Original Article

Clinical spectrum and risk factors for hospital-acquired septicemia in a tertiary care centre of North-East India

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Abstract

Introduction: Although several studies have shown an increasing prevalence of sepsis due to multidrug-resistant organisms, specific data on hospital-acquired septicemia is lacking. **Materials and Methods:** An observational prospective study was carried out for a duration of 1 year in which patients developing hospital-acquired septicemia were included and their disease spectrum and associated risk factors were analyzed. **Results:** Among a total of 350 patients, 145 came out to be culture positive. Genitourinary infections were the most common infections encountered in this study, whereas the presence of invasive device came out to be the most prevalent risk factor. **Conclusion:** Septicemia is still a rising problem; hence, we should manage it carefully. Coagulase-negative *Staphylococci* can no longer be considered as contaminants and it should be treated as pathogens.

Keywords: Hospital-acquired septicemia, Risk factors, sepsis

Introduction

Continuous or transient presence of microorganisms within the bloodstream is bacteremia, while its dissemination throughout the body with evidence of systemic responses toward microorganisms with variable severity is septicemia. Sepsis which is defined as a life-threatening organ dysfunction caused by a dysregulated host response to infection is increasingly becoming a major health-care problem affecting millions of people each year worldwide.[1] The incidence has shown an increasing trend over the last few decades and more than two-thirds of patients with sepsis die during their hospital stay only. Infections acquired during the hospital stay are generally called nosocomial infections, initially known as infections arising after 48 h of hospital admission.[2,3]

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In developing countries, the steep increase in septicemia cases is a major health problem and it has posed the biggest challenge for clinicians in the selection of appropriate antimicrobial agents, as it is further complicated by the development of resistance in organisms to antimicrobial agents, which is the mainstay of treatment. In addition, they impose a heavy cost on hospitals causing increased hospitalization time, increased morbidity, and mortality.[4,5] A bacteriological culture to isolate the offending pathogens remains the mainstay of definite diagnosis of septicemia. It takes a minimum of 2–3 days to finalize the culture report and start the appropriate therapy. Estimation of the associated risk factors is essential as it helps the clinicians to detect such patients early and thus prevent related mortality.

Although extensive research on neonatal septicemia is available worldwide and in India, very few studies have been conducted in regard to adult sepsis. Hence, we undertook a cross-sectional study to determine the clinical spectrum and also to estimate the risk factors associated with hospital-acquired septicemia.

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Materials and Methods

This was an observational, prospective study which was conducted in a tertiary care medical college and hospital after obtaining Institutional Ethics Committee and Institutional Review Board approval. The study duration was 1 year. All patients older than 18 years suspected of hospital-acquired sepsis from medicine, surgery, and emergency wards were included. In total, 350 hospitalized patients who acquired signs and symptoms suggestive of septicemia which were not present, either at the time of admission or within 48 h of hospital stay were taken up in this study. The diagnosis of sepsis was established based on the recognition of suspicion or confirmed source of infection with at least one organ dysfunction. Patients at risk of infection and sepsis were screened based on signs suggestive of infection and clinically detectable organ dysfunction. Cases of sepsis diagnosed 48 hours after hospital admission were classified as hospital-acquired septicemia. Patients who did not manifest any signs and symptoms were excluded from this study. Informed consent was obtained from patients or their concerned who were eligible based on the above-mentioned criteria. Patient's histories and clinical examinations were obtained, and routine investigations were done.

The following risk factors were recorded: presence of invasive device (indwelling bladder catheter and indwelling intravascular devices), severe injuries, immunosuppression, and age above 60 years.

About 5–10 ml of blood was collected from adult patients aseptically before administration of the antibiotics and inoculated into the BACTEC blood culture bottles bedside. These were transported immediately to the Microbiology Laboratory where they were put in the BACTEC instrument. Once the bottle beeped positive, routine subculturing was done on 5% sheep blood agar and McConkey agar. Once growth was obtained, these were identified using automated **VITEK 2** system.

