FREQUENCY, PATTERN AND ETIOLOGY OF NOSOCOMIAL INFECTION IN INTENSIVE CARE UNIT: AN EXPERIENCE AT A TERTIARY CARE HOSPITAL

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Background: Nosocomial infection is defined as an infection which develops 48 hours after hospital admission or within 48 hours after being discharged. The objectives were to assess the frequency of nosocomial infection in patients admitted to intensive care unit (ICU) and to determine the etiological factors in such patients. It was an Observational Study and conducted in Intensive Care Unit, Liaquat University Hospital Hyderabad Sindh Pakistan from January 2008 to November 2008. **Methods:** All patients above 16 years of age admitted in the ICU for more than 48 hours and developed clinical evidence of infection that did not originate from patients' original diagnosis at the time of admission, were included in the study. Data was entered in a proforma and analyzed using SPSS version 10.0. **Results**: During the study period, 97 out of 333 patients acquired nosocomial infection. The frequency of nosocomial infection was 29.13%. Respiratory tract infection was seen in 29 (30.1%), urinary tract infection in 38 (39.1%) and blood stream infection in 23 (23.7%) patients. Other infections we identified were skin, soft tissue, wound and gastrointestinal tract infections. **Conclusion:** Patients admitted in intensive care unit are at more risk of acquiring nosocomial infection from different sources. It is suggested that proper nursing care, sterilization and disinfection of instruments and equipment and careful handling of invasive procedures are the best tool to control these life threatening infections.

Keywords: intensive care unit, Nosocomial infection, Hospital acquired infection

INTRODUCTION

Nosocomial infection is defined as an infection which develops 48 hours after hospital admission or within 48 hours after being discharged[1] that was not incubating at the time of admission at hospital[2].

Patients admitted to the ICU have been shown to be at particular risk of acquiring nosocomial infection with a prevalence rate as high as 30%.[3] The risk of nosocomial infection in ICU is 5–10 times greater than those acquired in general medical and surgical wards.[4] A likely explanation for this increased risk is that critically ill patients frequently require invasive medical devices such as urinary catheters, central venous and arterial catheters and endotracheal tubes thus compromising normal skin and mucosal barriers.

The nosocomial infections are caused by bacterial, viral and fungal pathogens. The most common pathogens are staphylococci, pseudomonas, E-coli, mycobacterium tuberculi, candida, aspergillus, fusarium, trichosporon and malassezia. All are associated with increased morbidity and mortality.

Precautions to prevent nosocomial infection in ICU include use of hand hygiene before and after contact with patient and respiratory devices[5], aseptic technique during catheter insertion and care, and prompt removal of catheters that are no longer essential[6].

The rationale of this study was to determine the frequency and pattern of nosocomial infection in patients admitted to our intensive care unit (ICU) and to detect the etiological agent in such patients.

PATIENTS AND METHODS

This hospital based observational study was conducted from January 2008 to November 2008 at an 8-bedded general intensive care unit (ICU) of Liaquat University Hospital Hyderabad, Sindh, Pakistan. All patients who were above 16 years of age, admitted in the ICU for more than 48 hours with different complaints and presentations and developed clinical evidence of infection that did not originate from patient's original admitting diagnosis, were included in the study. These critical patients were referred for monitoring, observation and management from different departments, e.g., general surgery, neurosurgery, medicine, gynaecology/obstetric, nephrology/urology and accident/emergency departments. Patients admitted in ICU for less than 48 hours were not included in the study. A proforma was designed and used for data collection. A detailed history of patients was taken and thorough clinical examination was performed. Patients were examined on daily basis to assess the treatment response and to detect the evidence of development of any new infection. The temperature chart was also maintained and updated

regularly. All the routine investigations such as complete blood picture, blood sugar level, urine analysis and chest radiograph were also done. The relevant investigations were performed according to the clinical presentation of patients and also after taking opinion from consultants of relevant departments. The frequency was assessed by number of patients who acquired infection; the pattern was determined by the type of acquired infection while etiological agents were assessed by determining the pathogens or sources responsible for infection. Frequencies, percentages, Mean±SD were calculated by entering, saving and analyzing the data in SPSS version 10.0.0.

RESULTS

During our study period, total admissions to our ICU were 964. Mean±SD of age was 30.05±15.81 SD years. 493 (51.14%) were male and 471 (48.86%) were female.

