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Prevalence and outcome of infections in intensive care units of a tertiary care hospital in north India.

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Samiullah Sami Malik [1] - B,C,E,F,H,O. ORCID www.orcid.org/0000-0003-2091-9594
Muzaffar Maqbool [2] - A,E,F,G,H,J,N,O. ORCID www.orcid.org/0000-0003-4010-9900
Asma Rafi [2] - B,I,K,M,N,O. ORCID www.orcid.org/0000-0001-9867-3462
Najma Kokab [1] - A,F,G,J,O. ORCID www.orcid.org/0000-0001-7774-1382

[1] *General Medicine, HIMSR & HAHC, New Delhi, India.*
[2] *Department of Medicine, Government Medical College, Srinagar Kashmir, India.*

Address for correspondence:
Muzaffar Maqbool, MD. Department of Medicine, Government Medical College, Srinagar Kashmir, India. Karan Nagar, Srinagar, Jammu and Kashmir 190010, India.
Tel.: +91 7006218644; E-mail: muzaffarmaqbool75@gmail.com

Author Contributions (CRediT Taxonomy):

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Writing (Review & Editing) – **N**
Approved the final version - **O**

ABSTRACT

INTRODUCTION: Infection is a major cause of morbidity and mortality in Intensive Care Units (ICUs), more so in resource limited ICUs of low and lower-middle income countries. However relatively little information is available about epidemiology and outcome of such infections in our part of the world. The point was to provide information about the prevalence and outcome of primary and secondary (nosocomial) infections in ICUs.

MATERIAL AND METHODS: 257 adult patients admitted in medical and surgical ICUs over a period of 9 months were enrolled in the study. Patients fulfilling sepsis 3 criteria were categorized under “prevalence of the infections” and patients who developed infections after 48 hours of admission in ICUs were categorized under “secondary (nosocomial) infections”. Sequential Organ Failure Assessment score (SOFA score) was calculated at admission and after 72 hours of ICU stay. The patients were followed for 30 days.

RESULTS: Patients were distributed in two groups: 153 (59.5%) medical ICU and 104 surgical ICU patients. Prevalence of primary infection was significantly higher in medical ICU patients (p value < 0.05). A total of 93(60.8%) patients in medical ICU and 50(48.1%) patients in surgical ICU were admitted as primary infections (p value < 0.001). Secondary (nosocomial) infections occurred in 30 (19.6%) patients in medical ICU and 15 (14.4%) patients in surgical ICU (p-value 0.283). The average length of stay was 14 days in patients with nosocomial infections and 3.5 days for patients without secondary infections (p-value < 0.001). Out of total of 188 infected patients, 80 (42.5%) died whereas 17 (24.6%) of the 69 patients without infection expired (p-value 0.008). 112 patients with mean SOFA score of 11.35 ± 2.71 expired while as 145 patients with mean SOFA score of 5.84 ± 1.92 survived (p value < 0.001).

CONCLUSIONS: The prevalence of infections was more in medical ICU than in surgical ICU. The nosocomial infections significantly increase the average length of stay in ICUs. Mortality was significantly more in patients admitted with infection in Intensive Care Units. The higher the SOFA score, greater the mortality.

KEY WORDS: Intensive Care Units, mortality, nosocomial infections, Sequential Organ Failure Assessment (SOFA).

INTRODUCTION

In low and lower-middle income countries, infections are one of the most common and important causes of mortality [1,2]. Despite the decrease in infection related mortality in last 3 decades, they remain an important cause of death [2] and disability [1,3]. Nosocomial infections can be defined as those occurring within 48 hours of hospital admission, 3 days of discharge or 30 days of surgery [4]. These infections are associated with a considerable increase in morbidity and mortality of patients at a hospital as well as to significant increases in healthcare costs. Nosocomial infections occur in 5% to 17% of hospitalized patients [5]. Prevalence of ICU infections varies between 45% to 58% and incidence rates between 30 to 35% [6]. The European Prevalence of Infection in Intensive Care (EPIC) Study demonstrated nosocomial infection prevalence in ICU to be significantly higher at around 20.6% [7]. Studies in Europe and North America have reported that primary (at the time of admission) as well as secondary (nosocomial, ventilator associated, device-related, and others) infections are common in ICUs. ICU acquired infections have been reported to be associated with increased length of ICU and hospital stay [8] and an additional cost of about $3.5 billion/year [9].

