ORIGINAL ARTICLE

Infections in a Multi-Disciplinary Intensive Care Unit with Special Reference to Blood Stream Infection

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Abstract

*Objectives: To study the incidence of Blood Stream infections (BSI) in the ICU, to identify the predictors, to study the bacteriological profile and their antibiotic sensitivity patterns and to correlate the incidence of nosocomial infections with mortality. **Material & Methods**: It was conducted in the multidisciplinary adult ICU comprising of 13 beds in Christian Medical College, Ludhiana. **Results:** The incidence of nosocomial infections i.e. of Blood stream infections (BSI) has been found to 22.3%. Acinetobacter, E coli, Pseudomonas Aeruginosa and Staphylococcus aureus were found to be associated with resistant isolates in blood stream infections. Carbepenems and 4th generation cephalosporins were found to be most effective (100% sensitivity) in the treatment of all the nosocomial infection. Morality in the ICU was found to be 17.9%..We found that BSI was significantly associated with mortality. **Conclusion**: More frequent indication for ICU admission is blood stream infections (BSI). Acinetobacter is the most frequent organism and 4th generation Cephalosporins and Carbepenems are most effective in treatment of nosocomial infections.*

Keywords: Intensive care unit, Nosocomial Infection, Antibiotics

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Introduction

In the past few decades knowledge of the epidemiology of nosocomial infections has substantially increased. Nosocomial infection occurs in 5% to 10% of patients who are hospitalized in the United States [1,2,3] and is associated with increased morbidity, mortality, and hospital costs.[4-6] Nosocomial infection in intensive care units accounts for more than 20% of all nosocomial infections,[7] but rates of infection vary with the type of hospital and intensive care unit population studied.[8-10] Pneumonia, urinary tract infections, bloodstream infections, and surgical site infections are common amongst them. [11] The common organisms are: Staphylococcus aureus and Pseudomonas aeruginosa the two most common isolates in pneumonias; Candida albicans the most common isolate in urinary tract infections; and staphylococci responsible for about half of the bloodstream infections that originate from intravascular catheters. The microbial spectrum of these infections provides a valuable guide for selecting empiric antibiotic regimens.

This study was undertaken with the aim to study the incidence of nosocomial infection in ICU, to identify the predictors, to study the bacteriological profile and their antibiotic sensitivity patterns and to correlate the incidence of nosocomial infections with mortality studied centre.

Materials and Methods

The study was conducted in the multidisciplinary adult ICU comprising of 13 beds in Christian Medical College and Hospital,

Ludhiana. All patients who were studied during this period formed the study cohort. All patients who developed clinical signs of infection 24 hours after admission to ICU or within 48 hours of discharge from ICU were evaluated to determine the cause of fever.

In all patients, rectal temperature was recorded regularly using the mercury thermometer. New onset of temperature> 38.3C on two consecutive occasions was taken as an indicator for the clinical assessment. Laboratory or radiological evaluation for the presence of infection was performed depending upon the physical findings. Evaluation of fever also included blood culture and sensitivity. Two sets of blood samples of 5ml each were drawn from two different sites within a gap of 30 minutes and were cultured in the Bact/Alert culture bottles. Bottles indicating growth were sub-cultured on blood agar and MacConkey's agar. Additional blood cultures were performed thereafter whenever there was a high clinical suspicion of bacteremia.

In patients who developed inflammation or purulent discharge at the intravenous catheter exit site, pus expressed from the catheter site was sent for gram's culture and sensitivity. In addition, two blood culture samples were sent, one blood sample were drawn through the catheter and the other by venepuncture peripherally. The catheter was then removed and the catheter tip was sent for culture and sensitivity. The severity of illness was assessed in all patients at the time of admission to the ICU and at 48 hours by SOFA Score (Ferreira et al, 2001).

Results

Out of the 112 patients studied, 71 patients (63.4%) demonstrated no blood stream infection, 25 patients (22.3%) showed blood stream infection and 16 patients (14.3%) were not investigated for blood stream infection since they remained afebrile.

Out of the 25 patients who develop BSI in the ICU, 9 patients (36%) showed Staphylococcus aureus infection, 6 patients (24%) showed E coli infection, 3 patients (12%) showed Pseudomonas and 2 patients (8%) each showed Acinetobacter and Klebsiellapneumoniae.