Patients admitted for more than 48 hours were 333. Males were 161 (48.35%) and females were 172 (51.65%).

Ninety-seven (97) out of three hundred thirty three (333) patients were identified to acquire infection during their stay in the ICU. Thus the frequency of nosocomial infection was 29.13%. Mean age was 37.04±17.15 years.

Demographic data of patients who acquired nosocomial infection are summarized in Table-1.

Common infections observed in such patients are given in Table-2.

The hospital acquired pneumonia was observed in 29 (30.1%) patients. In 09 among these patients, endotracheal intubation was done to provide mechanical ventilatory support. They developed signs of consolidation after 5–7 days and we categorized them as ventilator associated pneumonia (VAP). The identified pathogens in such patients were streptococcus pneumoniae in 5 patients, methicillin resistant staphylococcus aureus (MRSA) in 2 patients and gram negative bacilli in 2 patients. Fourteen patients developed aspiration pneumonia and the identified organisms were anaerobes. In remaining 06 patients the pathogens responsible for consolidation (pneumonic patch) during hospital stay were Klebsiella and pseudomonas.

The urinary tract infection was observed in 38 (39.2%) patients. On urine culture and sensitivity (C/S), the pathogens detected were: E-coli in 10 patients, proteus mirabilis in 4 patients, Klebsiella in 02 patients, pseudomonas in 7 patients, coagulase negative staphylococci in 06 patients, staphylococcus aureus in 5 patients, enterococci in 3 patients and candida albicans in 1 patient. Since all these patients were catheterized, Foley's catheter was considered as the source of infection.

The bloodstream infection was detected in 22 (22.68%) patients. The organisms identified on blood culture/sensitivity were coagulase negative staphylococci [staphylococci epidermis in 1 patient and staphylococcus saprophyticus in 1 patient], staphylococcus aureus in 9 patients, methicillin resistant staphylococci MRSA in 4 patients, vancomycin resistant enterococci in 4 patients, enterococcus in 2 patients and enterobacter in 01 patient. The source of such bloodstream infections were intravenous cannulae and central venous line. All such pathogens were detected in blood on culture and sensitivity (blood for C/S).

Five (5.15%) patients developed watery and mucoid diarrhoea during hospitalization and were already on antimicrobial agents, i.e., 3 on 3rd generation cephalosporin and 2 on clindamycin. The stools of all such patients were sent to laboratory for culture and for stool assay (for clostridium difficile toxin) which was suggestive of pseudomembrane colitis.

The soft tissue infection (cellulitis, abscess) was found in 3 patients. Wound infection was observed in 22 (22.68%) patients referred from different wards, i.e., surgery, gynaecology/obstetrics and neurosurgery. Organisms detected in such patients were staphylococcus aureus and pseudomonas. The pressure (bed) sores or decubitus ulcers were observed in 27 (27.83%) patients. Post neurosurgery meningitis was found in 1 patient and his CSF examination revealed gram negative bacilli.

Table-1: demographic data of patients with nosocomial infection (n=97)

Age (Yrs)	Number	%	Male n (%)	Female n (%)
16–29	37	38.15		
30–39	26	26.81		
40–49	11	11.34		
50–59	8	8.24	51	46
60–69	7	7.21	(52.6%)	(47.4%)
70–79	5	5.15		
80+	3	3.10		
Mean±SD of age 37.04±17.15				

Table-2: Pattern of nosocomial infections in intensive care unit (n=97)

Infection	Patients	%
Urinary tract infection (UTIs)	38	39.2
Hospital acquired pneumonia	29	30.1
Bloodstream infections	22	22.7
Gastrointestinal infection	5	05.1
Wound infection	22	22.7
Infected pressure sores / Decubitus ulcers	27	27.8
Cellulitis / Abscess	3	3.1
Post neurosurgery meningitis	1	1.03

Table-3: Patients with nosocomial infection: ward of referral (n=97)

Ward of Referral	*Number*	%
Casualty Outpatient Department (COD)	12	12.4
Medicine	14	14.4
Gynaecology & Obstetric	20	20.6
General surgery	17	17.6
Neurosurgery	23	23.7
Cardiology	3	3.1
Urology & Nephrology	4	4.1
Orthopaedic	3	3.1
ENT	1	1

