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REVIEW
ΑΝΑΣΚΟΠΗΣΗ

Fortifying transplantation
Advancing infection prevention strategies for optimal outcomes

Comprehensive infection prevention is crucial in transplantation, but current guidelines often lack comprehensive coverage. Transplantation patients are particularly susceptible to various infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), emerging and reemerging infections, in-hospital fungal infections, respiratory viral infections, and central line-associated bloodstream infection (CLABSI). These infections pose significant challenges and can lead to serious complications, and increased mortality rates in transplant recipients. Overall, preventing infections in transplantation patients requires a multidimensional approach, including strict adherence to infection control measures, surveillance programs, education and awareness campaigns, and tailored prevention strategies based on the specific risks and challenges faced by transplant recipients. In conclusion, the vital importance of infection prevention in transplant cases is emphasized.

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J.K. Fajar,[1]
H. Suwito,[1]
M. Mazen,[1]
D.P. Widiaputro,[1]
K.A. Rahardja,[1]
E.J. Pratama,[1]
C. Risqiansyah,[1]
W. Firmansah,[1]
D. Pramudia,[1]
R.B. Wattimuri,[1]
C. Gersom,[1]
D. Candradikusuma[2]

[1]Brawijaya Internal Medicine Research Center, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia
[2]Division of Infectious Diseases and Tropical Medicine, Department of Internal Medicine, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia

Βελτίωση της μεταμόσχευσης: Προώθηση στρατηγικών πρόληψης λοιμώξεων για καλύτερα αποτελέσματα

Περίληψη στο τέλος του άρθρου

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1. INTRODUCTION

Transplantation has been a significant medical advancement throughout history. It involves the transfer of organs or tissues from a donor to a recipient to restore normal function or save a life.[1] The concept of transplantation was first introduced by Alexis Carrel and Charles Guthrie in 1905, when they successfully transplanted a kidney from one dog to another. Since then, transplantation has evolved significantly.[2] Over the years, the demand for transplantation has steadily increased due to the rising incidence of organ failure-related diseases.[3] While advancements in transplantation techniques and safety measures have improved over time,[4] there are still potential complications associated with the procedure. These complications include organ rejection, surgical complications, graft-versus-host disease, and infections.[5] Among all of these complications, infection is the most frequently encountered, and the occurrence

of infections can actually be minimized through proper infection management, defined as infection prevention.[6] Infection prevention plays a vital role in transplantation to mitigate the risk of post-transplant infections, which can have serious consequences for the recipient. Therefore, ensuring effective infection prevention measures is of paramount importance in the field of transplantation.[7]

Infection prevention refers to the measures and practices implemented to minimize the occurrence and transmission of infections in healthcare settings.[8] The history of infection prevention can be traced back to the discovery of the germ theory by Louis Pasteur and the pioneering work of Ignaz Semmelweis in the mid-19th century, who emphasized hand hygiene to reduce infection rates.[9] The benefits of effective infection prevention are substantial, encompassing a reduction in morbidity, mortality, length of stay (LOS), and healthcare costs.[10] In the context of transplantation, infection prevention encompasses various aspects, such as preventing the spread of multidrug-resistant organisms (MDROs) like methicillin-resistant *Staphylococcus aureus* (MRSA),[11] and vancomycin-resistant *Enterococcus* (VRE),[12] addressing emerging and reemerging infections,[13] managing in-hospital fungal infections, respiratory viral infections,[14] and preventing central line-associated bloodstream infections (CLABSI).[15] However, existing guidelines for transplantation often focused on individual aspects of infection prevention, lacking comprehensive coverage. Consequently, there was a need for an article that comprehensively discussed infection prevention in transplantation, aiming to provide a comprehensive overview that might contribute to improve outcomes for transplant patients.

2. OVERVIEW OF TRANSPLANTATION PATIENTS

Transplantation is a medical procedure that involves the transfer of an organ or tissue from one person, known as the donor, to another person, known as the recipient. It is typically performed to replace a diseased or damaged organ with a healthy one, improving the recipient's quality of life and potentially extending their lifespan.[1] Transplantation has become increasingly prevalent in modern medicine, with a growing number of individuals benefiting from this life-saving procedure. There are various types of transplantation, including solid organ transplants such as kidney, liver, heart, lung, and pancreas, as well as hematopoietic stem cell transplants, commonly referred to as bone marrow transplants. Each type of transplantation requires careful matching between the donor and recipient to minimize the risk of rejection and ensure a successful outcome.[16]

