Microbial and antimicrobial resistance profile of bloodstream infections: A hospital-based study

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Abstract

Background: Microbial invasion of the blood stream can have serious impact and can lead to morbidity and mortality due to multi organ failure within few days. Timely detection and treatment is vital and necessitates hospital admission and immediate intervention.

Aim: To investigate the aetiology and anti-microbial resistance patterns of bacterial isolates in blood stream infections.

Methods: This is a retrospective clinical-laboratory based study carried over one year period. This study was carried out from 1st December 2013 to November 30th 2014 at Nephrology urology referral and transplant centre, Bangalore. A total of 1083 blood samples collected over a year from clinically suspected cases of bacteremia were studied, bacteria were isolated and identified. Antibiogram was performed on all positive samples.

Results: Positive blood cultures were obtained in 19.94% cases of which gram negative bacteria accounted for 74.09% cases with Burkholderia cepacia [37.5%] predominant, followed by Esch.Coli ESBL [20.62%] and Pseudomonas aeroginosa [14.37%]. Gram positive cocci accounted for 14.35% cases with Staph. aureus (80.64%) predominant, followed by enterococcus faecalis (9.67%). In both gram negative bacilli and gram positive cocci male to female ratio was 1.6:1. The most sensitive drug for gram negative bacilli especially Burkholderia.cepacia was carbapenems with 98%, cotrimoxazole with 70% and ceftazidime with 80% susceptibility. ESBL, *Esch. Coli* had carbepenems 98.5% susceptibility. In case of gram positive cocci, linezolid & teicoplanin showed 99% susceptibility.

Conclusion: High prevalence of antimicrobial resistance was noted in this study, especially in Gram−negative bacteria. Hence, appropriate treatmenof BSIs should be based on the current knowledge of bacterial resistance profile as provided by microbiology laboratory. It would beadvisable for the clinicians to mandate antimicrobial sensitivity testing for suspected cases of BSIs.

Keywords: Antimicrobial resistance, Antibiogram, Blood stream infections, Haemodialysis

Introduction

Blood stream infections (BSIs) are an important cause of morbidity and mortality among hospitalised patients and the surveillance of aetiological agents in these infections is essential for their prevention and treatment. Microbial invasion of the bloodstream can have serious immediate consequences i.e., shock, multiple organ failure, disseminated intravascular coagulation (DIC) and death[1-3].

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Therefore, timely detection and identification of blood borne pathogens is important.

Increasing antimicrobial resistance is a worldwide concern. The prevalence of resistance of blood borne isolates is increasing the infection caused by MDR organisms which is more likely to prolong the hospital stay, increase the risk of death, and requires treatment with more expensive antibiotics[3,4]. In almost all cases, antimicrobial therapy is initiated empirically before the results of blood culture are available. Keeping in mind the high mortality and morbidity associated with septicemia, right choice of empiric therapy is of utmost importance[3,4]. Therefore, the present study was undertaken to analyze the various organisms causing blood stream infection and their antibiotic resistance patterns, as it would be a useful guide for clinicians initiating the empiric antibiotic therapy.

Material and Methods

A total of 1083 samples from clinically suspected cases of bacteremia were studied at Nephrology Urology Referral hospital and transplant centre, Bangalore for a period of one year from 1st December 2013 to November 30th 2014. Our institute is 65 bedded teaching hospital which caters to every clinical disease of Nephrology & urology patients including hemodialysis programme as well as kidney transplant programme. All the samples were collected from inpatients in our hospital during the study period and processed in the central laboratory.

Ten milliliters of venous blood, collected after wiping the venous part with sterilium & iodine, were inoculated into BD Bactec PLUS Aerobic/F culture vial for processing with the BACTEC9050 system [Becton & Dickinson New Jersey, USA] - Fully automated blood culture system for detection of growth in blood culture. The negative results were followed up to 7 days and final report was issued. While, in case of a positive growth, the Bactec 9050 automatically gives an alert. The positive bottles were then subcultured on Mac conkey and Blood agar. From the colonies on Mac conkey agar, 0.5 Mc Farland suspension was prepared, which was then subjected to identification and susceptibility testing by BD Phoneix (manufactured by Becton & Dickinson, New Jersey, USA] - which is a fully automated system for identification of organism and antimicrobial susceptibility as per the CLSI 2013 guidelines.

