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Culture profile and antibiogram of infective organisms from endotracheal secretions in mechanically ventilated patients of a tertiary care centre

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Abstract

Introduction: Mechanical ventilation, while life-saving, increases the risk of ventilator-associated pneumonia (VAP), commonly due to colonization of the lower respiratory tract by multidrug-resistant pathogens. Understanding local microbial patterns and resistance profiles is critical for optimizing empirical therapy and improving ICU outcomes.

Aims and Objectives

- To analyzed the culture profile and antibiogram of infective organisms isolated from endotracheal secretions in mechanically ventilated patients.
- To Approval for the study was obtained from the Institutional Ethics Committee, and written informed consent was secured from the patients' caregivers or legal representatives.

Material and Method:

Study Design: Cross Sectional Study

Study Period: The study was conducted over six months June 2023–November 2023.

Study Place: Department of Microbiology, M.P. Shah Government Medical College, Jamnagar, Gujarat.

Sample Size: Total sample size 113.

Study Population: Patients scheduled for elective microbiology laboratory

Sampling Method: Susceptibility Testing

Result: In total, 113 samples were processed. tracheal aspirates were 113, with males (47/113) outnumbered females (26/113). Out of a total of 113 samples, 73 (64.40%) were culture-positive and 40 (36.60%) were sterile. Acinetobacter spp. was the most common pathogen among 72 culture positives (27/73, 36.98%),

followed by Klebsiella spp. (21/73, 28.50%), Pseudomonas spp. (13/73, 17.80%), and Escherichia coli (8/73, 9.59%) and Staphylococcus aureus (6/73, 8.22%).

Conclusion: The study highlights the growing prevalence of multidrug-resistant pathogens in ventilated ICU patients, emphasizing the need for ongoing microbiological surveillance and judicious antimicrobial use to reduce morbidity and mortality.

Keywords: Ventilator-associated pneumonia, Endotracheal aspirate, Antibiogram, Multidrug resistance, ICU infections, Acinetobacter, Klebsiella

Introduction

Mechanical ventilation is a critical intervention in intensive care units (ICUs), often necessitated by respiratory failure, severe infections, or post-operative support. However, prolonged mechanical ventilation is associated with an increased risk of nosocomial infections, particularly ventilator-associated pneumonia (VAP). These infections result from the colonization of the endotracheal tube and respiratory tract by pathogenic microorganisms, which can lead to significant morbidity, extended hospital stays, and increased mortality rates. Understanding the culture profile and resistance patterns of infective organisms from endotracheal secretions is vital for guiding effective antimicrobial therapy.[1]

The emergence of multidrug-resistant (MDR) organisms in mechanically ventilated patients further complicates the management of these infections. Common pathogens include Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter baumannii, and Escherichia coli, which often exhibit resistance to first-line antibiotics. This alarming trend underscores the need for regular surveillance of the microbiological spectrum and antibiogram of organisms isolated from endotracheal secretions.

In this study, we aim to analyze the culture profile and antibiogram of infective organisms isolated from endotracheal secretions in mechanically ventilated patients at a tertiary care center.[2]

Aims and Objectives

- To analyzed the culture profile and antibiogram of infective organisms isolated from endotracheal secretions in mechanically ventilated patients.
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Sampling Method: Susceptibility Testing

Inclusion Criteria

The study included all patients aged who were mechanically ventilated for more than 48 hours for various clinical indications, such as respiratory failure, sepsis, or post-operative management.

Exclusion Criteria

Patients with existing pulmonary infections prior to mechanical ventilation or those on antibiotics before sample collection were excluded. A total of 48 patients meeting the inclusion criteria were enrolled in the study.

Data Analysis

All data were recorded in a structured proforma and analyzed using SPSS software (version 22.1).

Descriptive statistics were employed to summarize demographic details, microbiological findings, and antibiogram results. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as means with standard deviations. Associations between clinical and microbiological parameters were analyzed using chi-square or Fisher's exact tests, with a significance threshold set at $p < 0.05$.

