, laboratory, and microbiological findings. Clinical criteria suggestive of sepsis included temperature instability, apnea, bradycardia, respiratory deterioration, increased oxygen requirement, feeding intolerance, lethargy, hypotension, and poor peripheral perfusion. Laboratory criteria supporting the diagnosis included elevated C-reactive protein (CRP) and procalcitonin (PCT) levels, leukocytosis or leukopenia, neutropenia, and thrombocytopenia. Microbiological confirmation was defined as the isolation of *Acinetobacter baumannii* from blood, urine, or tracheal aspirate cultures obtained during evaluation for suspected infection.

A total of 39 culture samples obtained from the included neonates were analyzed. Demographic characteristics, laboratory findings, duration of invasive procedures, antibiotic exposure, culture results, antimicrobial susceptibility profiles, and clinical outcomes were retrospectively collected from electronic medical records using standardized data collection forms.

*A. baumannii* strains isolated from blood, urine, and tracheal aspirate specimens sent from the NICU to the hospital's Microbiology Laboratory were included in the analysis. Blood samples were inoculated into BACT/ALERT PF Plus bottles and incubated for seven days in the automated BACTEC 9240 blood culture system (Becton Dickinson, USA). Specimens showing growth detected by the automated system (blood, urine, and tracheal aspirates) were subcultured onto 5% sheep blood agar and Eosin Methylene Blue (EMB) agar. After 24 hours of incubation, plates with bacterial growth were evaluated. Isolates identified as Gram-negative coccobacilli on Gram staining, oxidase-negative, catalase-negative, and non-fermentative were further identified, and antimicrobial susceptibility testing was performed using the Vitek Compact automated system (bioMérieux, France) with Vitek Compact Pro and Vitek MS Prime cards.

Colistin susceptibility was determined using the broth microdilution method, which is accepted as the reference standard. Colistin susceptibility was determined using the broth microdilution method, which is accepted as the reference standard. The minimum inhibitory concentration (MIC) was defined as the lowest concentration that completely inhibited visible bacterial growth. Colistin susceptibility results were interpreted according to the current European Committee on Antimicrobial Susceptibility Testing (EUCAST) clinical breakpoints, where isolates with MIC values ≤2 mg/L were considered susceptible and those with MIC values >2 mg/L were considered resistant.

### *Statistical Analysis*

Statistical analyses were performed using SPSS software version. Due to the limited sample size, the analysis was primarily descriptive in nature. Continuous variables were expressed as median (minimum–maximum) values, while categorical variables were presented as numbers and percentages. The distribution of continuous variables was evaluated using visual and analytical methods. Because of the non-normal distribution and small sample size, non-parametric statistical methods were preferred. Comparisons between survivor and non-survivor groups, when applicable, were performed using the Mann–Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. A p value of <0.05 was considered statistically significant. However, due to the limited number of patients, the findings should be interpreted primarily as descriptive observations rather than evidence of causal associations or independent risk factors.

## Results

Of the 19 patients included in the study, 10 (52.6%) were male and 9 (47.4%) were female. The median gestational age was 28 weeks (range: 22–40 weeks). One infant was born at term, while the remaining infants were preterm. The median birth weight was 950 g (range: 450–3630 g). The distribution of gestational age and birth weight is presented in Table 1.

Regarding clinical characteristics, the median duration of antibiotic therapy prior to *A. baumannii* growth was 18 days (range: 3–31 days). The median duration of central venous catheter use was 12 days (range: 0–30 days), and the median duration of total parenteral nutrition (TPN) was 15 days (range: 0–35 days). The median duration of endotracheal intubation was 18 days (range: 0–75 days). The overall mortality rate was 42.1% (Table 1).

**Table 1. Demographic and clinical characteristics of the study population**

| Variable | Results |
|---|---|
| Gestational age, median (min–max), weeks | 28 (22–40) |
| <29 weeks, n (%) | 13 (68.4) |
| 29–31 weeks, n (%) | 4 (21.1) |
| ≥32 weeks, n (%) | 2 (10.5) |
| Birth weight, median (min–max), g | 950 (450–3630) |
| <1000 g, n (%) | 12 (63.1) |
| 1000–1499 g, n (%) | 3 (15.8) |
| ≥1500 g, n (%) | 4 (21.1) |
| Male sex, n (%) | 10 (52.6) |
| Duration of antibiotic use before culture positivity, median (min–max), days | 18 (3–31) |
| Duration of central venous catheter use before culture positivity, median (min–max), days | 12 (0–30) |
| Duration of total parenteral nutrition, median (min–max), days | 15 (0–35) |
| Duration of intubation, median (min–max), days | 18 (0–75) |
| Mortality, n (%) | 8 (42.1) |

Among the 19 neonates included in the study, 15 received colistin therapy during the course of treatment. Mortality was observed predominantly among extremely preterm and very low birth weight infants requiring prolonged invasive support. Patients who died generally had longer durations of mechanical ventilation, central venous catheter use, and total parenteral nutrition compared with survivors. Due to the limited sample size, no definitive conclusions regarding the impact of colistin therapy on mortality could be established.

