

Correlation between Duration of Placement of Non-tunneled Hemodialysis Catheter and Positive Bacterial Culture Incidence in Hemodialysis Patients

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Abstract

Non-tunneling hemodialysis catheter is one of the most convenient vascular accesses for hemodialysis in End Stage Kidney Disease (ESRD) patients. However, these catheters have the highest morbidity among all available accesses. Current guidelines recommend that non-tunneled hemodialysis catheters be placed for no more than 2 weeks to prevent bacterial contamination. This study was conducted in Dr. Hasan Sadikin General Hospital, Bandung, Indonesia, throughout January-December 2021. A correlation test with a prospective observational analysis design was applied to find the link between the duration of non-tunneled hemodialysis catheter placement and the incidence of positive bacterial culture on the catheter. Pearson correlation test was used to see the strength of the correlation, with a significance limit of 0.05. This study involved 28 subjects. The most common location for catheter placement was in the jugular vein, and laboratory examinations showed no correlation between leukocyte values and positive bacterial culture results. Hypertension and diabetes mellitus were not significant risk factors (p-value 0.887). At ≤ 14 days of catheter placement, only 1 (6.7%) of the subjects presented a positive culture result. Most of the positive bacterial culture results were found at a duration of 15-30 days of placement, (n=8; 53.3%). The results of the Pearson test showed a p-value of 0.036 and an r-value of 0.399, indicating a significant result with a strong correlation between the two variables. The duration of placement of hemodialysis catheters has a positive correlation with the incidence of positive bacterial cultures, which can increase the risk of systemic infection associated with hemodialysis catheters.

Keywords: Bacterial culture, correlation, duration of placement, non-tunneled hemodialysis catheters

Introduction

End-stage renal disease (ESRD) is an irreversible condition that is becoming an ever-growing problem in terms of morbidity, mortality, and cost. The inability of the patient's kidneys to perform their proper function requires the patient to undergo kidney replacement therapy as a means of increasing their life expectancy.^{1,2,3}

Dialysis catheters are the most convenient vascular access for hemodialysis as it can be done in multiple places, can be used immediately, are relatively low-cost, are easy to apply and

replaced, and do not require venous cannulation to be used for dialysis. Although their benefit also comes with the cost of higher morbidity rate due to the risk of thrombosis and infection.⁴

Bacterial contamination may be predisposed by several factors such as comorbid conditions, method of application, location of placement, and duration of the placement. Several coexisting conditions such as diabetes mellitus and hypertension can alter the immune system and increase risk of infection. Diabetic and hypertensive patients may experience microvascular complications that increase the skin susceptibility to damage. Added with poor blood flow, inhibiting the immune system to take effect in the lesion.^{5,6} Non-tunneled catheters are recommended to be used only for up to 2 weeks, placement and usage of more than 2 weeks may lead to an increased risk of contamination.

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Contamination of dialysis catheters is mostly caused by epidermal flora such as *Staphylococcus epidermidis* and *Staphylococcus aureus*. Contamination generally occurs through one of four pathways: colonization on the edge of the catheter by epidermal flora, colonization of the catheter lumen, hematogenic spread from other infectious sites, and contamination of the lumen.⁷

This study aimed to discover the correlation between the duration of placement of non-tunneled dialysis catheters with the incidence of positive blood bacterial culture related to catheter placement in Dr. Hasan Sadikin General Hospital Bandung, Indonesia.

Methods

This was a cross-sectional study. Subjects include all hemodialysis patients applied with non-tunneled dialysis lines in Dr. Hasan Sadikin General Hospital in January-December 2021. The inclusion criteria for the subjects are hemodialysis patients who have undergone non-tunneled dialysis catheters and agreed to comply with the study. Unrelated infection and infected catheter that required reinsertion in a different site are considered as the exclusion criteria. The minimal sample size was determined to be 28

samples. Demographic data such as gender and age were obtained. Comorbidities are also noted, namely diabetes mellitus and hypertension. Blood samples for culture were collected from the catheter. Subjects were then divided into two groups depending on their bacterial culture result and placement of the catheter. The subjects in each group were categorized based on the duration of catheter placement. Pearson correlational analysis was performed to determine the strength of the correlation between the duration of the placement and bacterial growth. Consent has been obtained from patients and the study has passed ethical clearance from the Health Research Ethic Committee of Dr. Hasan Sadikin General Hospital (document number LB.02.01/X.6.5/266/2021).

Results

A total of 28 samples were collected. The demography of the subject was predominantly male (15 subjects) with an average age of 49.93±14.40. Subjects with negative bacterial culture consisted of 9 male subjects and 6 female subjects (69.2% and 30.8% respectively of all negative culture subjects).

