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Prevalence and Antimicrobial Profile of Blood Infections from Clinical Isolates at Tertiary Care Hospital of North India

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Abstract

Background: Drug-resistant bacteria cause morbidity and mortality. Antimicrobial resistance profiles can assist in determining the best potential treatment for specific patients.

Material and Method: A hospital-based prospective cross-sectional study was undertaken using 553 clinical samples at the Tertiary Care Hospital, Patiala, Punjab, in the month of December 2022. The microorganisms were then isolated from blood samples and identified using conventional microbiological methods. The Kirby-Bauer disc diffusion method was used to test the antimicrobial susceptibility of several antimicrobial discs.

Results: Staphylococcus aureus (48.19%) was the predominant organism isolated from specimens, followed by Acinetobacter baumannii complex (17.40%), Escherichia coli (12.04%), Klebsiella pneumoniae (9.03%), Enterococcus spp. (7.83%), Proteus spp. (1.80%), Pseudomonas aeruginosa (1.20%), Enterobacter spp. The analyses revealed a high level of resistance was observed towards ceftriaxone and gentamicin by many isolates (S. aureus, Escherichia coli, Enterococcus spp., Proteus spp., and CONS). Most isolates showed equal resistance to penicillin, ampicillin, cloxacillin, vancomycin, and clindamycin. To manage the threat, national antimicrobial treatment, as well as the creation and execution of policy guidelines, are required. As a result, in clinical practise, appropriate drugs should be chosen based on the results of antimicrobial susceptibility tests.

Keywords: Blood, infection, antimicrobial resistance, Punjab,

Introduction

Blood infections and antibiotic resistance endanger modern healthcare and require the development of comprehensive national and global control strategies. Estimating incidence, complications, and associated mortality is difficult, especially in developing countries [(1)]. In developing countries like India, the burden is enormous, as most people cannot afford the more expensive alternative antibiotics. Antimicrobial resistance in this country is due to unregulated and often misused antibiotics. Moreover, the rapid spread of antibiotic-resistant bacteria threatens healthcare systems as the number of infectious diseases increases [(2)]. The emergence of various resistant strains, such as methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum beta-lactamase-producing pathogens (ESBL), and vancomycin-resistant Enterococcus (VRE), has led to the continued efficacy of antimicrobial agents[(3)]. Since the prevalence of these resistance strains varies geographically, it is critical to provide information on the current levels of antimicrobial resistance among common blood pathogens. The development of institutional antibiotic policies will assist clinicians in selecting the most appropriate empirical and definitive treatment agents for a given geographical location. The current study was conducted in a tertiary care hospital with the goal of learning about the prevalence and antibiotic sensitivity patterns of isolates in blood samples in order to use the information collected to develop antibiotic policies

and appropriate control measures.

Material and Methods:

The current cross-sectional investigation was carried out in the Department of Microbiology at a tertiary care hospital in Patiala for the month of December 2022. A total of 553 blood samples were considered for the study, which was received from various sections of the hospital. A total of 54 samples from the ICU, 166 samples from the outdoor patient unit, and 333 samples from the indoor patient unit were processed in the microbiology laboratory according to the usual protocol. Standard microbiological tests were used to identify all of the gram-positive cocci that were isolated in substantial numbers. Standard protocols were used to identify all of the isolates (catalase test, mannitol fermentation, slide coagulase, and tube coagulase tests). The samples were cultivated on blood agar and MacConkey agar plates and incubated aerobically for 48 hours at 37°C. The key criterion of identification was tube coagulase, which was conducted by diluting rabbit plasma in freshly made normal saline (1:6).

All of the strains were tested for antimicrobial susceptibility using the Kirby-Bauer disc diffusion method. Penicillin (10 units), ampicillin (30g), cloxacillin (10g), gentamicin (10g), vancomycin (30 g), ceftriaxone (30g), and clindamycin (5g) were the antibiotics tested (Hi Media Mumbai). Antibodies discs were placed on a Mueller Hinton Agar (MHA) (Hi Media, Mumbai) plate supplemented with 4% NaCl. CLSI criteria were used to measure zone sizes. The zones of clearance were examined using transmitted light. The Kirby-Bauer disc diffusion method on Mueller-Hinton agar (HiMedia Labs, Mumbai) with 24 hours of incubation at 35°C was used to test for methicillin resistance. The results were interpreted using CLSI criteria.

