Section: Microbiology

Original Research Article

ANTIBIOTIC SENSITIVITY PATTERN OF BLOOD CULTURE ISOLATES: A STUDY FROM A TERTIARY CARE HOSPITAL OF MAHARASHTRA

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Abstract

Background: Every organ in the body is at risk from microorganisms found in circulating blood. One of the most crucial roles of a microbiologist is the prompt detection and identification of blood stream pathogens, as several microbial diseases might have dangerous repercussions. Blood culture can help in analyzing the antibiotic sensitivity pattern which further could aid in the specific etiological diagnosis and rational use of antibiotics. **Objectives:** The objectives are to present study was conducted with aim to identify the antibiotic sensitivity pattern of blood culture isolates from the patients visiting a tertiary care hospital in Maharashtra. **Materials and Methods:** Present study was a prospective study that was carried out in the tertiary care hospital where patients with clinical suspicion of bacteraemia were enrolled and blood culture was performed. The isolates were identified by phenotypic characters and antimicrobial susceptibility performed. **Result:** Total 70 isolated of Gram-negative bacilli (GNB) and 24 isolates of Gram-positive cocci (GPC) was obtained. Among GNB, Acinetobacter species (asp), Escherichia coli (eco), Klebsiella pneumoniae ss. Pneumoniae (kpn), and Pseudomonas aeruginosa (pae) showed highest sensitivity for antibiotic Colistin. Among Gram positive cocci (GPC), Staphylococcus epidermidis (sep), Staphylococcus haemolyticus (shl), and Staphylococcus hominis (sho) showed highest sensitivity for antibiotic Daptomycin, Linezolid and Vancomycin. A higher resistance against antibiotics was observed in GNB as compared to GPC. Among GNB, Klebsiella pneumoniae ss. Pneumoniae (kpn); and among GPC, Staphylococcus epidermidis (sep) showed the highest antibiotic resistance. **Conclusion:** Due to their high likelihood of resistance, GNB can affect several organs when treated with antibiotics inconsistently. The key to preserving lives is the timely and appropriate implementation of empirical therapy, strict adherence to antimicrobial stewardship protocols, and vigorous management. This highlights the significance of strict infection control procedures, institutional antibiotic policies, and the rational use of antibiotics.

INTRODUCTION

Microorganisms present in the circulating blood whether continuously, intermittently or transiently are a threat to every organ of the body.[1] All vital organ in the body remained at risk by the invasion of microorganisms in the circulatory system. The outcome of infection could range from septic shock to multiple organ failure, disseminated intravascular coagulation, and mortality. Identification of bacterial agents in the circulation and assessment of their antibiotic sensitivity pattern is the crucial for the management and treatment of microbial infections.[2]

Sepsis is described as the presence of toxin produced by the bacteria and presence of large number of growing bacteria in the circulatory system. Individuals suffering from bloodstream infections typically exhibit systemic infection symptoms, including elevated inflammatory markers, fever, and leukocytosis. Blood stream infections could be primary due to spread from infective endocarditis.[1] Urinary tract infection, community-acquired pneumonia, or secondary

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infection brought on by surgical procedures or device-associated infections. The gold standard for identifying these infections is blood culture. However, in order to stop sepsis from developing uncontrolled, empirical antibiotic treatment is essential.[3]

Geographical location and antibiotic usage have an impact on the prevalence and sensitivity of microorganisms to antibiotics. The issue has gotten worse due to the overuse and irrational use of antibiotics, which has increased the number of bacteria having resistant to antibiotics. The understanding of the type of bacteria and the patterns of their antibiotic susceptibility is the key for treating bloodstream infections. Recommendations for the initiation of initial empirical therapy in cases of suspected bloodstream infection are also based on this knowledge. Once the organisms are identified and their patterns of antibiotic susceptibility are examined, specific therapy can be initiated to treat the microbial infection.[4]

In order to effectively treat diseases brought on by bacteria resistant to common antibiotics, it is critical to take into account the resistance pattern of each species. Numerous research carried out in India and other countries throughout the world indicated an increase in antibiotic resistance among blood stream illnesses.[3] After the causative agent is identified and antimicrobial susceptibility testing is done, empirical therapy can be reduced to a single antibiotic drug.[5] Present study was conducted with aim to identify the antibiotic sensitivity pattern of blood culture isolates from the patients visiting a tertiary care hospital in Maharashtra.

