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PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY OF STAPHYLOCOCCUS AUREUS IN ICU BLOOD

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ABSTRACT: This investigation investigated the drug susceptibility and prevalence of Staphylococcus aureus which were isolated from blood samples in the ICU. Conventional microbiological techniques were employed to analyze blood culture-positive samples for Staphylococcus aureus, and the Kirby–Bauer disk diffusion method was employed to evaluate antibiotic susceptibility in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines. Cefoxitin discs have demonstrated resistance to methicillin. The intensive care unit's predominant bloodstream isolate was Staphylococcus aureus, including MRSA, according to the study. The bacteria were susceptible to vancomycin and linezolid, but they were resistant to penicillin and erythromycin. The critical significance of antibiotic stewardship in intensive care units is underscored by the multidrug resistance of Staphylococcus aureus.

Keywords: *Staphylococcus aureus, ICU bloodstream infections, Antibiotic susceptibility, MRSA, Antimicrobial resistance, Blood culture*

1. INTRODUCTION

Bacteremia is the presence of microorganisms in the bloodstream without evidence of their proliferation. Bacteremia, despite its straightforward diagnosis, presents a substantial clinical risk due to its potential to swiftly develop into severe systemic infections. Septic shock, multiple organ failure syndrome, disseminated intravascular coagulation, and increased short-term mortality rates may be the consequences of inflammatory responses that are induced by microbial infiltration of the bloodstream. Bacteremia poses a threat to the life of a patient by granting pathogens direct access to vital organs. This is especially true for those who are truly ill.

Bacteremia can be classified as chronic, intermittent, transient, or transitory according to its duration and etiology. For those with compromised immune systems or other medical conditions, transient bacteremia can present substantial risks. The continuous development of their immune systems renders children, particularly those under the age of five, more susceptible to disease. The recognition of the organism and the substantiation of the condition are facilitated by the timely identification of bacteremia.

Blood culture continues to be the most effective method for diagnosing bacteremia. A severe invasive infection necessitating immediate antibiotic treatment is indicated by blood cultures that reveal pathogenic bacteria. Disease and mortality rates may be further exacerbated by inadequate or delayed treatment. Initially, determine the etiology of the disease and its susceptibility to antibiotics in order to direct treatment and prevent adverse effects.

Bacteremia is frequently indicative of the disease's origin and can result from a variety of etiologies. Genitourinary infections comprise 25% of the total, respiratory infections comprise 20%, abscesses comprise 10%, surgical site infections comprise 5%, and miscellaneous forms comprise 10%. The diagnosis and treatment of bacteremia are significantly impacted by its ambiguous etiology, particularly in patients who are severely ill. Due to the administration of broad-spectrum antibiotics, protracted hospitalizations, indwelling devices, and invasive operations, intensive care units are especially susceptible to bloodstream infections.

In intensive care units, Staphylococcus aureus is one of the most common bloodstream infections. Staphylococcus aureus has the potential to cause a variety of conditions, including moderate cutaneous and soft tissue infections, severe sepsis, pneumonia, endocarditis, and bacteremia. It is a substantial contributor to hospital-acquired infections due to its biofilm formation, attachment to medical devices, and evasion of immune responses.

This is particularly alarming due to the proliferation of methicillin-resistant Staphylococcus aureus (MRSA). MRSA infections are a substantial global health concern, with hospitals being the primary site of infection. Methicillin was developed in the 1960s to combat penicillin-resistant Staphylococcus aureus. Nevertheless, methicillin resistance emerged over the course of several years of clinical application, which limited the availability of treatment options and complicated therapeutic interventions. Prolonged hospitalizations, elevated mortality rates, and increased medical costs have been linked to the proliferation of MRSA in hospitals, particularly in intensive care units.

The incidence of morbidity and mortality is substantial in intensive care units due to the persistence of nosocomial infections. The weakened immune systems, invasive medical devices, and antibiotic-resistant diseases of critically ailing individuals render them particularly vulnerable. It is essential to comprehend the prevalence of bloodstream infections caused by Staphylococcus aureus and its level of antibiotic resistance in order to provide the most suitable patient treatment.

2. MATERIAL AND METHODS

Study Design: A detailed observational study was done at a hospital to find out how common Staphylococcus aureus was and what kinds of antibiotics it was resistant to in blood samples from patients in the Intensive Care Unit (ICU).

Study Setting and Duration: The study was done with help from the Intensive Care Unit (ICU) of a teaching hospital for secondary care in the Department of Microbiology. The research took place from ___ to ___, which is a total of ___ months.