Results: A total of 553 samples were provided to our microbiology laboratory from various departments' out- and in-patients for culture and sensitivity testing in the month of December 2022. The results showed that 166 samples among 553 showed substantial growth, and these were AMR surveillance priority infections exhibiting resistance to single or multiple medicines. A high prevalence of Staphylococcus aureus (80) was found in the present study, followed by Acinetobacter baumannii complex (29), Esch. Coli (20), Klebsiella pneumoniae(15), Enterococcus spp. (15), Proteus spp. (3), Pseudomonas aeruginosa (2), Enterobacter spp. (3), and CONS (2) as shown in Table 1. Overall, the percentage of Gram-negative bacteria was found to be 42.77%, whereas the percentage of Gram-positive bacteria was found to be 57.22%, as shown in Figure 1.

Table 1: Distribution of microorganisms in the blood samples of tertiary care hospital in the month of Dec 2022

Organism	Number	Percentage
Staphylococcus aureus	80	48.20%
Acinetobacter Baumannii Complex	29	17.50%
Esch.Coli	20	12.04%
Klebsiella Pneumoniae	15	9.03%
Enterococcus Spp	15	9.03%
Pseudomonas aeruginosa	2	1.20%
CONS	2	1.20%
Enterobacter Spp	3	1.80%

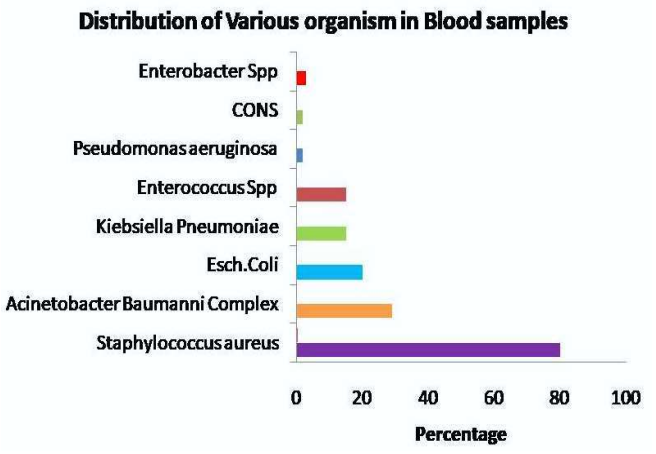


Figure 1: Representation of the percentage of microorganisms present in the blood samples of patients from a tertiary care hospital.

The antibiotic resistance of all the isolates was determined. The various antibiotics used in the study

were penicillin, ampicillin, cloxacillin, gentamicin, vancomycin, ceftriaxone, and clindamycin. Ceftriaxone has the highest resistance rate of any antibiotic tested. Ceftriaxone showed resistance to all the isolates *(Esch. coli, Acinetobacter baumannii complex, Enterococcus spp.*, P. aeruginosa, CONS, and S. aureus). Almost all of the isolates tested positive for ceftriaxone; the highest resistance was observed in Esch. coli. Gentamicin was also observed as the second-most resistant antibiotic, which showed resistance against S. *aureus, Enterococcus spp., Esch. Coli* and *CONS.* Vancomycin was completely ineffective against the MRSA patient. Vancomycin resistance was identified in all three isolates: S. aureus, *K. pneumoniae*, and *CONS.* Penicillin and clindamycin were completely resistant to all isolates of K. pneumoniae. Some of the isolates had equal resistance to penicillin, ampicillin, cloxacillin, vancomycin, and clindamycin, accounting for 9.1%. On the other hand, there was more resistance to gentamicin and ceftriaxone, accounting for 46.56% and 87.25% of the total, respectively. S. aureus was found to have equal resistance (60.67%) towards pencillin, cloxacillin, gentamicin, ceftriaxone, and clindamycin. Cons have been found to be resistant to ampicillin, gentamicin, ceftriaxone, clindamycin, and vancomycin.

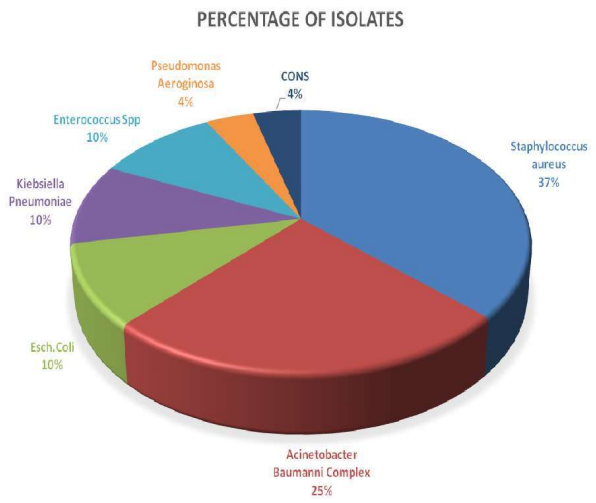


Figure 1 Percentage of Antibiotic Resistance of Bacterial Isolates

Table 1: Percentage of Antibiotic Resistance of Bacterial Isolates

Organisms	Penicillin	Ampicillin	Cloxacillin	Gentamicin	Vancomycin	Ceftriaxone	Clindamycin
Esch. Coli	9.1%	9.1%	9.1%	46.56%	9.1%	87.25%	9.1%
AB Complex		14.24%				50%	
Enterococcus sp.				23.33%		60.67%	
P. aeroginosa						60.67%	
S. aureus	60.67%		60.67%	60.67%	100%	60.67%	60.67%
K. pneumoniae	100%				100%		
CONS		64 %		27 %	5.6 %	27 %	

