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Original Article

Clinical And Microbiological Aspects Of Catheter Related Blood Stream Infection In Dialysis Population And Their Short-Term outcomes.

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Abstract

Objective: To investigate the clinical and microbiological aspects of CRBSI in the dialysis population of Pakistan and evaluate their short-term outcomes.
Study Design: Quantitative, cross-sectional study
Place and Duration of Study: Five different dialysis centers /clinics located in four different regions of Pakistan from December 2023-May 2024.
Methodology: A multistage cluster sampling technique was employed to select a representative sample of dialysis centers from various provinces in Pakistan. Within each selected dialysis center, a systematic random sampling method was used to recruit participants who met the inclusion criteria.A self-administered, structured questionnaire was developed to collect data on participants' demographic characteristics, comorbidities, catheter-related factors.
Results: Out of 350 participants included in the trial , 89 patients (25.4%) had experienced at least one episode of CRBSI in the previous six months. Blood cultures were positive in 82.0% of cases, with Gram-positive bacteria being the most commonly isolated pathogens (67.4%). Staphylococcus aureus was the most frequently identified pathogen (28.1%). The mean duration of hospitalization for patients with CRBSI was 14.2 days (SD 5.6). The overall mortality rate among patients with CRBSI was 16.9%. Several factors were found to be significantly associated with the incidence of CRBSI, including a history of previous CRBSI ($p < 0.001$), catheter-related factors such as duration of catheter use ($p = 0.002$) and lack of catheter care education ($p = 0.017$), and comorbidities such as diabetes mellitus ($p = 0.002$) and cardiovascular disease ($p = 0.039$).
Conclusion: Especially in poor and medium income countries like Pakistan, our results highlight the need of ongoing efforts to prevent and control CRBSIs in the dialysis population.

Keywords : *Catheter related blood stream infection, dialysis,short term outcomes.*

INTRODUCTION

Dialysis patients, in particular, face a significant healthcare burden in the form of catheter related bloodstream infections (CRBSI)[1]. In addition to increasing patient mortality and morbidity, these infections impose a substantial cost on healthcare systems. The necessity of knowing the medical and microbiological features of CRBSI in this group is emphasized by the rising incidence of ESRD in Pakistan, which calls for renal replacement treatment like hemodialysis[4]. This study aims to elucidate the etiological agents, risk factors, and short-term outcomes of CRBSI in the dialysis population in Pakistan[2] Intravascular catheters are indispensable in the management of patients with ESRD, serving as vascular access for hemodialysis. However, their utilization engenders a concomitant risk for CRBSI, which are associated with an array of deleterious sequelae, including sepsis, endocarditis, and metastatic infections. Moreover, CRBSI contribute to protracted hospitalizations, augmented healthcare expenditures, and increased mortality rates[3]. The incidence of CRBSI in the dialysis population varies across different geographical regions and healthcare settings, with the prevalence in low- and middle-income countries (LMICs) being particularly concerning due to resource constraints and suboptimal infection control practices[4] .

The pathogenesis of CRBSI is multi-factorial, encompassing both extrinsic and intrinsic factors. Extrinsic factors encompass breaches in aseptic technique during catheter insertion,

