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Original Research Article

Determination of resistance pattern of bacteriostatic antimicrobial drugs by analysis of blood culture reports

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ABSTRACT

Background: Determination of each isolated bacterium from blood culture and pattern of antimicrobial sensitivity has an important role epidemiologically in a region and can assist physicians in the determination of primary antimicrobial agents. In this study, schema of resistance of bacteriostatic antimicrobials in blood culture is evaluated. Determination of resistance pattern of bacteriostatic antimicrobial drugs by analysis of blood culture report.
Methods: A retrospective analysis of microbiological blood culture and antibiotics sensitivity results have been done. A total of 120 laboratory culture results were selected randomly during the observational period. These all-blood culture reports were analyzed for bacteriostatic antimicrobial resistance pattern.
Results: The 41 bacterial isolates were obtained from 120 blood culture reports, 24.39% (10) were gram positive and 75.60% (31) were gram-negative. The most frequently isolated gram-negative organisms were *K. pneumoniae* (34.14%) followed by *Pseudomonas* (12.19%), *E. coli* (12.19%). The most frequently isolated gram-positive organism was staphylococcus aureus. All isolates showed less resistance to bacteriostatic antibiotics like clindamycin, chloramphenicol, co-trimoxazole, doxycycline, linezolid, tetracycline, nitrofurantoin, erythromycin, tigecycline.
Conclusions: *S. aureus, E. coli* and *Klebsiella* spp. pseudomonas aeruginosa were the leading causes of septicaemia or any type of infection in our study finding. These bacteria isolates were highly resistant to bactericidal antimicrobials. But bacteriostatic antimicrobial has shown less resistance compared to bactericidal.

Keywords: Bacteriostatic antimicrobials, Blood culture, Resistance pattern

INTRODUCTION

Septicaemia is very common emergency in medicine. It is due to various dangerous and lethal infection. These infections are mostly of bacterial, viral or parasitic origin. In such septicaemic infection, blood culture and other cultures should be done before antimicrobial therapy. Determination of each isolated bacterium or micro-organisms from blood culture and pattern of antimicrobial sensitivity has an important role in a region. This can assist physicians in the determination of primary antimicrobial agents.[1] In this study, schema of resistance of bacteriostatic antimicrobials in blood culture is the evaluated.

The WHO defines antimicrobial resistance (AMR) as resistance to an antimicrobial drug that was once able to treat an infection by that microorganism. AMR is now becoming a global problem to the public health worldwide. The world health organization (WHO) has declared AMR as public health concern and has urged different countries to develop action plan to combat the problem. Knowledge of healthcare associated infections (HCAIs) and the AMR patterns of the isolates are very important towards guiding

empirical treatment. These data are crucial in rationalizing empirical treatment and set measures for surveillance. These can change policy in developing countries.[2]

Antimicrobial use is growing worldwide, and resistance to it is also increasing. Its impact is more in developing countries where infections are high. It is because of poverty, unhygienic environment, and poor health care facilities. In such scenario, the morbidity and mortality rate are also having increasing trend due to infectious diseases. The challenge of resistance also persists in developed countries. There is also increased probability of multidrug resistant organisms which have made the situation worsed.[3]

For more than 50 years, there are different alterations taken place in use of antimicrobials, such as change in kind and group of antimicrobials, sensitivity, and resistance pattern to various antibiotics. These changes are due to different causes such as emerging and re-emerging infectious disorders, over-the-counter use, and non-prescription utility of many antibiotics. Physicians and policy makers of every country can be helped by knowledge of trend in sensitivity and resistance patterns to make better decisions on their approach to resolve probable resistance.

Lack of national antibiotic resistance monitoring plan in developing countries will lead to unsuitable use in people and healthcare system workers. Development of infections and growing antibiotic resistance is a major concern around the world, and resistance pattern can be different according to geographic and epidemiological features. Sometimes these infections lead to multidrug resistance which can result in long-term hospitalization of patients, increase the rate of mortality, risk of other infections, and increased cost of the healthcare system. Therefore, in this investigation, the researchers analysed the pattern of AMR for different organisms at tertiary care hospital and teaching institute, Pune during Jan 2021-June2021, which can be a beneficial model for both clinicians in empirical therapy and policy makers.

Aim and objectives

The aim and objectives of the study were to determination of resistance pattern of bacteriostatic antimicrobial drugs by analysis of blood culture report.

