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Dr. Anuradha Shulania
Associate Professor,
Dept. of Microbiology
PGIMER & Dr RMLH,
New Delhi, India

Dr. Stuti Kansra
Medical Officer
Dept. of Microbiology
PGIMER & Dr RMLH,
New Delhi, India

Dr. Nandini Duggal
Consultant & Head
Dept. of Microbiology
PGIMER & Dr RMLH,
New Delhi, India

Correspondence
Dr. Anuradha Shulania
Associate Professor,
Dept. of Microbiology
PGIMER & Dr RMLH,
New Delhi, India

Prevalent pathogens and their behaviour in blood stream infections in a tertiary care hospital

Dr. Anuradha Shulania, Dr. Stuti Kansra and Dr. Nandini Duggal

Abstract
Bloodstream infections (BSIs) can range from in apparent bacteremia until fulminant septic shock with high mortality. The present study was undertaken to analyze the various prevalent pathogens causing BSIs and study their behavior in a tertiary care hospital. A total of 8091 blood specimens from clinically suspected cases were studied for 6 months from January 2018 to June 2018. Blood specimens were incubated in BacT/ALERT® 3D system. The positive blood isolates were identified and their antimicrobial resistance patterns were checked using modified Kirby-Bauer method. Out of 8091, 1445(17.8%) yielded growth of significant microorganisms. Among them Gram positive bacteria were 540 (37.3%). Gram negative bacilli were 899 (62.2%). Among the gram positive bacteria maximum resistance was seen with Erythromycin, ciprofloxacin and cotrimoxazole. Most of gram negative bacilli were multidrug resistant. Monitoring of data regarding the prevalence of microorganisms and its resistance patterns would help in formulating policies for empirical antimicrobial therapy.

Keywords: Blood, septicemia, sensitivity, resistance

1. Introduction
Blood is considered to be a sterile fluid unless proved otherwise. Invasion of the bloodstream by microorganisms constitutes one of the most serious situations in infectious disease. Microorganisms present in circulating blood whether continuously, intermittently, or transiently are a threat to every organ in the body [1]. Bloodstream infections (BSIs) are associated with a high mortality rate of 20%–50% and one of the most common health-care associated infections [2]. Clinical presentation ranges from benign transient bacteremia with little or no symptoms to fulminant septic shock with high mortality [3]. It requires rapid and aggressive antimicrobial therapy [4]. The change of prevalence and antimicrobial resistance pattern among bloodstream pathogens is a significant problem worldwide with severe consequences including increased cost of care, morbidity, and mortality [2, 5]. The increasing resistance to most commonly used antimicrobials results in a reduction in therapeutic options [5]. Thus, the detection of BSIs must be given priority in all health-care settings. Clinical laboratory diagnosis is crucial to avoiding delay in treatment [6-8]. Prevalence and susceptibility patterns of microorganism vary according to geography and even within the same hospital with time. A positive blood culture does not necessarily confirm infection, since contamination of blood can occur. The recovery of organisms traditionally considered as pathogens pose no problems in interpretation [9]. The use of automated culture system for monitoring blood cultures increases the speed and improves efficiency in detection of blood borne pathogens. The system monitors the consumption of carbon dioxide by calorimetric method, generally detecting positive growth after 48 hours. The infections caused by multidrug-resistant organisms are more likely to be associated with prolonged hospital stay, increased mortality and thus requires treatment with more expensive antimicrobials. In almost all cases, antimicrobial therapy is initiated empirically before the results of blood culture are available. Monitoring and analyzing the antimicrobial resistance pattern of most frequently isolated microorganisms help the clinicians to choose effective antimicrobial therapy as well as empirical antimicrobials. Therefore, the present study was undertaken to analyze the various prevalent pathogens causing BSIs and study their behavior in a tertiary care hospital to guide the clinicians for formulating antimicrobial policies for empirical therapy.

2. Material and Methods

A total of 8091 blood specimens from clinically suspected cases of septicemia were studied at a tertiary care hospital for 6 months from January 2018 to June 2018. This prospective study was conducted in the department of microbiology, PGIMER & Dr RML Hospital, New Delhi. During the six months period, 8091 samples received from various departments were processed and relevant findings were noted. Patients presented with prolonged fever or clinical impression of septicaemia/bacteraemia. History of antibiotic usage empirically either before or after admission was also obtained.

