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*Article Review*

# The Impact of Medical Device Associated Candida Infections on Immunocomprised Patient Outcomes in A Tertiary Care Settings

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## ABSTRACT

Medical practice across all specialties increasingly relies on the insertion or implantation of medical devices, yet these interventions carry inherent risks of bacterial and fungal infections of particular concern is the shifting epidemiology of Candida infections, where non-albicans Candida species now predominate in cases of hematogenously disseminated candidiasis in many healthcare institutions. These device-associated Candida infections represent a significant threat to patient outcomes, characterized by the organism's ability to adhere to device surfaces and proliferate as multicellular communities within self-produced extracellular matrices. The pathogenic process involves colonization of foreign materials, including intravascular catheters, urinary catheters, dentures, and various implanted medical devices, leading to resistant infections that are particularly challenging to treat. These device-associated infections can progress to Candida bloodstream infections, which are associated with significant mortality rates. However, research indicates that optimized diagnostic approaches and therapeutic management strategies can substantially improve patient outcomes. This mini-review aims to identify and address frequently overlooked opportunities in the management of device-associated Candida bloodstream infections, with particular emphasis on Early recognition and diagnosis of device-associated infections. Implementation of evidence-based preventive measures. Optimization of therapeutic interventions. Special considerations for high-risk and immunocompromised patients.

## INTRODUCTION

The most frequent cause of fungal infections in individuals with impaired immune system is Candida species. Puebla, L. J. (2012). The most often isolated species of Candida albicans is one of the most prevalent fungal pathogens linked to nosocomial infections in devices. It has been extensively reported in numerous investigations that Candida species can produce drug-resistant biofilms on a variety of devices, including voice prosthesis, dentures, catheters, and contact lenses(Chandra et al.2012).Candida is the fourth greatest cause of hospital -acquired (HA) bloodstream infections(BSI) and third main cause of bloodstream infections in critical care units (ICUs)Candida is the third major cause of central-line-associated bloodstream infections (CLABSIs) and the second largest cause of catheter related urinary tract infections (Lockhart, S. R. 2014).

The infection linked to medical devices caused by Candida is extremely resisted to medications and can have life-threatening consequences. Candidemia frequently develops in immunosuppressed patients-more precisely, in 10-20 % of those with leukaemia or myeloproliferative diseases and in upto 74% of AIDS patients (Dimopoulos, G.,et al.2007).In 1.8% of cases, solid or haematological malignancies, or underlying immunological defects, may predispose a person to candidemia, which arises throughout the clinical course of these illness( Ghrenassia, E., et al.2019). this, the number of people who are particularly vulnerable and at high risk of developing fungal infections is rising. These patients frequently require prolonged intensive care unit treatment, which leads to an overuse of intrusive gadgets, immunosuppressive medications, and broad -spectrum antibiotics (Agvald-Öhman et al.2008).

The purpose of this article is to assess the impact of medical device-related Candida infections on patient outcomes, especially in immunocompromised patients in tertiary care hospitals. This article will discuss the prevalence of medical device-related Candida infections, the risk factors that contribute to these infections in immunocompromised patients, and the diagnostic and therapeutic approaches that can optimize treatment outcomes. By paying attention to various aspects of managing this infection, this article aims to provide insights to improve the control and prevention of Candida infections in patients with compromised immune systems.

## RESEARCH METHODS

This article uses a literature review approach to collect and analyze data related to Candida infections associated with medical devices in immunocompromised patients. The main data sources are obtained from recent research on the epidemiology, pathogenesis, and prevention and treatment strategies for Candida infections in hospitals. This article also includes an analysis of the management of Candida infections in patients with various immunocompromised conditions, such as patients with leukemia, AIDS, or those undergoing immunosuppressive therapy. In addition, this article explores the latest treatment guidelines and innovations in antifungal therapy to treat these infections.

## RESULTS AND DISCUSSION

### Medical Device associated with Candida infections

This includes central line-associated bloodstream infections (CLABSIs) and central venous catheter bloodstream infections (CVCBSI), catheter-associated urinary tract infections (CAUTI), and ventilator-associated pneumonia (VAP) (Dadi, N.C et al.2021).

