Original Article

Profile of Catheter-Related Infections in Hemodialysis Patients with Double Lumen Catheters at Dr. Reksodiwiryo Hospital, Padang

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ABSTRACT

Background: Hemodialysis (HD) is the primary therapy for patients with advanced-stage chronic kidney disease (CKD). Although effective, the use of double lumen catheters (CDL) as vascular access in HD carries a high risk of infection.
Objective: This study aims to identify the infection profile in CKD patients using CDL during hemodialysis at Dr. Reksodiwiryo Hospital in Padang.
Methods: This study employs a retrospective descriptive design involving 60 hemodialysis patients from May to July 2024. The variables analyzed include age, gender, etiology, clinical manifestations, catheter location, catheter duration, and hematological parameters (leukocytes), with catheter-related infections (CRI) as the main dependent variable.
Results: The results show that the majority of patients were under 60 years old (51.7%), and more than half (56.7%) used CDL for less than 8 weeks. CDL infections most frequently occurred in the right jugular vein access (90.0%) with fever and chills as the primary symptoms (53.3%).
Conclusion: Using CDL for less than 8 weeks is linked to a high infection rate, with fever and chills as common symptoms. Recommendations include strict aseptic techniques during catheter insertion, prophylactic antibiotics for high leukocyte levels, and early planning for arteriovenous fistula (AVF) to minimize complications from long-term catheter use.
Keywords: Chronic Kidney Disease, Hemodialysis, Catheter Infection.

Introduction

HD is the most commonly used method of kidney replacement therapy for patients with CKD.[1,2] CKD has become a significant public health issue, with the number of cases increasing each year. At the terminal stage of the disease, hemodialysis is necessary to replace kidney function for patient survival.[3] Globally, it is estimated that around 843.6 million people are affected by CKD.[4] Recent data indicate that from 1990 to 2016, the global incidence and prevalence of CKD increased by 89% and 87%, particularly in countries with medium and low socio-demographic indices.[4] Over the past three decades, deaths from CKD are estimated to have doubled, making it the 11th leading cause of death in 2016, up from the 18th position in 1990.[4] The prevalence of hemodialysis reaches up to 89%. In Indonesia, data from the Indonesian Renal Registry indicate a significant rise in both new and ongoing HD cases in 2018, with new cases increasing from 30,831 in 2017 to 66,433 in 2018, and active cases growing from 77,892 to 132,142.[1,2] Effective hemodialysis depends on access to large blood vessels, which is often achieved through central venous catheterization using a double lumen catheter.[5]

However, using CDL carries a risk of infections, which can lead to higher mortality and

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morbidity rates.[6] Infections such as bloodstream infections, exit-site infections, and tunnel infections are common complications that can reduce the effectiveness of therapy and lead to increased healthcare costs.[7] Infection is the second most common cause of death among dialysis patients, and the rate of hospitalizations due to infections among hemodialysis patients has risen by 34% between 1993 and 2014 in the US.[8] Older patients, especially those over 60, are at a higher risk for catheter-related infections.[9] According to the Indonesian Kidney Registry, hypertension is the leading cause of death among dialysis patients, with many patients with CDL infections also suffering from comorbidities such as hypertension and diabetes.[10] Clinical signs of catheter-related infections include inflammation, fever, and elevated white blood cell counts.[11] The risk of catheter-related bloodstream infections (CLABSI) increases with the duration of catheter use, particularly after 20 days.[12] Most CDL placements (86.5%) in the right internal jugular vein risk infection, requiring proper care and monitoring.[13] This study identifies infections in CKD patients with CDL undergoing hemodialysis.

Methods

Design and participants

This study used a retrospective design and involved 60 patients with chronic kidney disease (CKD) undergoing hemodialysis with double lumen catheters (CDL) at Dr. Reksodiwiryo Hospital, Padang, during the period of May to July 2024. Included in the study were patients who used CDL as vascular access for hemodialysis and had complete medical records, including clinical and laboratory data. Patients who did not use CDL, had incomplete data, or were experiencing other active infections unrelated to the catheter were excluded from the study. The sample size was determined using a total sampling method, in which all patients who met the inclusion criteria during the study period were included. This approach is appropriate for retrospective studies with limited populations, as it allows for optimal use of available data and ensures that the findings are representative of the CDL patient population at the hospital.