Results

A total of 350 patients suspected of hospital-acquired septicemia were further investigated. Majority of the patients belonged to medicine ward (74.9%) followed by surgery and ER wards as shown in Figure 1.

In this study, genitourinary infections (36.9%) followed by pyrexia of unknown origin (16.3%) were found to be the most common clinically suspected primary sources of infection, whereas only 6.0% had gastrointestinal infections as shown in Table 1.

Out of 350 samples received, bacterial growth was seen in 145 samples. The culture positivity rate was observed to be 41.4%. 89 (61.4%) were Gram-positive and 56 (38.6%) of them were Gram-negative.

The maximum number of the isolates were in the age group 21–30 years, which accounted for 33% of the total 145 culture-positive cases. In the age group > 50 years, the number of isolates was 37, which accounted for 53.65% as shown in Figure 2.

Among Gram-positive isolates, the most common organism isolated was CoNS (51/89) followed by *S. aureus* (33/89). Among Gram-negative isolates, *Escherichia coli* (28/56) was the maximum followed by *S. typhi* (14/56) and *K. pneumonia* (10/56) as shown in Table 2.

Maximum number of isolates were obtained in Genito-urinary infections (74/145) followed by surgical site infections (26/145). Respiratory and gastrointestinal infections were the other two major clinical diagnoses (9.7%). CoNS (34/74) were the predominant isolate in genitourinary infections, while *S. aureus* (9/14) predominated in respiratory infections leading to septicemia. Most common organism isolated in surgical site infections was CoNS (12/26), while *E. coli* was the major isolate in cases due to sepsis as shown in Figure 3.

Maximum number of isolates were from the medicine ward (73.1%) followed by ER (16.6%). CoNS (41/106,5/15) was the predominant isolate in both medicine and surgery wards followed by *S. aureus* (25/106) and *E. coli* (18/106) in medicine.

Table 1: Frequency of distribution of cases based on clinical diagnosis (*n* = 350)

Diagnosis	Frequency	Percent
Pyrexia of Unknown Origin	57	16.3%
Respiratory Infections	40	11.4%
Genitourinary Infections	129	36.9%
Gastrointestinal Infections	21	6.0%
Cardiovascular Conditions	33	9.4%
Surgical Site Infections	41	11.7%
Sepsis	29	8.3%
Total	350	100.0%

Table 2: Pattern of the organism isolated (*n*=145)

Organism	Frequency	Percent
Gram-positive Cocci		
CoNS	51	35.2%
Staphylococcus aureus	33	22.8%
Enterococcus spp.	5	3.4%
Total	89	61.4%
Gram-negative Bacilli- Enterobacteriaceae		
Escherichia coli	28	19.3%
Klebsiella pneumonia	10	6.9%
Citrobacter spp.	1	0.7%
Total	39	26.9%
Gram-negative Bacilli -Nonfermenters		
Acinetobacter complex	1	0.7%
Salmonella typhi	14	9.7%
Proteus mirabilis	1	0.7%
Pseudomonas spp.	1	0.7%
Total	17	11.7%
Total	145	100.0%

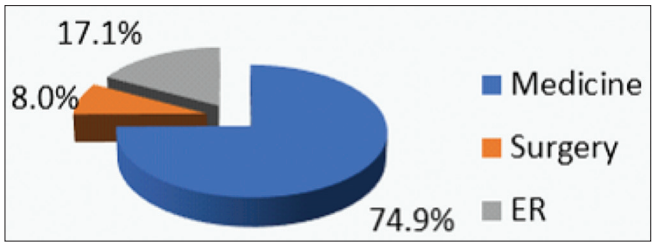

Figure 1: Ward-wise distribution of the samples (*n* = 350)

