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SHORT REPORT

Epidemiology of nosocomial infections in an intensive care unit at a tertiary care hospital in southern India: a retrospective study

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Abstract

Critically ill patients are at increased risk of developing nosocomial infection. Hospitals in developing countries are facing higher incidence of this problem. The aim of this study was to assess the epidemiology of infections in hospital. A retrospective study was conducted at CCU of a tertiary care teaching hospital in South India. All patients who stayed in ICU for more than 48 hours were included in the study. Relevant data on demographics, ICU length of stay, co-morbidities, pre-admission infections and number of devices were recorded from case records. The culture and sensitivity reports were accessed from the microbiology lab registers. Chi square, unpaired t-test and Fisher's exact test were used wherever applicable.

Out of 315 patients included in the study, 93 patients (29.5%) developed 126 episodes of ICU acquired infections (Incidence density rate; 70.3/1000 ICU days), of which common nosocomial infections were pneumonias (15.5%), urinary tract infections (8.9%), blood stream infections (8.2%) and surgical site infections (7%). Patients who acquired infections in ICU had longer ICU stay and received mechanical ventilation for longer hours. The most common isolates were *Pseudomonas aeruginosa* (24.9%), *Acinetobacter baumannii* (23.1%). In logistic regression analysis, following risk factors were significantly associated with higher infection rates: medical category, emergency surgery, diabetes, presence of tracheostomy and total parenteral nutrition (TPN). In conclusion TPN, medical category, emergency surgery, diabetes mellitus and presence of tracheostomy were significant risk factors which lead to higher infection rate. These data will help reinforce the infection control measures.

Keywords: Intensive care unit; Cross infection; Epidemiology; India.

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Introduction

ICU acquired infections (ICU-AIs) have evolved as serious threats with increasing mortality and morbidity. Developing countries are facing higher burden of this problem, largely due to lack of efficient infection control practices. Critically ill patients are particularly at risk of developing nosocomial infections.[1,2] ICU-AIs develop usually as a consequence of invasive devices or life support therapies resulting in longer ICU stay and increased economic load on patients and their families. Furthermore, multidrug resistant microbes are burgeoning in ICU making situation serious. Hence, it is vital to monitor as well as to control ICU-AIs. Data related to prevalence, risk factors, causative microorganisms, and outcomes of infection are obligatory to increase awareness of the impact of infections and help in updating of guidelines for diagnosis and treatment and to aid adequate and appropriate resource allocation. The current study was undertaken to describe epidemiological characteristics of infection in the ICU of a tertiary care teaching hospital in east coast territory of southern India.

Material and methods

A retrospective study was conducted at the CCU (Critical Care Unit) under department of Anaesthesiology in collaboration with department of Microbiology of a tertiary care teaching hospital in India over a period of one year. All patients who stayed in ICU for more than 48 hours were included in the study. Relevant data on demographics, ICU length of stay (LOS), co-morbidities, pre-admission infections and devices (types and number) were recorded from patients' case-files after obtaining approval from institutional ethics committee. The culture and sensitivity reports of blood, urine and exudates of all the patients were accessed from the microbiology lab registers. The overall ICU-AI rate was computed by dividing the total number of patients with ICU-AI by total number of patients admitted in ICU during the specified period. All statistical analyses were performed using SPSS software 19.0 (SPSS Inc. Chicago Ill, USA). Chi square, unpaired t test and Fisher's exact test were used wherever applicable.

Results

A total of 370 patients were admitted to the ICU between 1st July 2012 and 30th June 2013, of which 315 patients were included in the study. The mean age of patients was 40 ± 37 years, and 49.0 % were male. The mean ICU stay was 4.2 ± 5.6 days.

Ninety three patients (29.5%) developed 126 episodes of ICU-AI (Incidence density rate; 70.3/1000 ICU days), of which, lower respiratory tract infections were most prevalent (15.5%). The demographic data and clinical characteristics of 315 patients included in the study are presented in Table I. Overall ICU mortality was 12.6%, which was significantly higher in patients who acquired infections in the ICU (25.8% vs. 7.2%; p=0.0001). About 17.8% OF patients developed acute kidney injury during ICU stay. Surgical patients constituted majority (87.6%) of admissions to ICU.

