Characteristic Of Catheter Double Lumen Infection In Chronic Kidney Disease Patients At Dr. Mohammad Hoesin Hospital Palembang

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Abstract

The majority of chronic kidney failure patients (40-60%) require hemodialysis (HD) twice a week and often face problems with inadequate venous access. Hemodialysis patients with CKD often use an alternative to central venous access in the form of a well-tunneled double lumen (CDL) catheter or non-tunneled. However, the use of CDL causes many risks of infection This study aims to analyzed risk factors for CDL infection in patients with chronic kidney failure undergoing hemodialysis at dr. Mohammad Hoesin Hospital period January to December 2021.Descriptive study with retrospective study design was undertaken in the hemodialysis unit at dr. Mohammad Hoesin Hospital Palembang from January to December 2022. There were 100 samples who met the inclusion criteria. The relationship between independent and dependent variables was analyzed using the Chi Square test or Fisher's Exact. The most important risk factors were analyzed using the Logistic Regression test. All data were analyzed by SPPS version 22.0. In this study, there was no significant relationship between gender, age, ureum, creatinine, leucocyte and length of use with the incidence of CDL infection (p > 0,05), however there is a significant relationship between nutritional status with the incidence of CDL infection (OR = 31.418 (CI5% 10.028 – 98.438); p = 0.000); there was a significant relationship between catheter location with the incidence of CDL infection (p = 0.000); and there was a significant relationship between the type of catheter with the incidence of CDL infection (OR = 32.276 (CI5% 4.096 – 254.319); p = 0.000).In this study, it was found that the factors influencing CDL infection were nutritional status and type of catheter.

Keyword: Catheter, CDL, Chronic Kidney Failure, Haemodialysis, Infection

INTRODUCTION

Chronic kidney disease (CKD) has emerged as one of the most prominent causes of death and suffering in 21st century. CKD is a progressive condition that affects > 10% of the general population worldwide, amounting to > 800 million individuals (Kovesdy, 2022) . Due in part to the rise in risk factors, such as obesity and diabetes mellitus, the number of patients affected by CKD has also been increasing, affecting an estimated 843.6 million individuals worldwide in 2017 (Jager et al., 2019). Although mortality has declined in patients with end stage kidney disease (Saran et al., 2020), the Global Burden of Disease studies has shown that CKD has emerged as a leading of worlwide mortality (Aboyans & Collaborators, 2015) (Rhee & Kovesdy, 2015). The number of chronic kidney failure patients has increased progressively in recent years, related to chronic disease and age (Prevention, 2017). CKD is more prevalent in older individuals (Hill et al., 2016) (Johns & Jaar, 2013), women (Johns & Jaar, 2013), racial

minorities (Easterling, 1977) (Rostand et al., 1982), and in people experiencing diabetes mellitus (de Boer et al., 2020) (Gatwood et al., 2018) and hypertension (Kjeldsen, 2018). The incidence of chronic kidney failure (CRF) reaches 200 cases per million per year in many countries, although prevalence varies between countries: eg, US, Taiwan, and certain regions in Mexico are approaching almost 400 cases per million. Like other parts of the world, Indonesia equally suffers from a high burden of CKD. The National Basic Health Research (Riset Kesehatan Dasar, Riskesdas), reported that the CKD prevalence was 3.8 permil in 2018, increased from 2.0 permil in 2013 (Hustrini et al., 2022). In Indonesia, most etiologies are caused by diabetic nephropathy and hypertension (Kresnawan & Markun, 2012). According to the Indonesian Renal Registry (IRR) in 2016, the majority of patients with CRF were aged 45-54 years and were male. man. The majority of CRF patients (40-60%) require hemodialysis (HD) twice a week and often face problems with inadequate venous access (Friedman & Newsom, n.d.).

Hemodialysis depends on good vascular access so that blood flow in and out during hemodialysis can run well. The primary choice of vascular access for HD may be an arteriovenous fistula (AVF). However, AVF maturity is usually at least six weeks, patients with CRF often use an alternative to central venous access in the form of a double lumen catheter (CDL), both tunneled and non-tunneled. However, the use of CDL causes many risks of infection (Friedman & Newsom, n.d.) (INFEKSI, 2008).

