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Original Article

Comparison of Frequency of Pathogenic Micro-Organisms Causing Bloodstream Infections in Patients Admitted at Tertiary Care Hospital Rawalpindi

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ABSTRACT

Blood Stream Infections (BSI) are frequently occurring thing in hospital setting and if not tested and appropriate medicine not used, it has significant mortality and also adds an extra burden on health care. **Objective:** To find the frequency of various pathogenic micro-organisms causing bloodstream infections. **Methods:** Cross-sectional study was done in tertiary Care Hospital Rawalpindi from April 23 to August 23. Blood samples of 50 patients from two age groups were collected (n=25 above 60 years and n=25 ages 30-60 years). Blood samples were drawn into glass vial containing 20% EDTA to prevent blood clotting and then culture studies were performed. **Results:** Mean participant age in both study groups was 75.76 ± 8.9 and 46.88 ± 7.7 years ($p<0.001$). Blood culture analysis revealed that 42 isolates of *Staphylococcus aureus* was present in >60 years of patients and 55 isolates of *Staphylococcus aureus* were present in 30-60 years age group. 255 isolates of *Escherichia coli.* was present in >60 years' patients and 312 isolates of *Escherichia coli* were present in 30-60 years' age group. 9 isolates of *Klebsiella* was present in >60 years patients and 05 isolates of *Klebsiella* were present in 30-60 years age group years. **Conclusions:** Study showed that significant number of microorganism were present in collected blood culture samples. Among various strains of microorganisms, most common is *Escherichia coli*. Followed by *Staphylococcus aureus*. Study also highlights that BSI is a frequent occurring problem in hospital setting and if proper antibiotic administered, early cure can be achieved.

INTRODUCTION

Blood Stream Infections (BSI) include the presence of live microorganisms in the bloodstream, resulting in inflammation inside the host. This occurrence may significantly impact the clinical and hemodynamic characteristics, potentially leading to adverse outcomes [1]. The temporary presence of microbes in the circulation offers a potential hazard to several organs inside the body. If bloodstream infections are left untreated, they may result in severe outcomes such as shock, multiple organ failure, Disseminated Intravascular Coagulation (DIC), and ultimately, death [2]. Bloodstream infections represent a substantial global public health concern and have been linked to considerable morbidity and death [3]. While the prevalence of this phenomenon remains significant in industrialized nations, it is most pronounced in the least developed and emerging countries [4]. There exists a notable diversity in the epidemiology and pathogen profile of bacteria that are responsible for bloodstream infections [5]. Studies conducted in several countries including Canada, Australia, Finland, Denmark, Iceland, Sweden, New Zealand, and the United States have shown that the primary causes of Blood Stream Infections (BSI) are *Escherichia coli*, *Streptococcus pneumoniae*, and *Staphylococcus aureus* [3]. In contrast, there are variations

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in the pathogen profiles between Africa and Asia. *Salmonella enterica* has been identified as a significant causative agent of BSI in several African and Asian countries [6]. Empirical therapy is often used due to the possible consequences of BSI and the associated delays in conducting and obtaining culture results. The absence of treatment recommendations and the unavailability of susceptibility patterns for local isolates may potentially contribute to this phenomenon in poor countries [3]. An understanding of local antibiotic resistance trends may be beneficial in the selection of appropriate empirical medication, even within healthcare systems that have limitations or constraints [7]. There is now a growing phenomenon of BSI caused by Gram-negative germs, accompanied by a rise in the prevalence of drug-resistant strains [8]. Given the increasing prevalence of BSI worldwide and the emergence of antibiotic resistance among the organisms involved.

It is imperative to undertake research endeavors aimed at examining the pathogen profiles specific to Pakistan. Furthermore, it should be noted that there is a scarcity of published data pertaining to the nation in question. Consequently, there exists a pressing need for doing baseline investigations in this particular field. Consequently, a retrospective investigation was undertaken in order to ascertain the prevailing bacterial pathogens responsible for bloodstream infections in patients admitted at PEMH Rawalpindi.