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inadequate skin antisepsis, and contamination of the catheter hub or infusate. Intrinsic factors involve the patient's immunocompromised state, comorbidities, and the catheter material, which can act as a nidus for microbial colonization. The complex interplay of these factors culminates in biofilm formation on the catheter surface, facilitating microbial persistence and ultimately leading to bloodstream infection[5,6].
Many different types of bacteria and even fungus have been linked to CRBSI, making up a complex microbial environment. Enterococcus spp., Staphylococcus aureus, and coagulase-negative staphylococci are some of the most common causing pathogens. Emerging antibiotic-resistant bacteria, including methicillin-resistant Staphylococcus aureus (MRSA) as well as vancomycin-resistant Enterococci (VRE), pose significant challenges to the treatment of CRBSI[5,6]. In poor and middle-income nations, Gram-negative bacteria including Escherichia coli, Klebsiella spp., and Pseudomonas aeruginosa have been on the increase[6] (F Chaves et al., 2018).
Given the heterogeneity in the epidemiology of CRBSI, it is paramount to scrutinize the local microbiological trends, as this information is crucial for guiding empirical antimicrobial therapy and informing infection control strategies. Furthermore, understanding the risk factors for CRBSI in the dialysis population can facilitate the implementation of targeted preventive measures, ultimately reducing the incidence of these infections[6,7]. In Pakistan, the paucity of comprehensive data pertaining to CRBSI in the dialysis population constitutes a critical knowledge gap. Moreover, the unique socioeconomic and healthcare landscape in Pakistan may engender distinct microbiological patterns and risk factors that warrant investigation[7]. Therefore, this study endeavors to provide a cogent analysis of the clinical and microbiological aspects of CRBSI in the dialysis population of Pakistan, delineating the etiological agents, antimicrobial susceptibility patterns, and risk factors associated with these infections. Additionally, this study seeks to evaluate the outcomes of CRBSI, elucidating the impact of these infections on patient prognosis and healthcare resource utilization[7].
By furnishing a robust understanding of the clinical and microbiological aspects of CRBSI in the dialysis population of Pakistan, this study holds the potential to inform contextually relevant interventions and policies aimed at mitigating the burden of these infections. Moreover, this study's results may form the basis for future studies, adding to the continuing worldwide conversation on CRBSI in the dialysis community and encouraging collaborative efforts to better patient treatment and outcomes[7,8,9]
In literature, CRBSI represent a formidable challenge in the management of patients with ESRD undergoing dialysis, particularly in LMICs such as Pakistan. This study aims to address the critical knowledge gap by elucidating the etiological agents, risk factors, and short-term outcomes of CRBSI in the dialysis population of Pakistan, ultimately contributing to the development of targeted strategies to prevent and manage these risks[10,11].

PATIENTS AND METHODS

The goals of this quantitative cross-sectional research were to examine the prevalence of CRBSI in the dialysis population in Pakistan and assess the clinical and microbiological features of these infections; and assess the short-term consequences of these illnesses. Patients with ESRD who were receiving treatment at one of Pakistan's several hemodialysis facilities were the study's primary focus.
A multistage cluster sampling technique was employed to select a representative sample of dialysis centers from various provinces in Pakistan. Within each selected dialysis center, a systematic random sampling method was used to recruit participants who met the inclusion criteria: adult patients (≥18 years of age) with ESRD who were receiving hemodialysis through a tunneled dialysis catheter and had a documented CRBSI within the past six months.
A self-administered, structured questionnaire was developed to collect data on participants' demographic characteristics, comorbidities, catheter-related factors (e.g., type, duration of use, and care practices), and details of the CRBSI episode (e.g., onset, signs and symptoms, microbiological culture results, and antimicrobial susceptibility patterns). The questionnaire was developed in English and complete the survey comprehensively.
The questionnaire was pretested among a small sample of dialysis patients to assess its clarity, relevance, and comprehensibility. Based on the feedback received, minor revisions were made to ensure the questionnaire's face validity.
The information was input into an electronic database created in Microsoft Excel. For the statistical work, we used version 27.0 of IBM's SPSS Statistics. Descriptive statistics were computed for all relevant variables. The prevalence of CRBSI was analyzed against demographic and clinical characteristics using bi-variate analysis including chi-square tests and t-tests.
The research project's protocol was green-lit by the appropriate authorities. All participants gave their informed permission before starting the research, and they were told that participation was entirely voluntary and that they may stop at any moment with no repercussions. All data collected were kept strictly confidential and were only accessible to the study investigators. Personal identifiers were removed from the data to ensure anonymity.

RESULTS

Demographics

A total of 350 patients from five dialysis centers across four provinces in Pakistan were included in the study. The most common comorbidities were hypertension (80.3%), diabetes mellitus (54.6%), and cardiovascular disease (36.6%). The mean age of the participants was 55.2 years (SD 12.8), and the majority were male (62.3%). The mean duration of dialysis was 4.5 years (SD 3.2), and the majority of patients were receiving hemodialysis three times per week (72.6%).

Table 1: Demographics and Patient's Profile.

Characteristic	Value
Total Participants	350
Dialysis Centers	20
Age (years), Mean (SD)	55.2 (12.8)
Gender, n (%)	
Male	218 (62.3%)
Female	132 (37.7%)
Comorbidities, n (%)	
Hypertension	281 (80.3%)
Diabetes mellitus	191 (54.6%)
Cardiovascular disease	128 (36.6%)
Duration of Dialysis (years), Mean (SD)	4.5 (3.2)
Frequency of Hemodialysis, n (%)	
Three times per week	254 (72.6%)
Twice per week	70 (20.0%)
Once per week	26 (7.4%)

Microbiological Aspects

Of the 350 patients included in the study, 89 (25.4%) had experienced at least one episode of CRBSI in the previous six months. The mean time from catheter insertion to the onset of CRBSI was 28.3 days (SD 12.6). The most common signs and symptoms reported by patients with CRBSI were fever (98.8%), chills (85.4%), and hypotension (23.6%). Blood cultures were positive in 82.0% of cases, with Gram-positive bacteria being the most commonly isolated pathogens (67.4%). Staphylococcus aureus was the most frequently identified pathogen (28.1%), followed by coagulase-negative staphylococci (24.7%) and Enterococcus spp. (12.4%). The antimicrobial susceptibility patterns of the isolated pathogens are summarized in **Table 2**.