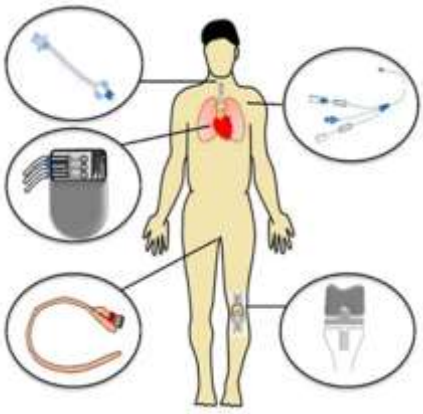

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Figure 1 summarizes the most common locations, where medical devices are administered.

**Catheter Related Bloodstream Infection (CRBSI)**

CRBSI refers to the development of blood stream infections (BSI) in hospitalised patients which is attributed to the presence of central line as a source of infection. (6)

A "central line" is any intravascular access device or catheter that ends in one of the main blood arteries or at or near the heart. A clinical definition known as CVCBSI is utilized to diagnose and treat patients, pointing to the catheter as the cause of BSIs. A single organism's presence of at least 15 Colony-Forming Units (CFU) per catheter is referred to as catheter colonization.

**Central Venous Catheter infections**

A central line CL is an intravascular device is mainly used for the pressure monitoring and administration of drugs total parental nutrition as well as for haemodialysis access (6). The majority of bloodstream infections (BSIs) are caused by central venous catheters (CVCs), whose widespread usage is linked to a significant risk of infectious complications that lengthen hospital stays and raise medical expenses. (Francolini, I., & Donelli, G. 2010)

An infection of Central venous Catheter for patients without neutropenia or severe immunodeficient, central venous catheter infections (CVCs) are thought to be the most significant risk factor for the development of candidemia. Catheters are responsible for almost half of bloodstream infections, including candidemia, that affect patients in intensive care units are thought to be the most half of bloodstream infections, including candidemia, that affect patients in intensive care units.

Some patients may be at risk because catheter-related infections are hard to cure and frequently need the removal of impacted devices. According to a review by Raad et al the control of bloodstream infections associated with intravascular catheters requires a multimodal strategy (see figure 1) (Cauda, R. (2009).

Table 2. Impact of Candidia infections of medical

| Device | Overall rate of infection (%) | Proportion of infections due to *Candida* spp. (%) | Mortality due to *Candida* infections (%) | Risk factors for *Candida* infections | Most common *Candida* spp. | Removal needed to achieve cure |
|---|---|---|---|---|---|---|
| Vascular catheters | 3.0–8.3 | 10.0 | 28.0–38.0 | *C. parapsilosis* in blood; positive quantitative or differential time to positivity of cultures; candidaemia without other source; hyperalimentation; persistent candidaemia on antifungal drugs | *C. albicans*, *C. glabrata* | Yes, in most cases[a] |
| Joint prostheses | 1.0–3.0 | <1.0 | NK | NK | *C. albicans*, *C. parapsilosis* | Yes |
| Dialysis access haemodialysis fistulas | 1.0–4.0 | ≤1 | 25.0–50.0 | NK | *C. albicans* | Yes |
| Haemodialysis grafts | 10.0–35.0 | ≤1 | 25.0–50.0 | NK | *C. albicans* | Yes |
| Peritoneal dialysis catheters | 23.0 | 2.4–7.0 | 5.0–25.0 | Prior hospitalization; recent bacterial peritonitis; gastrointestinal diseases; prior antibacterials; lupus | *C. albicans*, *C. parapsilosis* | Yes |
| Prosthetic valves | 2.9 | 2.0–10.0 | 33.0[a] | IV catheters; IV drug use; prosthetic valve recipients; fungaemia; immunosuppression; total parenteral nutrition; prior bacterial endocarditis; prolonged antibacterial use | *C. albicans*, *C. glabrata* plus *C. parapsilosis* | Yes |
| Pacemakers | 0.5–7.0 | 4.5 | NK | NK | *C. glabrata*, *C. albicans* | Yes[a] |
| ICDs | 2.2–7.2 | <1 | NK | NK | *C. albicans* | Yes[a] |
| VADs | 28.0–66.0 | 15.7–38.0 | 57.1–100.0 | NK, but possibly same as for fungal infections in ICUs | *C. albicans*, *C. parapsilosis* | Yes |
| VPSs | 6.0–15.0 | 1.0 | 9.0–30.0 | Broad-spectrum antibacterials; prior or concurrent bacterial meningitis; cerebrospinal fluid leakage; bowel perforation; abdominal surgery; steroids; indwelling catheters | *C. albicans*, *C. tropicalis* | Yes[a] |
| Urinary catheters | 10.0–30.0 | 21.0 | 19.8–39.0 | Diabetes mellitus; urinary tract infection; malignancy; antibiotic use; female sex; ICU patient; | *C. albicans*, *C. glabrata* | Yes[a] |

The type and duration of antimicrobial therapy, as well as the removal or retention of the CVC in conjunction with antibiotic catheter lock therapy, must be taken into account based on the causative organism. According to the Infectious Diseases Society of America (IDSA) guidelines, the recommended course of treatment for a Candida spp. infection consists of removing the CVC and administering suitable antifungal medications for 14 days following the latest blood culture demonstrating the presence of the candidemia.