MATERIALS AND METHODS

Study design:
Present study was a prospective, single centric, observational, descriptive, hospital-based, epidemiological study that was carried out in the tertiary care hospital where patients with clinical suspicion of bacteremia were enrolled. Adult patients with either gender were included while neonates and those with history of antibiotic intake in past 72 hours were excluded from the study. Patients suspected to have viral or parasitic infections, tuberculosis and those with autoimmune disease and on steroids were excluded. All the ethical guidelines were followed properly during the conduction of study.

Blood sample collection and bacterial culture:
Samples were taken from individuals who seemed to be suffering from blood stream infections. Every adult patient had 5–10 ml of blood drawn which was then inoculated in a blood culture bottle. A 50 ml vial of culture media was utilized. For seven days, bottles were incubated aerobically at 37˚C. Subcultures were conducted on Agar plates. If there was any discernible turbidity, subcultures were carried out after 48 hours and 7 days. Through the use of established methods and conventional biochemical testing, bacterial growth was recognized up to the species level. Using the disc diffusion technique, antimicrobial susceptibility testing was carried out. Gram-negative bacilli (GNB) and Gram-positive cocci (GPC) were tested using the antibiotics enlisted in the [Table 1] and [Table 2] respectively. The sensitivity was represented in percentage.

RESULTS

Among total 70 isolates of Gram-negative bacilli (GNB), there were 13 (18.57%) isolates of Acinetobacter species (asp), 25 (35.71%) isolates of Escherichia coli (eco), 14 (20%) isolates of Klebsiella pneumoniae ss. Pneumoniae (kpn) and 18 (25.71%) isolates of Pseudomonas aeruginosa (pae). [Figure 1]

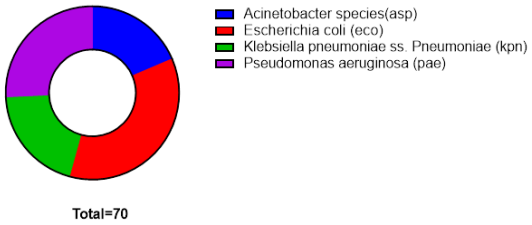

Figure 1: Number of isolates of Gran negative bacilli

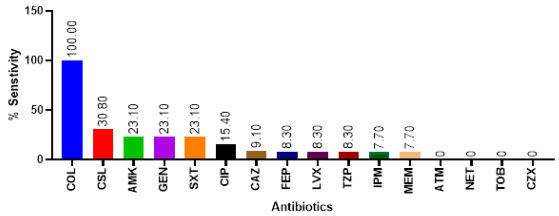

Figure 2: Antibiotic sensitivity pattern of Acinetobacter species (asp)

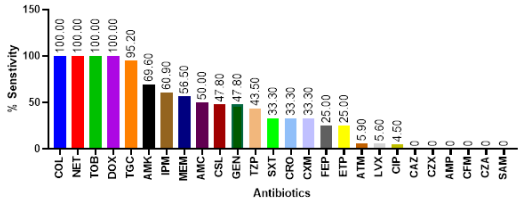

Figure 3: Antibiotic sensitivity pattern of Escherichia coli (eco)

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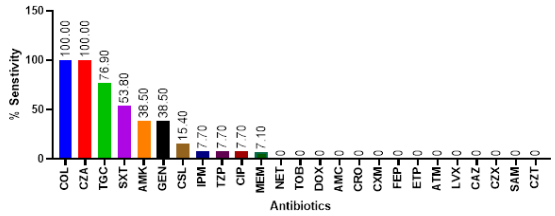

Figure 4: Antibiotic sensitivity pattern of Klebsiella pneumoniae ss. Pneumoniae (kpn)

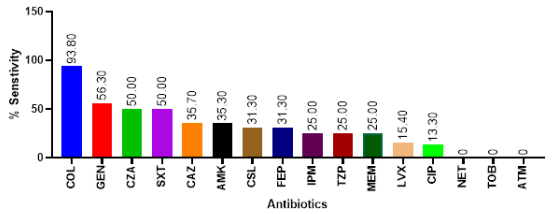

Figure 5: Antibiotic sensitivity pattern of Pseudomonas aeruginosa (pae)

