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Study of Bacterial Etiology of Bloodstream Infections and Their Antibiogram at a Tertiary Hospital.

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ABSTRACT

Bloodstream infections (BSIs) pose a significant public health challenge, with varying etiologies and antibiotic susceptibility patterns. Understanding these factors is crucial for effective patient management. This study, conducted at a tertiary hospital, aimed to investigate the bacterial etiology of BSIs and their antimicrobial susceptibility. A prospective study spanning one year (January 2018 to December 2018) was conducted at the Vijayanagar Institute of Medical Sciences, Bellary. A total of 180 blood samples were collected from patients with clinical suspicion of BSIs. Clinical diagnoses, distribution of cases by age and department, and bacterial isolates were analyzed. Antibiotic susceptibility patterns of Gram-positive cocci were assessed. Of the 180 blood samples, 44.4% yielded positive cultures. Genitourinary and respiratory infections were the most common clinically suspected sources of infection. K. pneumoniae, CONS, Acinetobacter, and S. aureus were the predominant isolates. S. aureus displayed resistance to Ampicillin (70%) and Cotrimoxazole (60%) but sensitivity to Doxycycline (50%), Amikacin (50%), and Levofloxacin (66.6%). CoNS showed similar patterns. S. pyogenes exhibited sensitivity to most antibiotics, except for Ampicillin, Cotrimoxazole, and Erythromycin. This study provides insights into the epidemiology and antibiotic susceptibility patterns of BSIs in a tertiary hospital setting. The diverse bacterial spectrum and resistance profiles emphasize the need for tailored antibiotic therapies. Prudent antibiotic use, individualized treatment, and age-specific considerations are crucial in effectively managing BSIs.
Keywords: Bloodstream infections, bacterial etiology, antibiotic susceptibility.

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INTRODUCTION

Bloodstream infections (BSIs) represent a significant public health concern and a leading cause of morbidity and mortality worldwide [1]. The etiology of BSIs is highly diverse, with various bacterial pathogens being responsible for these life-threatening conditions. Understanding the causative agents and their antimicrobial susceptibility patterns is of paramount importance for effective patient management and the development of targeted antibiotic therapies. This research study aims to comprehensively investigate the bacterial etiology of bloodstream infections and analyze their antibiogram at a tertiary hospital [2, 3].

The emergence of antibiotic resistance among bacterial pathogens has further complicated the treatment of BSIs [4-6]. As such, there is an urgent need to continually monitor and adapt antibiograms to guide clinical decision-making. Tertiary hospitals, serving as critical centers for advanced medical care, play a pivotal role in managing complicated infections. This study, conducted at such an institution, provides a unique perspective on the spectrum of bacteria causing BSIs in a tertiary healthcare setting [7, 8].

By analyzing the bacterial etiology and their antimicrobial susceptibility patterns, this research will contribute valuable data for optimizing antibiotic therapies, enhancing patient outcomes, and aiding in the global effort to combat antibiotic resistance [9-11]. Our study seeks to shed light on the evolving landscape of BSIs and the antibiotics used to combat them, with the ultimate goal of improving patient care and reducing the burden of these life-threatening infections.

METHODOLOGY

This study, entitled "Bacterial Etiology of Blood Stream Infections and Their Antibiogram at a Tertiary Hospital," followed a prospective study design and was conducted in the Department of Microbiology at Vijayanagar Institute of Medical Sciences, Bellary. The study duration spanned one year, from January 2018 to December 2018.

Inclusion and Exclusion Criteria

The study included all blood culture samples sent to the central laboratory of the Department of Microbiology at VIMS, Bellari. Exclusion criteria comprised patients already on antibiotic therapy, contaminated blood cultures, fungal isolates, and anaerobic bacterial isolates.