Table-4: Outcome of patients with nosocomial infection

Ward of Referral	*n*=97	Recovered *n*=66	Expired *n*=23	LAMA	DOR
COD	12	9	3	-	-
Medicine	14	11	3	-	-
Gynaecology/ Obstetric	20	15	5	-	-
General Surgery	17	13	4	-	-
Neurosurgery	23	9	7	4	3
Cardiology	3	2	-	-	1
Orthopaedic	3	3	-	-	-
Urology/ Nephrology	4	3	1	-	-
ENT	1	1	-	-	-

COD= Casualty Outpatient Department
DOR= Discharge on request (by attendants/relatives of patient)
LAMA= Leave against medical advise

DISCUSSION

Critically ill patients in intensive care unit are at a higher risk of nosocomial infection due to multiple causes including disruption of barriers to infection by endotracheal intubation and tracheostomy, urinary bladder catheterization and central venous catheterization.[7]

The most common nosocomial infection in medical ICUs is urinary tract infection, followed by pneumonia and primary blood stream infection.[8] Common infections detected in our study were catheter-related urinary tract infection, respiratory tract infection including ventilator associated pneumonia (VAP), bloodstream infection, wound infection and gastrointestinal and soft tissue infections.

The frequency of nosocomial infection reported in current study was 29.13%. In a relatively recent study by Muhammad *et al*, the frequency of nosocomial infection at two ICUs of a tertiary care hospital was 39.7%.[9] The higher frequency of nosocomial infection in the later study was attributed to the fact that a number of patients were on immunosuppressant drugs.

Urinary tract infection (UTI) is the most common and frequent nosocomial infection seen in critically ill patients.[10–12] In our study 38 (39.2%) patients were diagnosed to acquire urinary tract infection. The source of nosocomial UTIs was placement of Foley's catheter for longer duration. Richards and colleagues reported in the National Nosocomial Infections Surveillance System (NNIS) database that UTI was responsible for 20-30% of nosocomial infections in medical/surgical ICUs.[8] Finklestein and colleagues determined an incidence of 10–14% among 337 patients in a single Israeli ICU.[13] Rosser and colleagues found that catheterization and age (more than 50 years) were independent factors associated with the development of nosocomial UTI.[14]

Nosocomial pneumonia is the second most frequent nosocomial infection in critically ill patients[15], and represents the leading cause of death from infection acquired in hospital.[15] Over 90% of ICU acquired pneumonia develops during mechanical ventilation (VAP), and 50% cases of VAP occur in first 4 days after intubation.[16] The predominant pathogens isolated in VAP are pseudomonas aeruginosa, staphylococcus aureus and streptococcus pneumoniae.[17] Frequency of VAP reported in different studies was 9%[18], 18%[19] and 21%[9]. In our study, 30% patients acquired pneumonia during their stay at ICU.

Catheter related blood stream infection is a common nosocomial infection acquired in ICU, and in the USA alone, central venous catheterization is the cause of up to 28,000 deaths annually among patients in ICUs.[6] Common causative organisms for bloodstream infection identified in our study were coagulase negative staphylococci, staphylococcus aureus, methicillin resistant staphylococci (MRSA), vancomycin resistant enterococci (VRE), enterococcus, candida albicans and enterobacter. A study conducted in Brazil[20] has shown that Klebsiella pneumoniae is also emerging bloodstream infection while another study showed that it is among the top ten pathogens that cause bloodstream infections in United States and Canada.[21] Frequency of blood stream infection in our study was 22.7%. In the study by Muhammad *et al*[9], the frequency was 27%, probably because later study was conducted among critically ill patients admitted in nephrology and neurology intensive care units.

In our study, post-neurosurgery meningitis was found in 1 patient and his CSF examination revealed gram negative bacilli whereas in another study the pathogens responsible for post-neurosurgery meningitis were staphylococcus aureus, pseudomonas aeruginosa, Escherichia coli, and Acinetobacter baumannii.[22]

CONCLUSION

From this observational study, we concluded that critically ill patients admitted to ICU are at a greater risk of acquiring nosocomial infection. The common nosocomial infections we identified in our study were

nosocomial pneumonia including VAP, urinary tract infections (UTIs) and blood stream infections. We recommend that education and awareness among health care workers as well as adherence to standard guidelines for prevention of nosocomial infection should be used to reduce frequency of nosocomial infection in intensive care unit.

Competing Interests

The author(s) declare that they have no competing interests.

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