Discussion: Antibiotic resistance is a serious emerging problem in today's clinical practise, posing new obstacles for treating physicians and imposing a significant financial load on patient bystanders. In the current investigation, the antimicrobial resistance profiles of all isolates showed rising resistance to nearly all antibiotics frequently used.

Our study found a 32.18% positivity rate for blood cultures, which is comparable to earlier studies that found 28%, 32.7%, and 25% positivity rates, respectively. S. aureus, one of the oldest organisms known, remains a leading source of pyogenic infections in humans. The prevalence of S. aureus among clinical isolates in this investigation is

48.19%, which is similar to the prevalence of 30.4% reported by Bhatt et al. in 2011 (4). In the present study, among gram-positive isolates, the majority of isolates were *Staphylococcus aureus,* followed by *Enterobacter spp.*, whereas in gram-negative isolates, the majority of *Acinetobacter baumanni complex* was found, followed by *Esch.Coli, Klebsiella pneumonia, Enterococcus spp., Proteus spp., and Pseudomonas aeruginosa.* A study from Delhi (5) indicated similar findings as our study; it was found that among Gram-positive bacterial isolates (148), S. aureus (134) was the most prevalent, followed by *Enterococcus spp.* (14). There were 151 *Enterobacteriaceae isolates* and 165 non-fermenters among the Gram-negative bacterial isolates. Among *Enterobacteriaceae, K. pneumoniae* (98) was the most prevalent isolate, followed by *Esch.Coli* (21) *and Enterobacter spp.* (15). *Pseudomonas spp.* (56) was the most prevalent isolate among the non-fermenting Gram-negative bacteria, followed by *Burkholderia cepacia complex* (52) and *Acinetobacter spp.* (51) (5).

S. aureus is a well-known among Gram-positive bacteria for its resistance to a variety of regularly used antibiotics. Antimicrobial resistance is a worldwide threat, and the rising antibiotic resistance in *S. aureus* is concerning (6). MRSA has developed into a significant human pathogen with a broad spectrum of antibiotic resistance. MRSA's global scenario is not consistent, and there is significant diversity in its frequency around the world (7). Our findings revealed a 60.67% prevalence of MRSA, which is concerning given that the beta-lactam class of medicines, is widely used to treat bacterial infections. The high susceptibility of Gram-positive bacterial isolates to vancomycin is supported by other studies (8–10).

The antimicrobial resistance pattern of *Esch. Coli* against gentamicin has changed over time. It has been found that gentamicin resistance in animal *Esch. Coli* isolates grew from 0% in the 1970s to 28.1% in 2000–2002, with a rising tendency for resistance to gentamicin (1.28%/year, 95% CI 0.90%–1.69%; p 0.001) first identified in the 1980s and reaching a prevalence of 40% in 2002 (10). A study conducted in Jimma University Specialised Teaching Hospital also observed a (56.5%) resistance of ceftriaxone, which is similar to the findings of the current study (11). However, the study at the University of Gondar Hospital, Ethiopia, showed that the percentage of resistance strains observed against ceftriaxone The majority of the blood isolates tested positive for resistance to third-generation cephalosporins (ceftriaxone or ceftazidime). The bulk of these isolates were *Esch. Coli,* a gram-negative bacterium (10). This pathogen is the leading generator of extended spectrum beta-lactamase (ESBL), severely limiting therapy options in situations of infections. As a result, isolates of these strains have a relatively high potential for resistance development (12).

Conclusion: Active surveillance is essential in institutions treating immune-compromised patients in order to slow the spread of antibiotic resistance and contribute to the development of guidelines for empirical therapy. Monitoring the emergence of antimicrobial resistance would benefit ongoing regimens in developing countries like India. To manage the threat, national antimicrobial treatment, as well as the creation and execution of policy guidelines, are required. More research into the variables that promote resistance and the impact of resistance on treatment outcomes is needed. As a result, in clinical practise, appropriate drugs should be chosen based on the results of antimicrobial susceptibility tests.

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