

Research Article

Microbiological profile of hospital acquired blood stream infections in seriously ill medical patients admitted in tertiary care hospital

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ABSTRACT

Background: Hospital acquired infections (HAIs) are those which are acquired in hospital either due to any intervention or directly through various routes of entry into the body. Nosocomial infection not only adds to functional disability to patients but also increases associated cost of treatment. Major categories of HAIs include pneumonia, urinary tract infections (UTIs), blood stream infections (BSIs), and surgical site infections (SSIs).

Methods: The study was conducted to know the incidence of blood stream infections. The patients who developed infections after 48 hours of admission in the ward were included in the study. Blood cultures were performed. A total of 125 seriously ill patients admitted in medicine ward were studied prospectively.

Results: Out of a total of 125 patients, 10 (8%) patients developed BSIs. Gram negative isolates *Acinetobacter baumannii* and *Pseudomonas aeruginosa* were the most commonly isolated organisms from cases of BSIs. Most of the isolated organisms were susceptible to ticarcillin clavulanic acid.

Conclusions: HAI incidence was high in this study. Prevention programs in future should focus on patients with longer length of stay, invasive devices, and injudicious use of antibiotics to contain the incidence of HAIs.

Keywords: Hospital acquired infections, Bloodstream infection, Gram-negative bacteria, Antimicrobial agents

INTRODUCTION

Hospital acquired infections (HAIs), also known as nosocomial infections (NI) are defined as those occurring after 48 hours of hospital admission, within three days of discharge or 30 days of an operation.¹ Quite often, it is seen that colonisation precedes infection.² Nosocomial infections add to functional disability and emotional stress of the patient and may in some cases leads to permanent disability that reduces the quality of life. Prolonged hospital stay not only increases direct cost to patients or the payers but also the indirect costs due to lost work hours.³

Any hospitalised patient may acquire nosocomial infection but the rates of HAIs among hospitalised

patients mainly depend on the severity of underlying illness, the therapeutic interventions undertaken and the presence of an indwelling device/implant (i.e. use of central venous catheters, mechanical ventilation and urinary catheters), the underlying condition or the condition of immune system and the practice of adhering to standard practices.⁴ Furthermore, the hospital environment may support the acquisition of resistance to multiple antimicrobial agents by pathogens.⁵

The most commonly encountered HAIs are urinary tract infections (UTIs), surgical site infections (SSIs), pneumonia and bloodstream infections (BSIs).⁶ Nosocomial urinary tract infections account for upto 40% of infections in patients admitted in hospitals and 23% of infections in intensive care units.⁷ The incidence of

surgical site infections varies from 0.5 to 15% depending on the type of operation and underlying status of the patient. The main factor influencing acquisition of SSIs depends on whether the surgery has been categorised as clean, clean-contaminated, contaminated or dirty, length of the operation, and the patient's general condition.⁸ Hospital associated pneumonia occurs in patients on ventilators in intensive care units, where the rate of pneumonia is 3%. There is a high case fatality rate associated with ventilator-associated pneumonia (VAP), because of the associated comorbidity.³

Hospital acquired bloodstream infections are preventable source of morbidity and mortality. The use of intravascular devices is an important risk factor for the development of bloodstream infections.^{9,10} Critically ill patients are at particular risk for nosocomial bloodstream infections because of their debilitated condition and frequent need for invasive procedures. This accounts for 3-7% of cases in which central venous catheter is used.¹¹ The impact of nosocomial bloodstream infections on the outcome of critically ill patients has been extensively studied with an attributable mortality rate ranging from 19% to 35%. There are several sources of bacteraemic extension e.g. pneumonia, UTI and skin and soft tissue infection (particularly in burns patients).⁹ In the present study blood stream infection, was studied to know the burden of hospital acquired infection.

METHODS

This prospective study was conducted in the Department of Microbiology, Pt. B.D. Sharma PGIMS, Rohtak, India. A total of 125 patients were enrolled for the present study. Blood samples of subjects of the study was collected first at the time of admission to rule out community acquired infections and then after 48 hours of admission. Samples were also collected after development of clinical signs and symptoms of blood stream infection (BSI).¹²

Blood samples was collected in glucose broth and subcultured on blood agar and MacConkey agar after incubation at 37°C for 24 hours, 48 hours, 72 hours and on 7th day. In patients with suspected hospital acquired infection having any indwelling device like vascular access lines the sample was processed as per recommended guidelines. Inoculated culture plates were examined for growth after overnight incubation at 37°C. The colony morphology on the inoculated culture plates was observed and the subsequent identification was carried out following standard microbiological protocol.¹³⁻¹⁵

Data analysis and statistical methods

Data entry was performed using Microsoft Access and Excel and data analysis was performed using SPSS 20. Univariate comparisons among categorical variables were

performed using the χ^2 test. P value of <0.05 was considered significant.

