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BACTERIOLOGICAL PROFILE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF BLOOD CULTURE ISOLATES FROM A TERTIARY CARE INSTITUTE IN MUMBAI

Medical Microbiology

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ABSTRACT

Bloodstream infections (BSI) are infectious diseases defined by the presence of viable bacterial or fungal microorganisms in the bloodstream. Bloodstream infection is a major cause of morbidity and mortality despite the availability of broad spectrum and effective antimicrobials and major advances in supportive care. The study was performed to determine the bacteriological profile along with the susceptibility pattern of the blood culture isolates from inpatients in a tertiary care hospital. Three thousand and eighty two blood culture samples from March 2016 to February 2018 were included and processed as per standard guidelines. The maximum proportion of samples received for blood culture were from the pediatric population (2407) 78.1% and (675) 21.9% were from the adult population of which 588 (19.1%) were from the intensive care units and (87) 2.8% were from wards. The total culture positive samples were 741 (24%) of which the infections with gram positive cocci were 232 (31.3%) and with gram negative bacilli were 354 (47.8%) Candida species were isolated in 26 (3.5%) and 129 (17.4%) were skin commensals and reported as skin contaminants / collection contamination. The rate of blood stream infections in the study is 24%. The most common gram negative isolate is Pseudomonas aeruginosa and the most common gram positive isolate is Staphylococcus aureus. Salmonella Typhi was isolated in 4.2% from the pediatric population. Reduced sensitivity is seen to third generation cephalosporins thus Antimicrobial Stewardship practices will strengthen the quality of diagnosis and treatment thus minimising development of resistance as there are very few new therapeutic options.

KEYWORDS

Blood stream infections, blood cultures, pathogens, antimicrobial susceptibility

INTRODUCTION:

Bloodstream infections (BSI) are infectious diseases defined by the presence of viable bacterial or fungal microorganisms in the bloodstream (later demonstrated by the positivity of one or more blood cultures) Bloodstream infection is a major cause of morbidity and mortality despite the availability of broad spectrum and effective antimicrobials and major advances in supportive care. The diagnosis of BSI is done by blood cultures. Blood stream infections are categorised based upon the severity of infection and the extent of organ failure into Sepsis & Septic Shock. The infective causes of the above can be determined by blood cultures. A wide range of organisms are known to cause blood stream infections and it is subject to geographical distribution. There is an increasing trend of multidrug resistant organisms causing BSI and this impacts economic burden on the patient by prolonging the hospital stay, higher cost of antimicrobials and associated risks of complications.(1)

Blood culture is an important tool and gold standard for detection of BSIs. Low and middle income countries face challenges for implementation of blood cultures due to financial, logistical and infrastructure related constraints. (2) Blood cultures if performed correctly and at the right time are extremely helpful in appropriate treatment of BSIs. Blood cultures collection technique and amount of sample is extremely crucial to increase the specificity and sensitivity of the test. This also helps in reduction of contamination rates which may lead to misinterpretation of results.(2) Regular surveillance of blood culture bacterial pathogens and their susceptibility pattern is helpful. In most case scenarios the patient is started on empirical therapy and the samples for culture are sent mostly before initiation of antimicrobials, thus knowing the trend of the organisms and their antimicrobial susceptible pattern guides the clinician in deciding the appropriate empirical therapy which is a part of the antibiotic policy of the hospital / institute. Empirical treatment is effective in reducing the morbidity and mortality associated with BSIs and also prevents the irrational use of antimicrobials thus contributing to reduction in antimicrobial resistance. (1,3)

AIMS & OBJECTIVES:

To study the bacteriological profile along with the susceptibility pattern of the blood culture isolates from inpatients in a tertiary care hospital.

MATERIAL & METHODOLOGY:

A retrospective study from March 2016 to February 2018 was carried out in the Department of Microbiology in a tertiary care institute; all the blood culture samples received from inpatients of the institute were included in the study.

The samples which grew contaminants and double growth were excluded from the study.