Despite the significant advancements in transplantation techniques and immunosuppressive medications, complications can still occur. One of the most common complications after transplantation is infection.[5] The immunosuppressive drugs taken by transplant recipients to prevent organ rejection also suppress the immune system's ability to fight off infections, making them more vulnerable to bacterial, viral, and fungal pathogens.[17] The prevalence of infection after transplantation varies depending on multiple factors, including the type of transplant, the recipient's overall health, and the intensity of immunosuppression. Infections can occur in different organs or systems, such as the surgical site, urinary tract, lungs, or bloodstream. The risk of infection is highest in the early post-transplant period but remains a concern throughout the recipient's life, particularly when changes are made to their immunosuppressive regimen.[18]

Several factors contribute to an increased risk of infection among transplantation patients. These include the use of higher doses or combinations of immunosuppressive medications, advanced age, underlying comorbidities such as diabetes or chronic kidney disease, prolonged hospitalization, exposure to healthcare-associated pathogens, and the presence of invasive medical devices like catheters or drains. Close monitoring, strict infection control measures, and timely administration of antimicrobial therapies are crucial in mitigating the risk and managing infections in transplantation patients.[19]

3. BASIC OF INFECTION PREVENTION

Infection prevention refers to a set of practices and strategies aimed at reducing the risk of acquiring and spreading infections in healthcare settings and the community at large. It involves a comprehensive approach that encompasses various measures to mitigate the transmission of pathogens and maintain a safe environment for individuals. The history of infection prevention dates back centuries, but it was not until the mid-19th century that the significance of preventing infections gained recognition.[8] Ignaz Semmelweis, a Hungarian physician, was the first person to propose the importance of hand hygiene in reducing infections. His groundbreaking work showed a significant decrease in mortality rates among patients when healthcare providers washed their hands with an antiseptic solution.[9]

The primary purpose of infection prevention is to safeguard individuals from acquiring healthcare-associated infections (HAIs) or community-acquired infections.[20] HAIs are infections that develop as a result of receiving medical care, and they pose a considerable burden on patients, health-

care providers, and healthcare systems. By implementing effective infection prevention strategies, the goal is to minimize the risk of infections and create a safer healthcare environment.[21] There are several benefits associated with infection prevention. First and foremost, it saves lives by preventing the spread of potentially harmful pathogens. It also reduces the morbidity and mortality rates related to infections, lessens the burden on healthcare resources, and lowers healthcare costs. In addition, infection prevention plays a crucial role in protecting vulnerable populations, such as immunocompromised individuals and those undergoing invasive medical procedures.[10]

Various methods are employed in infection prevention. These include hand hygiene practices, which involve washing hands with soap and water or using alcohol-based hand sanitizers. Other strategies include proper disinfection and sterilization of medical equipment, adherence to standard precautions (such as wearing personal protective equipment), vaccination programs, surveillance and monitoring of infections, and education and training for healthcare workers and the general public.[7]

4. THE POTENCY OF INFECTION AMONG TRANSPLANTATION PATIENTS

Immune system plays a crucial role in protecting the body from infections, but in transplantation patients its functioning is altered due to the use of immunosuppressive medications. This compromised immune response increases the risk of infections in these individuals. Transplantation patients face a higher susceptibility to various types of infections due to multiple factors. The use of immunosuppressive drugs, such as corticosteroids and calcineurin inhibitors, inhibits the immune system's ability to recognize and combat pathogens effectively.[17,22] Additionally, the invasive procedures involved in transplantation, such as surgery and placement of indwelling medical devices, create entry points for potential pathogens. Prolonged hospital stays and frequent healthcare encounters further expose transplantation patients to healthcare-associated infections.[23]

Among the different types of infections seen in transplantation patients, some notable examples include MRSA, VRE, emerging and reemerging infections, fungal infections, respiratory viral infections, and CLABSI.[24] MRSA and VRE are antibiotic-resistant bacteria that pose a significant challenge in healthcare settings.[25] Emerging and reemerging infections, including multidrug-resistant organisms and novel viral infections like COVID-19, constantly evolve and can have severe consequences in immunocompromised individuals.[26] Fungal infections, such as candidiasis and aspergillosis, are particularly problematic in transplantation patients due to the suppressed immune response.[27] Respiratory viral infections, like influenza and respiratory syncytial virus (RSV), can lead to severe respiratory complications in transplant recipients.[14] Additionally, CLABSI, which occurs when bacteria enter the bloodstream through central lines, is a common and potentially life-threatening infection in transplantation patients.[28]

5. METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* IN TRANSPLANTATION PATIENTS

MRSA is a type of bacteria that is resistant to commonly used antibiotics, making it difficult to treat. It is often found in healthcare settings and can cause serious infections.[29] MRSA was initially detected among patients admitted to hospitals in the 1960s; however, it has experienced a swift expansion in the community since the 1990s.[30] The presence of MRSA colonization raises the likelihood of infection, and in approximately 50–80% of instances the infecting strains correspond to the colonizing strains.[29] Several risk factors increase the likelihood of MRSA, such as prolonged hospital stays, previous antibiotic use, invasive medical procedures, and weakened immune systems.[31] Clinical manifestations of MRSA vary depending on the site of infection and can include skin and soft tissue infections, bloodstream infections, and pneumonia.[32] Diagnosis of MRSA involves obtaining a sample from the infected site and performing laboratory tests to identify the bacteria and determine its antibiotic resistance profile.[33]

The prevalence of MRSA among transplantation patients is significant, approximately 8% in solid organ transplantation and 2% in hematopoietic cell transplantation, as these individuals often receive immunosuppressive drugs, which compromises their ability to fight infections.[34] MRSA infections are commonly observed in solid organ transplantation recipients shortly after the transplantation procedure, primarily within the first three months.[35,36] MRSA bloodstream infections (BSIs), and surgical site infections (SSIs), in particular, have been linked to extended hospital stays, increased healthcare expenses, and higher mortality rates compared to patients with methicillin-susceptible *Staphylococcus aureus* (MSSA) infections. In individuals with cystic fibrosis awaiting lung transplantation, the presence of MRSA in the respiratory tract has been associated with a poorer survival rate.[37] Solid organ transplantation recipients affected by MRSA infections also experience longer hospital and intensive care unit (ICU) stays and face elevated mortality rates, although these outcomes may

vary depending on the specific medical center, type of organ transplanted, and the site of infection.[35] The overall mortality rates for patients with invasive MRSA infections decreased by 31% between 2005 and 2011.[38]

To prevent MRSA in transplantation patients, strict adherence to infection control measures is crucial (fig. 1). This includes proper hand hygiene, regular screening for MRSA colonization, isolation precautions for infected or colonized patients, and appropriate use of antibiotics to minimize the development of resistance. Additionally, healthcare providers should promote education and awareness among patients and their families about MRSA prevention strategies.[11] For the screening method, while existing guidelines do not suggest regular screening, research indicates that patients who are colonized with MRSA before or after transplantation exhibit notably higher rates of MRSA-related complications, indicating the potential advantages of routine screening.[39] However, limited studies have examined the benefits of pre-transplant surveillance for preventing transmission, and there is a lack of data assessing the optimal locations, number of screening sites, and laboratory methods for implementing such strategies in transplant patients. Furthermore, although there have been few studies on the efficacy of pre-transplant decolonization efforts, a recent study suggested that such practices could be beneficial and cost-effective for certain populations undergoing solid organ transplantation.[40]

6. VANCOMYCIN-RESISTANT *ENTEROCOCCUS* IN TRANSPLANTATION PATIENTS

VRE refers to strains of *Enterococcus* bacteria that have developed resistance to the antibiotic vancomycin. *Enterococcus* species are commonly found in the gastrointestinal tract and can cause infections, with VRE being particularly concerning due to limited treatment options.[41] The initial detection of VRE in clinical isolates took place in England and France in 1986, and the subsequent year witnessed the isolation of VRE faecalis in the United States.[42] From a theoretical perspective, the triggers for the occurrence

