Etiology and Incidence of Infection in Mechanically Ventilated Medical Intensive Care Unit Patients in a Tertiary Care Hospital

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Abstract

Introduction. Intensive care unit (ICU) patients are at the greatest risk of acquiring nosocomial infections, partly because of their serious underlying disease, but also by exposure to life-saving invasive procedures. Hospital-acquired infections increase patient morbidity, increase the length of hospital stay and hospital costs, and also increases mortality rate. The basic knowledge of organisms infecting ICU patients is very important to empirically select appropriate antibiotics, so that the most likely infecting organisms are addressed.

Objective. The aim of the study was to find out the etiologic agents causing infection in medical intensive care unit patients.

Results. In our study of 289 patients, 180 (62.3%) showed a growth of organism during the stay in ICU. The most common site of infection was the respiratory tract in 138 patients (47.8%) with 60 patients (20.8%) showing *Acinetobacter baumannii*.

Key Words: Nosocomial Infection, etiology, Intensive Care Unit, *Acinetobacter baumannii*, Mechanical ventilation

Introduction

Infections and sepsis are the leading cause of death in non-cardiac intensive care units (ICU) and account for 40% of all ICU expenditures.[1] ICU patients are at the greatest risk of acquiring nosocomial infections, partly because of their serious underlying disease, but also by exposure to life-saving invasive procedures. Hospital acquired infections increase patient morbidity, increase the length of hospital stay and hospital costs, and increases mortality rate. The basic knowledge of organisms infecting ICU patients is very important to empirically select appropriate antibiotics, so that the most likely infecting organisms are treated.

Compared to patients in the general hospital wards, patients in ICUs have more chronic co-morbid illnesses and more severe acute physiologic derangements and thus are relatively immunocompromised.[2]. Multidrug-resistant pathogens, such as Methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), *Acinetobacter baumannii*, enterobacteriaceae that produce extended-spectrum beta-lactamases (ESBL) and carbapenem-resistant *Pseudomonas aeruginosa*, are all being isolated with increasing frequency in ICUs.[3,4]. Infections caused by these resistant pathogens are difficult to treat and are associated with increased morbidity, mortality, and cost.[5,6]. Although the overall global mortality due to infections has decreased in the last three decades it is still the most important cause of disability.[7,8]

Thus, India is no exception which shows the same trends.[9] A one day prospective point-prevalence study in 1,265 participating ICUs (75 countries worldwide) showed that 51% of the 12,796 patients were infected.[10] The most important nosocomial infections in the ICU are catheter-related bloodstream infections (CRBSIs), ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infections (CAUTIs). Many studies show CAUTIs as the most common nosocomial infection in ICUs.[11-14] However, other studies put VAP on the top of list.[15-18]

Objective. The aim of the study was to find the etiologic agents causing infection in medical ICU patients.

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Table I. Growths on Blood Culture

Organism Grown on culture	Frequency	Percent
No Growth	236	81.7
Staphylococcus aureus	*8*	*2.8*
Staphylococcus hominis	*7*	*2.4*
Staphylococcus hemolyticus	*9*	*3.1*
Staphylococcus epidermidis	*1*	*0.3*
Methicillin Resistant	*8*	*2.8*
Staphylococcus Aureus (MRSA)		
Staphylococcus warneri	*1*	*0.3*
Staphylococcus xylosus	*1*	*0.3*
Staphylococcus cohni	*2*	*0.7*
Enterococcus faecalis	*4*	*1.4*
Acinetobacter baumannii	*6*	*2.1*
Pseudomonas aeruginosa	*1*	*0.3*
Escherichia coli	*1*	*0.3*
Klebsiella pneumoniae	*3*	*1.0*
Yeast	1	0.3
Total	289	100.0