Double lumen cathether infection is a primary infection caused by a double lumen cathether (CDL) without any other organ or tissue attachment that is suspected as a source of infection other than in the blood (INFEKSI, 2008). In a study in Denmark, the prevalence of double lumen catheher index was 13.7% per 100 hemodialysis patients per year (Widiastuti & Wahjuprajitno, 2014). Study in Mohammad Hoesin (RSMH) Hospital Palembang was found that 41.2% of patients who used CDL in the hemodialysis installation had infections and germs that cause *Staphylococcus epidermis* and *Staphylococcus saphrophyticus* from blood culture results (Friedman & Newsom, n.d.).

There are a number of factors associated with the occurrence of double lumen catehteher infection both endogenous and exogenous factors. Causes Endogenous factors such as age (55% occur at age > 60 years, gender (58% in men), co-morbidities (38%), hematology, immunity, and patient's condition. Causes of exogenous factors can be length of stay, sterility of medical devices, hospital environment, health worker or nurse factors, and other patient factors (Suzuki et al., 2016).

This study aims to analyze risk factors for CDL infection in patients with chronic kidney failure undergoing hemodialysis at dr. Mohammad Hoesin Central General Hospital Palembang period January to December 2021.

METHODS

Descriptive study with retrospective study design on all patients undergoing hemodialysis in the hemodialysis unit at dr. Mohammad Hoesin Hospital Palembang from January to December 2022. The independent variables in this study included age, gender, nutritional status, location of catheter insertion, type of catheter, history of catheter insertion, duration of catheter insertion and hematology results (ureum, creatinine and leucocytes) while the dependent variable in this study was CDL infection.

Subject data was collected from secondary data from the central medical record. Data were taken from all CDL infection patients at the Hemodialysis Unit who had complete data. There were 100 samples who met the inclusion criteria. All participants had agreed to the informed consent which was explained before data collection or research started.

Data processing will be performed using SPSS 22.0 for Macintosh. All data was cross-checked with the database of the Vascular and Endovascular Surgery Division and RSMH medical records. Descriptive analysis was carried out to assess the characteristics and distribution of data for each variable which was then presented in tabular or graphical form. Numerical data is tested for normality, if the distribution is normal then the data used is the mean and if the data distribution is abnormal then the data used is the median.

The relationship between independent and dependent variables was analyzed using the Chi Square test or Fisher's Exact. The most important risk factors were analyzed using the Logistic Regression test.

RESULTS

General Characteristics of Research Subjects

With statistical analysis, the results showed that there was no difference in sex ($p = 0.423$) and age ($p = 0.699$) or age category ($p = 0.575$) between patients with and without CDL infection. However, there was a significant difference in nutritional status between patients with and without CDL infection ($p = 0.000$).

Clinical Characteristics of Research Subjects

Based on statistical analysis, the results showed that there were differences in the location of the catheter (p = 0.000) for the type of catheter (p = 0.000) between patients with and without CDL infections. However, there was no difference in the duration of catheter use between patients with and without CDL infection (p = 0.167).

Cut off Point of Ureum, Creatinine and Leukocyte

Using the ROC curve, the intersection points for each laboratory characteristic were obtained, namely urea (cut off 114.5 mg/dl; AUC 0.568 (CI95% 0.454 – 0.681); p = 0.245); creatinine (cut off 5.935 mg/dl; AUC 0.502 (95% CI 0.387 – 0.617); p = 0.972); and leukocytes (cut off 11.085 x 103 mg/dl; AUC 0.596 (95% CI 0.485 – 0.707); p = 0.100) (**Figure 1)**

Table 1. General Characteristics of Research Subjects

Characteristic	CDL Infection		OR (CI95%)	P value
	Yes (n = 47)	No (n = 53)		
Gender, n (%)			1.496	
• Female	26 (55.3)	24 (45.3)	(0.679 – 3.294)	0.423[a]
• Male	21 (44.7)	29 (54.7)		
Age (Years Old)				
• Mean ± SD	43.40 ± 20.05	42.39 ± 18.85		0.699[b]
• Median	50	42	-	
• Min-Max	5 - 79	9 - 73		
Age, n (%)				
• > 60 years old	12 (25.5)	10 (18.9)	1.474	0.575[a]
• ≤ 60 years old	35 (74.5)	43 (81.1)	(0.570 – 3.814)	
Nutritional status				
• Underweight	36 (76.7)	5 (9.4)	31.418	0.000[a]*
• Normoweight - Obese	11 (23.4)	48 (90.6)	(10.028 – 98.438)	