Table I. Patient Characteristics

Variables	No ICU acquired infections (N=222)	ICU acquired infections (N=93)	P value
Demographics			
Age (years)	40.45±16.66	44.17±16.13	0.0690#
Male Sex	102 (45.9)	51 (54.8)	0.1743*
ICU LOS (days)	2.54±1.96	8.05±8.91	<0.0001#
Duration of Mechanical Ventilation (Hours)	31.44±41.12	136.26±149.17	<0.0001#
ICU mortality	16 (7.2)	24 (25.8)	0.0001^
Pre-admission infection	21 (9.5)	24 (25.8)	0.0003^

Category of admissions			
Medical	21 (9.5)	18 (19.4)	0.0248^
Surgical	201 (90.5)	75 (80.6)	-
Emergency surgery	135 (67.2)	64 (85.3)	
Elective surgery	66 (32.8)	11 (14.7)	
Co-morbidities			
Cancer	35 (15.8)	7 (7.5)	0.0750^
Diabetes requiring insulin	5 (2.3)	10 (10.8)	0.0033*
COPD	3 (1.4)	4 (4.3)	0.2014*
Hypertension	20 (9.0)	10 (10.8)	0.7868^
Invasive devices			
Urinary catheter	222 (100)	93 (100)	-
CVC	188 (84.7)	77 (82.8)	0.8030^
Arterial line	168 (75.7)	70 (75.3)	1.0000^
Endotracheal tube	222 (100)	92 (98.9)	0.2952*
Tracheostomy tube	4 (1.8)	16 (17.2)	< 0.0001^
Drain tube	176 (79.3)	75 (80.6)	0.9034^
Intercostal tube	5 (2.3)	1 (1.1)	0.6742*
Nasogastric tube	198 (89.2)	78 (83.9)	0.2628^
Nutrition			
TPN	28 (12.6)	29 (31.2)	< 0.0001^
EN	134 (60.4)	24 (25.8)	< 0.0001^
PN+EN	16 (7.2)	7 (7.5)	1.000*
No Nutrition	159 (71.6)	33 (35.5)	< 0.0001^

*ICU, Intensive care unit; LOS, length of stay; COPD, Chronic Obstructive pulmonary Diseases; TPN, total parenteral nutrition; EN, enteral nutrition; TPN; *, Fischer exact test; #, Unpaired t-test; ^, Chi-square with Yates' correction.*

After univariate analysis, following risk factors were found to be significant in infected patients: ICU length of stay, duration of mechanical ventilation, preexisting infections, medical and emergency categories of admission and diabetes requiring insulin. Among devices, presence of tracheostomy tube was noted to be a significant risk factor in acquisition of infection in ICU. Similarly, total parenteral nutrition (TPN) was associated with a significantly higher rate of infection. After applying logistic regression analysis, following risk factors were significantly associated with higher infection rates: medical admissions, emergency surgery, diabetes, presence of tracheostomy and TPN (Table II).

Table II. Logistic regression analysis of risk factors for ICU acquired infections

Risk factors	P value	Adjusted Odd's Ratio	95% C.I.
Pre-admission infection	0.0003	3.33	1.74-6.4
Diabetes requiring insulin	0.003	1.20	0.40-3.63
Endotracheal tube	0.0004	20.98	1.26-349.68
Tracheostomy tube	<0.0001	11.32	3.67-34.92
TPN	0.0004	2.98	1.65-5.41

During the study period, out of 580 clinical specimens collected from 315 patients, 329 were found to be culture positive (median 1, range 17) and 251 specimens showed no growth (Table III). Range denotes the maximum number of specimens which were obtained for culture and sensitivity testing from a particular patient during his or her ICU stay. The most common isolates were *Pseudomonas aeruginosa* (24.9%) and *Acinetobacter baumannii* (23.1%). *P. aeruginosa* isolates showed high rate of resistance to tetracycline (86.2%), cefotaxime (70.7%), and ceftriaxone (61.0%). Colistin, carbapenems and amikacin were most effective antibiotics against *P. aeruginosa*.

