Study on the Clinical and Bacteriological Profile of Intensive Care Unit–Acquired Infections in a Rural Tertiary Care Hospital.

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ABSTRACT

Intensive Care Unit (ICU)–acquired infections remain a major cause of morbidity, mortality, prolonged hospital stay, and increased healthcare costs. Patients admitted to ICUs are exposed to multiple risk factors such as invasive procedures, prolonged hospitalization, immunosuppression, and broad-spectrum antibiotic use, predisposing them to nosocomial infections. The bacteriological spectrum and antimicrobial resistance patterns vary between institutions, necessitating local epidemiological data to guide empirical therapy and infection control practices. To study the clinical profile, microbial etiology, and predisposing risk factors of ICU-acquired infections in adult patients admitted to the medical ICU of a rural tertiary care hospital. This prospective observational study included 100 adult patients admitted to the medical ICU , who developed infections after 48 hours of ICU admission. Clinical features, risk factors, laboratory parameters, radiological findings, and microbiological culture results were analyzed. Standard definitions for ICU-acquired infections were used, and appropriate cultures were obtained prior to initiation of antibiotics. ICU-acquired infections were most commonly associated with invasive devices such as urinary catheters, endotracheal tubes, and central venous lines. Pneumonia, urinary tract infections, and bloodstream infections constituted the majority of cases. Gram-negative organisms predominated, with significant antimicrobial resistance noted among isolates. Prolonged ICU stay and device utilization emerged as key risk factors. ICU-acquired infections continue to pose a significant challenge in critical care settings. Continuous surveillance, strict infection control measures, and institution-specific antibiotic policies are essential to reduce infection rates and improve patient outcomes.

Keywords: ICU-acquired infections, nosocomial infections, bacteriological profile

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INTRODUCTION

Nosocomial infections, also referred to as hospital-acquired infections, are infections that develop during hospital stay and were neither present nor incubating at the time of admission. Among all hospital areas, Intensive Care Units (ICUs) represent the epicenter of nosocomial infections due to the concentration of critically ill patients requiring complex and invasive supportive care. ICU-acquired infections are defined as infections occurring after 48 hours of ICU admission or within 48 hours of transfer from an ICU. [1,2]

Despite accounting for only 5–10% of total hospital beds, ICUs contribute disproportionately to the overall burden of nosocomial infections, accounting for nearly 20% of all hospital-acquired infections. This increased vulnerability is attributed to multiple factors, including severity of illness, impaired host defenses, frequent use of invasive devices, prolonged hospitalization, and extensive exposure to broad-spectrum antimicrobials. [3,4,5]

ICU-acquired infections are associated with increased morbidity, mortality, prolonged ICU stay, and escalating healthcare costs. Moreover, these infections are often caused by multidrug-resistant organisms, limiting therapeutic options and complicating clinical management. The epidemiology and bacteriological profile of ICU infections vary across institutions, influenced by local infection control practices, antibiotic usage patterns, and patient demographics. [6]

In rural tertiary care settings, data on ICU-acquired infections remain limited. Understanding the local clinical patterns and microbial spectrum is essential for formulating effective prevention strategies and empirical treatment guidelines. (7) This study was undertaken to evaluate the clinical and bacteriological profile of ICU-acquired infections in adult patients admitted to the medical ICU of Meenakshi Medical College Hospital And Research Institute.

MATERIALS AND METHODS

This was a **prospective observational study**

Study Duration

The study was conducted over a period of **24 months**

Study Population

A total of **100 adult patients** admitted to the medical ICU were enrolled and followed prospectively until discharge or death.

Inclusion Criteria

- Age ≥18 years
- ICU stay of ≥48 hours
- Development of clinical features of infection after 48 hours of ICU admission or within 48 hours of transfer from ICU

Exclusion Criteria

- Evidence of infection at the time of ICU admission
- Development of infection within the first 48 hours of ICU stay
- Patients transferred from ICUs of other hospitals

Data Collection

All eligible patients underwent detailed clinical evaluation. Baseline investigations included complete hemogram and chest radiography at admission. Patients suspected of developing ICU-acquired infections were further evaluated with:

- Repeat hemogram
- Chest X-ray
- Urine routine examination and culture
- Paired blood cultures
- Site-specific cultures (sputum, endotracheal aspirate, urine, etc.) prior to initiation of antibiotics

Temperature monitoring was performed four-hourly. Diagnostic criteria for ICU-acquired infections were based on standard CDC definitions.

Microbiological Analysis

Samples were processed using standard microbiological techniques. Organisms were identified, and antimicrobial susceptibility testing was performed according to established laboratory protocols.

Statistical Analysis

Data were entered into a structured proforma and analyzed using appropriate descriptive statistical methods. Results were expressed as frequencies and percentages.

RESULTS

Table 1: Distribution of ICU-Acquired Infections by Type (n = 100)

Type of ICU-Acquired Infection	Number of Patients	Percentage (%)
Pneumonia (including VAP)	38	38.0
Urinary Tract Infection (CAUTI)	30	30.0
Blood Stream Infection (CLABSI)	22	22.0
Others (Skin/Soft tissue, GI)	10	10.0
Total	100	100.0

Pneumonia was the most common ICU-acquired infection, followed by catheter-associated urinary tract infections and bloodstream infections.