RESULTS

Table 1 shows the gender wise distribution of subjects of study among different age groups. Male to female ratio was found to be approximately 2:1. Mean age of the patients was 50±12.7 years. Maximum number of BSIs were among males in the age group of 41-50 (31.3%) while in females, maximum BSIs were seen in age group of 21-30 years (30.9%).

Out of 125 patients, 10 patients developed hospital acquired blood stream infections. Gram negative rods were (90%) more common than gram positive isolates. A single isolate of *Staphylococcus aureus* was the only gram positive organism responsible for causing BSIs. Distribution of gram negative isolates depicted in Table 2.

Table 1: Age and gender wise distribution of patient under study (n=125).

Age group (years)	Male		Female		Total	
	(n)	(%)	(n)	(%)	(n)	(%)
<20	03	3.6	02	4.7	05	4.0
21-30	12	14.4	13	30.9	25	20.0
31-40	09	10.8	02	4.7	11	8.8
41-50	26	31.3	04	9.5	30	24.0
51-60	12	14.4	09	21.4	21	16.8
>60	21	25.3	12	28.5	33	26.4
Total	83	66.4	42	33.6	125	100

Table 2: Details of the gram negative isolates recovered from the blood stream infections.

Isolate	Blood (n)
<i>Acinetobacter baumannii</i>	04
<i>Pseudomonas aeruginosa</i>	04
<i>Klebsiella</i> spp	01
Total	09

Table 3 depicts the antimicrobial susceptibility pattern of gram negative bacterial isolates other than *P. aeruginosa* isolated from patients with BSI. Isolates of *Acinetobacter* spp. were uniformly resistant to gentamicin, ceftazidime, cefepime, cefotaxime, cotrimoxazole but no isolate was found to be resistant to ticarcillin-clavulanic acid and ampicillin-sulbactam. Imipenem and doxycycline were found to be sensitive in 50% of the isolates whereas 75% of the isolates were sensitive to amikacin, meropenem and piperacillin-tazobactam. The only isolate of *Klebsiella* spp. was resistant to all the antimicrobial agents except imipenem, ampicillin-sulbactam and ticarcillin-clavulanic acid.

The antimicrobial susceptibility profile of *P. aeruginosa* isolates from patients with BSIs is depicted in Table 4. Imipenem, piperacillin-tazobactam and ticarcillin-clavulanic acid was sensitive in 75% of the isolates, whereas 25% of isolates were susceptible to gentamicin,

ceftazidime, amikacin, cefoperazone and imipenem. All the isolates were resistant to aztreonam, netilmicin, cefepime, ciprofloxacin. The only isolate of *S. aureus* was found to be susceptible to doxycycline, cephalixin, vancomycin and linezolid (Table 5).

Table 3: Antimicrobial susceptibility profile of bacterial isolates other than *P. Aeruginosa*, recovered from patients having BSI.

Bacterial isolate	Antimicrobial agent (%age sensitivity)												
	Amoxiclav	Gentamicin	Amikacin	Ceftazidime	Cefotaxime	Cefepime	Doxycycline	Ticarcillin-clavulanic acid	Meropenem	Imipenem	Piperacillin-tazobactam	Ampicillin-sulbactam	Cotrimoxazole
<i>Acinetobacter</i> spp (n=4)	25	0	75	0	0	0	50	100	75	50	75	100	0
<i>Klebsiella</i> sp (n=1)	0	0	0	0	0	0	0	100	0	100	0	100	0

Table 4: Antimicrobial susceptibility profile of *P. aeruginosa* isolated from patients having BSI.

Bacterial isolate	Antimicrobial agent (%age sensitivity)											
	Gentamicin	Ceftazidime	Amikacin	Aztreonam	Netilmicin	Cefepime	Cefoperazone	Imipenem	Meropenem	Piperacillin-tazobactam	Ciprofloxacin	Ticarcillin-clavulanic acid
<i>Pseudomonas aeruginosa</i> (n=4)	25	25	25	0	0	0	25	75	25	75	0	75

Table 5: Antimicrobial susceptibility profile of *S. aureus* isolate from patients with BSI.