Study Covariate

Operational definitions include: age (<60 or ≥60 years), gender (male/female), CKD etiology (hypertension, diabetes, or both), clinical manifestations (fever, chills, hyperemia, purulent secretion, etc.), catheter location (right femoral, right jugular, left jugular vein), duration of hemodialysis and catheter use (<8 or ≥8 weeks), leukocyte count (<5000, 5000-10000, >10000 cells/mm^3), and CDL infection (diagnosed via clinical symptoms and lab results).

Statistical analysis

Data were analyzed using SPSS 22.0 for Macintosh. Descriptive statistics included frequencies, percentages, means, and medians. Normality testing was performed on numerical data, with means reported for normally distributed data and medians for non-normal distributions. Cross-tabulation was used to examine relationships between categorical variables. Comparative analysis involved chi-square and other statistical tests to assess variable associations.

Results

Patient selection

In this section, the characteristics of the respondents are described, including age, gender, etiology, clinical manifestations, duration of HD, duration of CDL use, CDL access location, and leukocytes. To facilitate understanding, the results of the descriptive analysis will be explained as follows.

This study involved 60 respondents who were deemed eligible and met the criteria established by the researchers for inclusion. Based on Table 1, the characteristics of the respondents in this study are outlined. In terms of age, the majority of respondents in this study were under 60 years old, with 31 respondents (51.7%), while the remaining 29 respondents (48.3%) were 60 years old or older. Regarding gender, it was found that the majority of respondents in this study, 31 respondents

(51.7%), were female, while the remaining 29 respondents (48.3%) were male. Based on etiology, it can be observed that the majority of respondents, 49 people (81.7%), experienced hypertension or high blood pressure, followed by 6 people (10.0%) who had diabetes mellitus (DM), and the remaining 5 people (8.3%) who had both hypertension and diabetes mellitus. Regarding clinical manifestations in this study, it was found that the majority of respondents, 32 people (53.3%), experienced symptoms of fever with chills, while 11 people (18.3%) did not experience any clinical manifestations. A total of 8 people (13.3%) experienced symptoms of fever/chills, hyperemia, and purulent secretion, 6 people (10.0%) experienced symptoms of fever/chills and purulent secretion, and the remaining 3 people (5.0%) experienced clinical manifestations of fever/chills and hyperemia. Based on the duration of HD in this study, it was found that the majority of respondents, 55 people (91.7%), had undergone HD for 8 weeks or more, while the remaining 5 people (8.3%) had undergone HD for less than 8 weeks. Most respondents (56.7%) used CDL for less than 8 weeks, while 43.3% used it for 8 weeks or more. Regarding CDL access location, 90.0% had access in the right jugular vein, 6.7% in the left jugular vein, and 3.3% in the right femoral vein. (Figure 1) In terms of leukocyte levels, 51.7% had levels between 5000-10000, 25.0% above 10000, and 23.3% below 5000.

Table 1. Characteristics of hemodialysis patients using Double Lumen Catheter (CDL)

Respondent Characteristics	Frequency	Percentage
Age		
a. < 60 years	31	51.7%
b. > = 60 years	29	48.3%
Gender		
a. Male	29	48.3%
b. Female	31	51.7%
Etiology		
a. DM	6	10.0%
b. Hypertension	49	81.7%
c. Hypertension+ DM	5	8.3%
Clinical Manifestations		
a. Fever with chills	32	53.3%
b. Fever / Chills, Hyperemia, Purulent Secretion	8	13.3%
c. Fever/ Chills, Hyperemia	3	5.0%
d. Fever/ Chills, Purulent Secretion	6	10.0%
e. None	11	18.3%
Duration of HD		
a. < 8 weeks	5	8.3%
b. > = 8 weeks	55	91.7%
Duration of CDL		
a. < 8 weeks	34	56.7%
b. > = 8 weeks	26	43.3%
Location of CDL		
a. Vena Femoralis Dextra	2	3.3%
b. Vena Jugularis Dextra	54	90.0%
c. Vena Jugularis Sinistra	4	6.7%