Results

During the study period, 1083 blood cultures were analyzed, of which 216 microorganisms were isolated, out of which 214 were bacterial isolates and 2 were fungal isolates. The distribution and percentage of various bacterial and fungal isolates are shown in table 1, figure 1 and 2. Of the total patients studied, 135 were males and 81 were females giving a M:F ratio of 1.6:1(Table 2). The drug resistance patterns are depicted in tables 3,4 and 5.

Table 1. Distribution of Gram positive, Gram negative, Candida and Micrococci isolates.

Isolates (Number)	Percentage
Gram−negative bacteria (160)	74.07%
Gram−positive cocci (31)	14.35%
Candida spp (2)	0.95%
Micrococci Contaminants (25)	11.57%

Table 2. Distribution of isolates in male and female patients

Total isolates in male patients	135
Total isolates in female patients	81

Ratio between male to female 1.6:1

Table 3. Drug resistance pattern of Non-fermentors

Antibiotics	Burcholderia cepacia	P. aeroginosa	NF GNB
Ampicillin	100%	97%	60%
Amikacin	70%	40%	10%
Ceftazidime	50%	50%	30%
Ciprofloxacin	96%	90%	60%
Levofloxacin	80%	50%	20%
Gentamicin	90%	40%	10%
Trimethoprim-Sulphamethoxazole	70%	50%	NIL

Piptaz	50%	10%	NIL
Cefeperzone+ sulbactom	60%	10%	NIL
Imipenum/ Meropenem	NIL	NIL	NIL
Tigecycline/Colistin	ND	ND	ND

Table 4. Drug resistance pattern of Gram Positive Cocci Isolates

Antibiotics	Staph aureus	Enterococcus faecalis
Ampicillin	40%	30%
Cefazolin/Cephalexin	60%	20%
Pencillin	50%	40%
Oxacillin/cefoxitin	5%	nil
Linezolid	nil	nil
Teicoplanin	nil	nil
Ciprofloxacin	89%	75%
Oflaxacin	30%	30%
Gentamycin High Level	30%	10%
Trimethoprim-Sulphamethoxazole	10%	nil
Tetracyclin	nil	nil
Erytromycin	60%	50%
Clyndamycin	40%	30%
Vancomycin	nil	nil

Note: One isolate was MRSA

Table 5. Drug resistance pattern of Enterobacte riace Isolates

Antibiotics	E.coli/ Klebsiella (ESBL)	E.coli / Klebsiella (NON-ESBL)	Enterobacter cloaca	Salmonella
Ampicillin	100%	97%	60%	60%
Amikacin	70%	40%	10%	ND
Amoxillin+ clavulanate	100%	75%	30%	ND
Ceftriaxone/Cefotaxime	100%	60%	40%	NIL
Ceftazidime	100%	60%	30%	ND
Cefuroxime	100%	60%	30%	ND
Ciprofloxacin	96%	90%	60%	50%
Levofloxacin	80%	50%	20%	ND
Gentamicin	90%	40%	10%	ND
Trimethoprim-Sulphamethoxazole	60%	20%	NIL	NIL
Piptaz	50%	10%	NIL	ND
Cefeperzone+ sulbactom	50%	10%	NIL	ND
Imipenum/ Meropenem	NIL	NIL	NIL	ND
Tigecycline/Colistin	NIL	NIL	NIL	ND

ND- Not done

Note: Two isolates E.coli and Klebsiella each were carbapenamase producer and were sensitive to colistin and Tigecycline.