An Intensive Care Unit (ICU) in a hospital deal with patients that require critical care. The beds in ICU are often limited and resource constrained in middle income countries. ICUs are an important source of bacterial infections [7-12]. In India, infections remain an important cause of morbidity and mortality [12,13]. Several studies conducted from different regions of the country have reported that both primary and secondary(nosocomial) infections are widespread in Indian ICUs [12-16]. However the data regarding epidemiology of infections and outcome from ICUs of our part of country is lacking. The present study was conducted to determine the prevalence and outcome of Primary and Secondary (nosocomial) infections in medical and surgical ICUs of a tertiary care hospital of North India.

MATERIAL AND METHODS

This prospective observational study was conducted at SMHS hospital, a tertiary care hospital in Kashmir India. The eligible patients ≥18 years of age were recruited from surgical and medical ICUs of a 700-bedded tertiary care hospital over a period of 9 months from November 2018 to July 2019, after obtaining proper written consent from the patients/next of kin after explaining the nature of study in local and simple language. The patients were classified into two categories based on the admission criteria. Patients who had undergone surgery in the 4 weeks preceding admission were considered surgical admissions. All other admissions were considered medical admissions.

The demographic characteristics (age, gender, education, residence), clinical history, primary diagnosis, and outcomes of all the patients were taken. In each patient admitted to the ICU, the cultures of blood, urine, wound swab, sputum or endotracheal secretions, and other relevant specimens apart from routine baseline investigations were collected using standard procedures of admission and when indicated.

The patients who fulfilled with definition of infection using sepsis 3 criteria [17] were categorized under "*prevalence of the infections in ICU*" and patients who developed infections after 48 hours of admission in ICUs were categorized under "*secondary (nosocomial) infections in ICU*". Sepsis-related organ failure assessment score, also known as Sequential Organ Failure Assessment score (SOFA score) [18], was used to track a person's status during the stay in an ICU to determine the extent of a person's organ function or rate of failure. SOFA score was calculated at the time of admission in ICU and again after 72 completed hours of ICU stay. The patients enrolled in this study were followed for a period of 30 days to look for 30-day mortality. Outcomes included death, transfer to other hospital and recovery.

Statistical methods

All analyses were performed using SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. The relationship between two categorical variables was analyzed using Pearson Chi-square test. Exact p-values were reported when expected cell frequencies were <5. The difference between two means was analyzed using independent-samples t-test. Two-sided p-values were reported and $p<0.05$ was considered statistically significant.

Ethical considerations

The ethical approval for conducting this study was obtained from institutional ethical committee of *Government Medical College Srinagar* with approval number of 236/ETH/GMC/ICMR dated 19/10/2018.

RESULTS

A total of 257 patients were enrolled in the study. The study patients were distributed in two groups with 153 (59.5%) patients in medical category admitted in medical ICU and 104 patients in surgical category admitted in surgical ICU. Prevalence of primary infection was significantly higher in medical patients in comparison to surgical patients (p value <0.05). Majority of patients in our study i.e., 87 (33.9%) belonged to age group of 41-60 years followed by 76 (29.6%) who were aged 61-80 years, 45 (17.5%) belonged to age group of >80 years, 41 (15.9%) belonged to age group between 21-40 years, whereas 8 (3.11%) patients aged <20 years. There was statistically no significant difference in prevalence of primary infections in various age groups with p-value of 0.936. Out of 257 patients enrolled in study, 145 were males and 112 were females. 76 (52.4%) males and 57 (59.8%) females were admitted with primary infections. This difference was statistically not significant with p-value of 0.808 (Table 1). Out of total 257 patients enrolled in this study, 93 (60.8%) patients in medical ICU and 50 (48.1%) patients in surgical ICU were admitted as primary infections. Prevalence of primary infection was significantly higher in medical ICU in comparison to surgical ICU patients (p value <0.001). Secondary (nosocomial) infections occurred in 30 (19.6%) patients in medical ICU and 15 (14.4%) patients in surgical ICU and this difference was statistically not significant (p-value 0.283). The average length of stay was 14 days in patients with nosocomial infections whereas the average length of stay in patients without nosocomial infections was 3.5 days and this difference was statistically significant (p-value <0.001).

Table 1. Baseline characteristics of study population.