Leukocyte			
a.	< 5000	14	23.3%
b.	5000 - 10000	31	51.7%
c.	> 10000	15	25.0%

(a) **(b)**

Figure 1. Patients with infected CDL (Central Double Lumen Catheter)

Discussion

This study involved 60 hemodialysis patients at Dr. Reksodiwiryo Hospital in Padang, with the majority (51.7%) being under 60 years old. This aligns with Gupta et al. (2016), who also found that the average age of patients with CDL-related infections was under 60 years.[14] The theory states that elderly patients have reduced immune function and a higher risk of CKD-related comorbidities like hypertension and diabetes, increasing their risk of complications. In terms of gender, most respondents were female (51.7%).[15] Weldetensae et al. (2023) did not specify whether gender directly influences the risk of catheter-related bloodstream infections in hemodialysis patients.[11] The majority of respondents (81.7%) had hypertension, which was also found to be the primary cause of catheter-related infections in the study by Hajji et al. (2022), where 86% of hemodialysis patients with catheter infections had hypertension.[16] Hypertension is common among CKD patients and is a major cause of end-stage renal disease (ESRD), with 26.4% of patients having hypertension as the cause of their CKD.[17] Hypertension can worsen the progression of CKD and increase the risk of complications, including infections. Patients with uncontrolled hypertension are at higher risk of cardiovascular complications and infections, which can further deteriorate their kidney condition.[18] Meanwhile, only 10% of respondents had diabetes mellitus. Theoretically, elderly patients with comorbid diabetes mellitus are at higher risk of infection due to decreased organ function and a compromised immune system.[19]

In this study, most respondents (53.3%) exhibited symptoms of fever with chills. Iqbal et al. (2021) found that fever and chills occurred in 100% of patients with CDL infections, highlighting these symptoms as key indicators of serious systemic infections.[20] Fever and chills are the body's response to systemic infections, triggered by pyrogens released by either bacteria or the body itself in reaction to pathogens in the bloodstream.[21] In CDL infections, bacteria from the skin or catheter can enter the bloodstream, leading to a systemic immune response.[12] The frequent occurrence of fever and chills suggests they may be early indicators of severe systemic infections, highlighting the need for early detection and treatment to prevent serious complications like sepsis and reduce mortality.[22] In this study, most respondents (91.7%) had

undergone hemodialysis for 8 weeks or more. However, hemodialysis duration does not directly affect the risk of catheter-related bloodstream infections in CVC patients.[23]

In this study, the majority of respondents (56.7%) used CDL catheters for less than 8 weeks. Iqbal et al. (2021) reported that 68.4% of patients who used catheters for more than 14 days developed infections. Although the duration of CDL use may influence the risk of infection, this study did not find a significant association between using CDL for more than two weeks and the incidence of infection. Several studies suggest that using non-tunneled CDL for less than one week and replacing it regularly may reduce the risk of infection.[20] Non-tunneled catheters are commonly used as temporary access due to their ease of insertion, but they carry a higher risk of infection because they lack a subcutaneous cuff that serves as a barrier to bacterial colonization. In contrast, tunneled catheters are designed for long-term use and have a lower infection rate due to the cuff, which helps prevent the migration of microorganisms from the skin into the catheter lumen.[23] The Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines do not specify an exact time limit for CDL use, but emphasize the importance of regular monitoring and prompt removal once an arteriovenous fistula (AVF) matures or other permanent vascular access options become available.[23]