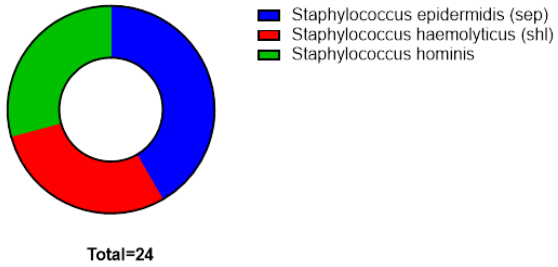

Figure 6: Number of isolates of Gran positive cocci

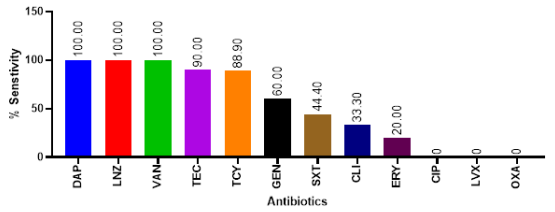

Figure 7: Antibiotic sensitivity pattern of Staphylococcus epidermidis (sep)

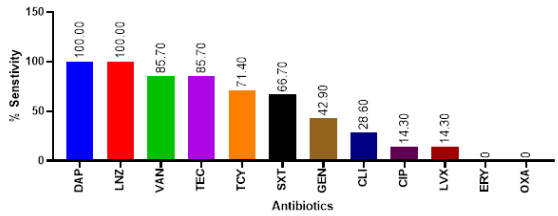

Figure 8: Antibiotic sensitivity pattern of Staphylococcus haemolyticus (shl)

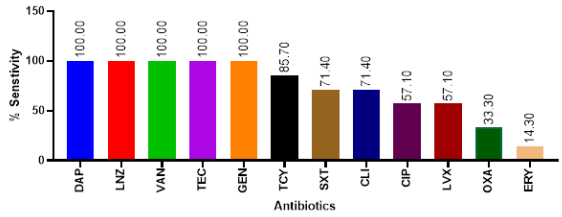

Figure 9: Antibiotic sensitivity pattern of Staphylococcus hominis (sho)

The antibiotic sensitivity pattern of Gram-negative bacteria was represented in [Table 1]. Among GNB, Acinetobacter species (asp), Escherichia coli (eco), Klebsiella pneumoniae ss. Pneumoniae (kpn), and Pseudomonas aeruginosa (pae) showed highest sensitivity for antibiotic Colistin and Polymyxin-B [Table 1].

Antibiotic sensitivity pattern of Acinetobacter species (asp) indicates highest sensitivity (100%) for Colistin/ polymyxin B whereas a high resistance was noticed against the Aztreonam, Netilmycin, Tobramycin and Ceftizoxime antibiotics [Figure 2].

Antibiotic sensitivity pattern of Escherichia coli (eco) indicates highest sensitivity (100%) for Colistin/Polymyxin B, Netilmycin, Tobramycin, Doxycycline whereas a high resistance was noticed against the Ceftazidime, Ceftizoxime, Ampicillin, Cefixime, Ceftazidime/Avibactam, and Ampicillin/Sulbactam antibiotics [Figure 3].

Antibiotic sensitivity pattern of Klebsiella pneumoniae ss. Pneumoniae (kpn) indicates highest sensitivity (100%) for Colistin, and Ceftazidime/Avibactam whereas a high resistance was noticed against the Netilmycin, Tobramycin, Doxycycline, Amoxyclav, Ceftriaxone, Cefuroxime, Cefepime, Ertapenem, Aztreonam, Levofloxacin, Ceftazidime, Ceftizoxime, Ampicillin/Sulbactam, and Ceftolozane/Tazobactam antibiotics [Figure 4]. Antibiotic sensitivity pattern of Pseudomonas aeruginosa (pae) indicates a high resistance against the Netilmycin, Tobramycin, Aztreonam [Figure 5].

