ORIGINAL ARTICLE

FREQUENCY OF STAPHYLOCOCCUS AUREUS IN BLOOD STREAM INFECTIONS AND THEIR DRUG SUSCEPTIBILITY PATTERN

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ABSTRACT

Background: Staphylococcus aureus is important cause of blood stream infections. The objectives of this study were to determine the frequency of Staphylococcus aureus in blood stream infections and their antimicrobial drug susceptibility pattern.

Materials & Methods: This cross-sectional study was conducted at the Department of Pathology, Shaikh Zayed Hospital, Lahore from April 2018 to March 2019. The sample size was 1527 positive blood cultures for bacteria selected through consecutive sampling technique. Research variables were; presence of positive blood cultures, presence of staphylococci in positive blood cultures, types of staphylococci and types of staphylococcus aereus. Frequency and percentage of blood stream infection caused by Staphylococcus aureus and susceptibility of Staphylococcus aureus to various antimicrobial drugs was detected by disc diffusion and e-strip method.

Results: Out of 12744 blood cultures, 1527(11.98%) were positive for bacteria. Out of these 1527, 339(22.20%) were positive for staphylococci. Out of these 339, 87 (5.69%) were staphylococcus aureus. Out of these 87, 48 (3.14%) were methicillin resistant (MRSA). Susceptibility of S. aureus isolates to various commonly used drugs was also detected.

Conclusion: Staphylococcus aureus is a significant cause of blood stream infection and can exhibit multi-drug resistance. Therefore drug susceptibility profile of pathogens prevalent in hospital should be monitored and kept in mind when prescribing antimicrobial drugs before getting results of antimicrobial drug susceptibility tests.

KEY WORDS: Staphylococcus aureus; Coagulase Negative Staphylococci; Blood Stream Infections; Bactaeremia.

INTRODUCTION

Blood Stream Infections (BSI) are a major cause of mortality, morbidity and excessive medical costs[1], Coagulase-negative Staphylococci (CoNS) and Staphylococcus aureus (S. aureus) are commonly isolated from blood stream infections.[2] CoNS are members of normal skin flora but can cause nosocomial infections in patients with predisposing factors such as indwelling devices.[3,4] BSI with S. aureus can lead to serious complications like metastatic infections and infective endocarditis or sepsis. Methicillin-Resistant Staphylococcus Aureus (MRSA) bacteraemia cases are reported worldwide and are associated with poorer clinical outcomes.[5]

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CoNS are usually contaminants in blood cultures but can be a cause of nosocomial infection in immune compromised patients and in patients having indwelling devices. Therefore, when isolated from blood culture, clinical correlation should be made, Strategies should be formulated so as to prevent contamination of blood cultures by skin flora. Campaigns should be launched in hospitals; training and educating hospital staff regarding use of aseptic techniques while drawing blood culture and prevention of blood culture bottles from getting contaminated. After implementing such strategies, number and frequency of CoNS isolated from blood cultures should be clearly monitored and results recorded to see efficacy of such programs. Efforts should be made to reduce number of blood culture contaminants so as to avoid misleading results and to differentiate cases of true bacteremia from contamination.

MRSA isolates are resistant to almost all β-lactam antimicrobial drugs. Resistance to antibacterial drugs of last resort against MRSA have been re-

ported in S. aureus, raising the concern regarding chances of untreatable multidrug-resistant (MDR) S. aureus infections.[6,7] Comparison of frequencies of blood stream infections in year 2011 and 2019 showed decrease in frequency of BSI caused by S. aureus as well as MRSA. This may be due to better infection control procedures and interrupting chain of transmission. However, there is further need to promote contact precautions to limit spread among patients. There should be hospital wide campaigns, given special emphasis on hand hygiene, creating awareness regarding transmission through fomites. Disinfection of hospital equipment and environment, precautions regarding use of intravenous catheters and indwelling devices can further limit spread of MRSA.

S. aureus can show variable levels of resistance to commonly used antimicrobials. Therefore it is of utmost importance to monitor trends in emerging drug resistance and must be taken into account while starting empiric antimicrobial therapy.

