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Original Article

Bloodstream Infection of Double Lumen Catheter among Hemodialysis Patient

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Background: Infection is one of complication of vascular access that can lead a higher morbidity, loss of access, and even mortality. Hospitalized hemodialysis patients with double lumen catheter (DLC) have a two to three higher risk for infection and death compared to patients with arteriovenous graft. The aim of this study was to determine the infection rate in dialysis double lumen catheter and its characteristic.

Method: A retrospective study was conducted in Sanglah General Hospital. Inclusion criteria was patients aged ≥18 years old who required DLC for hemodialysis access during April 2017 to March 2018. Exclusion criteria were patients without blood culture result and incomplete medical report. Data presented in a demographic data, including microbial pattern of bloodstream culture.

Result: Among 42 patients who was diagnosed with bacteremia (41.2%), 57% were male, and mostly using non-tunneled DLC. *Coagulase-negative Staphylococci* (23.8%) was the commonest pathogen of infected DLC, followed by *Staphylococcus aureus* (9.5%) and *Staphylococcus epidermidis* (7.1%). *Pseudomonas aeruginosa* and *Acinetobacter baumanni*, and nosocomial pathogen was counted for 4,8 %.

Conclusion: Infection rate in DLC among hemodialysis patients of Sanglah General Hospital was 28.6% with the most common etiology was *Coagulase-negative Staphylococci* (23.8%).

Keywords: LMWH, cancer, venous thromboembolism, enoxaparin, tinzaparin
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INTRODUCTION

Infection is one of complication of vascular access that can cause morbidity, vascular access damage, and even mortality. Bacteremia due to intravenous catheter use is called a catheter-related bloodstream infection (CBRSI). Infection is the most common complication, and dangerous, then could lead nosocomial bacteremia and septis.[1] Intravascular catheters are used in critical patients as access to fluids, administration of blood products, medication, nutrition, hemodynamic surveillance, and dialysis access.[1]

Chronic kidney failure is one of the public health problems throughout the world, characterized by a permanent decrease in the glomerular filtration rate. In 2012 according to The United States Renal Date System (USRDS) the prevalence of patients with chronic kidney failure reached 364,000 patients.[1-3]

Eighty percent of these patients undergo hemodialysis catheters for vascular access at first hemodialysis. Data from the Centers for Medicare and Medicaid Services (2007) shows a fairly high prevalence in the use of hemodialysis catheters at 69% in the first six months of hemodialysis and 41% in the first year of hemodialysis.[2,3] Whereas in Indonesia the number of patients with kidney failure is currently 300,000.4 Vascular access for hemodialysis includes the installation of a hemodialysis catheter, arterial-venous fistula (AVF) and arterial-venous graft (AVG).[5] When hemodialysis should be done immediately, a proper vascular access is necessary. Non-tunneled DLC is the best choice for our hospital when options for long-term access/tunneled DLC are not available.

Infection in a hemodialysis catheter could emerge a higher morbidity and mortality in hemodialysis patients. Infection in a hemodialysis catheter is multifactorial. Three factors that influence bacteremia in hemodialysis patients are patient immunity, bacterial virulence, and hemodialysis procedures.[6] Studies in Turkey and the Netherlands reported infections rate in the bloodstream or bacteremia after DLC insertion reaching 23.9% and 22%.[6,7] The incidence of hemodialysis catheter infection is 3-16%.[4] The incidence of bacteremia is 10 times more common in hemodialysis catheters than in arteriovenous fistulas or arterial-venous grafts.[6] In Indonesia, there is no data that shows the distribution of the incidence of complications from the installation of DLC, both tunneled and non-tunneled and other related factors.

Sanglah General Hospital is a referral hospital in the Eastern Indonesia region has

Table 1. Patient's demographic data

Variables	n=42, n (%)
Sex	
Male	24 (57.1)
Female	18 (42.9)
Age, mean ± SD	48.71 ±
BMI, mean ± SD	14.77
<18.5	20.68 ± 3.79
≥18.5	20 (47.5)
Type of double lumen	22 (52.5)
Tunneled	
Non-tunneled	3 (7.1)
Site of hemodialysis catheter insertion	39 (92.9)
Internal jugular vein	37
Subclavian vein	(88.1)
Femoral vein	3 (7.1)
Type 2 diabetes mellitus	2 (4.8)
Yes	
No	14 (33.3)
History of immunosuppressant drug	28 (66.7)
Yes	6 (14.3)
No	36 (85.7)

performed 102 DLCs in 2017 calendar year. The purpose of this study are to find out the incidence of infection as a complication of DLC insertion as well as infections rate, the characteristics of the CRBSI event, and the pattern of germs found from culture results.

METHOD

A retrospective study was done to evaluate the incidence of DLC infection, both tunneled and non-tunneled. Data was collected from April 2017 to March 2018 at Sanglah Hospital. The population of this study were patients who performed DLC insertions at the same hospital.