The blood culture samples were received in BHI broth from both the adult and pediatric population and processed manually. Conventional blood culture bottles were incubated aerobically at 37ºC for 07 days. Subcultures from the bottles were done after 24 hrs i.e. day 1, day 3, day 5 and day 7 on chocolate agar, blood agar and MacConkey's agar. The growth obtained on the different media was identified further by routine biochemical reactions and standard protocol. The antimicrobial sensitivity was done by Kirby Bauer disc diffusion method as per CLSI guidelines. For Gram-positive bacteria from blood isolates following drugs were tested: penicillin (10U), cefoxitin (30 µg), trimethoprim-sulfamethoxazole (1.25/23.75µg), gentamicin (10 µg and 120 µg), ciprofloxacin (5 µg), linezolid (30 µg), teicoplanin (30 µg), chloramphenicol (30µg). Vancomycin (30 µg discs). For gram-negative bacteria following drugs were tested: ampicillin (10 µg), gentamicin (10 µg), ciprofloxacin (5 µg), cefotaxime (30µg), cefepime (30 µg), and ceftriaxone (30 µg), Trimethoprim/ sulfamethoxazole (1.25/23.75 µg), ceftazidime (30 µg),amikacin (30 µg), piperacillin-tazobactam (100/10 µg),imipenem (30 µg), meropenem (30 µg), chloramphenicol (30 mcg),and ceftazidime-clavulanic (30/10 mcg) were tested.

RESULTS:

A total number of 3082 samples were processed from March 2016 to March 2018. The age group of the patients ranged from neonates to the geriatric population i.e. 1 day to 82 years of age. There were 41% (1266) patients in the 0-1year age group, followed by 36%(1112) in the 1.1 to 10 year age group, 1.6% (49) in the 11-20 years group, 4.4% (137) in 21-30 yrs group, 3.4% (106) in 31-40 yrs group, 4.5% (138) in 41-50 years group, 4.3% (134) in 51-60 yrs grouped 4.5 % (140) in 61-82 yrs group. The maximum number of samples received for blood culture were from the pediatric population (2407) 78.1% and (675) 21.9% were from the adult population of which 588 (19.1%) were from the intensive care units and (87) 2.8% were received from wards.

The total culture positive samples were 741 (24%) of which the infections with gram positive cocci were 232 (31.3%) and with gram negative bacilli were 354 (47.8%) Candida species were isolated in 26 (3.5%) and 129 (17.4%) were skin commensals and reported as skin contaminants / collection contamination.

The organisms isolated were Pseudomonas aeruginosa 19%, Klebsiella pneumoniae 9.9%, Acinetobacter baumannii 5.8%, E.coli 4.5%, Salmonella Typhi 4.2%, Enterobacter aerogenes 2%, Proteus spp. 1.5% amongst the gram negative and Staphylococcus aureus 18.6%, coagulase negative staphylococci 9.2%, Enterococci species 2.3% and Streptococcus pyogenes 1.2% amongst the gram positive

organisms. The fungal isolates were grouped as Candida albicans 2.3% and non Candida albicans 1.2%.The susceptibility pattern for P.aeruginosa was 82% for Imipenem and amikacin 81% for gentamicin and piperacillin-tazobactum. Acinetobacter species were sensitive to Amikacin 91% and Imipenem, 84% to piperacillin-tazobactum, 76% to cefipime, 72% to gentamicin and 65% to ceftazidime. Klebsiella species were sensitive to Imipenem and Amikacin 77% gentamicin 69%, and showed reduced susceptibility to piperacillin-tazobactum 65%, cefipime 62% and cefotaxime 58%. E.coli was sensitive to piperacillin-tazobactum, gentamicin, amikacin 91%, 76% to imipenem and 69% to cefipime susceptibility was reduced to cefotaxime 54%. All the gram positive isolates showed 100% susceptibility to vancomycin and linezolid. S.aureus was 91% susceptible to chloramphenicol 89% to gentamicin, 85% to ciprofloxacin and erythromycin, 76% to cefoxitin and 71% to penicillin. Enterococcus species were sensitive to gentamicin 76%, erythromycin 76%, ciprofloxacin 71% and penicillin71%. Streptococcus pyogenes were susceptible to all drug classes. The fungal isolates were sensitive to all drugs tested nystatin, ketoconazole, fluconazole, itraconazole and amphotericin B.