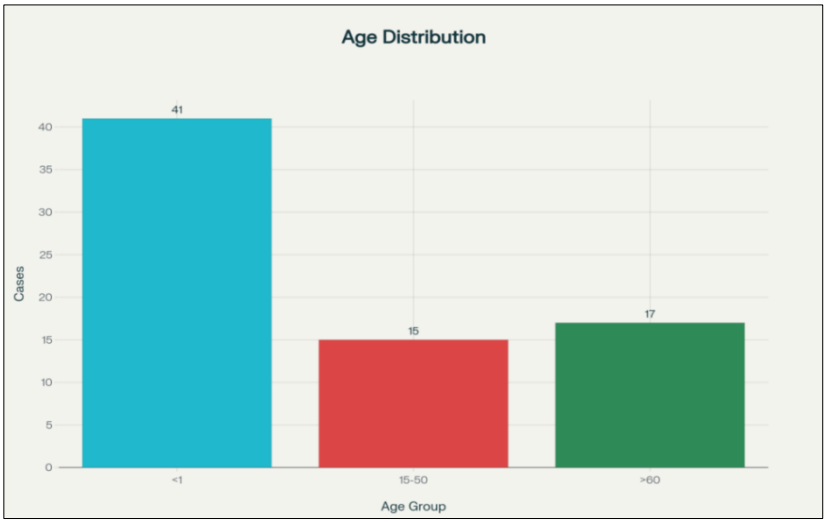
Result

Out of 113 pus samples received for culture and sensitivity in the microbiology laboratory, 73 (64.40%) samples yielded positive culture, and there was no growth in 40 (35.60%) samples.

Table 1: Age Distribution

Age (years)	Number of cases (n)	Percentage (%)
<1	41	56.17%
15–50	15	20.55%
>60	17	23.28%
Total	73	100%

Graph 1: Age Distribution

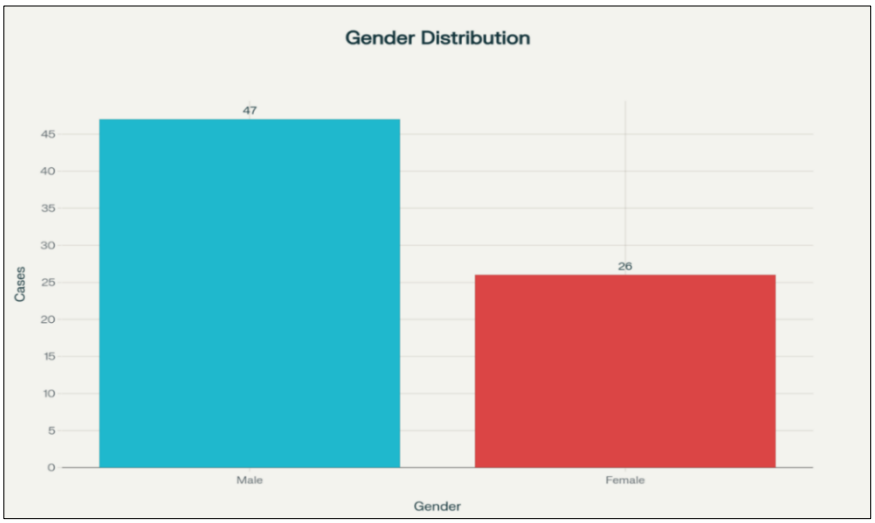


This indicates that the majority of positive cultures occurred in infants under one year, highlighting the vulnerability of this age group to lower respiratory and other infections.

Table 2: Gender Distribution

Sex	Number of cases (n)	Percentage (%)
Male	47	64.38%
Female	26	35.62%
Total	73	100%

Graph 2: Gender Distribution

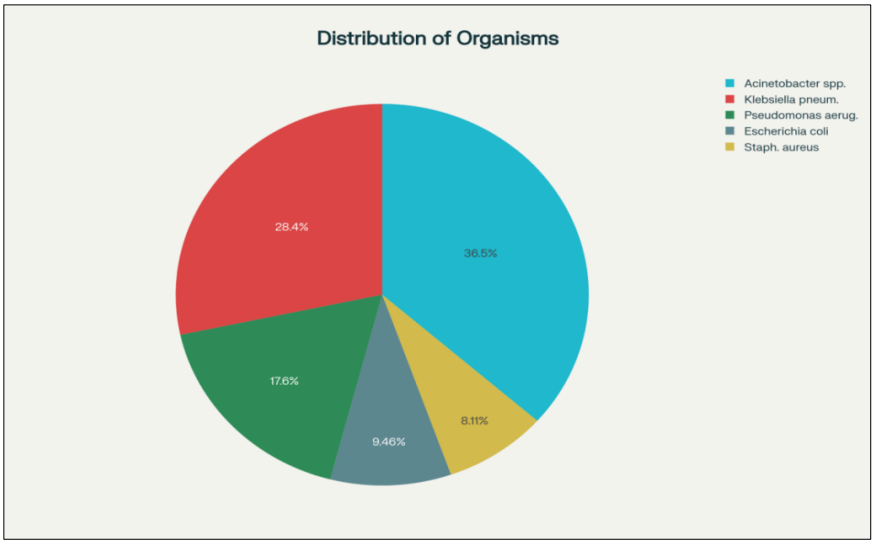


The gender distribution reveals a significant male predominance in culture-positive lower respiratory tract infections, with males accounting for 64.38% (47 cases) compared to females at 35.62% (26 cases), resulting in a male-to-female ratio of approximately 1.8:1.