Table 2: Distribution of Risk Factors Associated with ICU-Acquired Infections

Predisposing Risk Factor	Number of Patients	Percentage (%)
Prolonged ICU stay (>7 days)	72	72.0
Indwelling urinary catheter	68	68.0
Mechanical ventilation	60	60.0
Central venous catheter	46	46.0
Prior antibiotic therapy	58	58.0
Multiple invasive procedures	40	40.0

Prolonged ICU stay and use of invasive devices were the most common risk factors contributing to ICU-acquired infections.

Table 3: Bacteriological Profile of ICU-Acquired Infections

Microorganism Isolated	Number of Isolates	Percentage (%)
Klebsiella species	26	26.0
Pseudomonas aeruginosa	22	22.0
Escherichia coli	18	18.0
Acinetobacter species	14	14.0
Staphylococcus aureus	12	12.0
Enterococcus species	8	8.0
Total	100	100.0

Gram-negative bacilli were the predominant pathogens causing ICU-acquired infections, with *Klebsiella* and *Pseudomonas* species being the most frequently isolated organisms.

DISCUSSION

Intensive care unit (ICU)–acquired infections remain a major challenge in the management of critically ill patients and continue to contribute significantly to morbidity, mortality, prolonged hospitalization, and increased healthcare costs. The present study evaluated the clinical patterns, bacteriological profile, and associated risk factors of ICU-acquired infections in a rural tertiary care hospital, providing valuable institution-specific data that can guide preventive and therapeutic strategies. [8.9]

In this study, pneumonia constituted the most common ICU-acquired infection, followed by urinary tract infections and bloodstream infections. This finding is consistent with several national and international studies that have identified ventilator-associated pneumonia as the leading nosocomial infection in ICUs. The high incidence of pneumonia can be attributed to the frequent use of mechanical ventilation, impaired cough reflex, altered consciousness, and microaspiration of oropharyngeal secretions in critically ill patients. The prolonged duration of ventilation further increases the risk of colonization by pathogenic organisms, leading to infection. [10, 11, 12]

Urinary tract infections were the second most common ICU-acquired infection in the present study, predominantly associated with indwelling urinary catheters. Catheter-associated urinary tract infections are well recognized as the most frequent nosocomial infections in hospital settings. In ICUs, the risk is amplified due to prolonged catheterization, breaks in aseptic technique, and frequent manipulation of catheters. These findings emphasize the importance of adhering to catheter care protocols and early removal of urinary catheters whenever clinically feasible.

Bloodstream infections accounted for a substantial proportion of ICU-acquired infections in this study. The majority of these infections were associated with the use of central venous catheters, which serve as a direct portal of entry for microorganisms into the bloodstream. Similar observations have been reported in earlier studies, highlighting the critical role of catheter-related infections in ICU morbidity. Strict adherence to insertion bundles, maintenance protocols, and surveillance for early signs of infection is essential to reduce the incidence of bloodstream infections.

Analysis of predisposing risk factors revealed that prolonged ICU stay was the most common factor associated with ICU-acquired infections. Extended hospitalization increases cumulative exposure to invasive devices, healthcare personnel, and hospital flora, thereby elevating the risk of infection. Mechanical ventilation, indwelling urinary catheters, central venous lines, and prior antibiotic use were also frequently observed risk factors. The presence of multiple invasive devices in a single patient significantly increases susceptibility to infection, underscoring the need for judicious use of such interventions.

The bacteriological profile in the present study showed a predominance of Gram-negative organisms, with *Klebsiella* species and *Pseudomonas aeruginosa* being the most frequently isolated pathogens. This pattern is in agreement with studies from other Indian ICUs, where Gram-negative bacilli have emerged as the leading causes of nosocomial infections. The predominance of these organisms may be attributed to their ability to survive in hospital environments, form biofilms on medical devices, and acquire resistance to multiple antimicrobial agents.

A notable finding of this study was the high level of antimicrobial resistance among the isolated pathogens. Resistance to commonly used antibiotics poses a serious challenge in the management of ICU-acquired infections and limits therapeutic options. Prior exposure to broad-spectrum antibiotics was a common feature among infected patients, suggesting that inappropriate or prolonged antibiotic use may contribute to the selection of resistant strains. These findings highlight the importance of antimicrobial stewardship programs and the need for institution-specific antibiotic policies based on local susceptibility patterns.

The results of this study emphasize the critical role of infection control measures in preventing ICU-acquired infections. Simple yet effective strategies such as hand hygiene, barrier nursing, proper sterilization of equipment, and staff education can significantly reduce infection rates. Regular surveillance and feedback to healthcare workers are essential components of a successful infection control program.

In conclusion, ICU-acquired infections in the present study were predominantly associated with invasive devices and prolonged ICU stay, with Gram-negative organisms being the major causative agents. Continuous monitoring, strict adherence to infection control practices, rational antibiotic use, and regular surveillance are imperative to reduce the burden of ICU-acquired infections and improve patient outcomes in critical care settings, particularly in resource-constrained settings.

CONCLUSION

ICU-acquired infections represent a significant burden in critically ill patients, particularly in resource-limited rural tertiary care settings. Pneumonia, urinary tract infections, and bloodstream infections were the most common infections observed, predominantly caused by Gram-negative organisms with high antimicrobial resistance. Early identification of risk factors, judicious use of invasive devices, strict infection control practices, and rational antibiotic use based on local susceptibility patterns are essential strategies to reduce the incidence of ICU-acquired infections and improve patient outcomes.

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