Blood Sample Collection and Culture

Blood samples were collected from patients suspected of having bloodstream infections, ideally before the administration of antimicrobial therapy. Approximately 5-10 ml of blood from adult patients and 2 ml of blood from pediatric patients were aseptically collected from peripheral veins. These samples were then transferred into blood culture bottles containing Brain Heart Infusion broth. Subsequently, the samples were immediately transported to the laboratory for further processing.

Culturing of the blood samples was initiated by incubating the inoculated blood culture bottles at 37°C under aerobic conditions overnight. Subcultures were performed on days 2, 3, 4, and finally on day 7, involving the use of Blood agar, Chocolate agar, and MacConkey agar. Bacterial pathogens were specifically identified through a series of steps, including microscopic morphology examination, staining characteristics assessment, and the application of standard laboratory techniques to analyze cultural and biochemical properties. Initially, colonies on Blood/Chocolate and MacConkey agar were subjected to Gram staining for further identification.

RESULTS

180 blood samples were collected from patients clinically suspected of bacterial BSIs. It included patients attending to outpatient department as also those admitted to various departments. The study was done in the Department of Microbiology, Vijayanagar Institute of Medical Sciences, Bellary. The following tables and graphs illustrate the results in detail. A detailed analysis of the results was performed.

Out of the 180 blood samples received, 80(44.4%)were from females and 100(55.5%) were from males. Maximum samples obtained were in the age group of 0 – 10 years, accounting for 33.8% and and this trend was similar in both sexes.

Out of the total 180 samples received 77(42.7%) were from the Pediatrics department and 73(40.5%) from Medicine department and others. The same trend was noted in both males and female, except that an additional 10 samples in females were from the OBG department.

Table 1: Distribution of cases based on clinical diagnosis

Diagnosis	Case	Percent
Cental nervous system infection	6	3.3
Gatrointestinal infection	10	5.6
Genito-urinary Infection	61	33.9
Primary Bacterimia	21	11.7
Respiratory Infection	28	15.6
Skin and soft tissue infection	10	5.6
Surgical site infection	16	8.9
Undertermined	28	15.6
Total	**180**	**100**

Genito-urinary infections (33.9%) followed by respiratory infections (15.6%) were the common clinically suspected primary sources of infection.

Primary bacteremia accounted for 11.7% of the clinically suspected cases of BSIs.

However, of the total 180 samples received 28 (15.6%) of them had no specific clinical diagnosis.

Out of the total 180 blood samples processed, culture yielded bacterial growth in 80 samples. The culture positivity rate was 44.4%.

maximum number of isolates (61) was in the age group of 0 – 10 years, accounting for of the total 80 culture positive cases. In the age group > 50 years, the number of isolates was accounting for culture positive cases

Table 2: Pattern of the organisms isolated

Organism	Frequency	Percent
Gram Negative Bacilli –ENTEROBACTERIACEAE		
E.coli	4	5.0
K.pneumoniae	15	18.8
Citrobacter spp	8	10.0
Enterobacter spp	7	8.8
GRAM NEGATIVE BACILLI – NONFERMENTERS		
P.aeruginosa	8	10.0
Acinetobacter	10	12.5
GRAM POSITIVE COCCI		
CONS	13	16.3
S.aureus	10	12.5
Streptococcus spp	3	3.8
Enterococcus spp	2	2.5
Total	**80**	**100**

A total of 10 bacterial species were isolated *K. pneumonia*(18.8%), CONS(16.3%), *Acinetobacter* species(12.5%), S. aureus(12.5%) and *Citrobacter spp*(10%) were the five most common isolates

Among the GNB, *K.pneumoniae* was the most common followed by *Acinetobacter spp, Citrobacter spp and Pseudomonas aeruginosa.*