Single blood specimen was collected from inpatients and outpatients of our hospital during the study, and the specimens were processed in clinical microbiology laboratory. The contaminated, duplicate, and repeat specimens were excluded from the study. Blood sample was collected aseptically from each patient before the start of antimicrobial therapy. In case of adults, 5–10 ml (average 7 ml) and pediatrics 1–5 ml (average 3 ml) were inoculated in BacT/ALERT® FA and PF plus-aerobic bottles (BioMerieux, Durham, NC, USA), respectively. After inoculation, these bottles were immediately incubated in BacT/ALERT® 3D system (a fully automated blood culture system for detection of aerobic growth in blood samples). The blood specimens were incubated for a maximum period of 7 days, and if there was no growth, the result was read as negative. While in case of positive growth, the BacT/ALERT® system automatically showed an alert. Then the positive blood culture bottles were taken out and subcultured on blood agar and MacConkey agar plates. The growth was stained by Gram's staining method and was further identified by biochemical tests. Antibiotic sensitivity testing was done by modified Kirby-Bauer method as per Clinical Laboratory Standards Institute guidelines. The discs tested for Gram positive organisms were Cefoxitin (30ug), Ciprofloxacin (5ug), Cotrimoxazole (1.25/23.75ug), Vancomycin (30ug), Erythromycin (15ug), Tetracycline (30ug), Cefuroxime (30ug) and Linezolid (30ug). Gentamicin high (120ug) was used for *Enterococcus* species.

For Gram negative isolates gentamicin (10ug), amikacin (30ug), ciprofloxacin (5ug), cotrimoxazole (1.25/23.75ug), Ceftazidime (30ug), Cefotaxime (30ug), aztreonam (30ug), piperacillin-tazobactam (100/10ug), Meropenem (10ug), colistin (10ug), tigecycline (15ug) were tested.

3. Results

During the study of 6 months, a total of 8091 blood culture specimens were received from various clinical wards. Out of 8091 specimens, 1445 (17.8%) yielded growth of different microorganisms. From these isolates, 899 (62.2%) were Gram-negative bacilli, 540(37.3%) were Gram-positive cocci and rest 7 (0.4%) were yeasts. Figure 1 shows that the most common microorganism isolated are *Escherichia coli* followed by *Staphylococcus aureus*, *Pseudomonas* spp. and others.

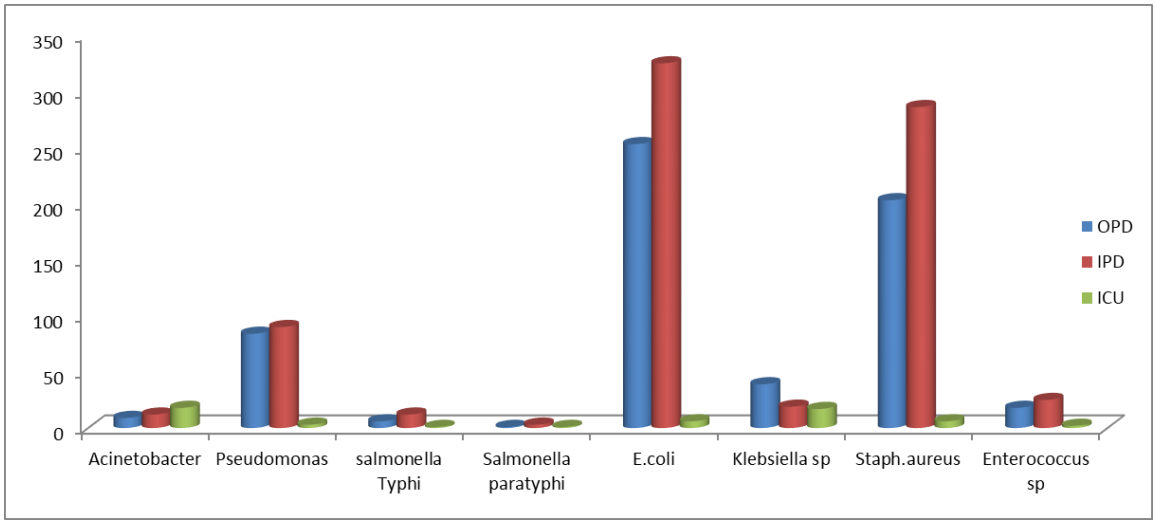

Fig 1: Distribution of various isolates from different areas

Among the gram positive bacteria maximum resistance was seen with Erythromycin, ciprofloxacin and cotrimoxazole. (Table 1) No resistance was seen with vancomycin. Most of gram negative bacilli were multidrug resistant. (Table 2) Resistance was more in case of admitted patients than out patients.