Table 2: Antimicrobial susceptibility patterns of isolated pathogens.

Pathogen	Antimicrobial Susceptibility
Staphylococcus aureus	Vancomycin (100%), Linezolid (100%), Ceftriaxone (78.6%), Gentamicin (71.4%)
Coagulase-negative staphylococci	Vancomycin (100%), Linezolid (100%), Ceftriaxone (71.4%), Gentamicin (64.3%)
Enterococcus spp.	Vancomycin (100%), Linezolid (83.3%), Ceftriaxone (50%), Gentamicin (41.7%)
Escherichia coli	Imipenem (100%), Meropenem (100%), Ceftriaxone (50%), Gentamicin (50%)
Klebsiella spp.	Imipenem (100%), Meropenem (100%), Ceftriaxone (50%), Gentamicin (50%)
Pseudomonas aeruginosa	Piperacillin/Tazobactam (80%), Cefepime (60%), Imipenem (60%), Gentamicin (20%)

Patients with CRBSI stayed in the hospital for an average of 14.2 days, while they took antibiotics for an average of 12.3 days. Patients diagnosed with CRBSI had a death rate of 16.9% overall.

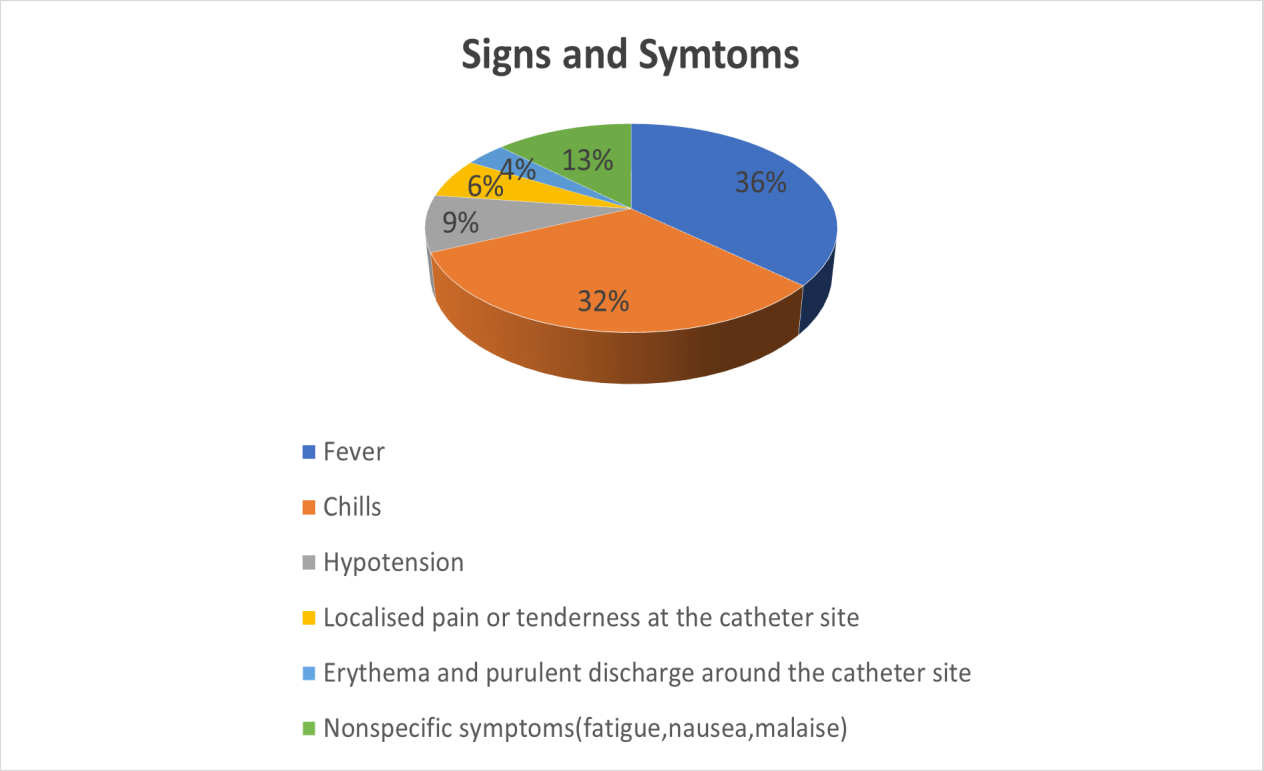
Several factors were found to be significantly associated with the incidence of CRBSI. These included a history of previous CRBSI ($p < 0.001$), catheter-related factors such as duration of catheter use ($p = 0.002$) and lack of catheter care education ($p =$