CoNS, *S. aureus* and *S. pyogenes* were the Gram-positive isolates

Table 3: Antibiotic Susceptibility Pattern of Gram-Positive cocci

Organism		Ak	Gen	Dox	Cip	AMP	COT	CX	E	LE	VA	LZ	AZM
S. aureus	S	5	4	5	2	1	2	2	4	2	2	2	1
	R	3	4	3	6	7	6	6	4	0	0	1	2
CONS	S	5	3	5	2	1	1	2	1	3	5	3	2
	R	3	5	3	6	7	7	6	7	2	0	2	3
S Pyogenes	S	1	2	1	2	0	0	0	0	0	0	0	0
	R	2	1	2	1	3	3	0	3	0	0	0	0
Entercoccus spp	S	0	1	0	1	0	0	0	0	0	1	1	0
	R	2	1	2	1	3	0	0	2	1	0	0	0

S. aureus showed high resistance to Ampicillin (70%), Cotrimoxazole (60%), Ciprofloxacin (60%). But the isolates were sensitive to Doxycycline (50%), Amikacin (50%) and Levofloxacin (66.6%).

CONS also showed similar sensitivity and resistant patterns S. pyogenes showed sensitivity to almost all the antibiotics except Ampicillin, Cotrimoxazole and Erythromycin to which it was 100% resistant.

All gram-positive isolates were 100% sensitive to Vancomycin.

DISCUSSION

Bloodstream infections (BSIs) represent a critical medical challenge with severe consequences for patients, and understanding the microbial etiology and antibiotic susceptibility patterns is essential for effective patient management. This study conducted at the Vijayanagar Institute of Medical Sciences, Bellary, investigated the bacterial etiology of BSIs and their antimicrobial susceptibility, shedding light on the distribution of cases, age groups affected, and the specific pathogens involved [12].

The study included 180 blood samples from patients with clinical suspicion of bacterial BSIs. These patients were drawn from both the outpatient and inpatient settings, reflecting the wide-ranging impact of BSIs on healthcare. The near-equivalent distribution of male (55.5%) and female (44.4%) patients in the study population demonstrates that BSIs do not discriminate by gender. The age distribution of the cases is noteworthy, with the highest prevalence observed in the age group of 0 to 10 years, constituting 33.8% of the study population. This finding is in line with previous research indicating that young children are more susceptible to infectious diseases, including BSIs, due to their developing immune systems. The fact that this trend was consistent across both sexes suggests that age plays a more significant role in susceptibility than gender in this context [3, 4].

The clinical diagnosis data revealed that genitourinary infections (33.9%) and respiratory infections (15.6%) were the most common suspected primary sources of infection. This aligns with the well-documented prevalence of urinary tract infections and respiratory tract infections as potential sources of BSIs. Primary bacteremia accounted for 11.7% of clinically suspected cases, underlining the significance of BSIs without a clear identifiable source. Surprisingly, 15.6% of the samples had no specific clinical diagnosis. These cases underscore the diagnostic challenges associated with BSIs, especially when clinical symptoms may be nonspecific or when infections have not yet manifested with organ-specific symptoms. These cases highlight the importance of routine blood cultures for early detection and prompt treatment.

Of the 180 blood samples processed, 44.4% showed positive cultures, indicating a considerable burden of bacterial BSIs in the study population. The age group of 0 to 10 years accounted for the highest number of isolates (61 out of 80), reinforcing the vulnerability of children to BSIs. In contrast, patients aged over 50 years contributed significantly to the culture-positive cases, further emphasizing that BSIs affect a wide age range.

The spectrum of bacteria identified in the study showcased a diverse range of pathogens. Among the Gram-negative bacilli, Enterobacteriaceae like K. pneumoniae, Citrobacter spp, and Enterobacter spp were prevalent, with K. pneumoniae being the most common. Nonfermenters like P. aeruginosa and Acinetobacter species also featured prominently. In the Gram-positive cocci category, Coagulase-Negative Staphylococci (CONS) and Staphylococcus aureus were the dominant isolates. This diverse bacterial spectrum emphasizes the complexity of BSIs and underscores the need for tailored antimicrobial therapies.