Study Population: People of all ages and genders who were brought to the intensive care unit with a clinical suspicion of septicemia were included in the study. Patients in intensive care who had fever, hypothermia, low blood pressure, tachycardia, or changes in mental state and were showing signs of a bloodstream infection were included in the study.

Inclusion Criteria

- ICU patients clinically suspected of septicemia
- Patients from whom blood culture samples were received during the study period
- Patients of all age groups and both genders

Exclusion Criteria

- Samples showing contamination

- Repeat blood samples from the same patient
- Patients already diagnosed with bloodstream infection prior to ICU admission

Sample Collection: Medical professionals with the right training took blood samples while following strict aseptic procedures. The venipuncture site was cleaned with 70% alcohol and povidone-iodine before the sample was taken, and it was then left to dry.

Blood samples from veins ranged from 5 to 10 mL for adults and 1 to 3 mL for kids. Quickly, enrichment media were added to sterilized blood culture flasks that held the blood samples. After being properly labeled, the bottles were quickly sent to the microbial laboratory for more testing.

Blood Culture Processing: The blood culture bottles were kept in an oxygen environment at 37°C and were checked every day for signs of bacterial growth, such as cloudiness, gas production, bleeding, or the formation of clots. Nutrient and blood agar plates were grown on top of bottles that were showing growth.

After 18 to 24 hours at 37°C, the plates were checked for bacterial growth. Bottles that didn't show any growth were left in the incubator for up to seven days before they were labeled as negative.

Identification of Staphylococcus aureus

Isolates obtained from positive blood cultures were identified using standard microbiological techniques. Preliminary identification was based on:

- Colony morphology on blood agar
- Gram staining (Gram-positive cocci in clusters)

The results were also supported by chemistry techniques. These were the evaluations:

- Catalase test
- Coagulase test (slide and tube methods)

The isolates were found to be Staphylococcus aureus after coagulase and catalase tests came back positive.

Antibiotic Susceptibility Testing: To test each proven Staphylococcus aureus isolate's antibiotic susceptibility, we followed the guidelines set by the Clinical and Laboratory Standards Institute (CLSI). We used the Kirby–Bauer disc diffusion method on Mueller–Hinton agar.

Mueller–Hinton agar plates were used to make and grow a standard inoculum that matched the 0.5 McFarland turbidity standard. After the antibiotic discs were put on top of the agar, the plates were kept at 37°C for 16 to 18 hours, making sure they didn't touch anything else.

For example, the following medicines were often used to treat staphylococcal infections:

Following the guidelines from CLSI, the inhibition zones were measured in millimeters and put into three groups: sensitive, moderate, and robust.

- Penicillin
- Cefoxitin
- Erythromycin
- Clindamycin
- Ciprofloxacin
- Gentamicin
- Amikacin
- Vancomycin
- Linezolid

After incubation, the diameter of the zones of inhibition was measured in millimeters and interpreted as Sensitive, Intermediate, or Resistant according to CLSI criteria.

Detection of Methicillin-Resistant Staphylococcus aureus (MRSA): The cefoxitin (30 µg) disc diffusion test showed that some Staphylococcus aureus isolates were not sensitive to methicillin. Methicillin-resistant Staphylococcus aureus (MRSA) was found in isolates with inhibitory zone widths of ≤21 mm, showing resistance. Methicillin-sensitive Staphylococcus aureus (MSSA) was found in isolates with inhibitory zone widths of ≥22 mm.

Quality Control: Standard reference strains were used for quality control during antibiotic susceptibility tests. Standard laboratory methods were used to test how well the disc, incubation settings, and medium preparation worked.

Data Analysis: As a fraction, the amount of Staphylococcus aureus found in all blood culture-positive isolates was calculated and written down. A statistical study of antibiotic susceptibility patterns was done to show how resistance and sensitivity are changing over time. Tables and figures show the results.

Ethical Considerations: Before the study began, it was approved by the Institutional Ethics Committee. Since blood samples were taken as part of normal diagnostic processes, there was no need for informed consent. The study took great care to protect patient privacy and made sure that all data was kept anonymous.