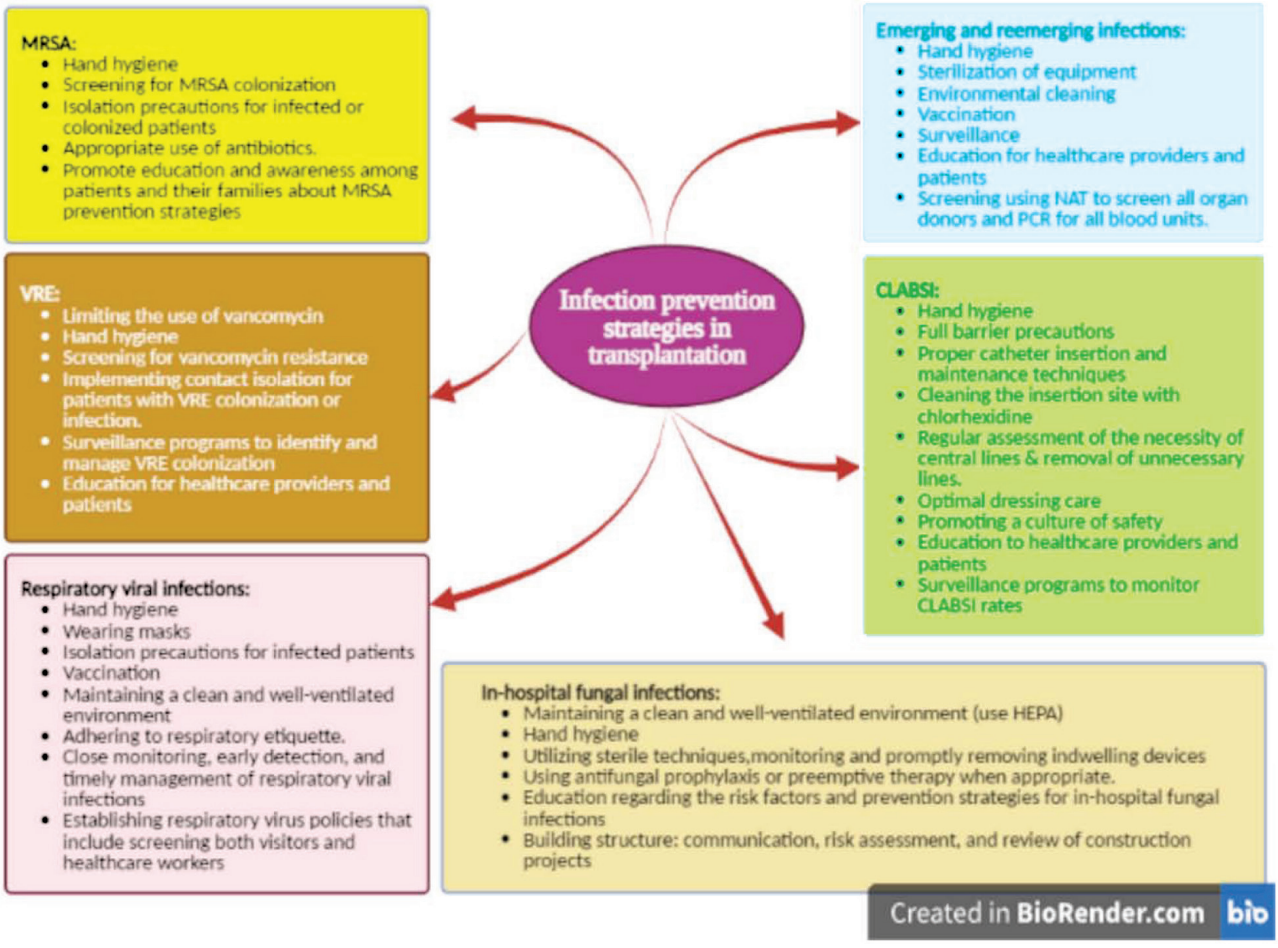

Figure 1. A condensed overview of the fundamental principles for preventing infections in patients undergoing transplantation.

of VRE vary in several regions. In Europe, the increase of VRE primarily occurred in community settings, attributed to the transmission of VRE from animal food products to humans. This transmission was believed to be linked to the utilization of avoparcin, a glycopeptide antibiotic used as a growth promoter in livestock.[43] On the other hand, in the United States, VRE was predominantly observed in hospital settings, thought to be associated with the growing usage of the glycopeptide antibiotic vancomycin.[44] Afterward, there was a swift dissemination of VRE within hospitals in the United States during the 1990s, followed by a similar occurrence in Europe during the 2000s. Eventually, this led to the worldwide spread of VRE.[45]

Factors that contribute to the risk of VRE include certain characteristics of the host and exposure to antimicrobials. An elevated risk of VRE colonization is associated with conditions such as immunosuppression, hematological malignancies, organ transplantation, prolonged stays in intensive care units (ICUs) or hospitals, residing in long-term care facilities, infection in multiple body sites, close proximity to other colonized or infected patients, hospitalization in units with a high prevalence of VRE, and the presence of serious comorbid conditions like diabetes, renal failure, and high Acute Physiology and Chronic Health Evaluation (APACHE) II scores.[46] Among these factors, prior exposure to antimicrobials is the most significant predictor of VRE colonization. This includes the use of oral and intravenous vancomycin, aminoglycosides, cephalosporins, antianaerobic agents, such as clindamycin and metronidazole, and carbapenems.[47] Clinical manifestations of VRE infections vary and can range from urinary tract infections to bloodstream infections, surgical site infections, and pneumonia. Nonetheless, the gastrointestinal (GI) tract is the primary site where VRE colonization predominantly takes place. Diagnosis of VRE involves obtaining samples from infected sites or screening high-risk patients, followed by laboratory tests to identify the bacteria and determine its resistance to vancomycin.[41]