Among the isolates in BSI, Enterobacteriaceae, Streptococcus pyogenes, Klebsiella and non-haemolytic streptococci showed 100% sensitivity to all the groups of antibiotics. Acinetobacter showed 100% sensitivity for carbepenems 3rd and 4th generation cephalosporins, chloramphenicol and macrolides. E coli showed 100% sensitivity for carbepenems, 3rd and 4th generation cephalosporins and macrolides. Pseudomonas showed 100% sensitivity for carbepenems and 4th generation cephalosporins, while Staphylococcus aureus showed 100% sensitivity for carbepenems and 4th generation cephalosporins and macrolide.

Table 1: Distribution of patients according to bacteriological profile in BSI

Organism	No. of patients	Percentage
Staphylococcus aureus	9	36.0
E coli	6	24.0
Pseudomonas aeruginosa	3	12.0
Acinetobacter	2	8.0
Klebsiellapneumoniae	2	8.0
Enterobacteriociae	1	4.0
Non-hemolytic streptococci	1	4.0
Streptococcus pyogenes	1	4.0

Table 2: Association of SOFA score and BSI

SOFA score	BSI absent		BSI present		p value
	Mean	SD	Mean	SD	
At baseline	7.59	3.56	7.84	3.13	0.731
After 48 hr	7.13	3.58	8.28	4.15	0.231

The mean baseline SOFA score in patients who developed BSI was 7.84 ± 3.13. Among the patients who did not develop BSI, the mean baseline SOFA score was found to be 7.59 ± 3.56. This association was found to be statistically not significant (p = 0.731). The mean SOFA score at 48 hours in patients who developed BSI was 8.28 ± 4.15. Among the patients who did not developed BSI, the mean SOFA score at 48 hours was 7.13 ± 3.58. This association also, was found to be statistically not significant (p = 0.231).

Table 3: Association of laboratory findings and BSI

Laboratory tests	BSI absent		BSI present		p value
	Mean	SD	Mean	SD	
Total leukocyte count (/mm^3)	14753.4	10485.8	15616.0	14162.7	0.786
S. albumin (g/dL)	2.99	0.77	2.72	0.83	0.152
PaO$_2$/FiO$_2$	127.93	79.76	147.97	95.71	0.312

Mean total leukocyte count was found to be 15,616 ± 14,162.7 / mm^3 among patients who developed BSI and 14753.4 ± 10485.8 / mm^3 among patients who did not develop BSI, the association being statistically not significant (p = 0.786). Hypoalbuminaemia was prevalent among the ICU patients. Mean serum albumin was 2.72 ± 0.83 gm / dL among patients who developed BSI and 2.99 ± 0.77 gm / dL among those who did not develop BSI, the association being statistically not significant (p = 0.152). The mean PaO$_2$/FiO$_2$ ratio was found to be 147.97 ± 95.71 among patients who developed BSI. Among the patients who did not have BSI, the mean PaO$_2$/FiO$_2$ ratio was 127.93 ± 79.76. This association was statistically not significant (p = 0.312).

Out of the 87 patients who did not develop blood stream infection, 76 (87.4%) survived and 11 (12.6%) died, while out of the 25 patients with blood stream infections, 16 (64%) survived and 9 (36%) died. The association of blood stream infection with mortality was found to be statistically highly significant (χ^2 value = 7.22, p value = 0.007).

Discussion

In our study, Acinetobacter, E coli, Pseudomonas aeruginosa and Staphylococcus aureus was found to be associated with resistant isolates in blood stream infections. Carbepenems and 4th generation cephalosporins were found to be most effective (100% sensitivity) in the treatment of all the nosocomial infections i.e. BSI.

In the EPIC study, antimicrobial resistance was reported for S aureus, P aeruginosa and coagulase negative Staphylococcus. Of the 528 ICU acquired infections associated with S aureus resistance pattern was reported in 456 (86%). Of these 59.6% was MRSA strains.[12]

Of the 504 ICU acquired infections associated with an appropriate positive P aeruginosa, patterns of resistance were reported in 410 cases. Gentamycin (46.3% of resistant isolates), Imipenem (21.1%), Ceftazidime (27.7%), ciprofloxacin (26.3%) and penicillin (37.4%) resistant isolates were found. Of the 335 ICU acquired infections associated with a positive culture of coagulase negative Staphylococcus, resistance pattern was reported in 279 cases. Methicillin (70.1%), Cefotaxime (68.6%) Gentamycin (66.1%) Vancomycin (3.5%) and Teicoplanin (9.3%) resistant isolates were found.[12]