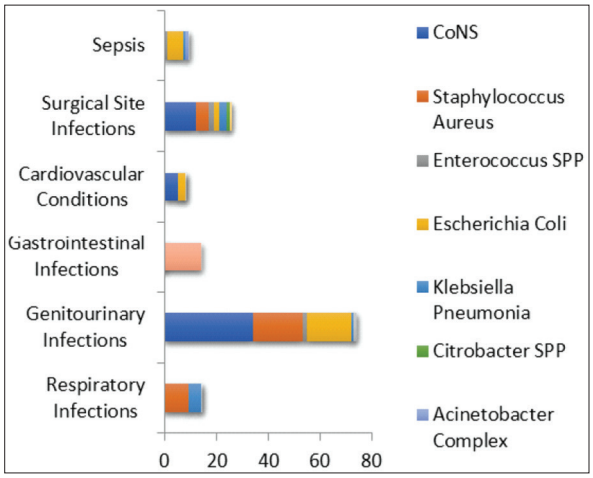

Figure 3: Distribution of isolates according to the clinical diagnosis (*N* = 145)

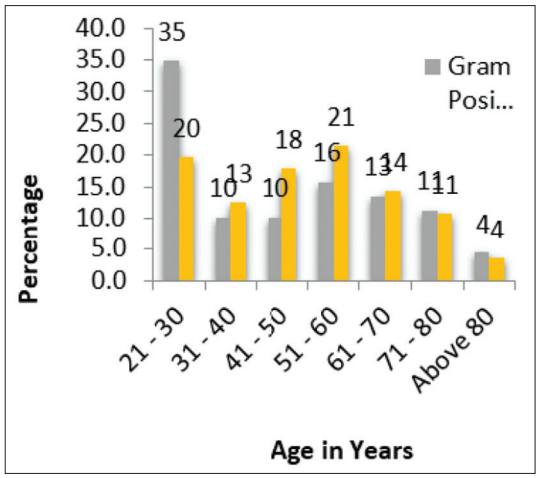

Figure 2: Age-wise distribution of culture-positive cases of septicemia (*N* = 145)

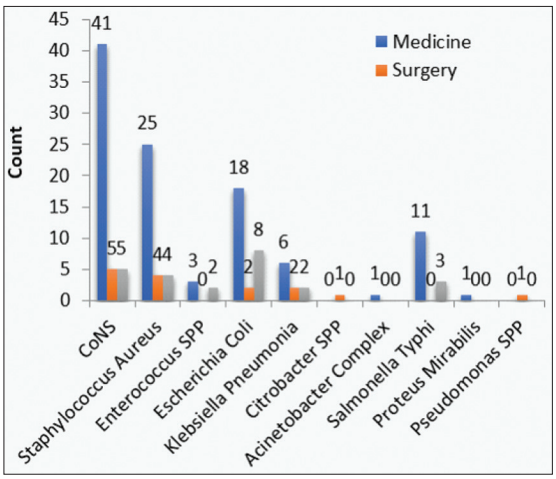

Figure 4: Ward-wise distribution of the culture isolates (*N* = 145)

The most common organism isolated from emergency was *E. coli* (8/24) followed *Salmonella typhi* (3/24) as illustrated in Figure 4.

The most common risk factor found in our study was the presence of an invasive device (29.7%) followed by age above 60 (25.4%). Immunosuppression in males was the commonest (28.4%), whereas the most common risk factor found in female patients was the insertion of an invasive device (37.4%) as shown in Figure 5.

The most common risk factor found in the age group 21–30 years was invasive device (17/110), whereas immunosuppression was found to be more common in 51–60 years (28/55). Other than the age factor, invasive device (15/32) and immunosuppression (11/32) were the common risk factors found in the age group 71–80 years as shown in Figure 6.

The presence of invasive device was the commonest risk factor found both in Gram-positive and Gram-negative cultures (42.7% and 42.95) followed by age above 60. A severe injury was found more in the Gram-negative cultures (18.0%) as shown in Figure 7.