Among total 24 isolates of Gram-positive cocci (GPC), there were 10 (41.66%) isolates of Staphylococcus epidermidis (sep), 7 (29.16%) isolates of Staphylococcus haemolyticus (shl) and 7 (29.16%) isolates of Staphylococcus hominis (sho) [Figure 6]. The antibiotic sensitivity pattern of Gram-positive cocci was represented in Table 1. Among GPC, Staphylococcus epidermidis (sep), Staphylococcus haemolyticus (shl), and Staphylococcus hominis (sho) showed highest sensitivity for antibiotic Daptomycin, Linezolid and Vancomycin [Table 2].

Antibiotic sensitivity pattern of Staphylococcus epidermidis (sep) indicate highest sensitivity (100%) for Linezolid, Vancomycin, Daptomycin whereas a high resistance was noticed against the Oxacillin, Ciprofloxacin and Levofloxacin [Figure 7]. Antibiotic sensitivity pattern of Staphylococcus haemolyticus (shl) indicate highest sensitivity (100%) for Linezolid, Daptomycin, whereas a high resistance was noticed against the Erythromycin and Oxacillin antibiotics [Figure 8].

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Antibiotic sensitivity pattern of Staphylococcus hominis (sho) indicate highest sensitivity (100%) for Linezolid, Daptomycin, Vancomycin, Teicoplanin and Gentamicin whereas a high resistance was noticed against the Erythromycin antibiotic [Figure 9].

Table 1: Antibiotic sensitivity pattern of gram-negative bacilli

Sn	Antibiotic	Abb.	aba	eco	kpn	pae
1	Amikacin	AMK	23.1	69.6	38.5	35.3
2	Amoxyclav	AMC		50	0	
3	Ampicillin	AMP		0		
4	Aztreonam	ATM	0	5.9	0	0
5	Cefepime	FEP	8.3	25	0	31.3
6	Cefixime	CFM		0		
7	Cefoperazone/Sulbactam	CSL	30.8	47.8	15.4	31.3
9	Ceftazidime	CAZ	9.1	0	0	35.7
10	Ceftazidime/Avibactam	CZA		0	100	50
11	Ceftolozane/Tazobactam	CZT			0	
12	Ceftriaxone	CRO		33.3	0	
13	Cefuroxime	CXM		33.3	0	
14	Ciprofloxacin	CIP	15.4	4.5	7.7	13.3
15	Colistin	COL	100	100	100	93.8
16	Doxycycline	DOX		100	0	
17	Ertapenem	ETP		25	0	
18	Gentamicin	GEN	23.1	47.8	38.5	56.3
19	Imipenem	IPM	7.7	60.9	7.7	25
20	Levofloxacin	LVX	8.3	5.6	0	15.4
21	Meropenem	MEM	7.7	56.5	7.1	25
22	Netilmycin	NET	0	100	0	0
23	Piperacillin/ Tazobactam	TZP	8.3	43.5	7.7	25
24	Tigecycline	TGC		95.2	76.9	
25	Tobramycin	TOB	0	100	0	0
26	Trimethoprim/Sulphathiazole	SXT	23.1	33.3	53.8	50
27	Ampicillin/Sulbactam	SAM		0	0	
28	Ceftizoxime	CZX	0	0	0	

Table 2: Antibiotic sensitivity pattern of gram-positive bacteria

S. No.	Antibiotic	Abb.	sep	shl	sho
1	Ciprofloxacin	CIP	0	14.3	57.1
2	Clindamycin	CLI	33.3	28.6	71.4
3	Daptomycin	DAP	100	100	100
4	Erythromycin	ERY	20	0	14.3
5	Gentamicin	GEN	60	42.9	100
6	Levofloxacin	LVX	0	14.3	57.1
7	Linezolid	LNZ	100	100	100
8	Oxacillin	OXA	0	0	33.3
9	Teicoplanin	TEC	90	85.7	100
10	Tetracycline	TCY	88.9	71.4	85.7
11	Trimethoprim/Sulfamethoxazole	SXT	44.4	66.7	71.4
12	Vancomycin	VAN	100	85.7	100

DISCUSSION

In present study, there were higher isolates of GNB (n=70) as compared to the GPC (n=24). Similar results has been reported in the study by Anjum and Mustafa, which reported GNB as the predominated as the causative agents of blood stream infections accounting for 61% of the bacterial isolates.[3] Banik et al also that reported 57% of the isolates were GNB.[6] In a longitudinal study by Khurana et. al., GNB amounting to 77% in 2013; 85% in 2014 and 81% in 2015 & 2016.[7] In the study by Vasudeva et al. maximum number of GNB which were isolated were E. coli (40.91%) followed by Klebsiella spp. (27.27%), P. aeruginosa (22.73%), and Citrobacter spp. (9.09%).[4]