Bacterial isolate (n=1)	Antimicrobial agent (%age sensitivity)									
	Erythromycin	Penicillin	Cefoxitin	Cephalexin	Clindamycin	Linezolid	Doxycycline	Ciprofloxacin	Vancomycin	
<i>S. aureus</i>	00	00	00	100	00	100	100	00	100	

DISCUSSION

Health care associated infections include all clinically evident infections that do not originate from patient’s original diagnosis at time of admission. The term nosocomial infection or hospital acquired infection is applied to any clinical infection that was neither present nor was incubating at the time of patient getting admitted in the hospital.³ Nosocomial infections may even manifest after discharge from the hospital, if patient was in

incubation period at the time of discharge. Also admission of large number of patients under a single roof could easily facilitate the transmission of infection from one patient to another. It has been estimated that about 3.5% of patients leave the hospital after having acquired infection, depending on the case, hospital conditions and many other factors.¹

In the present study, age of patients enrolled for the study ranged from 15 to 85 years with mean age of patients

being 50 years. The results of the present study are similar to those of Osmani and colleagues who reported mean age of 48.6 years.¹⁶ In the present study, there was a male preponderance among the cases. Male subjects constituted 61.4% of cases as compared to 23.7% female cases. The male to female ratio in the present study was 2.8:1. In contrast to this, another study by Mythri and Kashinath reported a subject ratio of 3.5:1.¹⁷ The incidence of nosocomial blood stream infections in the present study was 8.0%. Similarly an incidence of 10.93% was quoted by Pratham and colleagues.¹⁸ In contrast much higher incidence of 28% was quoted in a study conducted by Ginawi et al.¹⁹ Among the bacterial isolates causing HAIs, gram negative bacteria were more common (90%) as compared to gram positive bacteria (10%). Similar findings were reported by Naidu et al, who in their study, found Gram negative bacteria to be responsible for nosocomial infections in 92.8% of cases, whereas from the rest of 7% of the cases coagulase negative staphylococcus was isolated.²⁰

In the present study, *Acinetobacter baumannii* and *P. aeruginosa*, each were recovered in 40% of cases of blood stream infections, followed by *Klebsiella* spp. and *S. aureus* 10% each. Similar findings were reported by Akhtar N, who reported the prevalence of various organisms such as *P. aeruginosa* and *E. coli* as 31.6% each, followed by *Streptococcus pneumonia* in 21% and *K. pneumonia* in 10.5% of cases.²¹

Acinetobacter spp. was the commonest pathogen recovered from cases of blood stream infections, accounting for 40% of the cases. All the four isolates were resistant to gentamicin, ceftazidime, cefepime, cefotaxime, cotrimoxazole. Imipenem and doxycycline were effective in 50% of the isolates. Only 25% of isolates were resistant to amikacin, meropenem and piperacillin-tazobactam. No isolate was found to be resistant to ticarcillin-clavulanic acid and ampicillin-sulbactam. Biglari et al in their study found 79.4% of the *Acinetobacter* isolates to be multi-drug resistant.²²

In the present study *P. aeruginosa* was responsible for causing blood stream infection in 40% of the total cases. All the isolates were resistant to aztreonam, netilmicin, cefepime and ciprofloxacin. Seventy five percent of the isolates of *P. aeruginosa* were sensitive to imipenem, piperacillin-tazobactam and ticarcillin-clavulanic acid. Only 25% of the isolates were sensitive to ceftazidime, cefoperazone, gentamicin and amikacin. The Brazillian SCOPE surveillance in their finding reported that more than 40% of the isolates of *P. aeruginosa* were resistant to ciprofloxacin, gentamicin and cefepime.¹⁶

The only isolate of *S. aureus* recovered from a patient with blood stream infection was resistant to erythromycin, penicillin, cefoxitin and clindamycin. Ghadiri et al in their study reported that MRSA were isolated in 40% of the cases with BSI.²³

As evident from the results of present study and also from the observations of other authors, nosocomial infections in seriously ill patients have emerged as a significant problem. Furthermore injudicious and widespread use of antimicrobial agents has increased the risk of emergence of multi-drug resistant organisms and further spread of such strains, which not only increases the stay in hospital but also morbidity and mortality and total cost of treatment.

CONCLUSION

This study represents basic information for future monitoring of HAI and should be repeated periodically. Thus we believe that the future prevention program should focus on patients with longer length of stay and those with invasive devices. At the institutional level, it is urgent to establish HAI prevention programs. Elsewhere, prospective studies are desirable in order to describe more accurately HAI incidence as well as risk factors.

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