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Bacteriological profile of bloodstream infections at a tertiary care hospital in New Delhi

Anuradha Kumari
Tutor, Department of Microbiology, Narayan Medical College and Hospital, Jamuhar, Bihar, India.
Email: kukuanuradha1996@gmail.com

Dr. Himanshu Bhim Khatri
Associate Professor, Department of Microbiology, Surabhi Institute of Medical Sciences, Siddipet, Telangana, India.
Email: himanshubkhatri@yahoo.co.in

Manish Kumar Tiwari
Tutor, Department of Microbiology, Saraswati Medical College, Unnao, Uttar Pradesh, India
Corresponding author email: mprabhat111@gmail.com

***Abstract*---**Invasion of the blood stream by microorganisms constitutes one of the most serious situations in infectious disease. Aim: The aim of this study was to identify the bacteria that caused blood stream infections. Methods: This six months prospective and observational study was performed in the department of microbiology at All India institute of Medical Science (AIIMS), New Delhi, India, on 280 blood samples of patients admitted in wards and various ICUs. Microbial detection and identification were done by fully automated BacT/Alert 3D and VITEK 2 systems, respectively. Results: Of the 280 suspected cases, blood culture was positive in 186 (66.4%) cases. Of the 186 isolates, 123 (66.12%) were Gram negative bacterial isolates of which the predominant were *Klebsiella pneumoniae* (27.64%), *Pseudomonas aeruginosa* (16.26%), and *Escherchia coli* (15.44%). Of the positive isolates, 63 (33.87%) were Gram positive bacteria of which MRSA (36.50%) was the predominant organism followed by MSSA (31.74%) and MRCoNS (17.46%). Conclusion: In this study, blood culture was positive in a relatively high proportion of suspected cases of blood stream infections. Automation has higher sensitivity and specificity than conventional methods and can help in significantly reducing mortality and morbidity of blood stream infections.

***Keywords*---**blood culture, blood stream infection, bacteremia, sepsis, septicemia.

Introduction

Bloodstream infections (BSIs) are severe diseases which are characterized by a high morbidity and mortality [1, 2]. Empirical anti-infectious treatment is chosen on the basis of the clinical and epidemiological data and are started immediately after the sampling of blood culture bottles; however, until the microbial antimicrobial susceptibility test (AST) result becomes available, their appropriateness is questionable [3, 4], especially in the context of an increasing rate of multidrug-resistant organisms [5]. Rapid microbiological investigation including identification of the causative agent and its antimicrobial susceptibility testing (AST) report are therefore very crucial, as mentioned in the points below:

1. To adjust the anti-infectious therapy to avoid ineffective treatment.
2. To reduce the spectrum of anti-infectious therapy so as to limit the selection of resistant strains.
3. To limit the toxicity and the negative impact on beneficial bacteria of some broad-spectrum antibiotics or combined therapy.

The quantity of microbes present in the blood during BSI ranges from 1 x 10 CFU/mL [6, 7] to 1 × 10^3 - 10^4 CFU/mL [8]. Blood cultures currently represent the main method to determine the etiology of a BSI because they are highly sensitive and easy to perform. The sensitivity of blood cultures is largely related to the volume of the sample. For adult blood cultures, 10 mL of blood is inoculated into two bottles each (one aerobic bottle and one anaerobic bottle). This pair of blood culture bottles represents a set of blood culture. Before antibacterial treatment, two to four blood cultures, i.e. 20 mL to 40 mL of blood are necessary to detect a causative agent in 80% to 96% of bacteremias. Upon blood-culture positivity, the first step is to perform a Gram staining of the blood-culture aliquot. This is a mandatory step to confirm the presence of bacteria/fungi in the blood bottle [9]. Bacteremia is the presence of viable bacteria in the circulating blood. The detection of bacteria in blood is always abnormal. A minor injury occurring during tooth brushing, tooth extraction, abscesses, infected wound or boils, insertion of intravenous or bladder catheter, surgery, lung infections, urinary tract infections (UTI), gastrointestinal tract infections (GTI), burns or bedsores, pneumococcal pneumonia, meningitis, pyelonephritis, osteomyelitis, cholangitis, peritonitis, enterocolitis, and puerperal sepsis are some of the sources of bacteremia and blood culture is required for their detection[10].