The prevalence of VRE among transplantation patients is noteworthy, approximately 25% in hematopoietic cell transplantation[48] and 12–16% in solid organ transplantation,[49] as these individuals often receive immunosuppressive therapies, making them vulnerable to infections.[24] The mortality rate due to VRE in transplantation cases varies depending on the type of organ. The presence of VRE colonization before undergoing an intestinal transplant is linked to the occurrence of VRE bacteremia and an elevated mortality rate following transplantation.[50] In the case of liver transplantation, VRE colonization has been associated with a one-year mortality rate of approximately 60%. However, it remains unclear whether these infections and deaths occurred prior to or after the transplantation procedure.[51]

VRE infection presents in various ways, with some manifestations being more prevalent than others and some specific to certain organs. When abdominal organs are involved in transplantation procedures, there is a potential for complications due to early VRE infection after the surgery, often resulting from surgical issues or an extended stay in the ICU.[41] The most common forms of VRE infection are surgical site infections or infections within the organs or spaces, such as biliary tract infections and intra-abdominal abscesses in liver transplant recipients, pyelonephritis in kidney transplant recipients, and mediastinitis in thoracic transplant recipients. Surgical site infections are frequently accompanied by VRE bloodstream infection. While VRE can be the sole pathogen following solid organ transplantation, it is often part of a polymicrobial process, particularly in deep intra-abdominal infections.[52]

Preventing VRE in transplantation patients requires a multifaceted approach, including strict adherence to infection control measures, such as limiting the use of vancomycin, educating the staff, ensuring regular hand hygiene using antiseptic soap or a waterless antiseptic agent, screening for vancomycin resistance, conducting rectal VRE surveillance cultures, and implementing contact isolation for patients with VRE colonization or infection. Surveillance programs to identify and manage VRE colonization, along with education for healthcare providers and patients, are essential components of preventing VRE transmission in transplantation settings (fig. 1).[12] Nonetheless, there is still uncertainty about the effectiveness of these measures in regular hospital settings, and there are apprehensions about the financial implications of implementing them. A multicenter randomized cluster trial that implemented universal contact precautions in ICUs failed to demonstrate a reduction in VRE acquisition. However, the trial did observe a slight reduction in adverse events, although this reduction did not reach statistical significance.[53]

7. EMERGING AND REEMERGING INFECTION IN TRANSPLANTATION PATIENTS

Emerging and reemerging infections pose ongoing challenges to public health due to their ability to resurface or evolve into new threats. These infections refer to the appearance or resurgence of diseases that were previously unknown or under control.[26,54,55] Examples of emerging and reemerging infections include Ebola virus disease, Zika virus, severe acute respiratory syndrome (SARS), and drug-resistant bacteria such as MRSA and VRE.[56–58] Various factors

contribute to their emergence or reemergence, including environmental changes, globalization, increased travel, urbanization, population growth, antimicrobial resistance, and zoonotic transmission. Risk factors for emerging and reemerging infections can vary, but they often involve close contact with infected individuals or animals, inadequate sanitation, poor hygiene practices, and compromised immune systems.[59–61]

Transplantation patients are susceptible to emerging and reemerging infections due to their immunosuppressed state. The high occurrence of these infections among transplant patients is a major concern, although there are no precise figures reported to indicate the exact prevalence. The classification of emerging and reemerging infections in transplant recipients can be organized into three distinct categories. The first category encompasses microbial pathogens that likely have always affected transplant recipients, but their significant consequences have only recently been recognized. Examples of such pathogens include human herpesvirus 6 and 7, as well as adenoviruses. The second category consists of infections caused by pathogens that were previously known, but are now occurring more frequently or causing novel diseases. This could be attributed to the increased potency of modern immunosuppression methods (e.g., polyomavirus/BK virus nephropathy) or epidemiological factors that facilitate the spread of a particular microorganism (e.g., West Nile virus). The third and final category comprises emerging infections resulting from novel pathogens that cause previously unknown diseases. Illustrative examples of this category include SARS coronavirus, other coronaviruses, and potential pathogens that could arise from xenotransplantation (e.g., porcine endogenous retroviruses).[13]

Preventing emerging and reemerging infections in transplantation patients requires a comprehensive approach (fig. 1). This includes strict adherence to infection control practices, such as hand hygiene, proper sterilization of equipment, screening and isolation of potentially infected patients, environmental cleaning, and vaccination where available. Furthermore, ongoing surveillance, education for healthcare providers and patients, and research to understand the dynamics of emerging and reemerging infections are vital for effective prevention strategies.[24] On the other hand, the study also suggests that it is advisable to conduct nucleic acid testing to screen all organ donors for potential emerging and reemerging infections. Additionally, the blood agency should employ polymerase chain reaction (PCR) screening for all blood units. Moreover, posttransplant patients should be provided with specific precautionary guidelines.[13] Nevertheless, since cases of emerging and reemerging infections are closely related to the pandemic status of a particular region, it is advisable to tailor prevention measures according to the context of each area.