Figure 1. Percentage and Distribution of Gram negative isolates

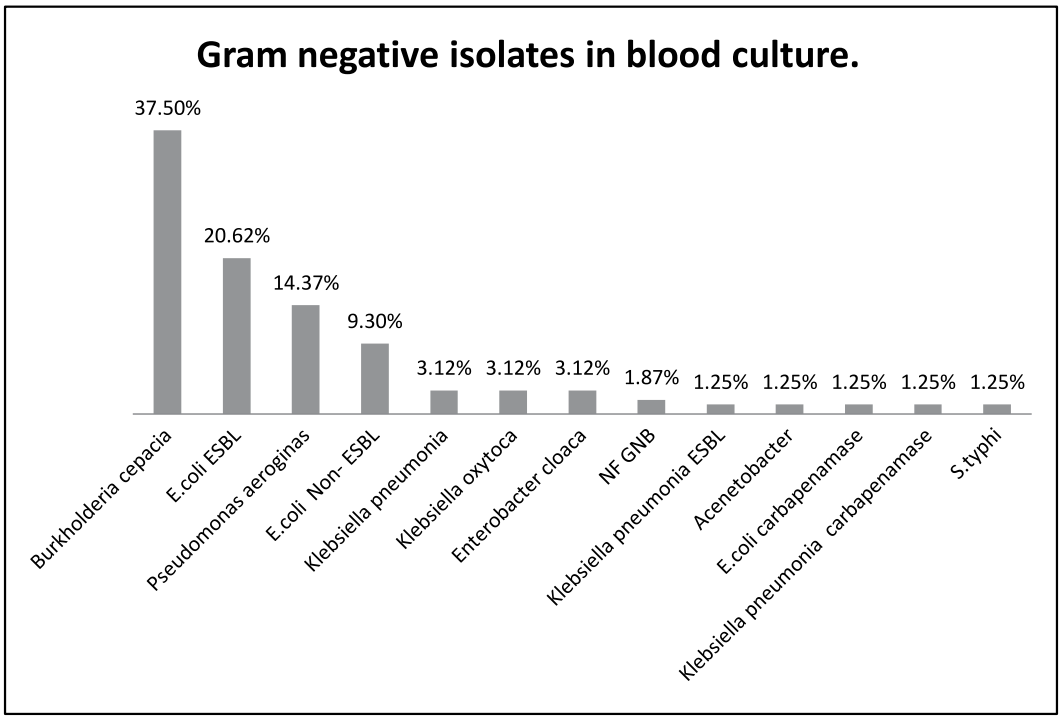
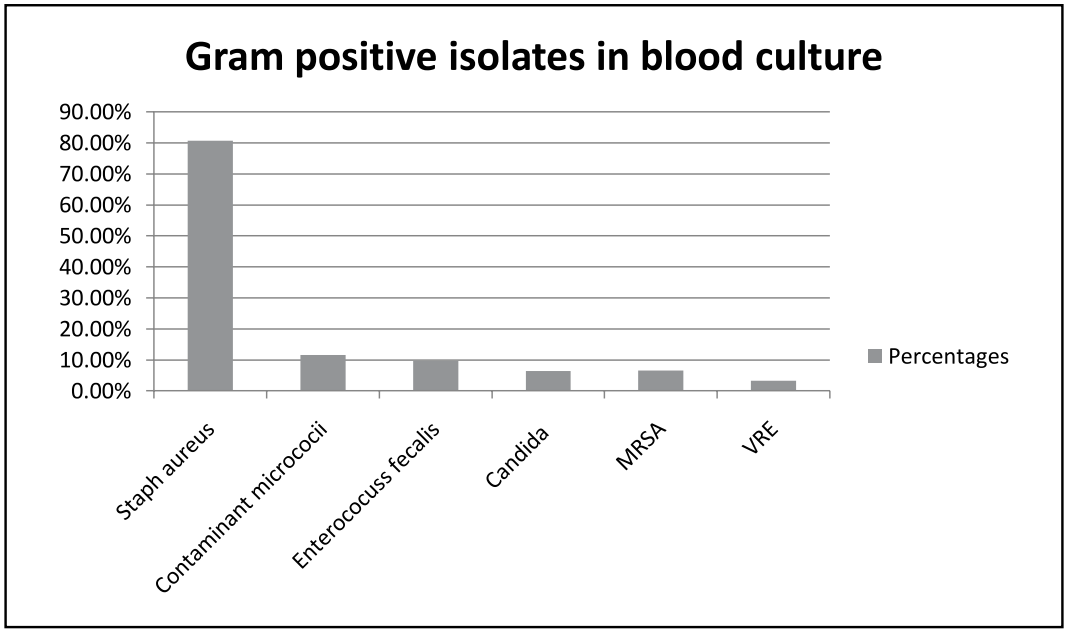