METHODS

This is a descriptive observational study. It was performed on blood cultures requested at microbiology department, of B. J. GMC, Pune. This hospital is an academic medical institute where different types of disorders and infection can be treated. That's why this institute is a good source of information of status in AMR. A retrospective analysis of microbiological culture and antibiotics sensitivity results have been done. A total of 120 laboratory culture results were collected during the observational period.

Bloodstream infections (BSI) and sepsis are major causes of morbidity and mortality worldwide. Blood culture-based diagnostics usually requires 1-2 days for identification of bacterial agent and an additional 2-3 days for phenotypic determination of antimicrobial susceptibility pattern. With the escalating burden of AMR rapid diagnostics becomes increasingly important to secure adequate antibiotic therapy. Results from this study hold great promise for future applications in clinical microbiology and for health care surveillance purposes.

RESULTS

In the period of study, reports of 120 blood cultures were collected from microbiology laboratories. The prevalence of positive cultures growth was 41. The frequency of bacteria isolated from blood cultures of patients is shown in Figure 1 and Table 1.

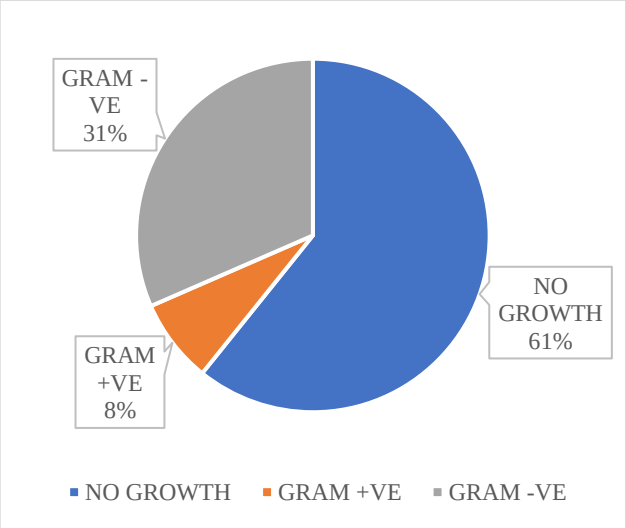

Figure 1: Culture growth reports analysis.

Table 1: Percentage of bacterial growth isolated from blood culture.

Bacterial growth isolated	Percentage (%)
Klebsiella pneumonia	34.14
Pseudomonas aeruginosa	12.19
E. coli	12.19
Non-fermented gram-ve bacilli	7.31
Acinetobacter	2.43
Citrobacter Kosai	2.43
***Serratia* species**	2.43
***Enterobacter* species**	2.43
Staphylococcus aureus	24.39

Out of 41 bacterial isolates, 24.39% (10) were gram positive and 75.60% (31) were gram-negative. The most frequently isolated gram-negative organisms were *K. pneumoniae* (34.14%) followed by *Pseudomonas* (12.19%), *E. coli* (12.19%), *Acinetobacter*, *Citrobacter Kosai*, *Serratia* species, non-fermented gram -ve bacilli and *Enterobacter* species (Figure 1 and Table 1). The most

frequently isolated gram-positive organism was *Staphylococcus aureus*. All isolates showed less resistance to bacteriostatic antibiotics like clindamycin, chloramphenicol, co-trimoxazole, doxycycline, linezolid, tetracycline, nitrofurantoin, erythromycin, tigecycline. Resistance pattern to these drugs is given in the Table 2.

Table 2: Resistance and sensitivity pattern observed.

Antimicrobial drugs	Resistance (%)	Sensitivity (%)
Clindamycin	0	100
Chloramphenicol	22.22	77.78
Co-trimoxazole	45.45	54.55
Doxycycline	0	100
Erythromycin	20	80
Linezolid	0	100
Nitrofurantoin	33.33	66.66
Tigecycline	0	100

In our study, all the isolates were resistant to bactericidal drugs Ampicillin, amoxicillin, cefixime, ceftizoxime, norfloxacin. Augmentin with clavulanic acid, aztreonam, cefepime, ceftazidime, ceftriaxone penicillin had the lowest sensitivity to all bacterial isolates. Whereas other bactericidal drugs like amikacin, cefoperazone, cefotaxime, cefoxitin, cefuroxime, ciprofloxacin, imipenem, piperacillin-tazobactam had moderate sensitivity. Carbenicillin, colistin, gentamycin, levofloxacin, ofloxacin, teicoplanin, vancomycin had the highest sensitivity.

In bacteriostatic drugs, clindamycin, doxycycline, linezolid, tigecycline are highly sensitive to *Citrobacter Kosai*, *E. coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *Staphylococcus aureus*. Antibiotics resistance pattern of another bacteriostatic antimicrobial is given in Table 3.

