"Risk Factors for Catheter Related Bloodstream Infection in Patients at a Hem dialysis Unit and Molecular Characterization of MDR Strains of Staphylococcal Species: A Prospective Study"

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Abstract:

Background: Catheter-related bloodstream infections are a major complication of central venous catheter use. This study examines risk factors associated with catheter-related bloodstream infections and its Molecular Characterization of MDR S.aureus strains**.**

Aim and Objectives: This study evaluates the risk factors, antimicrobial resistance and molecular characterization of Staphylococcal species for the development of bloodstream infections in patients undergoing hemo dialysis.

Methods: In this Prospective study, single-center study, chronic renal disease patients on hemo dialysis who presented with positive blood cultures during the study were included during a 1year study period. Quantitative blood cultures (QBC) and catheter tip cultures were performed for the diagnoses according to the standard procedures. Bio film production in catheters was detected by 'tissue culture plate' (TCP) method and molecular characterization of the gram positive resistant staphylococcal isolates was done. Antimicrobial susceptibility testing was done by Kirby-Bauer disc diffusion method as per CLSI guidelines and E-test.

Results: Catheter-related blood-stream infections (CRBSI) in Rama Medical College Hospital and Research Centre, Mandhana, Kanpur were 4.74 per 1,000 catheter days. Of the 3 isolates that caused CRBSI, 2 were MRCONS, 1 was MRSA. Of the 10 Staphylococcus spp, isolated 80% were bio film producers. Of the 2 S. aureus isolates 1 isolate(50%)harbor the mecA gene and identified as methicillin-resistant S. aureus (MRSA) and the remaining 1 (50%) isolates were methicillin-susceptible (MSSA.). All the Staphylococcal isolates including MDR strains were 100% sensitive to Vancomycin and Linezolid. The AO staining was more sensitive and Gram staining of catheters showed higher specificity. Conclusion: Antimicrobial resistance was significantly higher in bio film producing Staphylococcal species in this study. Infection prevention measures for bloodstream infections related to central venous catheter use should be intensified, as well as judicious use of this route for vascular access for hem dialysis.

Key words: CRBSI, MDR, MRSA, MRCONS, MSSA QBC, TCP, E-test

Introduction

Central venous catheters (CVSs) are indispensable in modern-day medical practice, particularly in intensive care units. Although such catheters provide necessary access, their use puts patients at risk for local and systemic infectious complications, including local site infection, catheter-related blood-stream infections (CRBSI), septic thrombophlebitis, endocarditic, and other metastatic infections resulting in increased morbidity and mortality [1,2,3] in patients on renal replacement therapy. (e.g., lung abscess, brain abscess, osteomyelitis, and endophthalmitis) [4].

Gram-positive bacteria are most frequently isolated in blood cultures of hemodialysis patients. The major virulence factor for these organisms is their ability to form bio film, which also confers resistance to antimicrobial treatment.

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Material and Methods

To determine the chronic renal disease patients on hemodialysis who presented with positive blood cultures. We conducted a Prospective study for a period of 1 year from November 2019 to December 2020 at Rama Medical College Hospital and Research Centre, Mandhana , Kanpur . Quantitative blood cultures (QBC) and catheter tip cultures were performed for the diagnoses according to standard procedures. Bio film production in catheters was detected by 'tissue culture plate' (TCP) method and molecular characterization of the gram positive resistant staphylococcal isolates were done using the Qiagen DNA extraction kit. Logistic regression was used for statistical analysis. Antimicrobial susceptibility testing was done by Kirby-Bauer disc diffusion method according to the CLSI guidelines and E-test.

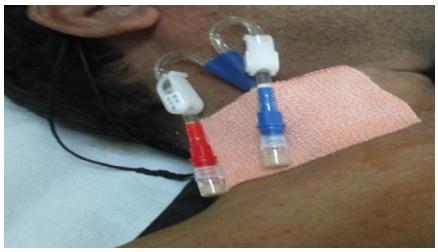

Figure 1: Patient inserted with CVSs

Figure 2: Catheter Tip

Results

From the above, we concluded our results stating that the catheter-related blood-stream infections (CRBSI) in Rama Medical College Hospital and Research Centre, Mandhana, Kanpur was 4.74 per 1,000 catheter days.

Of the 3 isolates that caused CRBSI, 2 were *MRCONS*, 1 was *MRSA*. Of the 10 Staphylococcus *spp*, isolated 80% were bio film producers. Of the 2 *S. aureus* isolates 1 isolate(50%) harbor the mecA gene and identified as methicillin-resistant S. aureus (MRSA) and the remaining 1 (50%) isolates were methicillin-susceptible (MSSA.) Femoral vein catheters insertion site, was found to be statistically significant as risk factors for CRBSI. All the Staphylococcal isolates including MDR strains were 100% sensitive to Vancomycin and Linezolid.. The AO staining was more sensitive and Gram staining of catheters showed higher specificity.

