

Frequency of Catheter Related Blood Stream Infections in a Cardiac Surgery Intensive Care Unit

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ABSTRACT

Introduction: Central venous catheter related bloodstream infections is a fatal complication of central venous catheter use and is associated with patient morbidity, mortality, and excess hospital costs. Study aimed to determine frequency of catheter related blood stream infections in patients admitted in Cardiac Surgery Intensive Care Unit.

Material and methods: This study was conducted at Microbiology laboratory of Punjab Institute of Cardiology, Lahore. A total number of 134 central venous catheter tip cultures along with percutaneously drawn blood cultures from patients suspected of having catheter related blood stream infection were collected. Blood cultures as well as central venous catheter tip cultures were processed to isolate microorganisms. Organisms were identified on the basis of colonial morphology, Gram staining and biochemical tests.

Results: Out of 134 central venous catheter tip cultures, 59.7% showed significant microbial growth. Most frequent colonizers were Coagulase negative Staphylococci (31.1%), *S. aureus* (26.7%), *Candida* species (22.2%), *Klebsiella* species (13.3%) and *Acinetobacter* species (4.4%). Out of 134 blood cultures, microbial growth was obtained from 11.9%. Microbes responsible for causing central line associated blood stream infection were *Candida* species (37.5%), *S.aureus* (25%), *Klebsiella* (25%) and *Acinetobacter* species (12.5%). Frequency of catheter related blood stream infection or frequency of catheter related candidemia was found to be 4.5%.

Conclusion: *Candida* species emerged as important cause of catheter related blood stream infection in patients admitted in cardiology intensive care units. Therefore in high risk patients catheter related candidemia and administration of antifungal drugs must also be considered.

Keywords: Catheter Related Infection, Central Venous Catheters, Candidemia, Intensive Care Units, Blood Culture

during catheter placement, microbial colonization of the insertion site, parenteral nutrition, blood transfusions, catheter placement for long duration and placement in the femoral vein.⁴ *Staphylococcus aureus* (*S. aureus*), Coagulase-negative Staphylococci (CoNS), Gram-negative rods, Enterococci, and *Candida* are among most common causes of CRBSI.⁵ Incidence of CVC-related fungemia is increasingly reported in recent years.⁶ *Candida* species which are members or normal flora of gastrointestinal tract can transiently colonize skin breach in skin barrier and subsequent colonization of central venous catheters can lead to candidemia.^{6,7} In the absence of any alternative source, all bloodstream infections in patients with a indwelling CVC are classified as Central line-associated bloodstream infections (CLABSI). This surveillance definition, used for non-research purposes, may overestimate number of infections attributable to the CVC.^{8,9} CRBSI is diagnosed by taking paired samples, CVC tip culture and blood drawn percutaneously from the peripheral vein. A definitive diagnosis of CRBSI requires that the same organism grow from at percutaneous blood culture and from a culture of the catheter tip.⁹

This study was conducted to determine frequency of central venous catheter tip colonization and catheter related blood stream infections in patients admitted in Cardiac Surgery Intensive Care Unit (ICU).

MATERIAL AND METHODS

This observational study was conducted over a period of 08 months from July 2018 to February 2019 at Microbiology laboratory of Punjab Institute of Cardiology, Lahore.

Inclusion criteria: Patients who were having clinical signs of bacteremia and septicemia and were suspected of having catheter related blood stream infection due to indwelling CVCs were selected. Paired samples, CVC tip culture and blood cultures were obtained from same patients.

INTRODUCTION

Catheter-related bloodstream infection (CRBSI) is defined as a blood stream infection for which an indwelling intravenous catheter acts as a portal of infection. Central venous catheters (CVCs) are commonly used in critically ill patients and their use can lead to various complications including CRBSI. CVCs are among main sources of nosocomial bacteremia and CRBSI.¹ Some organisms can produce biofilm and can colonize CVCs. CVC colonization is major cause of catheter related infections and bacteremia² and are associated with mortality rate of 12% to 25%.³ Various factors are associated with the increased risk of CVC related bacteremia such as catheter insertion without sterile barriers, complications

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	Number of positive cultures	Total number of cultures	Percentage
Frequency of CVC tip colonization	80	134	59.7%
Frequency of CLBSI	16	134	11.9%
Frequency of CRBSI	06	134	4.5%
Frequency of catheter related candidemia	06	134	4.5%

Table-1: Showing frequencies of catheter related blood stream infections

Exclusion criteria: Blood culture from patients who were not having central venous catheterization was excluded from this study. Inappropriately collected or labeled specimens were rejected.

