



Antimicrobial resistance pattern of *Klebsiella pneumoniae* in ventilator-associated respiratory infection in a neonate: A case-based study from rural Maharashtra, India

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Abstract

Ventilator-associated respiratory infections (VARI) represent a significant cause of morbidity and mortality in neonatal intensive care units (NICUs), especially in resource-limited rural healthcare settings. This case-based study investigates the antimicrobial resistance pattern of *Klebsiella pneumoniae* isolated from a ventilated neonate diagnosed with respiratory infection. A tracheal swab sample was processed using standard microbiological techniques, including Gram staining, culture, and antibiotic susceptibility testing following CLSI guidelines.

The isolate demonstrated extensive drug resistance, including resistance to beta-lactams, aminoglycosides, fluoroquinolones, and carbapenems. Phenotypic analysis suggested probable extended-spectrum beta-lactamase (ESBL) production and possible carbapenemase activity. These findings indicate a multidrug-resistant (MDR) profile, posing significant therapeutic challenges. The study highlights the growing burden of antimicrobial resistance in neonatal ICUs and emphasizes the urgent need for strict infection control practices, antimicrobial stewardship programs, and continuous surveillance in rural healthcare settings.

Keywords: *Klebsiella pneumoniae*, Neonatal ICU, Ventilator-associated infection, MDR, ESBL, Carbapenem resistance, Rural healthcare

Introduction

Ventilator-associated respiratory infections, including ventilator-associated pneumonia (VAP), are among the most serious healthcare-associated infections in NICUs. Neonates, particularly preterm infants, are highly susceptible due to underdeveloped immune systems, prolonged hospitalization, and invasive procedures such as mechanical ventilation.

Among Gram-negative pathogens, *Klebsiella pneumoniae* has emerged as a major causative organism due to its virulence factors and ability to acquire antimicrobial resistance mechanisms. The production of ESBLs and carbapenemases has made treatment increasingly difficult.

In rural settings like Barshi, Maharashtra, challenges such as limited diagnostic infrastructure, empirical antibiotic usage, and inadequate infection control contribute to the rise of resistant pathogens.

This study aims to analyze the resistance pattern of *Klebsiella pneumoniae* isolated from a ventilated neonate and provide clinically relevant insights.

Materials and Methods

1. Study Design

A case-based observational study.

2. Study Setting

NICU of a rural tertiary care hospital in Maharashtra, India.

3. Study Subject

A 22-day-old male neonate on ventilator support presenting with signs of respiratory infection.

4. Sample Collection

- Specimen: Tracheal swab
- Collected under aseptic conditions

5. Laboratory Processing

- Gram staining

- Culture on Blood agar and MacConkey agar
- Incubation at 37°C for 24 hours

6. Identification

- Colony morphology
- Biochemical tests
- Automated identification system

7. Antibiotic Susceptibility Testing

Performed using Kirby–Bauer disk diffusion method as per CLSI guidelines.

8. Detection of Resistance Mechanisms

- **ESBL:** Phenotypic inference
- **Carbapenemase:** Suspected based on resistance pattern

Results

Table 1: Culture Findings

- **Sample:** Tracheal swab
- **Gram stain:** Gram-negative bacilli
- **Organism:** *Klebsiella pneumoniae*
- **Infection:** Ventilator-associated

Table 2: Antibiotic Resistance Pattern

The isolate showed resistance to:

- **Ampicillin:** Resistant
- **Gentamicin:** Resistant
- **Ceftriaxone:** Resistant
- **Ciprofloxacin:** Resistant
- **Amikacin:** Resistant
- **Piperacillin:** Tazobactam – Resistant
- **Imipenem:** Resistant
- **Meropenem:** Resistant

Interpretation: Extensive drug resistance including carbapenems.

Table 3: Interpretation

- **MDR:** Yes
- **ESBL:** Probable
- **Carbapenemase:** Possible

Discussion

This study demonstrates a highly resistant strain of *Klebsiella pneumoniae* isolated from a ventilated neonate. The resistance to multiple antibiotic classes, including carbapenems, is particularly concerning.

The presence of ESBL production explains resistance to third-generation cephalosporins, while carbapenem resistance suggests emerging carbapenemase-producing strains. This aligns with global trends showing increasing MDR pathogens in NICUs.

In rural healthcare settings, the situation is worsened due to:

- Empirical antibiotic overuse
- Limited microbiology facilities
- Inadequate infection control

The findings highlight the importance of:

- Early diagnosis
- Targeted therapy
- Antibiotic stewardship

Conclusion

Klebsiella pneumoniae causing ventilator-associated infection in neonates can exhibit extensive antimicrobial resistance, including MDR and possible carbapenem resistance.

This poses a serious threat to neonatal survival and requires urgent intervention through surveillance and rational antibiotic use.

Recommendations

- Implement strict infection control protocols
- Establish antibiotic stewardship programs
- Perform routine antibiogram analysis
- Avoid unnecessary empirical antibiotic use
- Strengthen microbiology laboratory capacity

Limitations

- Single case study
- No molecular confirmation
- Limited sample size

Acknowledgment

The author acknowledges the NICU staff and diagnostic laboratory team for their support.

References

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