Figure 3: BancTec

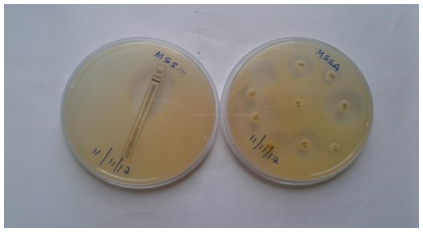

Figure 4: MSSA by E -test strip and AST method

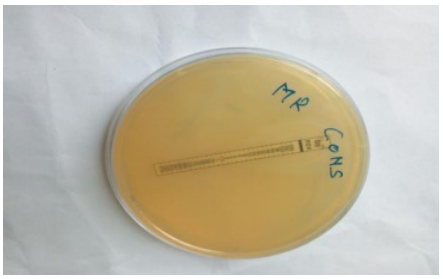

Figure 5: M R cons by E-test strip

Figure 6: MR cons by AST

Figure 7: MRSA by E-test strip

Figure 8: MRSA by AST

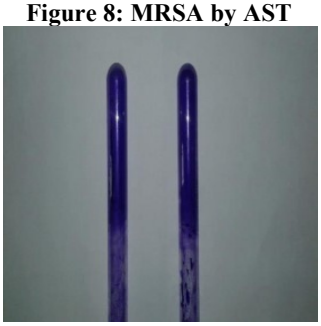

Figure 9: Bio film formation

Figure 10: DNA Extraction Kit

Figure 11: DNA Reagents

Figure 12: Isolated DNA from Bacterial culture of *S. aureus*

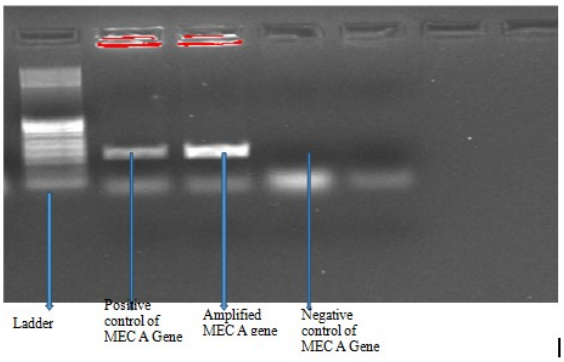

Figure 13: Amplified DNA with PCR for Mec A gene of S. aureus in this fig. Lane 1 is DNA ladder; Lane 2 is positive control of Mec A gene; Lane 3 is Amplified MecA gene; Lane 4 is Negative control for MecA gene

Discussion

In the present study Catheter-related blood-stream infections (CRBSI) in Rama Medical College Hospital and Research Centre, Mandhana, Kanpur was 4.74 per 1,000 catheter days which was similar to the study conducted by other author where CVC related bloodstream infection was 10.8 per 1000 (CVC-RBI)[5]. Gram-positive bacteria were isolated with the highest frequency which correlates with the study Fram D et al. [6]. Of the 3 isolates that caused CRBSI, 2 were MRCONS 1 was MRSA. Similarly other study show the highest organisms isolated by D F Fani et al. (2019) [7] of the 10 *Staphylococcus spp.* isolated 80% were bio film producers, of the 2 *S. aureus* isolates 1 isolate(50%) harbor the mecA gene and identified as methicillin-resistant S. aureus (MRSA) and the remaining 1 (50%) isolates were methicillin-susceptible (MSSA.) Permanent hemo dialysis catheters are associated with lower dialytic efficacy compared to arterio venous fistulae [8]. Moreover, there is an increased incidence of mechanical dysfunction [9], thrombosis [10] and bacteremia [11]. Related complications, especially infections, have unfavorable effects on morbidity, mortality and costs. Infections are the second most frequent cause of death in dialysis patients and therefore play a major role since they lead to about 1300 hospitalizations per 1000 patient years [12]. All the Staphylococcal isolates including MDR strains were 100% sensitive to Vancomycin and Linezolid. The AO staining was more sensitive and Gram staining of catheters showed higher specificity. Antimicrobial resistance was significantly higher in biofilm producing Staphylococcal species in this study.

Conclusion

Infection prevention measures for bloodstream infections related to central venous catheter use should be intensified, as well as judicious use of this route for vascular access for hemodialysis. Reducing exposure to the hospital environment through admission could contribute to a reduction in bloodstream infections in this population.

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