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Nosocomial infections in surgical intensive care unit: A retrospective single-center study

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Abstract---Background: Various microorganisms predominant in hospitals causes nosocomial infections (NIs) making patients in Surgical intensive care units (SICU) prone to NI. Aim: To study the prevalence, antibiotic and microbiological sensitivity, and resistance profiles, as well as the influence of NI in ICU, stay and mortality in patients admitted to our hospital's SICU. Materials and Methods:Over a period of a year, a retrospective investigation of all surgical ICU patients was performed. All patients who suffered withNIwere included in the study. The incidence of NI, their sites, and the bacteria that cause them have all been recognized. The grown bacteria's antibiotic sensitivity pattern was discovered. By comparing this group of patients with NIto a group of patients without NI in terms of age, gender, and clinical diagnosis, the impact of NIon ICU duration and death was assessed. Results:During the trial, 80 of the 235 patients who were admitted to ICU developed NIand were selected. The control group consisted of 80 patients who matched the research group's participants. In our research, 34.04% of patients had NI. The most prevalent nosocomial infection was skin and soft tissue infections (37.89%), which included surgical wound infections, followed by respiratory infections (24.21%) and genitourinary infections (22.11%). Escherichia coli (26.31%) and Acinetobacter species were the most prevalent pathogens causing NI(18.94%). Patients with NIspent 15.7 days in the ICU on average, compared to 6.4 days (P <0.05) for similar patients without infections. Patients with NIhad a death rate of 24.37

percent, while patients who didn't had NI had a mortality rate of 9.54 percent ($P < 0.05$). Conclusions: ICU duration of stay and mortality are significantly increased by the Nosocomial infections.

Keywords--klebsiella, acinetobacter, nosocomial infections, surgical intensive care unit, pseudomonas aeruginosa,

Introduction

Nosocomial infections (NI) are normal entanglements in patients hospitalized in ICU or intensive care units, with detailed rates of 5%-10% in European and American nations and around 25% in India.¹⁻⁸ The commonness of individual NI will rely upon many elements including the sort of health-care office (essential consideration versus tertiary consideration), kind of ICU (clinical versus careful versus medical-surgical versus consumes versus heart careful), and patient inflow in hospital.^{5,9-11} Due to specific characteristics, such as the type of surgical wound, type of surgery, duration of preoperative hospitalization, and need for blood transfusions, patients in Surgical intensive care units (SICU) are prone to NI.¹²

The treatment of NI is additionally confounded by anti-toxin obstruction and the multi-microbial infections in certain patients. Subsequently, information on the microbial profile and anti-microbial awareness examples of common microorganisms are fundamental. NI cause horribleness and increment mortality in hospitalized patients.¹³⁻¹⁵ Subsequently, the agreement and endeavors to decrease the pervasiveness of NI are significant. The point of our review was to decide the predominance of NI in our ICU and to investigate the normal microorganisms causing NI and their anti-microbial responsiveness and opposition profile. The effect of NI on the length of stay in ICU and mortality of ICU patients was likewise considered.

Materials and Methods

For a duration of 1 year (December 2020–December 2021), medical records of all adult (over 18 years) patients who were admitted to the SICU at Gouri Devi Institute of Medical Sciences and Hospital were reviewed. The Institutional Ethical Committee approval for the study was obtained. The study examined those who had signs of a new infection within 48 hours of ICU admission (NI study group). Microorganisms isolated from the site or blood, demographic parameters (age, gender, and admission diagnosis), location of the infection (skin and soft tissue infections (SSTIs), respiratory tract infections (RTIs), genitourinary system infections (GUSIs), abdominal infections (ABIs), Bloodstream infections (BSI), Central Nervous System infections (CNSIs), microorganisms isolated from the site or blood. Antibiotic sensitivity profiles and resistance patterns were found for *Escherichia coli*, *Acinetobacter*, *Pseudomonas*, *Klebsiella*, Methicillin-resistant *Staphylococcus aureus* (MRSA), etc. The study group was matched by age, gender, and diagnosis of ICU patients who did not have NI. ICU mortality was the primary endpoint. The number of days spent in the ICU was a secondary

outcome. For examining the length of ICU stay and death in both the groups Chi-square test was used.

Result

During the trial, 337 patients who were admitted to the surgical ICU. Out of which, 235 of these patients were admitted for longer than 48 hours, and their medical records were examined. A total of 80 patients displayed signs of NI (prevalence rate 34.04 percent). The study group was made up of these patients. SSTIs were most prevalent (37.89%), followed by RTIs (24.21%), and GUSIs (22.11 percent) [Table 1]. *E. coli*, *Klebsiella*, *Acinetobacter*, and *Pseudomonas* were commonly causing microorganisms for NI [Table 2]. Table 3 lists the most frequent bacteria based on the site of infection. Approximately half of the patients are over 60 years old, with men accounting for 3/4 of the total. A clinical diagnosis of the acute abdomen or abdominal surgery was found in two-thirds of the patients. Gram-negative bacteria were the most often grown microorganisms from samples taken from NI patients. Tables 4 and 5 show the antibiotic resistance and sensitivity profiles of the various bacteria isolated. Patients with and without NI spent 15.7 and 6.4 days in the ICU, respectively ($P < 0.05$) (see Table 6).