METHODS

After the ethical approval from the institutional review board, this cross-sectional study was carried out at Territory Care Hospital Rawalpindi from April 2023 to August 2023. Ethical Committee approval was taken from Hospital Ethical Committee under Letter Number A/28/226/EC/522/23 dated 20th March 2023. A sample size of 50 was calculated using WHO EPI sample size calculator, keeping confidence of interval 95% and margin of error 5% and using a study conducted by Bandy *et al.*, in 2020 [9]. It was the hospital-based survey conducted to estimate the frequency of pathogens resulting in the progression of bloodstream infection. For this purpose, 25 admitted patients were above years and 25 hospitalized patients of 30-60 years were selected for this research study. Patients with age above 30 years, of either gender, and with bloodstream infection in soft tissues due to microbial manifestations were included in this research study. Patients with blood cancer, thrombocytopenia, severely compromised immune system, other malignancy, and surgery were excluded from the study. A formal consent form was provided to the respective patients before the collection of blood. The questionnaire was also used to collect the clinical laboratory data in the blood culture data of BSI patients. Standardized protocols designed by the hospital's research committee in Pakistan were thoroughly followed. To determine the presence of a pathogen, blood culture samples were put into a blood culture system and cultured at 37°C for 7 days. Plates of MacConkey agar and blood agar were inoculated immediately with positive culture materials. After 18-24 hours of aerobic incubation at 37 degrees Celsius, the plates were inspected. Bacteria were isolated using methods recommended by the most recent Clinical and Laboratory Standards Institute (CLSI) guideline (2014-2017). Statistical Package for the Social Sciences (SPSS) version 23.0 was used for the quantitative analysis of collected data from Territory Care Hospital. The data underwent analysis via the use of statistical methods including chi-square, independent samples t-test, and frequency distributions. A study was undertaken to determine the notable disparity among bacterial isolates in relation to different age groups. The p values ≤0.05 was considered statistically significant.

RESULTS

A total of 50 patients full filling the inclusion criteria were included in the present study table 1 represent the clinical and demographic parameters of the study participants in study groups. Mean of participants age in both study groups was 75.76 ± 8.9 and 46.88 ± 7.7 years (p<0.001). Majority of the study participants in both study groups were males. Mean ± S.D of participants leucocytes in both study groups was 10.24 ± 1.5 and 14.6 ± 1.5109/l (p<0.001). Mean of participants neutrophils in both study groups was 70.68 ± 2.9 and 77.4 ± 1.4% (p<0.001). Mean of participants blood urea nitrogen in both study groups was 30.28 ± 2.35 and 33.6 ± 2.2 mg/L (p<0.001). Mean of participants creatinine in both study groups was 1.39 ± 0.20 and 1.7 ± 0.22 mg/L (p<0.001). Mean of participants albumin in both study groups was 2.80 ± 0.63 and 3.06 ± 0.44 mg/L (p=0.025). Mean of participants cholesterol in both study groups was 331.04 ± 106.5 and 448 ± 102.2 mg/L (p<0.001).

Table 1: Clinical Laboratory Data in the Blood Culture (n=50)

Variables	>60 Years of Patients (Mean ± S.D)	30-60 Years (Mean ± S.D)	p-Value
Age (Years)	75.76 ± 8.9	46.88 ± 7.7	<0.001
Leucocytes 109/L	10.24 ± 1.56	14.6 ± 1.5	<0.001
Neutrophils	70.68 ± 2.9	77.4 ± 1.4	<0.001
Blood Urea Nitrogen (mg/L)	30.28 ± 2.35	33.6 ± 2.2	<0.001
Creatinine (mg/L)	1.39 ± 0.20	1.7 ± 0.22	<0.001
Albumin (mg/L)	2.80 ± 0.63	3.06 ± 0.44	0.025
Cholesterol (mg/L)	331.04 ± 106.5	448 ± 102.2	<0.001
Gender N (%)			
Male	17 (68%)	18 (72%)	0.802
Female	8 (32%)	7 (28%)	

Blood culture analysis revealed that among 30 BSI patients, no *Staphylococcus* (-), *Acinetobacter*, and fungi were

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isolated in both study groups. 42 isolates of *Staphylococcus aureus* were present in >60 years of patients and 55 isolates of *Staphylococcus aureus* were present in 30-60 years age group. 25 isolates of *Streptococcus pneumoniae* was present in >60 years patients and 32 isolates of *Streptococcus pneumoniae* were present in 30-60 years age group. 25 isolates of other *Streptococcus species* were present in >60 years' patients and 26 isolates *Streptococcus species* were present in 30-60 years age group. 255 isolates of *Escherichia coli* was present in >60 years patients and 312 isolates of *Escherichia coli* were present in 30-60 years age group. 9 isolates of *Klebsiella* was present in >60 years patients and 05 isolates of *Klebsiella* were present in 30-60 years age group years. No Pseudomonas was isolated in >60 years patients and 08 isolates of Pseudomonas were present in 30-60 years age group. 01 isolates of *Enterobacter* was present in >60 years patients and 03 isolates of *Enterobacter* were present in 30-60 years age group. The same number of Proteus isolates were present in >60 years and 30-60 years BSI patients. 15 other gram-negative bacteria were present in >60 years patients and 05 isolates of other gram-negative bacteria were present in 30-60 years. 30 anaerobic micro-organisms present in >60 years patients but no anaerobic pathogenic bacteria were present in 30-60 years age group (Table 2).