Discussion

Sepsis is a systemic, harmful host response against infection which may lead to organ failure, shock, and even death. The mortality rate of sepsis ranges from 30%–40% and for severe sepsis even more than 50%. Mortality rate has not changed despite medical advancement for past two decades.[6] We included 350 study population of different age groups with different diseases. Out of 350 suspected cases of sepsis, we found 145 (41.4%) culture-positive cases. This finding was in coherent with other study.[7] All cases in our study were monomicrobial. This finding is in agreement with other studies.[8,9] We isolated Gram-positive organisms more than Gram-negative organisms in our study [Table 2]. This finding is in coherent with many studies.[10,11] In previous days, Gram-negative bacteria were more commonly isolated as causative agents of sepsis, while in current days, Gram-positive bacteria are getting increased over Gram-negative bacteria.[12] Probably, invasive procedures and lines were more frequently used to treat severely ill patients and this would be the possible explanation for increasing trend of Gram-positive organisms as causative agents of sepsis. However, some studies showed their findings in contrast to our studies.[13-16] In our study, all of the cases were having symptoms of septicemia, but none of them developed septic shock. Abe *et al.* stated that Gram-negative bacteria were significantly associated with septic shock than sepsis and severe sepsis, while Gram-positive

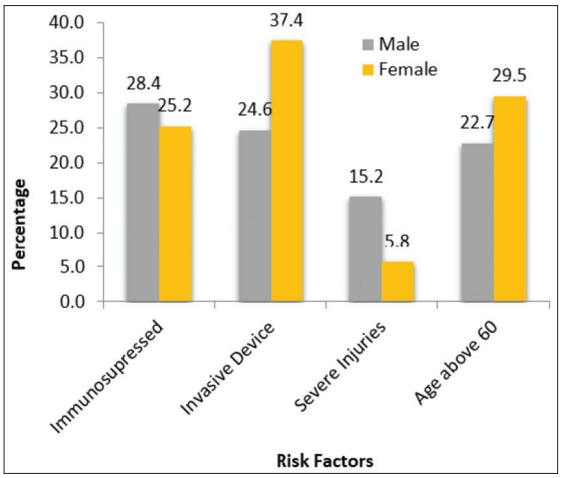

Figure 5: Sex-wise distribution of the risk factors (*N* = 328)

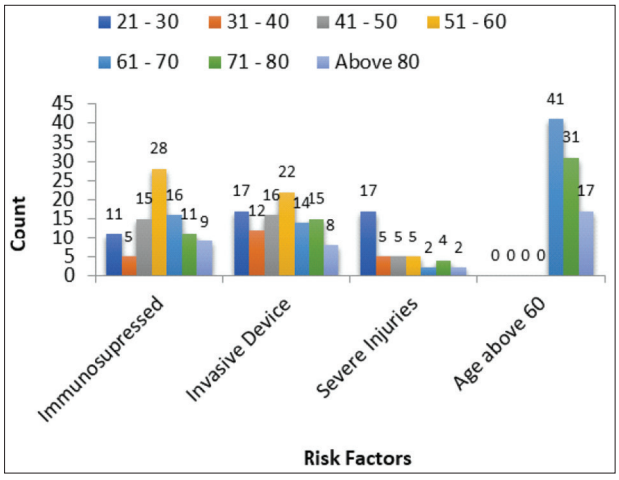

Figure 6: Age-wise distribution of the risk factors (*N* = 328)