8. IN-HOSPITAL FUNGAL INFECTION IN TRANSPLANTATION PATIENTS

In-hospital fungal infections present a significant challenge in healthcare settings. These infections refer to fungal diseases acquired during a hospital stay or healthcare-associated settings. They can range from superficial infections to severe systemic infections, posing a threat to immunocompromised patients.[62] Various types of in-hospital fungal infections include candidiasis, aspergillosis, cryptococcosis, mucormycosis, and invasive fungal infections.[63] Potential causes of these infections include prolonged antibiotic use, invasive medical procedures, indwelling catheters, contaminated environments, and compromised immune systems. Risk factors for in-hospital fungal infections include advanced age, organ transplantation, chemotherapy, prolonged hospitalization, and ICU stays. The clinical symptoms of fungal infections lack specificity, and similar to other infectious diseases, a strong level of suspicion is necessary for early diagnosis and effective treatment of these infections.[64] Systemic fungal infections are typically confirmed using standard criteria, which involve histopathological examination with special stains to identify fungal tissue involvement or the isolation of the causative agent from clinically sterile specimens through culture.[65]

Among transplantation patients, the prevalence of in-hospital fungal infections is notable due to their immunosuppressed state and exposure to fungal pathogens. The prevalence of fungal infections in transplant patients varies depending on the type of organ involved. Small bowel (11.6%) and lung (8.6%) transplants have the highest rates, followed by liver (4.7%), heart (4.0%), pancreas (3.4%), and kidney (1.3%) transplants.[66]

Preventing in-hospital fungal infections in transplantation patients requires strict adherence to infection control measures (fig. 1). This includes maintaining a clean and well-ventilated environment, implementing proper hand hygiene practices, utilizing sterile techniques during invasive procedures, monitoring and promptly removing indwelling devices, and using antifungal prophylaxis or preemptive therapy when appropriate. Additionally, education and awareness campaigns for healthcare providers and patients regarding the risk factors and prevention strategies for in-hospital fungal infections are essential to mitigate the transmission and impact of these infections.[24] On the

other hand, the study also suggests the implementation of positive pressure and high-efficiency particulate arresting (HEPA) filtration systems in high-risk inpatient units.[67] Furthermore, patients and their families should be educated about the importance of avoiding fungal exposures from sources such as potted plants, fresh flowers, gardening, composting, woodworking, dusting, and other activities known to generate airborne mold spores.[68]

Moreover, the prevention of fungal infections should also take into account the building structure. Air sampling can be conducted to measure the levels of airborne fungi inside and outside of hospitals before, during, and after construction projects. However, there is a lack of well-defined thresholds distinguishing safe levels from unsafe levels of fungal spores.[69] It is important to establish procedures for communication, risk assessment, and review of construction projects by environmental health teams prior to the commencement of the projects. These procedures should also include introductory education for contracted workers. Regular evaluation of active barriers, portable air-handling units, and construction staff is crucial to ensure compliance with guidelines. Centers should closely monitor fungal cases during construction projects and thoroughly investigate any potentially related incidents.[24]

9. RESPIRATORY VIRAL INFECTION IN TRANSPLANTATION PATIENTS

Respiratory viral infections present a significant challenge in the field of healthcare. These infections encompass a broad range of viral illnesses that primarily affect the respiratory system. Common examples of respiratory viral infections include influenza, parainfluenza virus 1–4, human metapneumovirus, respiratory syncytial virus (RSV), rhinovirus (common cold), adenovirus, and coronaviruses (including SARS-CoV-2).[70,71] Respiratory viruses are primarily transmitted between individuals through the respiratory route, and this can happen through different means, such as large droplets, small-particle aerosols, and contaminated surfaces that are then touched by hands, leading to self-inoculation. Risk factors for respiratory viral infections include crowded living conditions, close contact with infected individuals, compromised immune systems, advanced age, and certain medical conditions.[72]