A total number of 134 patients were selected from Cardiac surgery Intensive care unit. Before removing the CVC, skin around insertion site was cleaned with 70% ethanol to reduce contaminating skin flora. CVCs were removed aseptically and 2-inches of the distal tip of the catheter was clipped and transferred directly into a sterile container. Containers were labeled and transported to microbiology laboratory for further processing. CVC tips were cultured using Maki’s semi-quantitative roll plate method. Catheter tip colonization was defined as a positive culture with a colony count of ≥ 15 CFU/ml for the roll plate method. Organisms were further identified depending upon colony morphology, gram staining and biochemical tests. Blood samples from peripheral veins were collected percutaneously from selected patient population and dispensed in Brain heart infusion broth. Blood culture bottles were incubated for a maximum period of 14 days, processed to isolate various organisms. Statistical analysis was performed using SPSS version 16.0

RESULTS

Out of total 134 central venous catheter cultures, microbial growth was obtained from 80 (59.7%) CVC tips. From a total number of 80 Central Venous Catheter, 70 cultures revealed single microorganism while from 10 CVCs two isolates were obtained. A total number of 90 organisms were isolated from 80 central venous catheter tips. Among CVC tip colonizers, 28 (31.1%) were CoNS, 24(26.7%) S. aureus, 20 (22.2%) Candida species, 12(13.3%) Klebsiella species, 4(4.4%) Acinetobacter species and 2(2.2%) were Enterococcus species (Fig-1).

Out of 134 blood cultures, microbial growth was obtained from 16 (11.9%). Out of 16 positive blood cultures, main isolates were 6 (37.5) Candida species, 4 (25%) S. aureus, 2 (12.5%) Acinetobacter species and 4 (25%) Klebsiella species (Fig-2).

Regarding CRBSI, only 06 (4.5%) isolates from percutaneously drawn blood cultures matched the isolate from CVC tip of the same patient and the common organism isolated was Candida spp.

Frequency of catheter tip colonization was 59.7% while frequency of CLBSI was found to be 11.9%. Frequency of CRBSI in patients from cardiac surgery ICU was 4.5%. Out of these 16 isolates from blood culture only 06 isolates were same as isolated from CVP-tip of the same patient and the common organism isolated was Candida species in these cases. Frequency of Catheter Related Candidemia was found

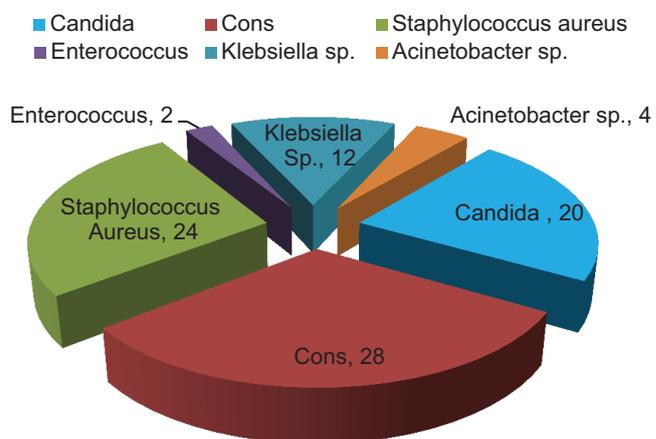


Figure-1: Showing frequencies of cvc tip colonizers

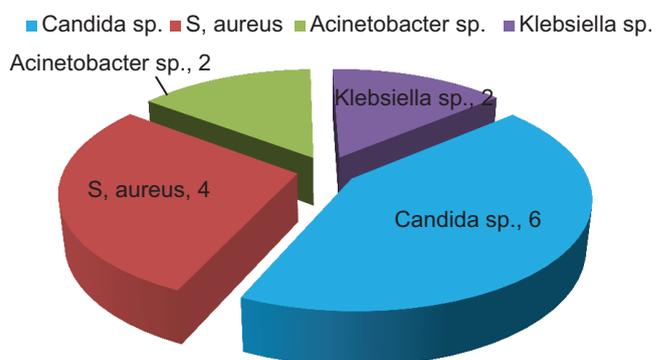


Figure-2: Showing causative agents of central line associated blood stream infection

to be 4.5% (table-1).