3. RESULTS

The isolates of Staphylococcus aureus were found by looking at the colonies on nutrition agar and blood agar plates. Figure 1 shows a S. aureus colony on blood agar. It had a clear area of beta-hemolysis and a round, convex shape with a clear edge. The population was anywhere from 1 to 3 mm across. It had a bright yellow color on the food, which was a sign of the carotenoid staphyloxanthin (Fig. 2). Clusters of 1 µm Gram-positive cocci were seen when the dye was applied (Fig. 3). Out of the 3,145 blood samples that were tested for this study, 315 were marked as positive because they showed growth on the culture media. The Bact/Alert 3D blood culture method showed that 2830 samples (89.99%) were sterile and did not grow, but this study showed a culture success rate of 10.01%. There were 315 culture-positive samples. Of those, 84 (26.2%) were gram-positive bacteria, 228 (72.4%) were gram-negative bacteria, and 3 (0.95%) were Candida spp. Sixty-one (72.61%) of the gram-positive bacteria were Staphylococcus aureus. Of the S. aureus samples, 77% were male and 23% were female. When compared to women, guys had a slightly higher rate of bacteremia. People aged 51 to 60 made up the largest group of S. aureus isolates (18.03%), more than people of any other age group. Table 1 shows how the ages of the S. aureus samples are spread out. Based on this study, 39.34% of patients in the CCU had S. aureus. This was followed by 27.90% in the MICU, 18.03% in the ICU, and 4.91% in the NICU, PICU, and SICU as a whole.

Fig. 1: S. Aureus Showing Beta Hemolysis on The Blood Agar

Fig. 2. S. Aureus Showing Golden Yellow Pigment on Nutrient Agar

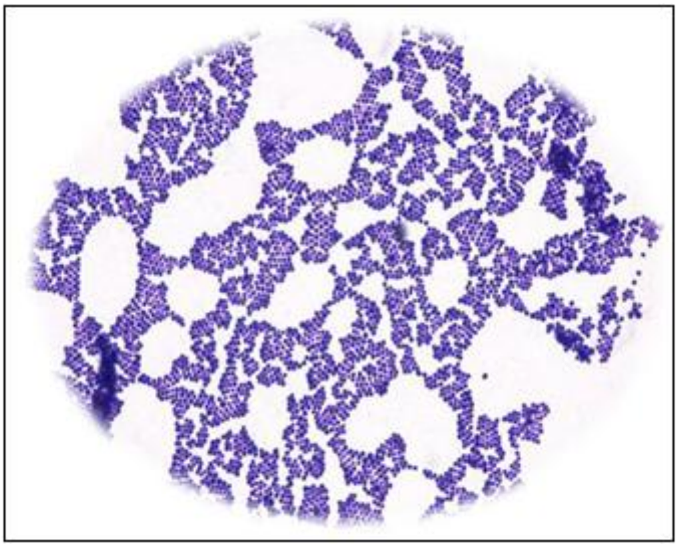

FIG. 3: Microscopic View of S. Aureus Showing Gram Positive Cocci in Clusters

Table 1: Age Wise Distribution of Bacteremia Due to S. Aureus

Sr.	Age Group	Number of	Percentage

No.	(Years)	Isolates	(%)
1	0–10	4	6.55
2	11–20	5	8.2
3	21–30	5	8.2
4	31–40	10	16.39
5	41–50	8	13.11
6	51–60	11	18.03
7	61–70	10	16.39
8	71–80	5	8.2
9	81–90	3	4.93
10	91–100	0	0
Total		**61**	**100**

Antimicrobial Sensitivity Pattern of S. aureus: Teicoplanin, doxycycline, minocycline (100%), vancomycin and tigecycline (96.72%), linezolid (91.80%), and rifampicin (90.16%) were the most efficacious in killing S. aureus. Daptomycin (80.32%), tetracycline (83.60%), clindamycin (62.29%), and gentamicin (55.73%) were moderately effective. Erythromycin (32.78%) and cotrimoxazole (42.62%) were not as effective.

Antimicrobial Resistance Pattern of S. aureus: The S. aureus isolates in this study were moderately resistant to erythromycin (67.22%) and cotrimoxazole (57.38%), but they were extremely resistant to benzylpenicillin (100%), oxacillin (96.72%), ciprofloxacin (90.17%), and levofloxacin (86.89). Clindamycin (37.70%), gentamicin (44.27%), daptomycin (19.67%), and tetracycline (16.40%) were less antibiotic-resistant. Table 2. Efficacy of antibiotics against S. aureus.