The prevalence of these viruses often shows distinct seasonal patterns, particularly in temperate regions. For example, influenza virus and RSV epidemics tend to occur during the winter months in these regions. In tropical areas, the seasonal patterns are not as clearly defined, as viruses can circulate throughout the year, with peaks potentially aligning with lower temperatures, humidity, or rainfall. These infections can cause mild to severe respiratory symptoms and have the potential for rapid transmission within communities and healthcare settings. Gathering a patient's clinical history and conducting a thorough examination can provide valuable hints in determining the exact viral diagnosis. However, the symptoms and manifestations of different viral infections often overlap and lack specificity. To reliably establish the cause of the infection, it is necessary to detect the presence of the virus, its antigens, or nucleic acids in respiratory or other relevant specimens. Alternatively, retrospective diagnosis can be made by demonstrating an immune response through analyzing paired serum samples taken at different times.[70]

Among transplantation patients, the prevalence of respiratory viral infections can be substantial due to their immunosuppressed state and increased vulnerability to infections. Given the occurrence of clinical outbreaks among immunocompromised patients at high risk, which can be directly traced back to healthcare settings, it is evident that respiratory viral infections pose a considerable threat.[73] These infections not only have the potential to impede the transplantation process but also lead to substantial complications following the transplant.[74] Therefore, it is crucial to prioritize respiratory virus prevention during the pre-transplant period as well.

Preventing respiratory viral infections in transplantation patients requires a comprehensive approach, including infection control practices (fig. 1). This includes regular hand hygiene, wearing masks, implementing isolation precautions for infected patients, promoting vaccination against common respiratory viruses, maintaining a clean and well-ventilated environment, and adhering to respiratory etiquette. Additionally, close monitoring, early detection, and timely management of respiratory viral infections in transplantation patients are crucial for minimizing complications and improving outcomes.[24] On the other hand, the guideline recommended that preventive strategies for respiratory viruses may involve various methods, such as isolating individuals with symptoms, conducting respiratory virus testing for symptomatic patients, and implementing measures to prevent close interactions between patients and healthcare staff. Establishing respiratory virus policies that include screening both visitors and healthcare workers can also be effective in reducing transmission. Additionally, vaccination is the most crucial preventive measure for transplant recipients and their close contacts in relation to respiratory viral infections. Influenza vaccination is particularly important and should be incorporated into comprehensive healthcare vaccine programs target-

ing patients, caregivers/families, and healthcare workers. Transplant recipients should receive inactivated influenza vaccines exclusively, as the use of live attenuated intranasal influenza vaccines is not recommended. The inactivated influenza vaccine now comes in a quadrivalent formulation and should be administered to transplant recipients within one month post-transplantation, acknowledging that its effectiveness may be somewhat limited during the first six months after the transplant.[14]

10. CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTION IN TRANSPLANTATION PATIENTS

CLABSI poses a significant challenge in healthcare settings. CLABSI can lead to severe complications and is associated with increased morbidity, mortality, and healthcare costs. In 2020, the rate of CLABSI in ICUs in the United States was 0.87 per 1,000 central lines.[75] These infections are linked to a mortality rate of 12–15%, and the odds of in-hospital death are notably increased, with an odds ratio as high as 2.75.[76] Furthermore, CLABSI is responsible for prolonged hospital stays and increased healthcare expenses, with each case costing approximately $ 46,000.[75]

CLABSI refers to an infection that occurs when bacteria or other pathogens enter the bloodstream through a central venous catheter or central line. The definition of confirming a CLABSI involves identifying a newly detected bloodstream infection through laboratory testing, excluding cases where the infection originated from another site in the body.[75] Several types of CLABSI can occur, including catheter-related bloodstream infections (CRBSI) and non-catheter-related bloodstream infections (non-CRBSI).[77] Potential causes of CLABSI include improper insertion or maintenance of central lines, poor hand hygiene, contamination of catheter hubs or connectors, and inadequate disinfection techniques. Risk factors for CLABSI include prolonged catheterization, immunosuppression, use of femoral insertion site, frequent line access, and inadequate infection control practices.[78,79] Diagnosing CLABSI involves blood cultures, with at least one positive culture from a peripheral vein and matching isolates from the central line.[80]

Among transplantation patients, the prevalence of CLABSI can vary depending on the specific transplantation procedure and associated risk factors.[81] Due to the strong association between CLABSI and the occurrence of life-threatening complications, as well as the potential for increased mortality rates, transplant patients are particularly vulnerable to its adverse effects. Consequently, it becomes crucial to prioritize CLABSI prevention as a necessary step to improve outcomes in transplant patients.