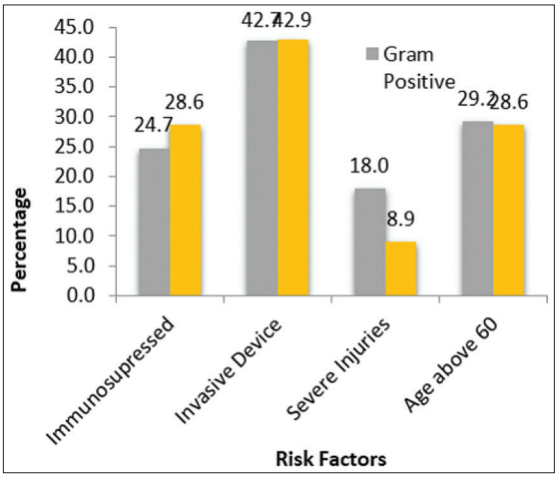

Figure 7: Association of the risk factors with culture-positive isolates

bacteria were associated with sepsis and severe sepsis than septic shock.[12] Probably, we isolated Gram-positive bacteria maximally and this could be one of the possible reasons that we did not find a patient with septic shock. Researchers found increased risk for Gram-positive bacteria among males due to genetic difference like polymorphism in lipopolysaccharide-binding protein and tumor necrosis factor gene.[17] Our study also found the same and males were having more Gram-positive bacteria as compared to females (61.8% vs. 38.2%). Coagulase-negative *Staphylococci* (CoNS) were the most common isolate as seen in other studies too.[18,19] CoNS was considered as contaminants until 1970s. After that, many studies notified CoNS as pathogens in their studies. *Escherichia coli* was the most common Gram-negative bacterial isolate. This is also seen in other study.[7]

We found genitourinary infections (36.9%) as the most common primary source of infection. This finding is opposite to many studies which identified respiratory tract infections as the most common primary source of infection.[16,20,21] Some other studies found different sources of infection.[15,22,23] In our study, at the time of diagnosis of sepsis, most of the patients were from medicine ward (73.1%) followed by emergency care (16.6%). The clinical implication of this finding is that infection control team should make a better infection control policy, especially targeting a particular area of higher incidence of sepsis and it should be strictly followed by health care personnel. Our study is in contrast to many studies which found maximum number from emergency care.[20,23] Xie *et al.* found most of the patients from surgery ward followed by emergency care.[16]

There are various risk factors which predispose to infection such as age, male gender, black race, chronic health conditions, socioeconomic status, long term care facilities, malnutrition, immunosuppression, prosthetic devices, and genetic factors.[24] Our study noted males predominant over females (62% vs. 38%) as seen in other studies too.[25] Esper *et al.* found males to be >25% increased risk for developing sepsis as compared to females in their study. The possible explanation is that hormonal difference between genders may be the reason of this dissimilarity.[17] Some studies pointed toward other reasons like increased pro-inflammatory response against endotoxin in females as compared to males or males more likely to be treated by invasive procedures.[24] There were 29.7% patients associated with invasive device in our study. Probably, proper aseptic precaution would not be taken during insertion or maintenance of invasive device. Hence, invasive devices should only be inserted in urgent cases and if it is inserted, should strictly adhere to infection control practices. Immunosuppressed patients contributed to 27.1% of all cases in our study. Lopez-Mestanza *et al.* and Greenberg *et al.* found 17.9% and 20% immunosuppressed patients with sepsis, respectively, in their study.[25,26] Host immune response gets blunted in immunosuppressed patients making the diagnosis difficult in sepsis. Greenberg *et al.* stated that immunosuppressed patients might be more prone to get infected with drug-resistant or opportunistic pathogens.[26] Age above 60 years was another risk factor contributing 22.7% in our study. According to Mayr *et al.*, there is increased chance to develop sepsis in older patients with more than half of cases in age over 65 years.[24] There are some studies which reported sepsis in elderly persons.[25,27] Shankar-Hari revealed increased age as one of the common risk factors for rehospitalization too.[28] It

might be due to the fact that older patients would have decreased immunity due to immunosenescence.[29] These above explained risk factors suggest that specific infection control practices should be followed while handling these patients to prevent progression of sepsis. Because these types of patients have increased risk of sepsis, hospital administration should provide some facilities on acute basis like targeted and timely administration of antibiotics and diagnostic services.

Conclusion

Septicemia is still a rising problem; hence, we should manage it carefully. Since culture isolates are less as compared to total number of cases, we should adopt different strategy to isolate pathogens for early appropriate therapy. Coagulase-negative *Staphylococci* can no longer be considered as contaminants and it should be treated as pathogens. Male sex, patients with invasive devices, immunosuppressed patients, older age groups, and patients with severe injury are vulnerable risk groups to develop sepsis; hence, some precautionary steps should be taken to handle these types of patients. These patients should also be provided some medical facilities like treatment and diagnosis on urgent basis to prevent development of sepsis.

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Conflicts of interest

There are no conflicts of interest.

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