Many infections in neonatal and pediatric age group can only be established on the basis of etiological agent recovered from blood. Neonatal septicemia refers to systemic infection in the new born confirmed by a positive blood culture [11]. It remains a major cause of morbidity and mortality amongst newborn especially in the developing countries where its incidence is higher than in the developed world [12]. Despite advances in newborn care, neonatal sepsis is still a leading cause of morbidity and mortality, especially in low birth weight and preterm babies [13, 14]. Neonatal septicemia can be divided into early-onset sepsis (EOS) and late-onset sepsis (LOS) depending on the age of presentation. The usual organism and the method of transmission are different in the two groups. EOS (first 72 h of birth) is due to vertical transmission during labor whereas LOS (after 72 h) is due to

vertical, horizontal, or nosocomial infection. The incidence and organisms causing neonatal septicemia varies geographically, and also over time [15].

Blood stream infections (BSI) are the major cause of morbidity & mortality among patients admitted in the intensive care unit (ICU) and surveillance of etiological agents in these infections are important for their prevention & treatment. Infectious diseases have been a major cause of morbidity and mortality since the earliest times in the history of mankind. Fight against microorganisms remains the focus of modern medicine despite the successes of vaccination and development of antibiotics in the previous century. Blood stream infection is the infection that requires one or more cultures positive for a bacteria or a fungus of blood samples obtained in the presence of fever (>38°C) not attributable to other causes (based on US centers of Disease control & prevention [16]. Community acquired bacteremia (CAP) was defined if the first positive blood culture was obtained before or within 48 hours of hospitalization. Blood stream infections are considered to be nosocomial if signs & symptoms of these infections become evident after 48 hours following hospital admission and/or if the patient had been hospitalized during the 2 weeks before the current admission.

Material & Methods

This observational study was performed in the Department of Microbiology, All India Institute of Medical Sciences (AIIMS), New Delhi, India, on 280 blood sample of patients admitted to wards and ICUs of AIIMS Hospital, New Delhi in a six month period from 2nd July, 2018 to 31st December, 2018. The study was conducted in accordance with the ethical standards of the Institutional Ethics Committee and informed consent was obtained from the patients (or parents in the case of minors). Suspected adults or children who satisfied the sepsis related organ failure assessment (SOFA) score, in whom blood culture was sent, were recruited for the study. Adults or children who did not satisfy the inclusion criteria were excluded from the study. All patients satisfying the inclusion criteria were coded. Patients were interviewed by structured questionnaire and their hospital records were used to know about their past medical conditions. Blood samples were collected by healthcare staff following strict aseptic precautions. Samples were collected before the start of antibiotics. Half ml to ten mL of blood (depending on the age group) was drawn using a sterile syringe, which was immediately inoculated into a blood culture bottle for BacT/Alert 3D automated microbial detection system. If no growth was flagged till five days, the culture was regarded as sterile. If the growth was flagged as positive, subculture was done on sheep blood agar, MacConkey agar, and chocolate agar. Identification of organisms was done using the VITEK 2 automated microbial identification system.

Results

Of the 280 suspected cases, blood culture was positive in 186 (66.4%) cases. Male patients had a higher positivity (63.97%) compared to female patients (36.02%). (Table-1). Out of the 186 culture positive organisms, culture positivity was highest in the age group of 61-80 years (35.48%) followed by the age group of 0-20 years

(24.73%). (Table-2). Gram negative isolates were more common (66.12%) than Gram positive (33.87%) (Table-3).