Preventing CLABSI in transplantation patients requires a comprehensive approach. This includes strict adherence to infection control measures such as hand hygiene, full barrier precautions (use of cap, mask, sterile gloves, sterile gown, full-size body drape), proper catheter insertion and maintenance techniques, cleaning the insertion site with chlorhexidine, regular assessment of the necessity of central lines, optimal dressing care, and prompt removal of unnecessary lines. Additionally, promoting a culture of safety, providing education to healthcare providers and patients, and implementing surveillance programs to monitor CLABSI rates are essential in preventing these infections among transplantation patients (fig. 1).[15]

11. CONCLUSIONS

In conclusion, transplantation patients are at an increased risk of infections due to the use of immunosuppressive medications, invasive procedures, and prolonged hospital stays. Infection prevention plays a crucial role in safeguarding these individuals from healthcare-associated and community-acquired infections. Strict adherence to infection control measures, such as hand hygiene, proper disinfection and sterilization of equipment, adherence to standard precautions, and vaccination programs are vital in mitigating the transmission of pathogens. Transplantation patients are susceptible to specific infections, including MRSA, VRE, emerging and reemerging infections, in-hospital fungal infections, respiratory viral infections, and CLABSI. Preventing these infections requires a multifaceted approach, including targeted surveillance, timely diagnosis, appropriate antimicrobial therapy, and education for healthcare providers and patients. By implementing effective infection prevention strategies, the goal is to reduce morbidity, mortality, healthcare costs, and the overall burden of infections among transplantation patients.

ΠΕΡΙΛΗΨΗ

Βελτίωση της μεταμόσχευσης: Προώθηση στρατηγικών πρόληψης λοιμώξεων για καλύτερα αποτελέσματα

J.K. FAJAR,[1] H. SUWITO,[1] M. MAZEN,[1] D.P. WIDIAPUTRO,[1] K.A. RAHARDJA,[1] E.J. PRATAMA,[1] C. RISQIANSYAH,[1] W. FIRMANSAH,[1] D. PRAMUDIA,[1] R.B. WATTIMURI,[1] C. GERSOM,[1] D. CANDRADIKUSUMA[2]

[1]Brawijaya Internal Medicine Research Center, Faculty of Medicine, Universitas Brawijaya, Malang,

[2]Division of Infectious Diseases and Tropical Medicine Department of Internal Medicine, Faculty of Medicine, Universitas Brawijaya, Malang, Ινδονησία

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Η πρόληψη των λοιμώξεων είναι μεγάλης σημασίας στη μεταμόσχευση και οι τρέχουσες κατευθυντήριες οδηγίες συχνά στερούνται ολοκληρωμένης κάλυψης. Οι ασθενείς που υποβάλλονται σε μεταμόσχευση είναι ιδιαίτερα ευαίσθητοι σε διάφορες λοιμώξεις, όπως ο ανθεκτικός στη μεθικιλλίνη *Staphylococcus aureus* (MRSA), ο ανθεκτικός στη βανκομυκίνη εντερόκοκκος (VRE), οι αναδυόμενες και επανεμφανιζόμενες λοιμώξεις, οι ενδονοσοκομειακές μυκητιάσεις, οι ιογενείς αναπνευστικές λοιμώξεις και οι λοιμώξεις που σχετίζονται με την κεντρική γραμμή (CLABSI). Αυτές οι λοιμώξεις θέτουν σημαντικές προκλήσεις και μπορεί να οδηγήσουν σε σοβαρές επιπλοκές και αυξημένα ποσοστά θνησιμότητας στους μεταμοσχευόμενους. Συνολικά, η πρόληψη λοιμώξεων σε μεταμοσχευμένους ασθενείς απαιτεί πολυδιάστατη προσέγγιση, περιλαμβανομένης της αυστηρής τήρησης των μέτρων ελέγχου των λοιμώξεων, των προγραμμάτων επιτήρησης, των εκστρατειών εκπαίδευσης και ευαισθητοποίησης και των προσαρμοσμένων στρατηγικών πρόληψης με βάση τους συγκεκριμένους κινδύνους και τις προκλήσεις που αντιμετωπίζουν οι μεταμοσχευόμενοι. Τονίζεται η ζωτική σημασία της πρόληψης των λοιμώξεων στις μεταμοσχεύσεις.

Λέξεις ευρετηρίου: Αποτελέσματα στρατηγικής πρόληψης, Έλεγχος μόλυνσης, Μεταμόσχευση, Πρόληψη λοιμώξεων

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Corresponding author:

J.K. Fajar, Brawijaya Internal Medicine Research Center, Department of Internal Medicine, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia
e-mail: gembyok@gmail.com