Table 2: Antibiotic Susceptibility Pattern of S. Aureus. (N=61)

Sr. No.	Antibiotic Tested	Sensitive Isolates n (%)	Resistant Isolates n (%)
1	Benzylpenicillin	00 (0.00)	61 (100.00)
2	Oxacillin	02 (3.28)	59 (96.72)
3	Gentamicin	34 (55.73)	27 (44.27)
4	Ciprofloxacin	06 (9.83)	55 (90.17)
5	Levofloxacin	08 (13.11)	53 (86.89)
6	Erythromycin	20 (32.78)	41 (67.22)
7	Clindamycin	38 (62.29)	23 (37.71)
8	Linezolid	56 (91.81)	05 (8.19)
9	Daptomycin	49 (80.33)	12 (19.67)
10	Teicoplanin	61 (100.00)	00 (0.00)
11	Vancomycin	59 (96.72)	02 (3.28)
12	Tetracycline	51 (83.60)	10 (16.40)
13	Tigecycline	59 (96.72)	02 (3.28)
14	Rifampicin	55 (90.17)	06 (9.83)
15	Cotrimoxazole	26 (42.62)	35 (57.38)
16	Doxycycline	61 (100.00)	00 (0.00)
17	Minocycline	61 (100.00)	00 (0.00)

4. DISCUSSION

Blood Culture Positivity Rate: Blood infections are a significant cause of mortality in the intensive care unit. The experiment required 3,145 blood samples to be completed. There were 2,830 sterile samples (89.98%) and 315 positive blood cultures (10.01%). The blood culture positive rate of this investigation was comparable to that of other ICU studies. Culture positivity can be influenced by antibiotic treatment, blood volume, sample timing, and aseptic technique.

Prevalence of Staphylococcus aureus Bacteremia: Staphylococcus aureus was detected in 1.93% of the processed blood samples (61). The majority of bloodstream infections in intensive care units are caused by S. aureus, although this study discovered that it is less prevalent. Disparities in infection control, antibiotic use, intensive care unit patients, and illness severity may be the cause of these discrepancies.

Gender-wise Distribution of Staphylococcus aureus Isolates: Men were more likely to develop S. aureus bacteremia, according to this investigation. Fourteen isolates (23%) were obtained from female patients, while 47 isolates (77%) were obtained from male patients. The increased incidence may be attributed to the fact that males experience a greater number of invasive operations, ICU admissions, and other conditions. The gender distribution in ICU bacteremia studies is consistently consistent.

Age-wise Distribution of Staphylococcus aureus Isolates: The percentage of Staphylococcus aureus isolates among individuals aged 51 to 60 (18.03%) was the highest, followed by all other age groups. This is illustrated in Table 1. The frequency of illness may be increased in older individuals as a result of their weakened immune systems, frequent hospitalizations, long-term ailments, and use of invasive medical devices. It is more probable that these incidents will result in blood infections in elderly ICU patients.

Antibiotic Susceptibility Pattern of Staphylococcus aureus: In antibiotic susceptibility experiments, teicoplanin, doxycycline, and minocycline (100%) were more effective than Staphylococcus aureus that spread through the bloodstream. Linezolid (91.80%), rifampicin (90.16%), and vancomycin (96.72%) also demonstrated efficacy, suggesting that these antibiotics are still capable of treating S. aureus infections that are severe in ICUs.

Daptomycin (80.32%), gentamicin (55.73%), clindamycin (62.29%), and tetracycline (83.60%) were moderately sensitive. The overuse of antibiotics results in the development of antibiotic-resistant bacteria that are less contagious.

The ineffectiveness of erythromycin (32.78%) and cotrimoxazole (42.62%) in ICU isolates suggests resistance. I am concerned about this development due to the widespread use of antibiotics in the medical field.

Antibiotic Resistance Pattern: The isolates in this study were resistant to benzylpenicillin due to the prevalence of Staphylococcus aureus beta-lactamases. The ICU contains a significant number of MRSA bacteria, as 96.72% of the pathogens were resistant to oxacillin. The resistance to ciprofloxacin (90.17%), levofloxacin (86.89%), and erythromycin (67.22%) was particularly high.

The detrimental effects of antibiotic abuse and the critical importance of antimicrobial regulation are underscored by the elevated rates of fluoroquinolone and macrolide resistance.

Clinical Implications: Antibiotic-resistant Staphylococcus aureus should be monitored in intensive care units, according to this investigation. Rapid identification, antibiotic selection, and infection control are required due to the significant prevalence of drug-resistant microorganisms. In order to enhance patient outcomes and prevent resistant infections, empirical therapy should be informed by local antibiogram data.