Table 3: Distribution of Isolated Organisms

Sr. No.	Organism	Number (%)
1	Acinetobacter spp.	27 (36.98%)
2	Klebsiella pneumoniae	21 (28.50%)
3	Pseudomonas aeruginosa	13 (17.80%)
4	Escherichia coli	7 (9.59%)
5	Staphylococcus aureus	6 (8.22%)
Total		73 (100%)

Graph 3: Distribution of Isolated Organisms



- Acinetobacter spp. dominates the isolates, comprising 36.98% of culture-positive cases, reflecting its robust survival in ICU settings and resistance to disinfection.
- Klebsiella pneumoniae accounts for 28.50%, underscoring its high prevalence and ESBL-mediated resistance concerns in hospital-acquired pneumonia.
- Pseudomonas aeruginosa represents 17.80%, consistent with its device-associated infection profile and biofilm-forming capacity.
- Escherichia coli (8.50%) and Staphylococcus aureus (8.22%) are less frequent but clinically significant; E. coli's gut translocation and S. aureus's MRSA outbreaks warrant continued vigilance.

Table 4: Antimicrobial Susceptibility Pattern of Staphylococcus aureus

Antibiotic	No. of isolates	Percentage
Azithromycin	2	33.3%
Erythromycin	2	33.3%
Clindamycin	5	83.33%
Cefoxitin	1	16,6%
Doxycycline	5	83.33%
Minocycline	5	83.33%
Tetracycline	2	33.3%
Linezolid	6	100%
Ciprofloxacin	4	66.6%
Levofloxacin	4	66.6%
Gentamicin	2	33.3%
Total Isolate:	6	

Efficacy was highest for meropenem and imipenem (85.7%), followed by piperacillin/tazobactam (71.4%) and amikacin (71.4%). Moderate activity was seen with ampicillin-sulbactam and gentamicin (57.1% each). First-line beta-lactams and beta-lactam/β-lactamase inhibitors showed variable efficacy (ampicillin 14.3%; amoxicillin-clavulanate 28.6%; ceftriaxone, cefotaxime, cefuroxime, cefepime, cefoxitin 42.9% each). Fluoroquinolones and cotrimoxazole were less active (28.6% each). These patterns underscore prioritizing carbapenems, piperacillin/tazobactam, and aminoglycosides for empirical therapy.

Antibiotic Class Sensitivity Comparison and Acinetobacter Spp

Table 5: Aminoglycosides

Antibiotic	Present Study	Sharma et al.	Snehitha et al.
Amikacin	29.6%	22%	35%
Gentamicin	29.6%	22%	35%

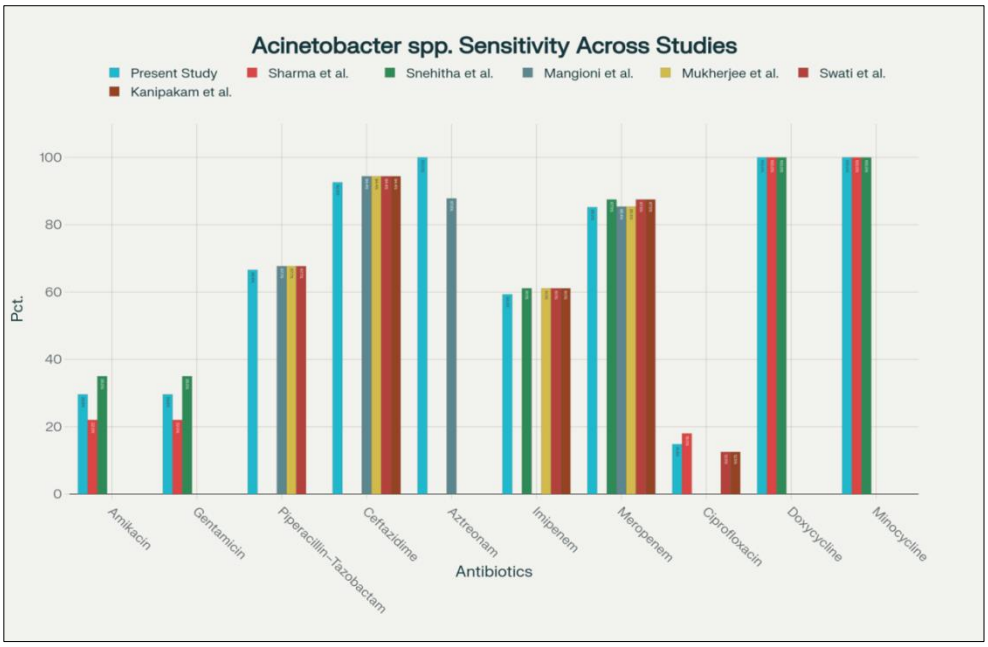
Aminoglycoside susceptibility remains low in this cohort, contrasting with literature (22–35%). likely due to prevalent modifying enzymes.[4]