Table III. Pathogenic organisms isolated from various specimens

	Specimens (number of isolates)						
Organisms (total number of isolates)	**Tracheal aspirate**	**BAL**	**Blood**	**Central line tip**	**Wound/ pus**	**Peritoneal wash**	**Urine**
Pseudomonas spp. (82)	49		6	1	9	5	12
Acinetobacter baumannii (76)	55	-	5	-	1	-	8
E. coli (45)	6	1	2	2	10	12	13
Enterococcus faecalis (32)	5	-	3		3	9	12
Candida non-albicans (32)	16	-	3	-	3	3	7
Klebsiella pneumoniae (21)	-	-	-	-	8	1	12
Enterobacter spp. (14)	6	-	3	-	-	-	5
Staph aureus (10)	-	-	-	-	10	-	-
S. pneumoniae (6)	-		-	-	3	3	-
Staphylococcus epidermides (6)	-	-	2	4	-	-	-
Providentia spp (3)	-	-	2	-	1	-	-
Proteus mirabilis (2)	-	-	-	-	-	2	0

BAL, Broncho Alveolar Lavage

Discussion

Although intensive care units constitute less than 10% of total hospital beds, more than 20% of all nosocomial infections are acquired in ICUs.[1] Wide variability in rates of ICU acquired infections in various countries and hospitals of same country point to disparities in case mix, severity of illnesses, infection control policies, compliance to hand hygiene, staff to patient ratio and ICU designs.[3] ICU-AI rate is also linked to health care expenditure of a country and higher rates of infection have been reported in countries allocating a smaller proportion of their gross domestic product (GDP) to health care.[2]

High infection rate in our ICU is a subject of worry, since it is a direct risk to mortality. There are certain issues related to environmental engineering (space, ventilation, traffic flow and air conditioning) which may explain higher infection rate in our set up. Non-central air-handling systems (Split A.C.) are susceptible to problems associated with excess condensation accumulating in drip pans and improper filter maintenance, therefore, centralized A.C. is better in controlling infection rate. A recent randomized control trial conducted in ICUs of three hospitals revealed that copper alloy coating of surfaces in ICU rooms significantly lowered the rate of nosocomial infections.[4] Mean ICU LOS was significantly longer in patients who acquired infections in ICU in present study which could be due to longer and repeated exposures to invasive devices and environment.[5]

Lung was the commonest site of ICU-AI in the present study. However a drop in respiratory infection rate

was noted (15.5%, 95% confidence interval 11.5-19.5%) compared to that in a previous study from our hospital (18%, 95% confidence interval 14.05-21.95%).[6] Reduction of nosocomial pneumonia rate may be attributed to regular use of closed suction system and Subglottic suction devices in preceding six years. However, this drop is small and insignificant and could be due to sampling bias. Previous study included patients from all ICUs in contrary to present study which included patients from a single ICU only. In our study, medical category and emergency surgery posed a significant risk of developing infection. This finding is consistent with Extended Prevalence of Infection in Intensive Care (EPIC II) study, a large 1-day, prospective point prevalence study.[2] The medical patients were immunocompromised, having various co-morbidities and higher severity of illness; these factors rendered medical patients more susceptible to infections. A Turkish study found that diabetes mellitus was associated with higher ICU-AI, which is in agreement with the findings of our study.[7] As also evident from present study; early use of TPN has been reported to increase the rate of infection, in a randomized multicentric clinical trial.[8]

Strategic data collection from reliable sources by a qualified physician and a fair sample size form the strengths of our study. Limitations of this study were missing data of some patients and consequently many variables, which may have been potential risk factors, could not be studied. We defined ICU LOS as total duration of ICU stay which also includes the duration of stay in which patient was treated for infection. We could not determine the impact of duration of ICU stay prior to acquisition of ICU-AI on incidence of ICU-AIs. Hence, it is unclear whether the prolonged ICU stay was the cause of increased risk of ICU-AIs or the result of same. Theoretically it is a vicious cycle once infection sets in, if not controlled immediately, can invariably prolongs ICU LOS and long stay in turn may complicates the existing infection or can expose the patients to acquire new infections. Another limitation was that severity of illness scoring could not be ascertained for our patients and hence, a bias may exist due to differing severity of illness. Future prospective studies encompassing such factors may help eliminate these biases.

Conclusion

Rate of ICU acquired infections, especially respiratory infections, is considerably higher in our centre. TPN, medical admissions, emergency surgery, diabetes mellitus and presence of tracheostomy were significant risk factors which led to higher infection rate. These data will help amend and reinforce the infection control measures and facilitate adequate and appropriate resource allocation.

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