Table II: Growths on Urine Culture

Organism Grown on culture	Frequency	Percent
No Growth	252	87.2
Enterococcus faecalis	4	1.4
Pseudomonas aeruginosa	1	0.3
Escherichia coli	4	1.4
Klebsiella pneumoniae	2	0.7
Yeast	23	8.0
Candida albicans	3	1.0
Total	289	100.0

Table III. Growth on Endotracheal Aspirate

Organism Grown on culture	Frequency	Percent
No Growth	138	47.8
Staphylococcus aureus	1	0.3
Staphylococcus hominis	1	0.3
Methicillin Resistant	5	1.7
Staphylococcus aureus		
(MRSA)		
Kocuria spp	2	0.7
Mixed flora	1	0.3
Kocuria kristinae	1	0.3
Citrobacter	3	1.0
Elizabethkingia	1	0.3
Proteus mirabilis	1	0.3
Cardiobacterium	1	0.3
Hemophilus. influenzae	1	0.3
Acinetobacter baumannii	60	20.8
Pseudomonas aeruginosa	18	6.2
Escherichia coli	17	5.9
Klebsiella pneumoniae	30	10.4
Candida albicans	4	1.4
Burkholderia cepacea	4	1.4
Total	289	100.0

Materials and Methods

This prospective study was conducted in the Medical ICU of Government Medical College Srinagar. The study was designed and carried out in accordance with the principles of the declaration of Helsinki and with approval from ethics review board of Government Medical College Srinagar. Cultures from the blood, urine, and endotracheal tube aspirate were taken after 72hrs of hospitalisation. Only the cultures obtained after 72hrs of hospitalisation were included in the study to fulfil the required criteria for hospital acquired infection. The blood culture was obtained after proper sterile precautions and inoculated in liquid broth culture bottle and incubated at 37°C the inoculation time was 24, 48, and 72hrs and observed after these intervals to look for growth of organism. The endotracheal aspirate and urine were inoculated and observed for the same period as blood culture on agar plate.

The data were analysed using *SPSS 23* software.

Inclusion Criteria. All non-cardiac, non-surgical patients with age > 14 years who were on mechanical ventilation for respiratory support were included in this study.

Infections that developed 48 hours after admission into the ICU were considered ICU-acquired.

Exclusion criteria. Patients with already culture documented infection 48hrs prior to MICU admission

- Age < 14 years (Paediatric Group)
- Patients who needed surgical intervention or had post-surgery complications, all those were admitted in surgical intensive care units
- Patients with cardiac events who were sent to the cardiac ICU.

Results

Over a period of six years, 289 patients were admitted in the medical ICU of our hospital. The minimum age was 14 years and maximum age of 85 years with mean age of 47.19 years. Out of 289 patients 151 (52.2%) were males and 138 (47.8%) were females. 180 patients had positive culture.

Blood Culture. In all 289 patients, blood cultures were obtained after 72 hrs in MICU. *Staphylococcus aureus* was the most common organism obtained in 37 patients from blood culture (12.8%). Among these patients infected with *Staphylococcus*, the most common was *Staphylococcus hemolyticus* in 9 patients (3.1%), followed by methicillin sensitive *Staphylococcus aureus* in 8 patients (2.8%), methicillin resistant *Staphylococcus aureus* (MRSA) in 8 patients (2.8%), *Staphylococcus hominis* in 7 patients (2.4%), *Staphylococcus cohni* in 2 patients (0.7%), *Staphylococcus epidermidis*, *Staphylococcus warneri* and *Staphylococcus xylosus* 1 patient each (0.3%) (*Table I*)

Urine Culture. Out of 289 patients 252 (87.2%) patients did not show any growth on urine culture obtained 72 hours after admission to MICU. Thirty-seven patients

(12.8%) had positive urine culture. The most common organism found was yeast in 23 patients (8%) followed by *Enterococus faecalis* and *Escherichia coli* in 4 patients each (1.4%), *Candida albicans* in 3 patients (1%) and *Pseudomonas aeroginosa* in 1 patient (0.3%) (*Table II*).