[a]*Chi Square Test*, *p < 0.05

[b]*Mann Whitney Test*, *p < 0.05

Table 2. Clinical Characteristics of Research Subjects

Characteristic	CDL Infection		OR (CI95%)	P value
	Yes (n = 47)	Yes (n = 47)		
Catheter Location				
• Femoral	10 (21.3)	0 (0)	-	0.000[a]*
• Jugular	37 (78.7)	53 (100)		
Catheter Type				
• Shortterm	18 (38.3)	1 (1.9)	32.276	0.000[a]*
• Longterm	29 (61.7)	52 (98.1)	(4.096 – 254.319)	

Length of Use				
• ≤ 6 months	37 (78.7)	34 (64.2)	2.068	0.167[b]
• > 6 months	10 (21.3)	19 (35.8)	(0.844 – 5.066)	

[a]*Fisher Exact Test*, *p < 0.05

[b]*Chi Square Test*, *p < 0.05

In this study, patients with CDL infection obtained ureum, creatinine, and leukocyte levels of 119.09 ± 78.23 mg/dl (ureum range 11 – 415 mg/dl); 6.15 ± 3.94 mg/dl (creatinine range 0.51 – 19.59 mg/dl) and 14.06 ± 8.11 x 103 mg/dl (leukocyte range 2.89 – 32.8 x 103 mg /dl). With statistical analysis there was no difference in ureum (p = 0.244), creatinine (p = 0.972) and leukocytes (p = 0.100) between patients with and without CDL infection.

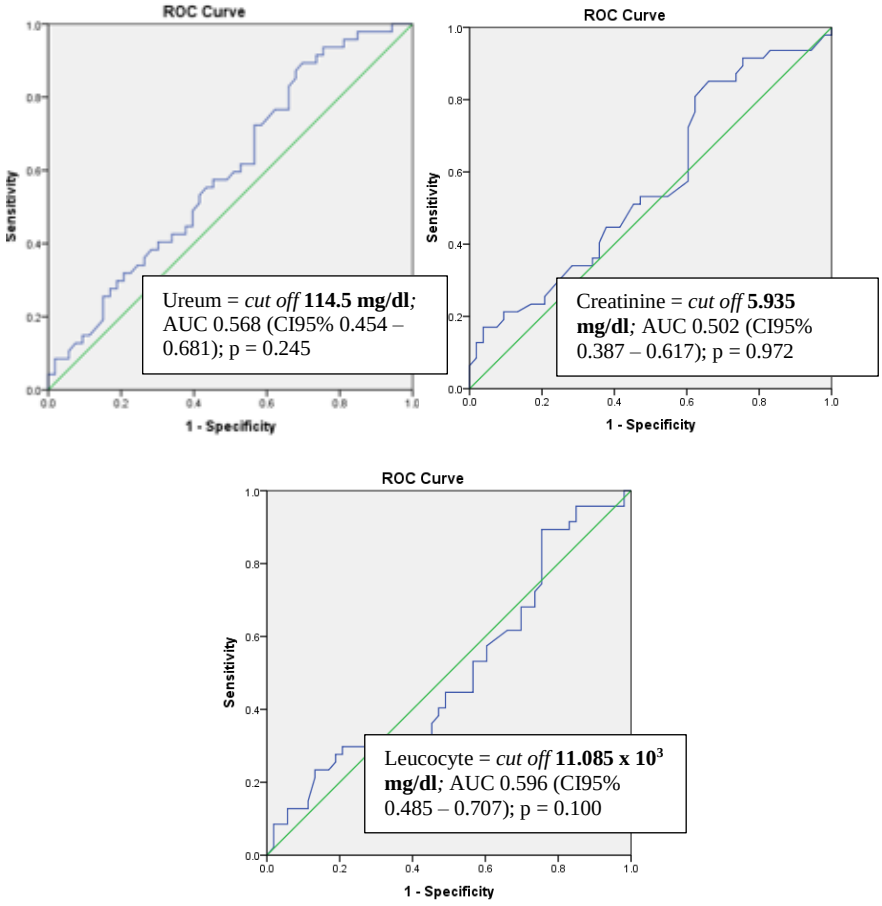

Figure 1.