Table 6: Comparative Analysis between Antibiotic of Acinetobacter spp.

Antibiotic	Present Study	Sharma et al.	Snehitha et al.	Mangioni et al.	Mukherjee et al.	Swati et al.	Kanipakam et al.
Amikacin	29.6%	22%	35%	–	–	–	–
Gentamicin	29.6%	22%	35%	–	–	–	–
Piperacillin–Tazobactam	66.6%	–	–	67.7%	67.7%	67.7%	
Ceftazidime	92.6%	–	–	94.4%	94.4%	94.4%	94.4%
Aztreonam	100%	–	–	87.8%	–	–	–
Imipenem	59.3%	–	61.1%		61.1%	61.1%	61.1%
Meropenem	85.2%	–	87.5%	85.4%	87.5%	87.5%	87.5%
Ciprofloxacin	14.8%	18%			12.5%	12.5%	12.5%
Doxycycline	100%	100%	100%	100%	–	–	–
Minocycline	100%	100%	100%	100%	–	–	–

Acinetobacter spp. shows uniformly low aminoglycoside susceptibility (29.6% vs. 22–35%), moderate piperacillin–tazobactam activity (66.6% vs. 67.7%), and excellent ceftazidime (92.6% vs. 94.4%) and aztreonam (100% vs. 87.8%) efficacy. Imipenem activity is concerningly low (59.3% vs. 61.1%), while meropenem remains robust (85.2% vs. 87.5%). Fluoroquinolones are ineffective (14.8% vs. 12.5–18%). Tetracyclines maintain universal activity (100%).

Graph 4: Comparative Analysis between Antibiotic



Discussion

In this study, endotracheal secretions were sent for bacteriological culture and sensitivity to recognize the organisms which would help in initiating and or modifying antibiotic therapy appropriately and help in preventing the occurrence of ventilator associated

pneumonia (VAP) or Hospital acquired pneumonia (HAP) and helps bring about favourable outcome. This study to determine the culture profile and antibiogram of infective organisms from endotracheal secretions in mechanically ventilated patients at a tertiary care centre. Total 113 samples were processed tracheal aspirates were 113, with males (47/113) outnumbered females (26/113). Out of a total of 113 samples, 73 (64.40%) were culture-positive and 40 (36.60%) were sterile. Acinetobacter spp. dominates the isolates, comprising 36.98% of culture-positive cases, reflecting its robust survival in ICU settings and resistance to disinfection. Efficacy was highest for meropenem and imipenem (85.7%), followed by piperacillin/tazobactam (71.4%) and amikacin (71.4%). Moderate activity was seen with ampicillin-sulbactam and gentamicin (57.1% each). Acinetobacter spp. shows uniformly low aminoglycoside susceptibility (29.6% vs. 22–35%), moderate piperacillin–tazobactam activity (66.6% vs. 67.7%), and excellent ceftazidime (92.6% vs. 94.4%) and aztreonam (100% vs. 87.8%) efficacy.

Conclusion

The study highlights the growing prevalence of multidrug-resistant pathogens in ventilated ICU patients, emphasizing the need for ongoing microbiological surveillance and judicious antimicrobial use to reduce morbidity and mortality. Ventilated patients represent a population at risk of developing ventilator-associated pneumonia and subsequent mortality. Bacteriological and antibiogram analysis of endotracheal secretions in these subjects serves as an effective tool for monitoring the hospital's infection control and antibiotic stewardship programs and identifying temporal trends that impact patient management decisions.

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