Susceptibility Pattern Of Gram Positive Organisms:

Organisms	Penicillin	Erythromycin	Cefoxitin	Chloramphenicol	Gentamicin	Ciprofloxacin
Staphylococcus aureus	71%	85%	76%	91%	89 %	85%
CONS Coagulase negative Staphylococcus species	91%	88%	85 %	92%	90 %	87 %
Enterococci	71%	76%	--	--	76 %	71 %
Streptococcus pyogenes	100 %	100%	--	--	100 %	100%

Susceptibility Pattern Of Gram Negative Organisms:

Organisms Non Fermenters	Gentamicin	Amikacin	Ceftazidime	Cefipime	Piperacillin Tazobactum	Imipenem
Pseudomonas aeruginosa	81 %	82 %	79 %	79 %	81 %	82 %
Acinetobacter spp.	72 %	91 %	65 %	76 %	84 %	91 %

Organisms Eterobacteriaceae	Gentamicin	Amikacin	Cefotaxime	Cefipime	Piperacillin Tazobactum	Imipenem
Klebsiella spp.	69 %	77 %	58 %	62 %	65 %	77 %
E.coli	91 %	91 %	54 %	69 %	91 %	76 %
Enterobacter spp	73 %	73 %	67 %	73 %	80 %	80 %
Proteus spp	64 %	64 %	54 %	54 %	82 %	82 %

Organisms	Ampicillin	Ciprofloxacin	Cotrimoxazole	Chloramphenicol	Azithromycin	Ceftriaxone
S. Typhi	86%	93 %	93%	93%	100%	100%

Susceptibility Pattern Of Fungal Isolates – Candida Species

Organisms	Ketoconazole	Itraconazole	Fluconazole	Nystatin	Amphotericin B
Candida albicans	100 %	100 %	100 %	100 %	100 %
Non albicans Candida	100 %	100 %	100 %	100 %	100 %

DISCUSSION:

The study aims to study the bacteriological profile and antimicrobial sensitivity pattern of the isolates grown from blood culture samples. Accurate diagnosis of blood stream infections in patients with appropriate identification and antimicrobial susceptibility helps with timely intervention there by saving many lives. Blood culture is one of the most important clinical samples received in a clinical microbiology laboratory. Any delay in the diagnosis amounts to a time lag in initiation of appropriate treatment, each hour of delay in starting the treatment leads to a decrease in survival by an average 8% (3) Funk et al state that in the first 12 hours of sepsis there is a 1% mortality for every 5 mins of delay in initiation of therapy. (4)This highlights the importance of blood cultures in sepsis and any fever cases for diagnosis and appropriate treatment.

The present study indicates that the majority of the samples were received from the neonatal age group 41% followed by the pediatric age group from 1 year to 10 years 36% and 21.9% from the adult population. A Nigerian study by Wariso et al had 49.1 % of samples from the neonates and 39.9% from children and 11.6% from adults. (5) Katyal et al have reported that 84% of their samples were from neonates(6) this probably due to sample size being limited to only intensive care units. The no growth percentage of the blood culture samples was 76% and the percentage of growth in the samples was 24%. A study by Katyal et al and Wariso et al both, have a growth positivity rate in blood culture samples as 24.86% and 22.5% which is similar to present study (5,6) vis a vis in a study by Gohel et al the positivity rates were as low as 9.2% (1) also in a study by Sonawane et al the positivity rates are low ie 10.29%.(7) The studies showing lower rates of infection may be due to the selective population of the study. Amongst the growth in blood culture samples in the present study gram positive isolates were 31.3% and gram negative isolates were 47.8% Anjum et al have shown the rate for gram positive infection to be 39% and gram negative infection to be 61%. Another study by Palewar et al, gram negative infections comprised 69% and gram positive isolates were 31%.(3) Katyal et al study showed higher rates of gram positive infection at 57.14% and the gram negative infections were 42.85% (6) Gohel et al too showed higher gram positive infection rates at 58.3% followed by gram negative infections at 40.2%(1) Variations in growth rates are due to the population being tested and geographical areas. Fungal isolates were 3.5 % of candida and non albicans Candida species in the current study which is comparable to a study by Ghosh et al (8)where Candida and non albicans Candida species are the only fungal isolates with a positivity rate of 3.22%, in another study Karam El-Din et al showed 15.2% rate of fungal isolates and candida and non albicans candida species were the most common isolate. (9) Gohel at el reported a lower rate of fungal infections comprising of only Candida and non albicans candida species at 1.5% (1) The commensal / contaminants reported in the current study is 17.4% which comprised of coagulase negative staphylococcus, micrococci and diphtheroids, Ghosh et al have reported a contamination rate of 16.13% which includes only coagulase negative staphylococcus (8) another study by Malik et al the contamination rate for blood cultures was 16 % and the common contaminants were coagulase negative staphylococcus, micrococci and diphtheroids (10)