Ureum, Creatinine and Leukocyte ROC Curves

Table 3. Hematology Characteristics of Research Subjects

Characteristic	CDL Infection		P value
	Yes (n = 47)	No (n = 53)	
Ureum (mg/dl)			
• Mean ± SD	119.09 ± 78.23	**135.06 ± 75.13**	0.244
• Median	107	116	
• Min-Max	11 – 415	17 – 306	
Creatinine (mg/dl)			
• Mean ± SD	6.154 ± 3.94	**6.452 ± 4,26**	0.972
• Median	6.55	5.76	
• Min-Max	0.51 – 19.59	0.51 – 23.77	
Leucocyte (x 10^3 mg/dl)			
• Mean ± SD	**14.06 ± 8.11**	11.66 ± 7.78	0.100
• Median	12.82	9.55	
• Min-Max	2.89 – 32.8	1.47 – 32.49	

Mann Whitney Test, *p < 0.05

Table 4. Hematology Characteristics of Research Subjects

Characteristic	CDL Infection		OR (CI95%)	P value
	Yes (n = 47)	No (n = 53)		
Ureum				
• ≤ 114 mg/dl	24	24	1.261	0.244
• > 114 mg/dl	23	29	(0.574 – 2.770)	
Creatinine				
• ≤ 5,845 mg/dl	26	23	1.615	0.972
• > 5,845 mg/dl	21	30	(0.732 – 3.562)	
Leucocyte				
• ≥ 11.085 x 10^3 mg/dl	26	24	1.496	0.100
• < 11.085 x 10^3 mg/dl	21	29	(0.679 – 3.294)	

Chi Square Test, *p < 0.05

Relationship of General Characteristics with CDL Infection

With statistical analysis, the results showed that there was no significant relationship between gender and the incidence of CDL infection, patients with female sex were 1.496 times more at risk of experiencing CDL infection than patients with male sex (OR = 1.496 (IK5% 0.679 – 3.294); p = 0.423); there was a non-significant relationship between age and the incidence of CDL infection, patients with age > 60 years were 1.474 times more at risk of having CDL infection than patients aged ≤ 60 years (OR = 1.474 (CI5% 0.570 – 3.814); p = 0.575); and there is a significant relationship between nutritional status and the incidence of CDL infection, patients with poor nutritional status are at risk of 31.418 times experiencing CDL

infection compared to patients with moderate to obese nutritional status (OR = 31.418 (CI5% 10.028 – 98.438); p = 0.000) (**Table 1**).

Relationship of Clinical Characteristics with CDL Infection

With statistical analysis, the results showed that there was a significant relationship between catheter location and the incidence of CDL infection, patients with catheter locations at risk of femoral vein significantly experiencing CDL infection compared to patients with catheter locations in the jugular vein (p = 0.000); there was a significant relationship between the type of catheter and the incidence of CDL infection, patients with short-term catheter types were at risk of 32.276 times experiencing CDL infection compared to patients with long-term catheter types (OR = 32.276 (CI5% 4.096 – 254.319); p = 0.000); and there was no significant relationship between the duration of catheter use and the incidence of CDL infection, patients with a duration of catheter use ≤ 6 months had a 2.068 times risk of experiencing CDL infection compared to patients with a duration of catheter use > 6 months but not statistically significant (OR = 2.068 (IK5% 0.844 – 5.066) ;p = 0.167) (**Table 2**).

Relationship of Hematology Characteristics with CDL Infection

With statistical analysis, the results showed that there was no significant relationship between urea levels (p = 0.706), creatinine levels (p = 0.322) and leukocyte levels (p = 0.423) and the incidence of CDL infection (**Table 4**).

Factors Affecting Cathether Double Lumen Infection in Patients with Chronic Renal Failure Undergoing Hemodialysis.

In this study it was found that the factors influencing CDL infection were nutritional status and type of catheter. Underweight status was significantly 25.065 times more at risk of developing CDL infection than patients with normoweight to obese nutritional status (OR = 25.065 (95% CI 6.828 – 92.005); p value = 0.000) and patients with short-term catheter were significantly 29.392 times more at risk of developing CDL infection compared to patients with long-term catheter type (OR = 29.392 (95% CI 2.971 – 290.786); p value = 0.004) (**Table 5**).