When the indications for hospitalization were evaluated, the vast majority of neonates were admitted due to prematurity (94.7%; n = 18) and respiratory distress syndrome (RDS) (94.7%; n = 18). Only one case (5.2%) was admitted with a diagnosis of sepsis/pneumonia (Table 2).

A total of 39 culture samples were analyzed. The majority of isolates (71.7%; n = 28) were obtained from tracheal aspirate specimens. Blood cultures were positive in 9 cases (23.1%). Growth in urine cultures was detected in only 2 cases (5.2%) (Table 3).

Laboratory parameters obtained at the time of sampling of the first culture demonstrating growth were evaluated. The most frequently observed abnormal laboratory findings were elevated C-reactive protein (CRP) levels (68%) and thrombocytopenia (42%). The remaining laboratory parameters are presented in Table 4.

Antimicrobial susceptibility test results based on a total of 39 culture isolates are presented in Table 5. Accordingly, 92.3% (n = 36) of the *Acinetobacter baumannii* isolates were susceptible to colistin, while 5% (n = 2) were resistant and 2.5% (n = 1) demonstrated intermediate susceptibility (Table 5).

## Discussion

Our study demonstrated that *Acinetobacter baumannii* infections predominantly affected extremely preterm and very low birth weight neonates requiring prolonged invasive support and were associated with high mortality rates in our tertiary-level neonatal intensive care unit. The majority of affected infants were born at <29 weeks of gestation (68.4%) and had a birth weight below 1000 g (63.1%), emphasizing extreme prematurity and very low birth weight as major predisposing factors for infection in our cohort. These findings are consistent with recent NICU studies reporting prematurity, prolonged hospitalization, and invasive interventions as

**Table 2. Indications for hospital admission**

| Variable | n (%) |
|---|---|
| Prematurity | 18 (94.7) |
| Respiratory distress syndrome (RDS) | 18 (94.7) |
| Sepsis/Pneumonia | 1 (5.2) |

**Tablo 3. Distribution of culture specimens**

| Culture type | n (%) |
|---|---|
| Tracheal aspirate | 28 (71.7) |
| Blood culture | 9 (23.1) |
| Urine culture | 2 (5.2) |

**Tablo 4. Acute phase reactants prior to the first positive culture in 19 neonates**

| Parameter | n (%) |
|---|---|
| CRP >10 mg/dL | 13 (68.0) |
| PCT >2.5 ng/mL | 7 (37.0) |
| Leukocytosis (>20,000/mm$^3$) | 5 (26.0) |
| Neutropenia (<1500/mm$^3$) | 1 (5.0) |
| Thrombocytopenia (<100,000/mm$^3$) | 8 (42.0) |

CRP: C-reaktif protein, PCT: Procalsitonin

**Tablo 5. Antimicrobial susceptibility results of *Acinetobacter baumannii* isolates**

| Antibiotic | Susceptible n (%) | Intermediate n (%) | Resistant n (%) |
|---|---|---|---|
| Gentamicin | 0 (0) | 0 (0) | 39 (100) |
| Levofloxacin | 0 (0) | 0 (0) | 39 (100) |
| Amikacin | 13 (33.3) | 0 (0) | 26 (66.7) |
| Ciprofloxacin | 0 (0) | 3 (7.7) | 36 (92.3) |
| TMP/SMX | 3 (7.7) | 0 (0) | 36 (92.3) |
| Meropenem | 4 (10.3) | 1 (2.5) | 34 (87.2) |
| Colistin | 36 (92.3) | 1 (2.5) | 2 (5.0) |

TMP/SMX: Trimethoprim/sulfamethoxazole

major determinants of multidrug-resistant *A. baumannii* infection (11,12,13). In a recent systematic review and meta-analysis, Diao et al. (9) identified prolonged ICU stay, invasive ventilation, and prior broad-spectrum antibiotic exposure as major contributors to multidrug-resistant *A. baumannii* infections in critically ill patients. Similarly, neonatal studies have consistently demonstrated increased susceptibility among extremely preterm and extremely low birth weight infants because of immune immaturity and the need for prolonged intensive care support (8,12).

In our cohort, tracheal aspirates represented the predominant source of positive cultures (71.7%), suggesting that ventilator-associated pneumonia (VAP) was the most frequent clinical manifestation of infection. In addition, the median duration of intubation was 18 days, reflecting prolonged exposure to invasive respiratory support. Previous studies have similarly demonstrated a strong relationship between prolonged mechanical ventilation and *A. baumannii*-associated VAP in neonatal intensive care units. Rangelova et al. (13) reported that neonates requiring mechanical ventilation for more than 48 hours had a substantially increased incidence of VAP, with *A. baumannii* identified among the leading pathogens. More recently, Zhou et al**.** (14) demonstrated that prolonged ventilatory support and duration of intubation were independently associated with increased mortality and multidrug-resistant gram-negative infections in NICU patients. These findings support our observation that prolonged respiratory support plays a critical role both in infection development and adverse clinical outcomes.