**Catheter Associated Urinary tract infections**

It is considered as the most common HAI worldwide accounting for upto 40% of nosocomial infections. About 70-80% of healthcare-associated UTI are attributable to the presence of an indwelling urinary catheter. (6) The use of antifungal drugs during the instrumentation operation may be advised since urinary colonization by Candida species in critically ill and immunosuppressed patients appears to increase the risk of candidemia, particularly in those undergoing urinary tract instrumentation (Pierrotti, L. C., & Baddour, L. M. (2002).

**Cardiac devices**

Cardiac equipment fungi infections cause 1-6% of prosthetic valve endocarditis cases, with Candida accounting for upto 63% of cases. Furthermore, the predicted rates of cardiac device. Infection following the implantation of a ventricular assist device (VAD), an implanted cardioverter-defibrillator (ICD), or a permanent endocardial pacemaker (PPM) range from 0.13% to 19.9% and have increased by 124% in the last years. (Cauda, R. (2009).

Improvements in the medical and surgical treatments, such as immunosuppression, intracardiac prosthetic device implantation, extended IV catheter use, exposure to several broad-spectrum antibiotics, and reconstructive cardiovascular surgery, have been linked to the apparent rise in fungemia and FE cases observed over the past 20 years.( Pierrotti, L. C., & Baddour, L. M. (2002)

**Other devices**

Since it is widely known that fungal pathogens, particularly those of the species Candida, May attach to foreign surfaces, fungemia in the context of prosthetic) device. (Bagdasarian, N.G.,at el.2009) There has only been one report of Candida species affecting other prosthetic joints, and the most often affected prosthetic joints are hip and knee prostheses. (Cauda, R. (2009).

In neurosurgery shunt devices are frequently used, and the most common consequences is shunt infection. Despite that fact that bacteria are the pathogens most frequently linked to infections, there have been more reports of fungal infections recently, particularly from Candida species( Montero,A.,et al 2000).In a retrospective analysis, discovered that 17% of shunt infections (8 out of 48) were caused by fungus. The patients were all preterm infants who had hydrocephalus and required a ventriculoperitoneal shunt (Chiou, Chen-Chia, et al.)

**Prevention and Management Strategies**

Specific guidelines that include both technological and nontechnological preventative techniques have been devised in order to lower the frequency of bloodstream infections due to intravascular catheters. Aspects of particular importance include aseptic methods, hand cleanliness, catheter insertion site selection, quality assurance, and ongoing education. Additionally, every stage in the pathophysiology of biofilm formation could serve as a target for preventative measures. (Von Eiff,C et al 2005)

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Systemic antifungal therapy and catheter removal are recommended by the treatment guidelines for bloodstream infections caused by Candida catheters. Case studies have shown that lipid formulations of echinocandins and amphotericin B are effective in treating catheter-associated candidiasis. (Chandra, J., Mukherjee et al.2012).

It was recently shown that filastatin may be able to stop C. albicans from adhering to biotic and abiotic surfaces and filamenting, two processes that lead to the production of biofilms and pathogenicity Prior research has shown that filastatin also prevents C. dubliniensis, C. tropicalis, and C. parapsilosis from adhering to polystyrene surfaces (Nett, J. E., et al).

## CONCLUSION

Candida infections associated with medical devices are a significant health problem, especially in immunocompromised patients who are at higher risk of these infections. Invasive medical devices such as central catheters, urinary catheters, and other implantable devices can become a site of colonization for Candida, which then forms a difficult-to-treat biofilm, increasing the risk of systemic infections such as candidemia. Patients with immunocompromised conditions, such as those suffering from leukemia, AIDS, or undergoing immunosuppressive therapy, are at greater risk of developing this infection, which can be fatal without proper management.