Nosocomial infection National Surveillance Service (NINSS) surveyed bacteremia from 1997-2002 in the English hospitals found that over 40% of the isolates causing hospital acquired bacteremias were Staphylococci (26% S Aureus and 16% coagulase negative Staphylococcus followed by E coli and Enterococci. Over half of S aureus were resistant to methicillin (54% MRSA) and 67% coagulase negative staphylococci were resistant to methicillin. There was no evidence of resistance to Vancomycin among Staphylococcus aureus. Enterococcus showed resistance to vancomycin varying from 3% for Enterococcus faecalis to 17% for Enterococcus faecium. Among the E coli maximum drug resistance was seen against ciprofloxacin (10%) whereas ceftazidime (3%), amikacin (3%) and imipenem / meropenem (<1%) showed low resistance rate.[13]

The international SENTRY Antimicrobial Surveillance Program documented trends in the occurrence of pathogens that are related to altered resistance patterns. Over the past decade, surveillance programs have repeatedly documented an increase in trend in resistance patterns. Among the gram positive pathogens today Vancomycin resistant enterococci (VRE), β-lactam resistant and multi-drug resistant Streptococci and methicillin resistant S aureus (MRSA) are of primary importance. From 1990 to 1997, the prevalence of VRE increased from < 1% to 15%; the rate of vancomycin resistant Staphylococci remains quite rate. The rate of penicillin resistance among Pneumococci has

increased from 20-25% in 1990 to 25-50% in 1997 according to the SENTRY antimicrobial surveillance Program. Similarly the most important gram negative resistance problems that impact on nosocomial infections today are extended spectrum β-lactamases (ESBLs) in Klebsiellapneumoniae, E coli and Proteus mirabilis, high level 3rd generation cephalosporin β-lactamase resistance among Enterobacter and Citrobacter and multi-drug resistant Pseudomonas aeruginosa Acinetobacter and Stenotrophomonas maltophilia.[13]

Conclusion

In our study we found nosocomial infection i.e. Blood stream infections (BSI) in 22.3% of ICU cases. Onset of fever in most cases after 2 days of ICU admission. Staphylococcus Aureus is the most frequent causative organism for BSI.

References

1. Dixon RE. Effect of infections on hospital care. Ann Intern Med 1978;89:749-53.
2. Wenzel RP, Ostermeyer CA, Townsend TR et al. Development of a statewide program for surveillance and reporting of hospital-acquired infections. J Infect Dis 1979;140:741-6.
3. Horan TC, White JW, Jarvis WR. Nosocomial infection surveillance, 1984. MMWR 1986;35:17S-29S.
4. Green JW, Wenzel RP. Postoperative wound infection: a controlled study of the increased duration of hospital stay and direct costs of hospitalization. Ann Surg 1977;185:264-8.
5. Givens CD, Wenzel RP. Catheter-associated urinary tract infections in surgical patients: a controlled study on the excess morbidity and cost. J Urol 1980;124:646-8.
6. Haley RW, Schabert DR, Von-Allmen SD et al. Estimating the extra charges and prolongation of hospitalization due to nosocomial infections: a comparison of methods. J Infect Dis 1980;141:248-57.
7. Wenzel RP, Thompson RL, Landry SM et al. Hospital-acquired infections in intensive care unit patients: an overview with emphasis on epidemics. Infect Control 1983;4:371-5.
8. Donowitz LG, Wenzel RP, Hoyt JW. High risk hospital-acquired infection in the ICU patient. Crit Care Med 1982;6:355-7.
9. Brown RB, Hosmer D, Chen HC et al. A comparison of infections in different ICUs with the same hospital. Crit Care Med 1985;13:472-6.
10. Chandrasekar PH, Kruse JA, Mathews MF. Nosocomial infection among patients in different types of intensive care units at a city hospital. Crit Care Med 1986;14:508-10.
11. Richards MJ, Edwards JR, Culver DH et al. The National Nosocomial Infections Surveillance System: nosocomial infections in combined medical-surgical intensive care units in the United States. Infect Control HospEpidemiol 2000;21:510-5.
12. Vincent JL, Bihari DJ, Suter PM et al. The prevalence of nosocomial infection in intensive care units in Europe: results of the European Prevalence of Infection in Intensive Care (EPIC) Study. JAMA 1995;274:639-44.
13. Renaud B, Brun-Buisson C. Outcomes of primary and catheter related bacteremias. Am J RespirCrit Care Med 2001;163:1584-90.