The isolates amongst the gram positive cocci were Staphylococcus aureus 18.6% , Coagulase negative Staphylococcus species (CONS) 9.2% , Enterococcus species 2.3% and Streptococcus pyogenes 1.2% respectively. Legba et al have reported a higher percentage of Enterococcus species followed S.aureus.(11) In a study by Katyal et al CONS was the most common isolate amongst gram positive cocci followed by Staphylococcus aureus and enterococci species. (6)

The gram negative bacilli constituted 47.8% of the total culture positive samples the gram negative bacteria isolated were Pseudomonas aeruginosa 19%, Klebsiella pneumonia 9.9%, Acinetobacter baumannii 5.8%, E.coli 4.5%, Salmonella Typhi 4.2%, Enterobacter aerogenes 2%, Proteus spp.1.5%. The present study highlights that pseudomonas aeruginosa was the most common organism isolated amongst gram negative bacilli, various other studies show a gram positive cocci predominance (1,4,12) and some show gram negative bacteria as the major isolates (3,5,7,11,13). The gram negative bacteremia in this study is slightly higher than gram positive bacteremia due to a tertiary care setting. Fungal isolates in blood culture in the present study grew candida albicans and various species of non albicans candida such as C.tropicalis and C.parapsilosis. The study showed the percentage of non fermenting gram negative bacteria higher than others at approximately 24.8% which is a cause of great concern as these bacteria are multidrug resistant and have limited treatment options thus the need of reserved drugs to be sought for their treatment which further attributes to antimicrobial resistance. Salmonella Typhi positivity rate was 4.2% in present study where in most of the isolates belonged to the pediatric age group, other studies by Sonawane et al had a positivity rate of 7.7% where as Palewar et al had a rate of 0.5% (3,7) variations in rate can be attributed to the varied age group of patients being tested along with geographical distribution of the studies.

The gram negative bacilli were sensitive to the following class of drugs carbapenems, aminoglycosides, betalactam inhibitors like piperacillin-tazobactam and third generation cephalosporins. Salmonella Typhi amongst the gram negative bacilli were 100% sensitive to ceftriaxone and azithromycin and 93% sensitive to the fluroquinolones, chloramphenicol and cotrimoxazole.

The gram positive bacteria showed good susceptibility to glycopeptides, oxazolidinones, aminoglycosides and chloramphenicol. The fungal isolates were susceptible to all drug classes tested i.e. polyenes, azoles and triazoles.

CONCLUSION:

The present study highlights the bacteriological profile and antimicrobial susceptibility pattern of blood culture isolates in a tertiary care center. The study concludes that

1. The rate of blood stream infections in the study is 24%. A slight seasonal variation in the infection rates may be seen during monsoons when there is an increase of fever cases.
2. The most common gram negative isolate is Pseudomonas aeruginosa and the most common gram positive isolate is Staphylococcus aureus.
3. Blood cultures are one of the most important tools for detection of blood stream infections in all patients. Timely diagnosis with accurate bacterial isolate identification and its antimicrobial susceptibility is most crucial for treatment of these infections.
4. Empirical treatment options should be made for wards and intensive care units as per the hospital antibiogram so that appropriate antimicrobials can be administered to prevent further complications in patients.
5. Reduced susceptibility is seen towards third generation cephalosporins. Antimicrobial Stewardship involves right diagnosis in the right patient at the right time thereby helping in appropriate treatment of all patients. Stewardship practices strengthen the quality of diagnosis and treatment thus preventing development of resistance as there are very few newer drugs in the pipeline
6. Accurate diagnosis and interventions can thus prevent both prolonged stay and development of antimicrobial resistance in the patients.

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