Early diagnosis and treatment of BSI is lifesaving as one third of BSI-related deaths occur within the first few days after the diagnosis. Blood stream infections are associated with significant morbidity and mortality. Various aspects of healthcare treatment and delivery may affect the trends among pathogens causing BSI but limited data regarding primary sources of infection that can be used to prevent such infections is available.[9] The objectives of this study were to determine the frequency of S. aureus in blood stream infections and their antimicrobial drug susceptibility pattern.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Pathology at Shaikh Zayed Hospital, Lahore, a tertiary care hospital, from April 2018 to March 2019. The sample size was 1527 positive blood cultures for bacteria selected through consecutive sampling technique. Identification was done on the basis of colonial morphology and gram stain. Gram positive, catalase positive cocci were labeled as Staphylococci. Coagulase and deoxyribonuclease (DNase) test were performed. Coagulase positive and DNase-positive cocci were identified as S. aureus while those with coagulase and DNase-test negative were called coagulase negative Staphylococi. Frequency of bacteraemia caused by S. aureus and CoNS, was calculated and recorded. Susceptibility of S. aureus to various drugs like Penicillin (10 U), Cefoxitin (30 µg), Gentamicin (10 µg), Ciprofloxacin (5 µg), Erythromycin (15 µg), Fusidic acid (10 µg), Linezolid (10 µg) and Vancomycin was detected by according to Clinical and Laboratory Standards Institute (CLSI) recommendations.[8] Isolates showing resistance to Cefoxitin were labeled methicillin resistant. Susceptibility of S. aureus to various antimicrobial drugs was detected by disc diffusion and e-strip method. Research variables were; presence of positive blood cultures, presence of staphylococci in positive blood cultures (yes, no), type of staphylococci (CoNS, Staph aereus) and type of staphylococcus aereus (MRSA, MSSA). Susceptibility of isolates to various drugs was detected and was reported as frequency and percentage using SPSS version 16.0.

RESULTS

Out of 12744 blood cultures, 1527 (11.98%) were positive for bacteria. Out of these 1527 positive cultures, 339 (22.20%) were positive for staphylococci. Out of these 339 staphylococci positive cultures, 87 (5.69%) were staphylococcus aureus. Out of these 87 staphylococcus aureus bacteria, 48 (3.14%) were methicillin resistant (MRSA). The proportion of MRSA vs. MSSA is given in Fig 1.

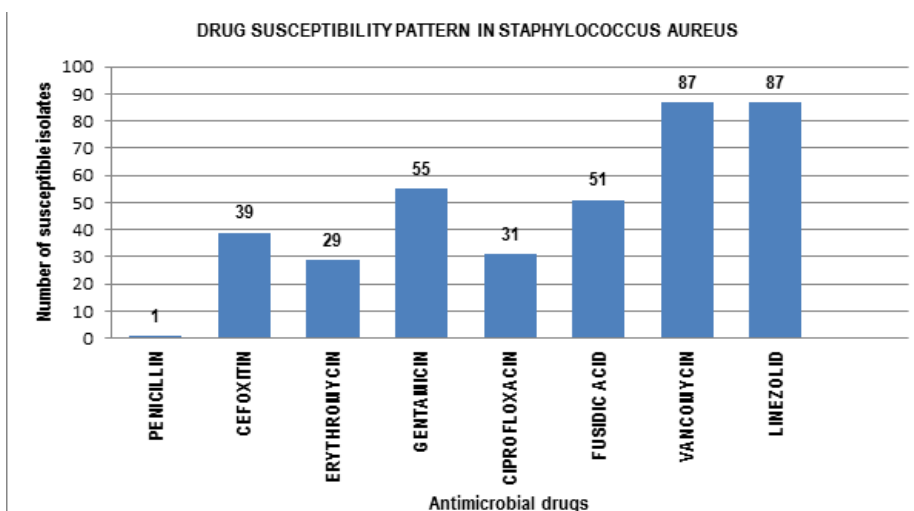Susceptibility of S. aureus isolates to various commonly used drugs was detected and is represented by Fig 2.

Figure 2: Drug susceptibility patterns in S. aureus in Shaikh Zayed Hospital, Lahore, Pakistan (n=87)

Table 1: Frequency of drug resistance in S. aureus isolates in Shaikh Zayed Hospital, Lahore, Pakistan (n=87)

S. No.	Antimicrobial drug	Staphylococcus aureus		
1	Penicillin G	86 (98.9%)		
2	Methicillin	48 (55.2%)		
		MSSA	MRSA	Total
1	Penicillin G	38 (97.4%)	48 (100%)	86 (98.9%)
2	Erythromycin	18 (46.1%)	40 (83.3%)	58 (66.7%)
3	Ciprofloxacin	15 (38.5%)	41 (85.4%)	56 (64.3%)
4	Gentamicin	2 (5.1%)	30 (62.5%)	32 (36.8%)
5	Fusidic acid	17 (43.6%)	19 (39.6%)	36 (41.4%)
6	Vancomycin	0 (0%)	0 (0%)	0 (0%)
7	Linezolid	0 (0%)	0 (0%)	0 (0%)