Our patients were also characterized by prolonged central venous catheterization and extended total parenteral nutrition (TPN) exposure. The median duration of central venous catheter use was 12 days, while the median duration of TPN exposure was 15 days. Similar invasive risk profiles have been described in previous neonatal studies. Lee et al. (15) demonstrated that prolonged intubation, central venous catheterization, and prolonged TPN administration were highly prevalent among neonates with *A. baumannii* bacteremia. Likewise, Hsu et al. (16) identified prolonged invasive device exposure as an independent risk factor for endemic *A. baumannii* infection in NICUs. In a recent multicenter neonatal sepsis analysis, prolonged catheter use and invasive respiratory support were strongly associated with multidrug-resistant gram-negative infections and increased mortality. Taken together, these findings suggest that minimizing the duration of invasive procedures may represent one of the most important preventive strategies in reducing infection burden in neonatal intensive care units (17).

The mortality rate in our cohort was 42.1%, which is comparable to rates reported in recent literature evaluating neonatal *A. baumannii* infections. Mortality occurred predominantly among extremely preterm and very low birth weight neonates requiring prolonged invasive support. Pillay et al. (18) reported a mortality rate of 41.7% among neonates with Acinetobacter sepsis in a multicenter cohort study. A recent review by Howard et al. (17) further emphasized that mortality in multidrug-resistant *A. baumannii* infections is strongly influenced not only by antimicrobial resistance patterns but also by underlying disease severity, prematurity, and invasive supportive requirements. These findings are consistent with our observation that mortality in neonatal *A. baumannii* infection reflects the combined impact of multidrug resistance and severe baseline clinical vulnerability.

Antimicrobial susceptibility testing in our study demonstrated high resistance rates to carbapenems and aminoglycosides, further supporting the multidrug-resistant nature of the isolates. Meropenem resistance was detected in 87.2% of isolates, whereas colistin demonstrated the highest susceptibility rate (92.3%) among the tested antimicrobial agents. Similar resistance patterns have been reported in recent neonatal surveillance studies evaluating multidrug-resistant gram-negative pathogens in intensive care settings (19-20). Although colistin therapy demonstrated favorable in vitro susceptibility results in our cohort, treatment response and survival outcomes were also strongly influenced by prematurity, severity of illness, and duration of invasive supportive therapies. Therefore, clinical outcomes should not be attributed solely to antimicrobial susceptibility findings.

Colistin continues to represent an important therapeutic option for multidrug-resistant *A. baumannii* infections in neonatal intensive care units; however, concerns regarding nephrotoxicity and neurotoxicity remain clinically important. In our cohort, 15 of 19 neonates received colistin therapy, and no severe nephrotoxicity or neurotoxicity requiring treatment discontinuation was observed. Similar findings have been reported in recent neonatal studies evaluating colistin safety profiles. Aksoy et al. (21) reported predominantly mild AKI findings in preterm neonates receiving colistin according to modified neonatal KDIGO criteria. In addition, a recent systematic review by Nakwan et al. (20) concluded that colistin may be relatively well tolerated in neonatal populations when careful renal and electrolyte monitoring is maintained during therapy. Nevertheless, larger prospective

neonatal studies are still required to better define the long-term safety profile of colistin in extremely preterm infants.

### *Study Limitations*

The present study has several limitations. First, it was conducted in a single tertiary center with a relatively limited sample size, restricting the generalizability of the findings. Second, the retrospective design and absence of a control group prevented identification of independent risk factors and limited the ability to establish causal relationships. In addition, the descriptive nature of the statistical analysis limited robust comparisons regarding mortality and treatment outcomes. Detailed MIC distribution data were not available for all isolates. Despite these limitations, our five-year dataset provides valuable insight into the clinical characteristics, invasive risk factors, antimicrobial resistance profiles, and outcomes of neonatal *Acinetobacter baumannii* infections in a tertiary-level NICU setting.

## Conclusion

*Acinetobacter baumannii* infections in the neonatal intensive care unit represent a significant cause of morbidity and mortality, particularly among extremely preterm and low birth weight infants. The high rate of carbapenem resistance identified in our study, together with limited therapeutic alternatives, suggests that colistin may remain an important therapeutic option for multidrug-resistant *Acinetobacter baumannii* infections. In neonatal intensive care units, prevention remains paramount. Reducing both the number and duration of invasive procedures, along with strict adherence to fundamental infection control measures—such as meticulous hand hygiene—are essential strategies to limit the burden of these infections.

### *Ethics*

**Ethical Approval:** Ethics committee approval was obtained from the Bursa City Hospital Clinical Research Ethics Committee prior to the initiation of the study (approval number:2025-21/7, date: 05.11.2025). The study was conducted in accordance with the principles of the Declaration of Helsinki.

### *Footnotes*

**Conflict of Interest:** No conflict of interest was declared by the authors.

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