Parameter	Prior infection N (%)	No infection N (%)	Total (%)	p-value
Category				
Medical ICU	93(60.8)	60(39.2)	153(59.5)	**0.044**
Surgical ICU	50(48.1)	54(51.9)	104(40.5)	
Age (Years)				
<20	5	3	8(3.1)	
21-40	24	17	41(15.9)	
41-60	47	40	87(33.9)	0.936
61-80	39	37	76(29.6)	
>80	25	20	45(17.5)	
Gender				
Males	76(52.4)	69(47.6)	145(56.4)	0.808
Females	57(59.8)	55(40.2)	112(43.6)	

Table 2. Baseline characteristics of study population.

Prevalence of infections in medical and surgical ICUs			
ICU	**N**	**% age**	**P-value**
Medical ICU	93	60.8	**<0.001**
Surgical ICU	50	48.07	
Incidence of nosocomial infections in medical and surgical ICUs			
Medical ICU	30	19.6	0.283
Surgical ICU	15	14.4	
Relationship between nosocomial infections and average length of stay (ALOS) in ICUs			
Nosocomial infections	**N**	**Median (Days)**	**P-value**
Present	45	14	**<0.001**
Absent	212	3.5	
Systems involved in primary infections			
System	**Number**		**Percentage**
Respiratory	83		58.0
Urinary	47		32.9
Others (skin, soft tissue, wounds)	13		9.1
Systems involved in nosocomial infections			
Respiratory system	29		64.4
Urinary system	9		20.0
IV Line/Catheter related blood stream infections	4		8.9
Others (SSTIs / bed sores)	3		6.7
30-day outcome of patients in ICUs without infection			
Parameter	**Number (69)**		**Percentage**
Mortality	17		24.6
Recovered	32		46.4
Transferred to other hospitals	20		29.0
30-day outcome of patients in ICUs with infection			
Parameter	**Number (188)**		**Percentage**
Deaths in ICU	80		42.6
Deaths out of ICU	10		5.3
Patients recovered	98		52.1

In patients admitted with primary infections, respiratory system was involved in 83 (58%) patients followed by urinary system in 47 (32.9%) patients while as others (skin, soft tissue, and wounds) involvement was seen in 13 (9%) patients. In patients with nosocomial infections (n=45), respiratory system was involved in 29 (64.4%) patients followed by urinary system in 9 (20%), IV line / catheter related blood stream infections in 4 (8.9%) and others (SSTIs / bed sores) in 3 (6.7%) patients. 30-day follow-up of patients revealed that among 69 patients admitted in ICU without infection, 17 (24.65%) patients expired, 32 (46.37%) patients recovered, and 20 (28.98%) patients were transferred to other hospitals for further management whereas among 188 infected patients, 80 (42.6%) patients died in ICU, 10 (5.33%) patients expired out of ICU while as 98 (52.1%) patients recovered successfully (Table 2).

Out of total of 188 ICU patients with infection (primary/ nosocomial), 80 (42.5%) patients died. Of the 69 patients in ICU without infection, 17 (24.6%) patients expired. This difference was statistically significant (p-value 0.008). Out of 153 patients admitted in medical ICU, 60 (39.2%) patients died whereas 37 (35.5%) patients, out of 104 admitted patients, died in surgical ICU. This difference was statistically not significant (p-value 0.554). Of the 257 study patients, 112 patients with mean SOFA score of 11.35±2.71 expired while as 145 patients with mean SOFA score of 5.84±1.92 survived (p< 0.001) (Table 3).

Table 3. Comparison of mortality of study patients.

ICU mortality in patients with or without infection				
Parameter	**Died**	**Survived**	**Mortality Percentage**	**p-value**
No. of patients with infection(n=188)	80	108	42.5	**0.008**
No. of patients without infection (n=69)	17	52	24.6	
ICU mortality of study patients				
ICU Mortality	**Total No. of Patients**	**No. of Deaths**	**Percentage**	**p-value**
Medical ICU	153	60	39.2	
Surgical ICU	104	37	35.5	0.554
Total	257	97	37.7	
Correlation of SOFA score with mortality in study patients				
Outcome		**N**	**Mean±SD**	**p-value**
Died		112	11.35±2.71	**<0.001**
Survived		145	5.84±1.92	