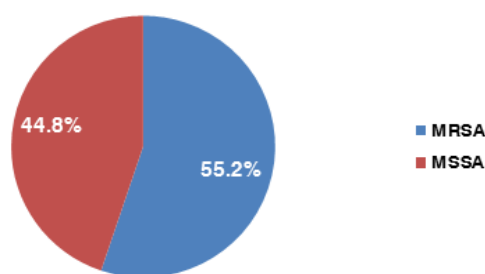**FREQUENCY OF BACTERAEMIA CAUSED BY MRSA AND MSSA**

Figure 1: Proportion of bacteremia caused by MRSA and MSSA in Shaikh Zayed Hospital, Lahore, Pakistan (n=87)

Frequency and percentage of resistance to various commonly used drugs in MRSA and MSSA strains was calculated and is shown in Table 1.

DISCUSSION

In this study, organisms that were isolated from blood cultures were gram negative bacteria, CoNS, S. aureus and Streptococci. Approximately 22.2% isolates from blood culture were members of genus Staphylococcus. Approximately, 74.3% of staphylococcal isolates from blood cultures comprised of CoNS while 25.7% were S. aureus. A study by Wilson et al also reported E. coli, CoNS and S. aureus as most common isolates from BSIs.[9]

CoNS and S. aureus were frequent isolates from blood cultures. Coagulase negative Staphylococci when isolated from blood culture bottles depict faulty technique and special emphasis on improving blood sampling technique should be given. CoNS are members of normal flora of human skin and mucous membranes. Therefore, it is necessary to distinguish pathogenic CoNS from contaminants in blood cultures.[3] Blood culture contamination and misleading culture results lead to diagnostic uncer-

tainty and increased health costs due to unnecessary treatment and testing.[10] Several studies found CoNS as the most common blood culture contaminants, representing 70 to 80% of all contaminated blood cultures.[10] Majority of isolates of coagulase-negative staphylococci from blood cultures are contaminants but these organisms are also an increasing cause of true bacteremia in patients with prosthetic devices and central venous catheters.[10]

Comparing frequencies of blood stream infection caused by S. Aureus, CoNS, MRSA MSSA in this study with a previous one conducted in Shaikh Zayed hospital in 2011, we found that 29% blood cultures were found to be positive for staphylococci in 2011 that reduced to 22.2% in 2019. Overall, percentage of isolation of CoNS increased from 60% to 74.3% indicating increased blood culture contamination rates, while isolation of S. aureus from BSIs decreased from 40% to 25.7% probably due to implementing infection control and interrupting chain of transmission. In 2011, 34% of S. aureus isolates were found to be MSSA and 66% were MRSA while in this study 44.8% isolates were MSSA and 55.2% were MRSA.[11] The overall frequency of MRSA out of total blood cultures decreased from 1.25 to 0.37%. A CDC report showing comparison of Surveillance data from 2005 to 2014 estimated that healthcare-associated MRSA incidence has decreased by 44.87% and overall incidence of MRSA infections has decreased by 39.51%.[12]

Infection control guidelines recommend that blood cultures should be obtained before initiation of antibiotics. Effective empiric antimicrobials should be administered within the first hour of recognition of septic shock and severe sepsis. Empiric combination therapy should not be continued for more than 3–5 days. After getting results of antimicrobial susceptibility test, most appropriate single antimicrobial drug should be administered at the earliest.[13] Nosocomial spread of drug resistant strains of S. aureus has been reported.[14] Therefore drug susceptibility profile

of strains circulating in particular area or hospital is important. In this study, 98.9% S. aureus were resistant to Penicillin and 55.2% to Cefoxitin. Therefore in blood stream infection caused by MRSA, S. aureus will be resistant to almost all beta lactam drugs. Resistance to Ciprofloxacin was seen in 64.3% of S. aureus; gentamicin resistance in 36.7% of S. aureus; Fusidic acid resistance in 41.4% of S. aureus and 66.7% of S. aureus isolates were resistant to Erythromycin.

A study by Gu B reported Linezolid resistance in 0.05% of S. aureus strains.[14] Therefore, prescribing Linezolid can select drug resistant organisms and clonal spread of resistant strains in hospitals. However in this study, all S. aureus isolates were susceptible to Vancomycin and Linezolid.

CONCLUSION

Staphylococcus aureus is a significant cause of blood stream infection and can exhibit multi-drug resistance. Therefore drug susceptibility profile of pathogens prevalent in hospital should be monitored and kept in mind when prescribing antimicrobial drugs before getting results of antimicrobial drug susceptibility tests.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	NA, NK
Acquisition, Analysis or Interpretation of Data:	NA, NK, NM, MI, TZ, HTH
Manuscript Writing & Approval:	NA, NK, NM, MI, TZ, HTH

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.