DISCUSSION

Catheter related blood stream infection like CLBSI and CRBSI are a major cause of hospital acquired blood stream infection. This study was conducted to highlight CVC tip colonization, organisms causing CVC colonization and associated blood stream infections. Frequency of CVC tip colonization was 59.7%. CoNS (31.1%) were most frequent colonizers followed by S. aureus (26.7%), Candida species (22.2%), Klebsiella species (13.3%), Acinetobacter species (4.4%) and Enterococcus species (2.2%). A study by Sapkota J. reported CVC tip colonization rate of 39.6% and most frequent colonizers as CoNS followed by S. aureus, Enterococcus faecalis and Pseudomonas aeruginosa. CVC tip colonization with Candida was found in less than 1% of cases.¹⁰

In this study, incidence of CLBSI was found to be 11.9%, Candida (37.5), S. aureus (25%), Klebsiella (25%) and Acinetobacter sp. (12.5%) were cause of CLBSI. Regarding CRBSI, incidence of CRBSI was found to be 4.5%. A study

by Aktaş E. et al. reported incidence of CRBSIs as 13.9%¹¹ while study by Shibata W reported incidence as high as 26.4%.¹² Some studies documented CVC related bacteremia in 1.4% and CRBSI 0.2% of patients.¹⁰ In this study, most common cause of CRBSI in Cardiac surgery ICU was found to be candida. Cases of candidemia in ICU are increasingly reported in the last decade.¹³ *Candidemia* is fourth most common nosocomial bloodstream infection.^{13,14} In this study frequency of Catheter related candidemia was found to be 4.5%. Some studies documented incidence of candidemia in ICU patients as 4.1%.¹⁵ CVC use enhance the risk of candidemia in hospitalized patients as approximately 80% of patients with candidemia have CVCs in place.¹⁶

Some studies reported incidence of *Candida* spp. as 7.7/1000 admissions with an attributable mortality of 40–50%.¹⁷ In cardiac surgery ICUs, cardiopulmonary bypass, mechanical ventilation, bacteremia, and diabetes mellitus are independent predictors of candidemia.¹⁸ Early diagnosis and administration of prompt antifungal therapy in such cases is critical as any delay is associated with increased mortality.¹⁹ Many invasive fungal infections due to *Candida* species are diagnosed after patient's death due to rapidly progressive clinical course and problems with prompt and early diagnosis.²⁰ Recent IDSA guidelines recommend use of empiric antifungal therapy in critically ill patients with risk factors for invasive candidiasis and no other known cause of fever.²¹

CONCLUSION

This study highlighted that *Candida* species are an important cause of catheter related blood stream infection in patients from Cardiac surgery ICUs. In patients admitted in cardiac surgery wards or cardiology ICUs with suspected catheter related blood stream infections, catheter related candidemia must also be considered. While prescribing empiric antibacterial therapy, preliminary antifungal treatment must be started in patients with suspected catheter related candidemia as early diagnosis and prompt treatment can be lifesaving in these patients.

REFERENCES

- Gahlot R, Nigam C, Kumar V, Yadav G, Anupurba S. Catheter-related bloodstream infections. *Int J Crit Illn Inj Sci.* 2014; 4: 162–67.
- Rosa L, Cutone A, Coletti M, Lepanto MS, Scotti M, Valenti P, et al. Biotimer assay: a reliable and rapid method for the evaluation of central venous catheter microbial colonization. *J Microbiol Methods.* 2017;143:20–5.
- Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. *Mayo Clin Proc.* 2006;81:1159–71
- Lona-Reyes JC, López-Barragán B, De La Rosa AJ, Pérez-Molina JJ, and Ascencio-Esparza EP. Central venous-catheter related bacteremia: incidence and risk factors in a hospital in western Mexico. *Boletín Médico del Hospital Infantil de México.* 2016; 73:105-10.
- Shah H, Bosch W, Thompson KM, Hellinger WC.