The location of placement of the catheter

Table 1 Characteristics of Subjects

Variables	Total (n=28)	Positive bacterial culture (n=15)	Negative bacterial culture (n=13)	p*
Gender				
Male	15	6	9	0.131
Female	13	9	4	
Age (year)				
Average	49.93±14.40	51.07±11.38	49.31±18.35	0.662
Median	48	54	58	
Range	21-74	23-70	21-74	
Location of placement				
Internal jugular vein	22	12 (80%)	10 (77%)	0.850
Femoral vein	6	3	3 (23%)	
Comorbidities				
Diabetes mellitus	3	3	0 (0%)	0.887
Hypertension	15	5	10 (76.9%)	
Diabetes mellitus and hypertension	10	7	3 (23.1%)	

* Pearson test

Table 2 Duration of Catheter Placement and Culture Result

Duration of placement	Total n=28	Positive Bacterial Culture n=15	Negative Bacterial Culture n=13
≤14 days	4 (14.3%)	1 (6.7%)	3 (23.1%)
15–30 days	17 (60.7%)	8 (53.3%)	9 (69.2%)
1–2 months	6 (21.4%)	5 (33.7%)	1 (7.7%)
2–3 months	1 (3.6%)	1 (6.7%)	0 (0%)

was mostly found in the internal jugular vein (22 subjects; 78.6%). Mapping of comorbidities found that 53.6% of subjects had hypertension, 35.7% had hypertension and diabetes mellitus, and 10.7% had diabetes mellitus only.

Most of the non-tunneled lines were placed for more than 14 days (24 subjects; 85.7%), with the majority of the subjects ranging from 15-30 days (17 subjects; 60.7%).

The correlation between the presence of bacterial colonies and the duration of catheter placement was analyzed using the Pearson test. A significant result was yielded ($p < 0.005$) with a strong positive correlation ($r > 0$) as shown in Table 3.

Discussion

Demographic characteristics of the subjects in this study bear an insignificant correlation with the incidence of bacterial infection. Previous studies also displayed inconclusive and varying results in terms of the correlation between gender and the formation of bacterial colonies.^{8,9,10}

The location of catheter placement in this study was mostly in the internal jugular vein which may also explain why there are more subjects with positive bacterial culture in the jugular vein group compared to the femoral vein group. Both groups have a similar proportion of positive bacterial culture and a total number of subjects in the respective group. Pearson’s test

yielded a non-significant result, which is true with previous studies that had different results regarding the correlation between the location of placement and bacterial culture results.¹¹

The proportion of subjects with diabetes mellitus that yielded a positive bacterial culture result appeared to be the highest compared to other comorbidities. Diabetes mellitus is known to interfere with infection control and therefore people with diabetes mellitus are more susceptible in developing bacterial colonies in high-risk areas. This explanation held when we observe that the proportion of subjects that had diabetes mellitus & hypertension with positive culture is also higher compared to subjects with hypertension only. However, an analytical test showed that these comorbidities do not have a significant correlation with culture results, suggesting that other factors play a bigger role in the formation of bacterial colonies.¹⁰

Crosstabulation between the duration of placement and culture result displayed that the length of placement is following positive bacterial culture result. Almost all positive bacterial culture results (93.3%) came from subjects with a duration of placement of more than 14 days. The analytical test also shows a significant result with a strong positive correlation between the duration of placement and culture result. It is also noteworthy that the longer the duration of the placement, the greater the proportion of duration and bacterial culture result, suggesting that the risk of infection becomes greater the longer that the catheter is in place. This finding

Table 3 Correlation between Duration of Placement and Bacterial Culture

Duration of placement	Total n=28 (%)	Positive bacterial culture n=15 (%)	Negative bacterial culture n=13 (%)	p*	r*
≤14 days	4 (14.3%)	1 (6.7%)	3 (23.1%)	0.001	0.739
>14 days	24 (85.7%)	14 (93.3%)	10 (76.9%)		

* Pearson test

supports the current existing guidelines from the National Kidney Foundation/Kidney Disease Outcomes Quality Initiative (NKF/KDOQI) that recommend placement of non-tunneled lines of no more than two weeks.^{12,13}

Most of the colonies found in the bacterial culture are colonies of *Staphylococcus aureus*. This discovery is consistent in the duration of placement groups and is following the bacteria found in previous studies. According to previous literature, the second most common colony to be found is coagulase-negative *Staphylococci* (CoNS). We understand now that normal skin flora are the most common pathogen of infection in patients with non-tunneled dialysis lines. An evaluation of aseptic procedures and aftercare may shine some more light on the prevention of these infections.¹⁴

In this study, the authors have found a strong correlation between the duration of placement of a non-tunneled dialysis catheter with the incidence of positive bacterial culture. The longer the duration of the placement, the greater the risk of infection. This study also supports the existing guidelines and recommendations of non-tunneled line usage of no more than two weeks to prevent unnecessary morbidities and cost inefficiencies due to infection.

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