Table 5. Factors Affecting CDL Infection

Variable	Unadjusted*		Adjusted**	
	OR	*p value*	aOR	*p value*
Nutritional status	31.418	0.000	**25.065**	**0.000**
Catheter Type	32.276	0.000	**29.392**	**0.004**
Catheter Location	-	0.000	2137842100	0.998
Length of Use	2.068	0.167	1.371	0.661

**** Chi Square Test***

***** Logistic Regression Test***

DISCUSSION

In this study, 47 people (47%) had CDL infections. This number is not much different from the results of a study by Wiradana et al., (Wiradana et al., 2021) in 2021 in Denpasar which reported that 41.2% of 102 patients undergoing hemodialysis had CDL infections. In a study by Iqbal et al., (Iqbal et al., 2022) in Padang in 2022, they reported a higher percentage of CDL infections, out of a total of 40 hemodialysis patients who underwent CDL installation, 27 patients (67.5%) had CDL infections. From this study, the results showed that there was no significant difference in sex and age between patients with and without CDL, so it can be concluded that the incidence of CDL infection in this study was not influenced by gender and age. In addition, there is no relationship between age and gender with CDL infection.

The general characteristic that has a relationship with CDL infection in this study is nutritional status. Patients with underweight nutritional status are at risk of 31.418 times experiencing CDL infection compared to patients with normoweight to obese nutritional status. These results are in line with Wahyu et al research in 2022 which reported that the majority of patients with CDL infection were underweight and these results were statistically significant ($p = 0.000$).

Based on clinical characteristics, it was found that the location of the catheter and the type of catheter differed significantly between patients with and without CDL infection. All patients who had catheters placed in the femoral vein had CDL infection, 18 of 19 patients with short-term catheter types had CDL infection. This result is in line with the study of Wahyu et al., (Wahyu et al., 2022) who reported that all patients who had a catheter placed in the femoral vein and patients with the short-term type of catheter had CDL infections. In contrast to the study by Ali et al., (Ali et al., 2019) who reported that only 16.7% of patients who had catheters placed in the femoral vein had CDL infection. The right internal jugular vein is the preferred initial insertion site for tunneled catheter insertion, whereas femoral catheters are generally less preferred than internal jugular catheters because of concerns about catheter dysfunction and increased risk of infection (Miller et al., 2016).

Installation of CDL must be careful, especially when installing "short-term" CDL, it is necessary to pay attention to the skin and tissue around the insertion site. All CDL insertions with skin infections around the CDL insertion site carry a high risk of infection because infection at these sites along the surface can cause migration of extraluminal organisms into the bloodstream. This risk is reduced by both the use of “Longterm” CDL and the subcutaneous catheter tunneling technique and by increasing the distance between the skin-catheter and the catheter-veins (Chand et al., 2009).

Ureum and creatinine are nitrogen-containing end products of metabolism. Urea is a major metabolite derived from dietary protein and tissue protein turnover. Creatinine is a product of muscle creatine catabolism. Both are relatively small molecules (60 and 113 daltons, respectively) that distribute water throughout the body. The normal range for urea nitrogen in blood or serum is 5 to 20 mg/dl, or 1.8 to 7.1 mmol urea per liter. Meanwhile, normal serum creatinine (sCr) varies depending on the subject's body muscle mass. For adult males, the normal range is 0.6 to 1.2 mg/dl and for adult females, with generally lower muscle mass, the normal range is 0.5 to 1.1 mg/dl (Walker et al., 1990). While leukocytes (also called white blood cells) are components of blood cells that lack hemoglobin, have a nucleus and are able to move. Leukocytes protect the body from infection and disease by: ingesting foreign materials and cell debris; by destroying infectious agents and cancer cells; or by producing antibodies (Britannica, 2020).

Ureum and creatinine are parameters that are widely used to assess Chronic Kidney Disease (CKD) status. Ureum and creatinine are good indicators of normally functioning kidneys and increased serum is an indication of kidney dysfunction (Pandya et al., 2016). The results of this study showed that there were no significant differences in urea, creatinine and leukocyte levels between patients with and without CDL infection. Urea levels ≤ 114 mg/dL, creatinine levels ≤ 5.845 mg/dl and leukocyte levels ≥ 11,085 x 103 mg/dl were found slightly more in patients with CDL infection but with a slightly different percentage, whereas patients without CDL infection were found more urea level > 114 mg/dL, creatinine level > 5.845 mg/dl and leukocyte level < 11.085 x 103 mg/dl but the percentages are not much different and the difference is not statistically significant. The similarity of these levels is probably because all the samples in this study were chronic kidney failure patients.

CONCLUSION

From these results we can conclude that there was no effect of ureum, creatinine and leukocyte levels on the incidence of CDL infection and based on the multivariate test results, the factors that influence the incidence of CDL infection are nutritional status and type of catheter. Patients with underweight nutritional status and short-term catheter types are significantly more at risk of developing CDL infection.

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