Figure 2. Percentage and Distribution of Gram positive isolates



Among the Gram-negative isolates, the predominant isolates were Burkholederia cepacia [37.5%] Esch.coli [ESBL] [20.62%] Pseudomonas aeroginosa[14.37%] Esch.coli non [ESBL] [9.3%] klebsiella pneumonia & Klebsiella oxytoca, Acenetobacter baumannii & Enterobactercloaca [3.12%] NF GNB [1.87%] ESBL producers. Esch. coli & Klebsiella pneumoniae isolates showed least resistance to carbapenems,, and tigecycline and moderate resistance to betalactamase inhibitors combination. Burkholderia cepacia Pseudomonas aeroginosa & Acenetobacter baumannii showed least resistance to Carbapenem and Ceftazidime.

Among Gram positive isolates Staph aureus showed least resistance to Vancomycin and Linezolid.

Discussion

Blood culture positivity was seen in 216/1083 [19.94%] cases which is quite similar to Mehta et al[1], China & Gupta[2] but lower to other studies of Kamga et al[3], Kavitha et al[4] Roy et al[5] and others[6,7]. The proportion of gram negative organisms was 160/216 [74.07%] and gram positive was 31/ 216 [14.35%] respectively, which is similar to studies like Mehta et al[1], Mehdin ejad et al[8], Bharti et al[9]. Gram negative organisms have taken over gram positive organisms in hospitals settings[10,11]. This difference could be related to an active dialysis programme at our institute. We observed that significant proportion of our patient pool is immunocompromised due to Chronic Kidney Disease status and on regular dialysis or post kidney transplant which led to bacteremia with various organisms like Burkholederia cepacia, Pseudomonas aeroginosa and Esch. coli Extended spectum Beta-Lactamase producer which commonly does not lead to bacteremia in healthy non immunocompromised patient. High prevalence of antimicrobial resistance was noted in this study, especially in Gram−negative bacteria. This might be due to indiscriminate use of antibiotics in hospital[12].

There may be another reason that the non-fermentor like Burkholderia cepacia and Pseudomonas aeroginosa, extended spectrum beta−lactamase producer Gram-negative bacteria are prevalent in the hospital environment[13].

Antimicrobial resistance profile of Gram−negative bacteria had shown a higher rate of resistance as compared with Gram−positive bacteria. Most of the Gram−negative bacteria were multidrug resistant with a very high resistance to beta−lactam antibiotics. A lower resistance was seen to carbapenems, and Beta Lactum Inhibitors. It may be concluded from the study that early diagnosis and appropriate treatment of BSIs should be based on the current knowledge of bacterial resistance profile, which should be provided by microbiology laboratory from time to time. This in turn implies that blood cultures must always be obtained in all cases of suspected bacteremia and septicemia, so that both the common pattern of causative organisms and their susceptibility pattern are available.

Though intensive investigation has been done, it would be good to implement the blood culture bundle that is use a Aerobic, Anaerobic and a fungal bottle for blood culture and more importantly use a test like procalcitonin to ensure that the bacterial and fungal causes are diagnosed rapidly in these pool of patients[14,15].

A diligent search of other sources of infection and also viral causes need to be studied in a extended study to arrive at a etiological diagnosis

Conclusion

Antimicrobial resistance particularly among Gram negative isolates continues to be high and increasing at a rapid rate, especially in haemodialysis set up, coordinated infection control interventions and antimicrobial stewardship policies are warranted in order to decrease the rate the emergence of resistance. As the practice of prescribing antibiotics is completely unregulated, cheap generics are available, usage of all kinds of antibiotics for even minor illness as well as viral respiratory infections is widespread and there are not many newer antimicrobials in research pipeline, it is foreseen that if the same kind of practice continues the antibiotic resistance is likely to go up and we will face serious crisis of antibiotics in near future.

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