Management of Candida infections associated with medical devices requires a multidisciplinary approach, including rapid diagnosis, effective antifungal treatment, and removal of infected medical devices. Prevention of this infection must involve the implementation of strict aseptic practices, training of medical staff, and the use of new technologies that can prevent Candida albicans from attaching to medical devices. Early detection, proper management of therapy, and improved prevention efforts are essential to reduce mortality and improve treatment outcomes for immunocompromised patients.

With the increasing prevalence of Candida infections in hospitals, especially in patients with immune disorders, it is important to continue developing and optimizing prevention and treatment strategies to reduce the adverse effects of these infections on patients.

## REFERENCES

1. Agvald-Öhman, C., Klingspor, L., Hjelmqvist, H., & Edlund, C. (2008). Invasive candidiasis in long-term patients at a multidisciplinary intensive care unit: Candida colonization index, risk factors, treatment and outcome. Scandinavian Journal of Infectious Diseases, 40(2), 145–153. https://doi.org/10.1080/00365540701534509
2. Apurba S Sastry M D, DN B MNAMS PDCR, Sandhya Bhat M D DNB MNAMS Essentials of microbiology, 3rd Edition
3. A. N., Pagani, F. D., & Malani, P. N. (2009). Fungemia associated with left ventricular assist device support. Journal of Cardiac Surgery, 24(6), 763-765.
4. Bagdasarian, N. G., Malani, A. N., Pagani, F. D., & Malani, P. N. (2009). Fungemia associated with left ventricular assist device support. Journal of Cardiac Surgery, 24(6), 763-765.
5. Cauda, R. (2009). Candidemia in patients with an inserted medical device. Drugs, 69, 33-38.
6. Chandra, J., Mukherjee, P. K., & Ghannoum, M. A. (2012). Candida biofilms associated with CVC and medical devices. Mycoses, 55, 46-57.
7. Chiou, C. C., Wong, T. T., Lin, H. H., Hwang, B., Tang, R. B., Wu, K. G., & Lee, B. H. (1994). Fungal infection of ventriculoperitoneal shunts in children. Clinical infectious diseases, 19(6), 1049-1053.

8. Dadi, N. C. T., Radochová, B., Vargová, J., & Bujdáková, H. (2021). Impact of healthcare-associated infections connect.
9. Dimopoulos, G., et al. "Candidemia in immunocompromised and immunocompetent critically ill patients: a prospective comparative study." European Journal of Clinical Microbiology & Infectious Diseases 26 (2007): 377-384.ed to medical devices—An update. Microorganisms, 9(11), 2332.
10. Francolini, I., & Donelli, G. (2010). Prevention and control of biofilm-based medical-device-related infections. FEMS Immunology & Medical Microbiology, 59(3), 227-238.
11. Ghrenassia, E., Mokart, D., Mayaux, J., Demoule, A., Rezine, I., Kerhuel, L., Calvet, L., De Jong, A., Azoulay, E., & Darmon, M. (2019). Candidemia in critically ill immunocompromised patients: report of a retrospective multicenter cohort study. Annals of Intensive Care, 9(1). https://doi.org/10.1186/s13613-019-0539-2
12. .Lockhart, S. R. (2014). Current Epidemiology of Candida Infection. Clinical Microbiology Newsletter, 36(17), 131–136. https://doi.org/10.1016/j.clinmicnews.2014.08.001
13. Mellinghoff, S. C., Cornely, O. A., & Jung, N. (2018). Essentials in Candida bloodstream infection. Infection, 46(6), 897–899. https://doi.org/10.1007/s15010-018-1218-1
14. Montero, A., Romero, J., Vargas, J. A., Regueiro, C. A., Sanchez-Aloz, G., De Prados, F., ... & Aragon, G. (2000). Candida infection of cerebrospinal fluid shunt devices: report of two cases and review of the literature. Acta neurochirurgica, 142, 67-74.
15. Puebla, L. J. (2012). Fungal infections in immunosuppressed patients. immunodeficiency.
16. Pierrotti, L. C., & Baddour, L. M. (2002). Fungal Endocarditis, 1995–2000. Chest, 122(1), 302-310.
17. Nett, J. E., Zarnowski, R., Cabezas-Olcoz, J., Brooks, E. G., Bernhardt, J., Marchillo, K., ... & Andes, D. R. (2015). Host contributions to construction of three device-associated Candida albicans biofilms. Infection and Immunity, 83(12), 4630-4638.
18. Von Eiff, C., Jansen, B., Kohnen, W., & Becker, K. (2005). Infections associated with medical devices: pathogenesis, management and prophylaxis. Drugs, 65, 179-214.