Endotracheal tube aspirate culture. Out of 289 patients there was no growth obtained from endotracheal tube aspirate in 138 patients (47.8%) *Acinetobacter baumannii* was the most common organism obtained in 60 patients (20.8%). *Klebsiella pneumoniae* was the second most common organism from endotracheal tube aspirate in 30 patients (10.4%) followed by *Pseudomonas aeruginosa* in 18 patients (6.2%) *Escherichia coli* in 17 patients (5.9%), methicillin resistant *Staphylococcus aureus* (MRSA) in 5 patients (1.7%), *Candida albicans and Burkholderia cepacea* in 4 patients each (1.4%), *Citrobacter* in 3 patients (1%), *Kocuria* in 2 patients (0.7%) *Staphylococcus aureus*, *Staphylococcus hominis*, Mixed flora, *Kristinae*, *Elizabethkingia*, *Proteus mirabilis*, *Cardiobacter*, and *Hemophilus influenzae* in 1 patient each (0.3%) (*Table III*).

Discussion

The primary aim of our study was to find out the etiologic agent of infection in the medical ICU. The incidence of nosocomial infections varies according to the setting, that is, the type of hospital or intensive care unit, the patient population and the precise definition and surveillance techniques used to identify a nosocomial infection.[19]. In our study we found 180 out of 289 (62.3%) patients had some kind of infection which was grown in culture media during their ICU stay. This is higher than reported in different studies and more than twice the findings compared to large European studies.[20,21]

Our study was closer to EPIC II which has documented point prevalence of 52% infection.[22] However, all these studies included patients from ICUs in general. Our study included patients with only non-cardiac and non-surgical medical illness to which sepsis contributes a major part and could be the reason for the higher incidence of infection. In the EPIC II study, the most frequently reported sites for ICU acquired infections were the lungs (64%), abdominal (19%), and blood (15%). In our study the most common site of infection was also respiratory tract with 47.8% of the patients showing positive growth from tracheal aspirate.

Although recent years have seen swings in the pathogen pattern toward Gram-positive bacterial infections, still most studies report that more than half of the nosocomial infections occurring in the ICU are due to Gram-negative bacteria.[10,14,23,24] In our study too, the most commonly isolated organisms were Gram-negative *Acinetobacter baumannii* which was found in 60 patients (20.8%). In our study 138 patients (47.8%) had positive growth in the endotracheal aspirate and respiratory tract was the most common site of infection which is consistent with EPIC II.

In our study, 18.7% of patients had positive blood cultures which is consistent with other studies.[25] The most common organism obtained was *Staphylococcus sp* seen in 37 patients (12.7%). The isolation of organism is crucial for verifying the appropriateness of antibiotic therapy, which is known to reduce morbidity and mortality.[26,27]. Thirty-seven patients in whom urine cultures were positive showed that the most common organism found was yeast in 23 patients (8 %). There has been a marked increase in opportunistic fungal infections involving the urinary tract, of which *Candida* species are the most prevalent.[28,29] The fungal species (yeast) was detected in only 1 patient (0.3%) from the blood stream which is very low compared to the 15% reported elsewhere.[30,31] These have reported that fungal pathogens are also becoming increasingly common among patients with nosocomial bloodstream infections. The reason for low yield of fungal growth from our study could be due to low incidence of immunocompromised states in our study population.

Meliha et al found infection rate of 70.9 in 100 patients and 56.2 in 1,000 patient-days.[32] Pneumonia (35.4%) and bloodstream infections (18.2%) were the most common infections; *Staphylococcus aureus* (30.9%) and *Acinetobacter spp*. (26.8%) were the most frequently isolated microorganisms.

Conclusion

The incidence of ICU infections is much higher in developing countries compared to developed countries however the etiology of infection is almost similar. Gram-negative organisms are still the most common cause of ICU infections and respiratory tract is the most common site of infection in ICU patients.

Conflict of Interest. The authors declare no conflict of interest

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