- Intravascular catheter-related bloodstream infection. *Neurohospitalist.* 2013; 3:144-51
- Escribano P, Guinea J, Marcos-Zambrano LJ, Martín-Rabadán P, Fernández-Cruz A, Sánchez-Carrillo C, et al. Is catheter-related candidemia a polyclonal infection? *Med Mycol.* 2014; 52: 411-16.
- Fletcher S. Catheter-related bloodstream infection. *Contin Educ Anaesth Crit Care Pain.* 2005; 5: 49–51.
- Woodward B, Umberger R. Review of Best Practices for CLABSI Prevention and the Impact of Recent Legislation on CLABSI Reporting. SAGE. 2016: 1–7
- Wolf J, Curtis N, Worth LJ, Flynn PM. Central Line–Associated Bloodstream Infection in Children *Pediatr Infect Dis J.* 2013;32:905-10.
- Sapkota J, Mishra B, Jha B, Sharma M. Bacteriological profile and their antimicrobial susceptibility pattern in central venous catheter tip culture. *Journal of Pathology of Nepal.* 2017, 7:1059-61.
- Aktas E, Sari EN, Seremet Keskin A, Piskin N, Kulah C, Comert F. Causative agents of intravenous catheter-related infections and their antibiotic susceptibilities. *Mikrobiyol Bul.* 2011;45:86-92.
- Shibata W, Sohara M, Wu R, Kobayashi K, Yagi S, Yaguchi K, et al. Incidence and Outcomes of Central Venous Catheter-related Blood Stream Infection in Patients with Inflammatory Bowel Disease in Routine Clinical Practice Setting. *Inflamm Bowel Dis.* 2017;23:2042-47
- Leleu G, Aegerter P, Guidet B. Systemic candidiasis in intensive care units: a multicenter, matched-cohort study. *J Crit Care.* 2002;17:168-75
- Leroy G, Lambiotte F, Thévenin D, Lemaire C, Parmentier E, Devos P, et al. Evaluation of “Candida score” in critically ill patients: a prospective, multicenter, observational, cohort study. *Ann Intensive Care.* 2011; 1: 50.
- Hadley S, Lee WW, Ruthazer R, Nasraway SA Jr. Candidemia as a cause of septic shock and multiple organ failure in nonimmunocompromised patients. *Crit Care Med* 2002; 30:1808 – 14
- Ben-Ami R, Weinberger M, Orni-Wasserlauff R, Schwartz D, Itzhaki A, Lazarovitch T, et al. Time to blood culture positivity as a marker for catheter-related candidemia. *J Clin Microbiol.* 2008;46:2222–6.
- Michalopoulos AS, Geroulanos S, Mentzelopoulos SD. Determinants of candidemia and candidemia-related death in cardiothoracic ICU patients. *Chest.* 2003; 124:2244-55
- Ostrosky-Zeichner L, Pappas PG. Invasive candidiasis in the intensive care unit. *Crit Care Med.* 2006;34: 857-63
- Delaloye J, Calandra T. Invasive candidiasis as a cause of sepsis in the critically ill patient. *Virulence.* 2014; 5: 161–169
- Jaworski R, Irga N, Haponiuk I, Chojnicki M, Arlukowicz E, Steffek M, et al. Candidemia in children after complex congenital heart defects surgery treated with caspofungin – our own experience and a review of literature. *Med Sci Monit.* 2011; 17: PH35-39.
- Pappas PG, Kauffman CA, Andes D, Benjamin DK Jr, Calandra TF, Edwards JE Jr, et al. Clinical practice

guidelines for the management of candidiasis: 2009 update by the Infectious Diseases Society of America. Clin Infect Dis. 2009;48:503–35.

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