In the present study, the most common GNB was Escherichia coli (eco) (35.71%) followed by Pseudomonas aeruginosa (25.71%), Klebsiella pneumoniae (20%), and Acinetobacter species (18.57%). In the previous study by Vasudeva et al., E. coli as the commonest GNB which is similar to the findings of this study.[4] Above findings were consistent with the studies done by Fayyaz et al,[8] and Karlowsky et al,[9] who reported maximum number of E. coli in GNB in their studies. Similar findings were also found in the studies done by Karunakaran et al,[10] and Aiken et al,[11] for GNB. In the study by Anjum and Mustafa, Klebsiella was the most common GNB isolated.[3] Banik et al has reported that most common GNB was Acinetobacter

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followed by Klebsiella spp.[6] In the study by Bhatnagar and Patel, among 46.50% GNB, Pseudomonas (13.71%) and Klebsiella species (13.04%) were predominant.[1] However, Karlowsky et al,[9] and Karunakaran et al,[10] reported more of coagulase-negative Staphylococci in their study, and Kaur and Singh,[12] reported higher prevalence of Salmonella typhi among GNB in their study. In our study, the most common GPC was Staphylococcus epidermidis (41.66%) followed by Staphylococcus haemolyticus (29.16%) and Staphylococcus hominis (29.16%). In the study by Vasudeva et al. maximum number of GPC was of S. aureus 13 (52%) followed by coagulase-negative Staphylococcus spp. 8 (32%), Enterococcus spp. 2 (8%), and Streptococcus pneumoniae 2 (8%).[4]

GNB is this study exhibit highest sensitivity for Colistin and Polymyxin-B. E. coli in our study showed 60.9% sensitivity against the imipenem. In the study by Vasudeva et al. among GNB, imipenem showed 88.88% sensitivity to E. coli, 100% to Klebsiella spp., and 50% to Citrobacter spp.[4] In the present study, antimicrobial resistance patterns of GNB showed increasing resistance pattern to almost all the antibiotics routinely used. In the previous study by Bhatnagar and Patel also reported that GNB are resistant to Cefixime (97.56%) and cotrimoxazole (95.12%).[1]

GPC is this study exhibit highest sensitivity for Linezolid, Vancomycin, Daptomycin. Similar observations have been made by the Vasudeva et al., which found that GPC were 100% sensitive to vancomycin and linezolid.[4] The results were consistent with the studies done by Fayyaz et al. [8], Marshall et al,[13] and Kaur and Singh.[12] In present study, GPC found to exhibit resistance against Erythromycin, Oxacillin, Ciprofloxacin and Levofloxacin. In the previous study by Bhatnagar and Patel, similar results have been reported indicating that GPC have high resistance to penicillin, followed by Erythromycin, Ciprofloxacin and cotrimoxazole.[1]

When compared to several previous researches, there was difference in the antibiotic sensitivity rate of the diverse organisms identified in the current investigation. This might be because an organism's susceptibility to antibiotics varies and is dependent on the usage of antibiotics, the prevalence of strains, and the patterns of antibiotic resistance in a given location. There are many limitations on our investigation. Clinical microbiological laboratories are where blood culture is mostly performed, and the standard of clinical diagnosis may be lacking. Sociodemographic variables were not taken into account and the sensitivity testing only comprised commonly used antibiotics. Future research must overcome these obstacles, and appropriate procedures must be put in place in order to protect these life-saving medications in the future.

CONCLUSION

All isolates exhibited a resistance pattern to both newly developed medications and frequently given antibiotics in present study. This demonstrates the limited selection of antibiotics available for the treatment of potentially fatal bloodstream infections. The establishment of multidrug resistance bacteria may be caused by the irrational long-term use of strong antibiotics in weakened host conditions. In order to prevent increasing drug resistance, the study underscores the need of physicians prescribing antibiotics with reason and the institute's strict infection control strategy, in addition to the necessity of developing new medications and vaccines.

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