Table 3: Comparison of resistance pattern of bacteriostatic drugs.

Growth/ antibiotics	Chloramphenicol (%)	Co-trimoxazole (%)	Erythromycin (%)	Nitrofurantoin (%)
Klebsiella pneumonia	33.33	44.44	-	33.33
Pseudomonas aeruginosa	0	0	-	-
E. coli	0	50	-	50
Non-fermented gram -ve bacilli	-	50	-	0
Acinetobacter	0	100	-	-
Citrobacter Kosai	-	-	-	-
***Serratia* species**	-	0	-	-
***Enterobacter* species**	100	100	-	-
Staphylococcus aureus	-	40	20	-

DISCUSSION

AMR is a major clinical problem in treating infections caused by microorganisms. The resistance to the antimicrobials has increased over the years. Resistance rates vary from country to country and region to region. Overall, isolates from Latin American countries show the high resistance rates to all antimicrobial agents followed by Asian-Pacific isolates and European strains; while the strains from Canada exhibit the lowest resistance pattern by Gales et al.[4]

In this study, it was accounted that majority of the organisms isolated were the gram-ve. In which *Klebsiella pneumonia* was the predominant pathogen isolated. *Klebsiella pneumonia* has shown a slow but steady increase in resistance to several bacteriostatic antimicrobials like chloramphenicol, co-trimoxazole, nitrofurantoin. These drugs should no longer be prescribed as initial empirical therapy in our region.

Pseudomonas aeruginosa has shown high sensitivity to several bacteriostatic antimicrobials like chloramphenicol, co-trimoxazole. These drugs can be prescribed as initial empirical therapy in our region. *E. coli* has shown high sensitivity to bacteriostatic antimicrobials like chloramphenicol, but increased resistance to co-trimoxazole and nitrofurantoin. Hence chloramphenicol can be prescribed as initial empirical therapy in *E. coli* infection. Non-fermented gram-ve bacilli, *Acinetobacter* has shown increased resistance to co-trimoxazole. *Enterobacter* species has shown almost complete resistance to chloramphenicol and co-trimoxazole.

Gram + ve bacterial isolates like staphylococcus aureus has shown increasing resistance to several bacteriostatic antimicrobials like co-trimoxazole, erythromycin. These drugs should not be prescribed as initial empirical therapy in our region.

As noted from other studies, *S. aureus* and *Klebsiella pneumonia* were the most common bacterial isolates from blood culture. However, their sources remain unknown from the present study though other studies have documented both endogenous and exogenous sources from hospital environment could be potential one by Seni et al.[16]

Most of the blood culture tests were colonized with a single bacterial species. These data are confirmed by Mohammed et al that found single bacterial growth, while

Yeong et al showed a higher number of polymicrobial resistant species in wound bacterial cultures within the first 72 hour.[17,18]

We found that a substantial proportion of pathogens isolated from blood culture demonstrated AMR, principally among methicillin-resistant *S. aureus* and gram-negative organisms. These pathogens were commonly resistant to first line antibiotic drugs (e.g., fluoroquinolones, penicillin's, ceftriaxone) at rates that were much higher than those reported with bacteriostatic anti-microbial drugs. Similar surveillance has been seen in other countries in Africa, such as Kenya. In general, the most common aetiologies of bacteraemia here, as well as in the United States and several countries in Europe, were similar. The exception was gram-ve microorganism, which was isolated more frequently in India and African countries where low socioeconomic strata are more.

Limitations

The analysis based on getting information from microbiological request/report forms therefore it was difficult to tell whether the infection originated from the community, or it was healthcare-associated. Other important epidemiological information such as patient's outcome, duration of hospital stays etc. was not reported. The limitations of this study are the small sample size and being a retrospective study, it was difficult to retrieve all the relevant clinical data which could have given more inputs regarding other contributing factors for the development of resistance pattern of bacteriostatic antimicrobial drugs.

CONCLUSION

S. aureus, *E. coli* and *Klebsiella* spp. *Pseudomonas aeruginosa* were the leading causes of septicaemia or any type of infection in our study finding. These bacteria isolates were highly resistant to bactericidal antimicrobials. But bacteriostatic antimicrobial has shown less resistance compared to bactericidal. High utilization rate of antibiotics is the most important contributory factor for the development of AMR and continuous surveillance is needed in order to keep national guidelines on antimicrobial therapy updated. More studies are needed in view of AMR pattern to bacteriostatic and bactericidal drugs.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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