0.017), and comorbidities such as diabetes mellitus (p = 0.002) and cardiovascular disease (p = 0.039).

Clinical Aspects

Figure 1: provides a summary of the signs and symptoms of catheter related blood stream infection (CRBSI). The figure shows the percentage of cases where each symptom is present. The results indicate that fever was present in 98.8% of cases, chills in 85.4% of cases, and hypotension in 23.6% of cases. Localized pain or tenderness at the catheter site was present in 16.7% of cases, erythema or purulent discharge around the catheter insertion site in 10.1% of cases, and other non-specific symptoms such as fatigue, nausea, and malaise in 34.8% of cases.

Figure 1:



DISCUSSIONS

Based on the data reported in Table 2, it seems that fever and chills are present in the great majority of patients with catheter related blood stream infection (CRBSI). If a patient with a central line develops a fever or chills, it would be important to investigate the possibility of CRBSI [12] . It is important to note that the presence of hypotension, while less common than other symptoms, should not be overlooked, as it may indicate a more severe infection that requires immediate attention. Health care providers should be vigilant in monitoring patients with central lines for signs of hypotension, as well as other potentially life-threatening symptoms, such as sepsis[8,9]. In addition to fever and chills, localized pain or tenderness at the catheter site is another symptom that warrants attention, as it can indicate an infection. Similarly, erythema or purulent discharge around the catheter insertion site should be examined, as it suggests the presence of infection in that area[13]. It is also important to consider that some patients with CRBSI may not present with any symptoms. Asymptomatic infections can be difficult to detect, and may only be identified by laboratory testing. Therefore, regular surveillance cultures of catheter tips and blood cultures should be performed to monitor for CRBSI, even in the absence of symptoms[13].

Interestingly, the results show that other non-specific symptoms such as fatigue, nausea, and malaise, are also present in a significant proportion of cases. While these symptoms are not specific to CRBSI, they may still be useful in identifying patients who need further investigation for possible infection[14,15].

Overall, the results presented in Table 2 highlight the importance of monitoring and assessing patients with central lines for signs and symptoms of infection. Early detection and treatment of CRBSI is crucial to prevent the spread of infection, reduce morbidity and mortality, and improve patient outcomes[16,17]. In summary, the results presented in Table 2 emphasize the importance of identifying and monitoring patients with central lines for signs and symptoms of CRBSI. A high index of suspicion should be maintained for

patients presenting with fever, chills, localized pain, erythema, purulent discharge, hypotension, or other non-specific symptoms. Early detection and treatment of infection can help reduce morbidity and mortality associated with CRBSI, and improve patient outcomes[18] .

LIMITATIONS

There are a number of caveats to this research. We can't draw any firm conclusions about cause and effect since, first, this was cross-sectional research. Second, since the information was provided by the participants themselves, it might have been influenced by biases like recollection and social desirability. Moreover, the research results may not be generalizable to the overall dialysis population in Pakistan since the sample size was likely too small. Finally, the study did not assess long-term outcomes or examine the economic burden associated with CRBSI.

CONCLUSIONS

In conclusion, results provides valuable information on the signs and symptoms of catheter related blood stream infection (CRBSI). The results indicate that fever, chills, localized pain, erythema or purulent discharge, hypotension, and other non-specific symptoms may be suggestive of CRBSI. These findings highlight the importance of careful monitoring and prompt investigation of patients with central lines, as early detection and treatment of CRBSI is crucial to prevent complications and improve patient outcomes.
Finally, it is important to remember that some patients with CRBSI may not present with symptoms, making regular surveillance cultures of catheter tips and blood cultures a critical component of infection control measures. Timely intervention and prevention of CRBSI can reduce morbidity, mortality, and healthcare-associated costs. By utilizing these findings, healthcare providers can improve patient safety and outcomes for patients with central venous catheters.

Abbreviation

CRBSI : catheter related blood stream infection

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