Table 1: Types of nosocomial Infections (NI)

Type	Number of Patients	Percentage (%)
Skin and soft tissue (including surgical site infections)	36	37.89
Respiratory tract	23	24.21
Genitourinary system	21	22.11
Abdomen	8	8.42
Bloodstream	6	6.32
Central nervous system	1	1.05
Total	95	100

Total SICU patients with >48hr in ICU=235. Patients with NI=80 (prevalence=34.04%). Some patients were infected with multiple NI. SICU: Surgical Intensive care unit

Table 2: Nosocomial Infection causing micro-organisms

Microorganisms	No. of infected Patients	Percentage (%)
<i>Escherichia coli</i>	25	26.31
<i>Acinetobacter</i>	18	18.94
<i>Pseudomonas</i>	16	16.84
<i>Klebsiella</i>	11	11.58
Methicillin-resistant <i>Staphylococcus aureus</i>	6	6.32
Others	19	20.01
Total	95	100

Some patients were infected with multiple NI

Table 3: Microorganisms that cause nosocomial infections, according to the type of infection

Microorganisms	SSTIs %	RTIs %	GUSIs %
Escherichia coli	32.84	8.78	36.43
Acinetobacter	16.54	25.94	9.11
Pseudomonas	4.22	30.34	27.72
Klebsiella	11.94	17.69	4.57
MRSA	4.22	-	-

MRSA: Methicillin-resistant Staphylococcus aureus; SSTIs: Skin and soft tissue (including surgical site infections); RTIs: Respiratory Tract Infections; GUSIs: Genitourinary system infections

Table 4: Antibiotic drug resistance profile of microorganisms

Drugs	Acinetobacter (%)	E. coli (%)	Pseudomonas (%)	Klebsiella (%)
Imipenem	0	5.25	5.25	5.25
Amikacin	4	34.44	27.37	15.92
Gentamicin	11	24.66	23.05	13.09
Doxycycline	10	18.09	0	16.92
Piperacillin tazobactam	0	5.25	13.98	9.72
Ciprofloxacin	11	3.88	17.34	9.72

Table 6: Gram-negative bacteria that are resistant to more than three antibiotic types

Microorganisms	Percentage (%)
Escherichia coli	6.43
Acinetobacter	64
Pseudomonas	6.01
Klebsiella	15.38

Table 7: The average length of stay in intensive care units and the % fatality rate

Groups	Average number of days in ICU	Percentage mortality
Test group (with NI)	15.7	24.37
Controls (without NI)	6.4	9.54

NI: Nosocomial Infections; ICU: Intensive Care Units

In the study group, there was a statistically significant increase in ICU stay and percentage death ($P < 0.05$).

Discussion

Our study recorded an ICU NI rate of 34.04%. A study from North India found that suggested similar NI rate (33.5%), however it was more EPIC study (20.6%).²⁻⁴ Kuwait documented a lesser rate of 10.6% among SICU patients and according to another study conducted in 2011, there was a lower rate among medical ICU patients (9.6%).^{5,6} A study from tertiary consideration ICU in North India in mixed medical-surgical ICU patients noticed a NI rate of 58.86%.⁷ SSTI was the most prevalent NI, followed by respiratory infections, genitourinary infections.

Gram-negative bacilli were commonly causing NI in our investigation. (*E. coli* > *Acinetobacter* > *Pseudomonas* > *Klebsiella*) (73.67 percent). The majority of researchers have found that Gram-negative bacilli predominate in NI in and out of the ICU.^{2-7,9-11,13-15} These studies have been published in a range of contexts, including medical, surgical, mixed medical-surgical, and respiratory settings. Gram-positive bacteria have only been described as the main pathogen in NI very seldom, as in the SOAP investigation.⁸ *S. aureus* was the most common organism in this investigation, with 50 percent of the bacteria being MRSA.

In our investigation, 64 percent of *Acinetobacter* isolates were multidrug-resistant (MDR), meaning they were resistant to over three classes of antibiotics. Several investigations have found that MDR is present in two-thirds of *Acinetobacter* isolates from patients.¹⁶⁻¹⁸ In our investigation, almost 33% of the *E. coli* isolated were MDR. The reported percentage of MDR conditions in *E. coli* isolates ranged from 22% to nearly 80%.^{2,19} MDR bacteria are a serious concern to ICU patients. With limited therapeutic choices, these patients are at an elevated risk of morbidity and mortality.

The influence of NI on patient mortality and morbidity in hospitals is debatable. However, some recent studies back up the idea that NI increase ICU patient mortality and morbidity.^{20,21} NI caused a considerable increase in ICU stay and mortality in our ICU. Several studies, including several in India, noted that patients with NI spend more time in the ICU than patients without infections.^{2,3,5,8,19-21} In ICU patients who develop NI, mortality rates range from 10% to 40%. The mortality rate in our ICU was 24.37 percent, which was significantly greater than the rate among patients who did not have NI. As a result, aggressive steps to decrease the occurrence of NI should be performed.

There were few limitations to our research. The research was carried out in a surgical ICU at a teaching hospital. It's a single-center research project. It is cautionary to explore and extend our findings to the general population. A multicentric study encompassing multiple specialties in ICU, such as neurosurgical ICU and cardiovascular surgery ICU, would add greater value to such findings, in addition to providing information on NI in these study groups. The sample size for our study was small as well. A study with a higher sample size will be sufficiently powered to reveal the intricacies of NI in the surgical ICU population, as well as offer a foundation for investigating factors linked to mortality in this population.

Furthermore, bacterial patterns in one ICU (even within a major hospital) may differ significantly from those in another, so keep this in mind when extrapolating

our findings to other ICUs. Our research was notable for demonstrating the statistical relevance of NI in SICU patients.

Conclusion

One-third of surgical ICU patients get nosocomial infections. Major bacterias detected in these patients are MDR Acinetobacter and E. coli. These patients' hospital morbidity and mortality are greatly increased by nosocomial infections.

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