In clinical practice, CDL usage may range from several weeks to years, depending on the availability and quality of vascular access and the facility's ability to manage complications. Therefore, routine evaluation of catheter condition and implementation of infection prevention standards such as aseptic technique, proper dressing care, and minimizing catheter manipulation are essential to reducing the incidence of CDL-related infections.[12] According to CDC guidelines, several proven methods to prevent infection include daily skin cleansing with chlorhexidine, routine disinfection of the catheter hub (access site), the use of antimicrobial-coated catheters, and replacing sutures with sutureless securement devices. If these procedures are implemented consistently, the risk of infection can be significantly reduced, even when the catheter is used for a relatively short period.[24]

In this study, the majority of respondents (90.0%) had CDL catheters inserted in the right jugular vein, while only 3.3% had them placed in the right femoral vein. This finding aligns with the report by Dahlan et al. (2023), which stated that approximately 86.5% of CDL placements were performed in the right internal jugular vein. Although this site is anatomically considered safer and associated with a lower risk of infection compared to other sites, particularly the femoral vein, infections can still occur.[13] Several studies support this site preference in clinical practice. Meta-analyses have shown that femoral catheters carry a significantly higher risk of catheter-related bloodstream infections (CRBSI), especially when used for less than one week, up to three times higher than catheters placed in the jugular vein. A study in Pakistan involving 400 patients also reported a higher incidence of CRBSI at femoral sites (14%) compared to jugular sites (6.5%).[25] These findings reinforce that placement of CDL in the right internal jugular vein, as shown in this study, is consistent with evidence-based practice aimed at minimizing infection risk.

However, the occurrence of infections even at lower-risk sites indicates that catheter location alone does not guarantee safety. Insertion technique, hygiene, wound care, and regular monitoring remain critical components in preventing catheter-related infectious complications.[12] Based on leukocyte levels, it was found that the majority of respondents in this study, 31 people (51.7%), had leukocyte levels ranging from 5,000 to 10,000. In the study by Weldetensae et al. (2022), more than half (60.6%) of the participants had leukocyte levels below 10,000 cells/mm3.[11] High leukocyte levels are usually considered a sign of the body's immune response to infection. However, in the context of the mentioned study, high leukocyte levels (more than 10,000 cells/mm3) do not necessarily indicate an increased risk of catheter infection, but can be used as one of the clinical parameters to aid in diagnosis and monitoring.[11] To reduce

the risk of catheter infection based on leukocyte levels, regular blood tests should be performed to monitor leukocyte levels. High leukocyte levels may indicate an ongoing infection or potential risk of infection.[12]

Conclusion

The study found that using a double lumen catheter for less than 8 weeks is associated with a high infection rate, with over half of the patients experiencing infections. The most commonly reported clinical symptoms were fever and chills, indicating the body's response to the infection. Therefore, close monitoring of patients using CDL is crucial to detect and prevent further complications. Catheter insertion should be done using strict aseptic techniques to prevent contamination. Prophylactic antibiotics may be beneficial, especially for patients with high leukocyte counts or a history of infections. Families should be educated about signs of infection, such as fever and redness at the catheter site. Early planning for an arteriovenous fistula (AVF) is recommended to minimize risks from prolonged catheter use.

Limitations of the Study

Limitations include an observational design, a single-center sample, a short observation period, and the lack of evaluation of infection impact on quality of life.

Declarations

Ethics approval and consent to participate

This study adhered to the guidelines for the Declaration of Helsinki and received approval from the Ethics Committee of the Dr. Reksodiwiryo Hospital, Padang, Indonesia, under reference number B/251/VII/2024.

Competing interests

There are no conflicts of interest in writing this article.

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Author's Contribution

Idea/concept: MPP, AV, EV, HH. Design: MPP, AV, EV, HH. Control/ supervision: MPP, AV, EV, HH. Data collection/ processing: MPP, AV, EV, HH. Analysis/interpretation: MPP, AV, EV, HH. Literature review: MPP, AV, EV, HH. Writing the article: MPP, AV, EV, HH. Critical review: MPP, AV, EV, HH. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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