Table 2: Frequency of Pathogenic Micro-Organisms Causing Bloodstream Infections in Soft Tissues of Patients, Admitted at Territory Care Hospital Rawalpindi (n=50)

Micro-Organisms Encountered in Hospital	Pathogens	
	>60 Years of Patients (n=25)	30-60 Years of Patients (n=25)
Number of Patients	15	15
Staphylococcus coccus (-)	0	0
Staphylococcus aureus	42	55
Streptococcus pneumoniae	25	32
Other Streptococcus Species	25	26
Enterococcus	0	7
Escherichia coli	285	312
Klebsiella	09	5
Pseudomonas	0	8
Enterobacter	01	3
Acinetobacter	0	0
Proteus	8	8
Other gram (-)	15	5
Anaerobes	30	0
Fungi	0	0

DISCUSSION

The rise of antibiotic-resistant bacteria, both acquired in the community and in hospitals, is posing a growing threat to the effectiveness of antimicrobial therapy. This is especially evident in the selection of empiric antimicrobial treatment. The occurrence of Multi Drug Resistant (MDR) pathogens is often attributed to the overutilization of broad-spectrum antimicrobial drugs, as shown by the fact that over 60% of patients in Intensive Care Units (ICUs) are administered antimicrobials throughout their critical care stay [10]. In contrast to infections produced by bacteria that are not MDR, studies have indicated that MDR infections in hospitalized patients incur an extra cost ranging from $6,000 to $30,000 per patient [11, 12]. Various behavioral modifications have been suggested in the ongoing effort to combat MDR organisms, with the aim of mitigating the negative impact on antimicrobial treatment [13]. Strategies such as antimicrobial cycling and de-escalation systems have been employed in ICUs [14]. Nevertheless, the administration of broad-spectrum antimicrobials in patients with critical illnesses is considered essential owing to the limited room for mistake in selecting appropriate medication [15]. In such cases, the first choice of antimicrobials that effectively target the causative bacteria is of utmost significance [16]. According to the findings of Lipsitch *et al.*, the utilization of antimicrobials that do not currently have resistance will exhibit a positive correlation at the individual level with the presence of bacteria that are resistant to a different antimicrobial. However, at the population level, this utilization will have a negative correlation with the overall prevalence of resistance to the aforementioned antimicrobial [17]. The outcome of Blood Stream Infections (BSIs) is influenced by many variables. The correlation between mortality and several factors such as the severity of infection, underlying disorders, advanced age, and poor antimicrobial treatment seems to be significant [18]. The epidemiology of microbial pathogens causing Blood Stream Infections (BSIs) has undergone significant changes throughout the years, accompanied by a simultaneous rise in antibiotic resistance [19]. Overall in the present study, the most frequent bacterium was Escherichia coli in the bloodstream followed by Staphylococcus aureus and Anaerobes in soft tissues of BSI patients. Similar to our findings, A. Santaro *et al.*, reported a higher frequency for Escherichia coli and aureus species of bacteria in BSI patients [20]. In contrast to our research study, the recent findings of Gonzalez et al., reported that Pseudomonas aeruginosa were frequently involved in causing BSI infection [21].The rise of antibiotic-resistant bacteria, both acquired in the community and in hospitals, is posing a growing threat to the effectiveness of antimicrobial therapy. This is especially evident in the selection of empiric antimicrobial treatment. The occurrence of Multi Drug Resistant (MDR) pathogens is often attributed to the overutilization of broad-spectrum antimicrobial drugs, as shown by the fact that over 60% of patients in Intensive Care Units (ICUs) are administered antimicrobials throughout their critical care stay [10]. In contrast to infections produced by bacteria that are not

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CONCLUSIONS

Blood Stream Infections (BSI) are a frequently occurring and challenging thing in hospital setting, especially in indoor settings of a hospital. They carry significant morbidity and mortality and if not treated properly and diagnosed at right time, they are the source of extra burden on health care. Our study showed that significant microorganism was present in the tested samples and among them, the most common occurring microorganism was *Escherichia coli* followed by *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Klebseilla species.* The other rare includes aneorobes and *Enterobacter.*

Authors Contribution

Conceptualization: SS
Methodology: SN, KN
Formal analysis: HR
Writing, review and editing: AM, MA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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