The antibiotic susceptibility patterns of the isolated organisms are of paramount importance for effective treatment. In this study, Gram-positive cocci exhibited relatively high sensitivity to Vancomycin, a critical antibiotic for treating resistant Gram-positive infections. However, S. aureus displayed significant resistance to Ampicillin (70%) and Cotrimoxazole (60%), highlighting the challenge in treating Staphylococcus aureus BSIs. In contrast, S. aureus showed sensitivity to Doxycycline (50%), Amikacin (50%), and Levofloxacin (66.6%). Coagulase-Negative Staphylococci (CONS) shared similar sensitivity and resistance patterns with S. aureus. This resistance profile underscores the importance of careful antibiotic selection to ensure effective treatment and minimize the risk of antibiotic resistance development. S. pyogenes exhibited notable sensitivity to most antibiotics tested, except for Ampicillin, Cotrimoxazole, and Erythromycin, to which it was 100% resistant. The sensitivity to a broad spectrum of antibiotics is promising for the treatment of infections caused by this pathogen.

The findings of this study have several clinical implications. First, it highlights the considerable burden of BSIs, particularly among children and the elderly. Second, the diversity of bacterial isolates underscores the importance of individualized treatment based on antibiotic susceptibility profiles. Third, the prevalence of resistant strains, especially among Gram-positive cocci, underscores the need for prudent antibiotic use to prevent further resistance development.

CONCLUSION

In conclusion, this study provides valuable insights into the epidemiology of BSIs in a tertiary hospital setting. It emphasizes the need for ongoing surveillance, effective diagnostic strategies, and antibiotic stewardship programs to manage BSIs effectively and reduce the burden of antimicrobial resistance. Furthermore, the results underscore the importance of considering age and clinical diagnosis in the treatment approach for BSIs.

Figure 1: Biochemical reactions of *K. pneumoniae*

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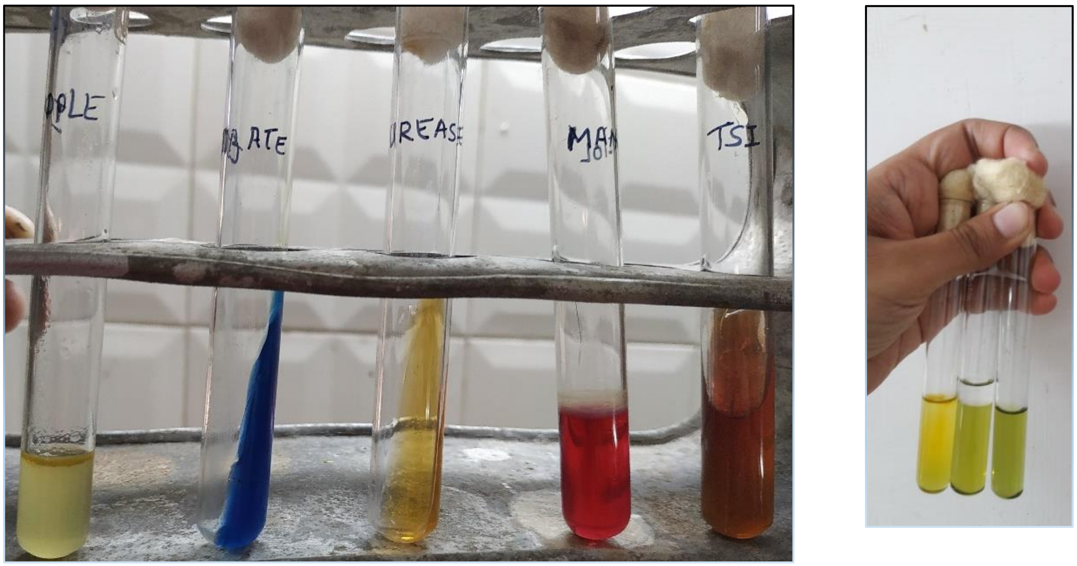

Figure 2: A) Indole, Citrate, Urease, Mannitol and TSI B) OF test

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