DISCUSSION

Our study patients were distributed in two groups with 153 (59.5%) patients in medical category and 104 (40.5%) in Surgical category. The mean age of our study patients was 56.4±21.76 years with 18 years patient being the youngest one and 88 years as the oldest one. The prevalence of infections in medical ICU was observed to be 60.8% in comparison with surgical ICU infection rates of 45.07%. The difference was observed to be statistically significant with p<0.001. A 24-hours point prevalence study conducted by Vincent et al. found that 54% of patients in ICU had suspected or proven infection [19]. A study done by Toufen and colleagues [20] found that patients admitted to the medical ICU presented with more overall infections (72.1% vs. 55.0%) with a significant correlation between prevalence of infection in medical ICU and surgical ICU patients (p < 0.05). Out of 153 patients in medical ICU, 30 (19.6%) were found to have nosocomial infection while of the 104 patients in surgical ICU, nosocomial infection was found in 15 (14.4%) patients (p=0.283). This is in agreement with the study conducted by Ghosh A. and colleagues [21] who report the rate of nosocomial infection during 2016-2018 at 13%. A study conducted by Despotovic Aleska et al. found the prevalence of hospital acquired infections in adult ICUs in 32.7% of studied patients [22].

Out of 257 patients enrolled in this study, respiratory system was involved in 149 (58%) patients followed by genitourinary system in 84 (33%) patients while as others (skin, soft tissue and wounds) involvement was seen in 24 (9%) patients. A study conducted by Vincent et al. [8] reported that lungs were the most common site of infection, accounting for 64% of infections, followed by the abdomen (20%), the bloodstream (15%), and the renal tract/genitourinary system (14%). However, in patients with nosocomial infections (n=45), respiratory system was involved in 29 (64.4%) patients followed by urinary system in 9 (20%), IV line / catheter related blood stream infections in 4 (8.9%) and others in 3 (6.7%) patients. This is in line with various studies that report the most common nosocomial infections to be that of respiratory tract (bronchitis, pneumonia) followed by urinary tract (cystitis, pyelonephritis), bloodstream infections (septicemia), skin and soft tissue infections and surgical site infections [21,23-25]. The average length of stay in ICU was 14 days with a range of 11-38 days in patients with nosocomial infections while in patients without nosocomial infections the median ICU stay was 3.5 days with a range of 2-7 days. The similar results have previously been reported by Olaechea and colleagues [26] and Dasgupta et al. [27] who reported that the median ICU stay for infected patients with nosocomial infection was 13 days and 17.28 days respectively. In our study, of the 257 patients, 112 patients with mean SOFA score of 11.35±2.71 expired while as 145 patients with mean SOFA score of 5.84±1.92 survived (p< 0.001). Similar findings were observed by Shabir and Maqbool [28] which was evidenced by significantly higher SOFA score of 5.50 ± 1.89 in survivors and 11.67 ± 2.87 in non-survivors. Paary et al. [29] also conducted a study in which mean SOFA score was 5.70 ± 3.4 in survivors and 9.30 ± 3.7 in non-survivors. Out of 257 patients, 39.2% patients expired in medical ICU (60/153) while as 35.5% patients expired in surgical ICU (37/104) (p=0.554). A study by Toufen et al. [20] reported that the mortality rate in ICU was 30% in which 35.2% expired in medical ICU while as 26.1% died in surgical ICU.

Out of 257 enrolled patients, 92 (35.79%) patients expired in ICUs, 15 (5.84%) patients expired out of ICUs, 20 (7.79%) were transferred to other hospitals for further necessary management while as 130 (50.58%) patients recovered fully. The comparable results were obtained by Vincent et. al, who reported a mortality of 30% in patients with suspected or proven infection [19]. Engel and colleagues also reported that the ICU and hospital mortality of patients with severe sepsis was 48.4 and 55.2%, respectively [30].

Limitations - This study reports the prevalence of primary and nosocomial infections in medical and surgical ICUs but does not compare the prevalence among various centers due to smaller sample size and limited resources.It would have been worthwhile to study detailed microbiological profile of patients with infections, that would have given a deeper insight into the pattern of infections and resistance pattern so as to strengthen local antimicrobial protocol.

CONCLUSIONS

The study concludes that the prevalence of infections was more in medical ICU than in surgical ICU. The nosocomial infections significantly increase the average length of stay in ICUs. The mortality is significantly more in patients admitted with infection compared to the ones who were admitted without infection in Intensive Care Units. The higher the SOFA score, greater the mortality.

SUPPLEMENTARY INFORMATION

Funding: *This research received no external funding.*
Institutional Review Statement: *The study was conducted according to the guidelines of the Declaration of Helsinki.*
Informed Consent Statement: *Informed consent was obtained from all subjects involved in the study.*
Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
Conflicts of Interest: *The authors declare no conflicts of interest.*

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