Table 1: % Sensitivity of Gram negative isolates

Gram negative bacilli	Location	Gentamicin	Amikacin	Ciprofloxacin	Cotrimoxazole	Ceftazidime	Piperacillin	Cefotaxime	Aztreonam	Pip+tazo	Netilmicin	Meropenem	Colistin	Tigecycline	Ampicillin	Ofloxacin
Acinetobacter	OPD	100	100	70	75	50	-	50	50	100	-	-	100	100	-	-
	IPD	17	30	17	37	20	-	33	50	83	-	33	100	100	-	-
	ICU	22	22	5	22	5	-	11	5	27	17	5	90	55	-	-
Salmonella typhi	OPD	100	100	40	100	-	-	100	-	-	-	-	-	-	100	40

	IPD	71	71	17	100	-	-	100	-	-	-	-	-	-	100	25
	ICU	100	100	100	100	-	-	100	-	-	-	-	-	-	100	100
Salmonella paratyphi	OPD	100	100	100	100	-	-	100	-	-	-	-	-	-	100	100
	IPD	67	67	33	67	-	-	100	-	-	-	-	-	-	100	30
	ICU	100	100	100	100	-	-	100	-	-	-	-	-	-	100	100
Esch. coli	OPD	70	88	17	17	39	-	29	47	88	82	89	-	-	-	-
	IPD	62	81	8	10	21	-	17	-	73	68	75	100	100	-	-
	ICU	16	83	33	16	16	-	13	-	66	33	-	100	33	-	-
Klebsiella spp	OPD	100	94	71	67	74	-	61	100	100	50	-	100	100	-	-
	IPD	76	65	28	21	25	-	28	-	70	100	-	100	100	-	-
	ICU	5	5	5	17	5	-	17	5	5	-	17	100	70	-	-
Pseudomonas	OPD	71	72	61	75	85	83	-	100	97	-	100	-	-	-	-
	IPD	63	63	57	60	63	68	-	66	88	-	84	-	-	-	-
	ICU	0	0	0	-	33	33	-	100	66	100	66	100	-	-	-

Table 2: %Sensitivity of Gram positive isolates

Gram positive cocci	location	Cefoxitin	tetracycline	erythromycin	Ciprofloxacin	Cotrimoxazole	vancomycin	cefuroxime	Genta-high	linezolid
Staph aureus	OPD	79	84	42	24	42	100	80	-	-
	IPD	68	88	43	26	46	99	65	-	-
	ICU	33	66	33	33	16	100	33	-	-
Enterococcus	OPD	-	17	0	0	100	100	-	75	75
	IPD	-	50	0	0	33	94	-	17	75
	ICU	-	50	0	0		100	-	50	50

4. Discussion

BSI is a major cause of morbidity and mortality worldwide. Antimicrobial therapy is the mainstay of treatment of BSI along with management of severe sepsis and septic shock. [10] During last few years, clinicians have witnessed a growing incidence of BSIs along with resistance against commonly used antimicrobials [11]. Therefore, this present study was undertaken to detect the prevalence of microorganisms isolated from blood and study their antimicrobial resistant patterns in a tertiary care hospital. In our study, the total number of positive cultures was 1445 (17.8%). Whereas Arora, [12] Khanal [13] and DS Murthy [14] *et al*. have reported 20.02%, 44% and 24.3% respectively. In India, the variation might be due to the fact that most of the patients are given the antibiotics before they come to the tertiary care hospital & other reason is that in most of the cases self-medication is very common [15].

In our study, the predominant organisms were *E. coli* (40.5%) and *Staphylococcus aureus* (34.3%), followed by *Pseudomonas* spp. (12.3%), *Klebsiella* spp (5.2%), *Enterococcus* spp. (3.1%), *Acinetobacter* spp. (2.7%) and *Salmonella* spp. (1.6%). Similar distributions of microorganisms were noted by Fayyaz *et al*. and Parihar *et al*. respectively [16, 17, 18].

Amongst the gram positive organisms maximum resistance was seen with Ciprofloxacin (76%) followed by Erythromycin (58%) and Cotrimoxazole (58%). Arora *et al*. has reported maximum resistance with erythromycin (69.67%). None of our strain showed resistance against vancomycin and this drug therefore can be effectively used if methicillin resistance is suspected during treatment [19]. Most of the gram negative bacilli were multidrug resistance. Other workers also have reported majority of gram negative isolates in their study as multidrug resistance. Maximum resistance was seen against ciprofloxacin (83%), ceftazidime (80%), amikacin (70%), Gentamicin (83%) and piperacillin (76%). It was shown by *Escherichia coli*, *Pseudomonas*, *Klebsiella* and *Acinetobacter* spp. Arora *et al*. have reported Ampicillin resistance (89.96%), cephalexine (68.7%) and piperacillin (51.71%). In this study we found carbapenems to be effective in the treatment of multidrug resistant gram negative infections in patients admitted in wards and ICUs. OPD isolates were usually sensitive to most of the antibiotics.

5. Conclusion

Escherichia coli and *Staphylococcus aureus* were the predominant blood borne pathogens isolated in our region. Most of the Gram‑negative bacilli were sensitive to tigecycline and colistin. The majority of Gram‑positive cocci were sensitive to vancomycin and linezolid. There is the emergence of antimicrobial resistance in almost every corner of the world pointing toward active microbial surveillance in all clinical settings. Such monitoring of data regarding the prevalence of microorganisms and its resistance patterns would definitely benefit the current prescribed antimicrobial regimens, especially in resource‑limited countries.

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