5. CONCLUSION

Staphylococcus aureus is uncommonly identified in blood cultures; however, this investigation indicates that it induces bloodstream infections in patients undergoing critical care. S. aureus bacteremia was higher in men and elderly adults, which implies that the risk of infection is elevated by demographics, invasive surgeries, other health issues, and extended ICU stays. Beta-lactams, fluoroquinolones, and macrolides were ineffective against S. aureus isolates; however, glycopeptides and other reserve antibiotics were effective. This complicates the management of critical care microorganisms that are resistant to numerous antibiotics. The significance of monitoring systemic infections, local antibiotic resistance, and antimicrobial usage for empirical treatment is underscored by these findings. Critical care patients are safeguarded by robust infection control and antibiotic stewardship systems. These measures also reduce the resistance of Staphylococcus aureus.

REFERENCES:

1. Jaisi N, Pathak P, Shah PK and Dahal PR: Bacteremia, and antibiotic Susceptibility Pattern of isolated from Patients Visiting Hospital of Kathmandu. Tribhuvan University
2. Journal of Microbiology 2018; 5(1): 39-44.
3. Sweta SO, Sanjay JM, Kikani MK and Sunil GO: Bacteriological profile and antibiogram of blood culture isolates from patients of rural tertiary care hospital. Inter J of Microbiology and Mycology 2016; 4(3): 1-7.
4. Mittal V, Mittal V, Khan M, Sharma, Mittal S and Rathish KC: Bacteriological profile and antibiogram of Bacterial isolates from blood culture of a tertiary care teaching hospital: A Retrospective trail. Paripex- Indian Journal of Research 2021; 10(03): 36-38.
5. Nimri LF, Rawashdeh M and Meqdam MM: Bacteraemia in children's Etiological agents' focal sites and risk factors. Journal of Tropical Pediatrics 2001; 47: 356-360.
6. Bhatt CP, Karki BMS, Baral B, Gautam S, Shah A and Chaudhary A: Antibiotic susceptibility Pattern of Staphylococcus aureus and Methicillin Resistant Staphylococcus aureus in a tertiary care hospital. Journal of Pathology of Nepal 2014; 4: 548-551.
7. Mir BH and Srikant DR: prevalence and antimicrobial susceptibility of methicillin resistant Staphylococcus aureus and coagulase – negative Staphylococci in a tertiary care hospital. Asian J Pharm Clin Res 2013; 6(3): 231-234.
8. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; 30th informational supplement, CLSI document M100. Wayne PA 2023; 30.
9. Nazir A, Sana I, Preezada BY and Farooq T: study of prevalence and antimicrobial susceptibility pattern of blood culture isolated from a tertiary care hospital of north India. International Journal of Research in Medical Science 2018; 6(12): 4046-4052.
10. Jhajhria A, Yadav AK, Parihar G and Gupta PS: Bacteriological profile and antimicrobial susceptibility of blood culture in a tertiary care hospital Ajmer. International Journal of Medical and Health Research 2018; 4(6): 7-11.

11. Cugati S and Saikumar C: Prevalence and antibiotic Susceptibility Pattern of Staphylococcus aureus isolated from Blood culture in a Tertiary care centre. Journal of Medical Science and Clinical Research (JMSCR) 2017; 05(04): 20842-20847.
12. Afrasyabi R, Modiri L, Issazadeh K, Darsanaki RK and Masiha A: Prevalence and antibiotic susceptibility pattern of Staphylococcus aureus isolated from Personnel and patients in roudbar hospitals. Journal of pure and Applied Microbiology 2013; 7(2): 1379-1382.'
13. Kumhar GD, Ramachandran VG and Gupta P: Bacteriological analysis of blood culture isolates from neonates in a tertiary care hospital in India. J Health Popul Nutr 2002; 20(4): 343-347.
14. Kante M, Uma P, John MS and Naidu MP: Bacterial profile bloodstream infection and antibiotic susceptibility pattern of isolates. International Journal of Current Microbiology and Applied Science 2014; 3(12): 222-233.
15. Wasihun AG, Wlekidan LN, Gebremariam SA, Dejene TA, Welderfael AL, Haile TD and Muthupandian S: Bacteriological profile and antimicrobial susceptibility patterns of blood culture isolates among febrile patient in Mekelle hospital Northern Ethiopia. Springer Plus Journal 2015; 4: 1-7.
16. Zeki C, Murat K and Osman A: Prevalence, and antimicrobial Resistance of Staphylococcus aureus isolated from Blood culture in University Hospital Turkey. Global Journal of Infectious Diseases and Clinical Research 2015; 1(1): 10-13.