Table 1: Gender distribution (n=280)

Sex	Total number of cases investigated (n=280)	Blood cultures with positive growth	
		Number	Percentage
Males	163	119	63.97
Females	117	67	36.02
Total	280	186	100%

Table 2: Positivity according to age group (n=280)

Age group	Total number of cases investigated (n=280)	Isolates from blood cultures with growth	
		Number	Percentage
0-20 years	72	46	24.73
21-40 years	60	40	21.50
41-60 years	55	34	18.27
61-80 years	93	66	35.48
Total	280	186	100

Table 3: Prevalence of Gram positive and Gram negative bacteria (n=186)

Organism	Number	Percentage
Gram negative	123	66.12
Gram positive	63	33.87
Total	186	100

Of the 186 isolates, 123 were Gram negative bacterial isolates of which the predominant ones were *Klebsiella pneumoniae* (27.64%), *Pseudomonas aeruginosa* (16.26%), and *Escherchia coli* (15.44%) (Table-4). Of the positive isolates, 63 were Gram positive of which MRSA (36.50%) was the predominant organism followed by MSSA (31.74%), and MRCoNS (17.46%) (Table-5).

Table 4: Prevalence of Gram negative bacterial isolates

Bacterial isolates	Number of isolates	Percentage %
Klebsiella pneumoniae	34	27.64
Citrobacter spp.	10	8.13
Acinetobacter spp.	17	13.82
Escherchia coli	19	15.44
Enterobacter spp.	8	6.50
Pseudomonas aeruginosa	20	16.26
Proteus mirabilis	11	8.94
Alkaligen spp.	4	3.25
Total	123	100

Table 5: Prevalence of Gram positive bacterial isolates

Bacterial isolates	Number of isolates	Percentage %
MSSA	20	31.74
MRCoNS	11	17.46
MRSA	23	36.50
MSCoNS	6	9.52
Non hemolytic *Streptococcus* spp.	3	4.76
Total	63	100

Discussion

Blood stream infections are a major cause of morbidity and mortality among patients in a health care setting . The cause of infection is multifactorial and consequences depend on the pathogens associated, source of infection, underlying risk factors, and timely intervention and appropriate treatment received. Prevalence of bacteria may differ in various geographical locations and this may have implications on the choice of antimicrobial therapy. The study was undertaken with the intent to determine the prevalence of blood stream pathogens in this part of India.

In our study, the positivity rate was 66.4%. A study by Uslan DZ et al., [17] had a similarly high positivity of 61.84%. But another study by Banik A et al., [18] had a very low positivity of 14.74%. The variations in positivity can be primarily explained by the difference of volume of the blood sampled for culture [19]. In the present study, male patients had a higher positivity (63.97%) compared to female patients (36.02%) (Table-1). In many other studies, there was a higher incidence of bacteremia in males than females [17] [18] .

In our study out of 186 culture positive organisms, the maximum number of culture positive isolates were seen in the age group of 61-80 (35.48%) followed by 0-20 years (24.73%). (Table-2). A study by Uslan DZ et al., [17] also had the highest positivity (61.69%) in patients aged more than 60 years. But in the study of Banik A et al., [18] positivity was highest in the age group of 0-20 (71.48%). It is a well accepted fact that extremes of age have a higher risk of serious infections due to lower immunity.

In this study, Gram negative isolates were more common 123 (66.12%) than Gram positive 63 (33.87%) (Table-3). This was in contrast to the study by Banik A et al., [18] which had a higher positivity of Gram positive cocci (60.37%). In the present study, out of 123 total gram negative bacterial isolates, *Klebsiella pneumoniae* was the predominant organism (27.64%) followed by *Pseudomonas aeruginosa* (16.26%) and *Escherichia coli* (15.44%). (Table-4). On the contrary, the study by Banik A et al., [18] had *Acinetobacter* spp. as the predominant organism (30.61%) followed by *Klebsiella* spp. (26.53%) and *E. coli* (11.22%). In our study, among the all Gram positive organism MRSA was predominant (36.50%) which was followed by MSSA (31.74%). (Table-5). However, the study by Banik A et al., [18] had the preponderance of MSSA (39.87%) over MRSA (27.60%).

Conclusions

In this study, blood culture was positive in a relatively high proportion of suspected cases of blood stream infections. Authors recommend that as far as possible, automation should be used for detection and identification of organisms causing blood stream infection. Automation has higher sensitivity and specificity and can help in significantly reducing mortality and morbidity of blood stream infections. The bacteriological profile may vary in different studies and this may be attributable to factors like geographical and local prevalence of organisms, proper aseptic collection of blood specimens, volume of the blood collected, and conventional versus automated methods used for detection and identification.

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