Inclusion criteria were patients aged ≥18 years who required DLC for hemodialysis access. Patients whose medical records were incomplete, without blood culture and double lumen culture data, also DLC with the purpose outside of hemodialysis would be excluded. Research variables included age, sex, diabetes mellitus, hypertension, body mass index, history of DLC infection for previous hemodialysis, type of DLC used, insertion site, duration of insertion until the appearance of DLC infection and germ pattern obtained from the culture.

The data will be showed in a percentage frequency for the nominal data, and for the numeric data will be showed in mean +- SD (standard deviation). This study did not need statistic evaluation, in consequence, there was no *p*-value in this study.

RESULT

A total of 102 patients underwent DLC insertion, and 42 of them met the inclusion criteria in this study, Table 1. A total of 12/42 (28.6%) subjects experienced bacteremia originating from the installation of DLC. From these 12, 10 subjects (83.3%) performed non-tunneled DLC, while 2 patients (16.7%) used tunneled DLC. As many as 38 patients (90%) had no history of previous DLC installation. For the insertion sites in internal jugular veins 37 subjects (88.1%), without a history of diabetes mellitus (66.7%), without a history of using immunosuppressant drugs (85.7%), used non-tunneled DLC (92.9%), male (57.1%), and subjects with a BMI <18.5 (47.5%), Table 1.

Blood cultures were obtained from 42 subjects. In two individuals had each two microorganisms in the blood culture results. The most frequent organism was *Staphylococcus coagulase-negative* founded in 10 patients (23,8%), followed by *Staphylococcus aureus* in 4 patients (9.5%), then *Staphylococcus epidermidis* in 3 patients (7.1%). As 17 subjects showed no bacteria growth (40.5%), Table 2. There was multi-resistant in *Acinetobacter baumannii* and *Staphylococcus haemolyticus.*

DISCUSSION

This study showed that most infections occurred in the use of non-tunneled DLC (83.3% vs 16.7%). These results are consistent with various studies which state that the incidence of infection in the insertion of non-tunneled DLC is higher than that of tunneled DLC.[6,8,9,10] A study in the Netherlands in 2004 stated that non-tunneled DLC is a risk factor for infection, with a probability three times higher than tunneled DLC with 95% CI range 1.54-5.94.[11] The Dacron cuff in tunneled DLC is used as an anchor to place the catheter subcutaneously, then the catheter will be bound to the connective tissue so that it is more stable and less likely to change places. This cuff also functions as a barrier to prevent the migration of microorganisms into body.

The installation of a double lumen catheter associated with infection is mostly found in subjects aged 35-60 years. This study differs from the study of Powe *et al* which stated that there was a correlation between old age and hemodialysis catheter infection. Older patients have a higher risk of developing bacteremia due to catheter placement.[9] In general, old age is said to be a risk factor for various infectious diseases. This difference in results is due to the age of the subjects who are not normally distributed. Differences in age showed that in this study chronic kidney disease patients were more common at a younger age. Old age, diabetes mellitus, hypertension, and BMI <18.5 are associated with irregular immune mechanisms in subjects diagnosed with end-stage renal failure.[10]

This study showed that the internal jugular vein installation was predominantly in 37 individuals (88.1%), and it bears the consequences that the infections are more common from this site of insertion, although a closer look must be wisely justified. This result is different from the study by Reyna (2014) and Borges (2015) who found that the location of DLC installation in the femoral area was associated with a higher rate of infection compared to jugular and subclavian locations.[12,13] In theory, the femoral region is more humid than the neck which facilitates the growth and accumulation of bacteria.[9,15] On the other hand, the difference in the results of this study is due to the very limited number of femoral double lumen installations (6.9%) compared to the number of internal jugular installations. Some studies suggested that femoral location shows a higher rate of infection than jugular location, and jugular location is more at risk of infection than subclavian. But the article failed to evaluate the most significant variable.[16,17]

Infection due to *Staphylococcus* is the most common infection in this study. This is consistent with the research of Ratnaja and Susan, who reported the occurrence of *Staphylococcus aureus* infection in

Table 2. Characteristics of blood culture

Organism	Sensitive antibiotics/anti-fungi	n=44, n (%)
Candida non-candida albicans	Fluconazole	1 (2.3)
Kocuria kristinae	Amikacin, Cotrimoxazole, Erytromycin	1 (2.3)
*Staphylococcus aureus**	Flucloxacillin, Oxacillin, Cefalotin, Cefazolin, Cefuroxime, Ceftriaxone, Cefepime, Gentamycin, Ciprofloxacin, Levofloxacin, Erytromycin, Clindamycin, Naffcillin, Amoxicillin Clavulanic Acid, Amoxicillin Sulbactam, Moxifloxacin, Tetracycline, Tigecycline, Cotrimoxazole	4 (9.5)
*Staphylococcus epidermidis**	Gentamycin, Clindamycin, Linezolid, Vancomycin	3 (7.1)
*Pseudomonas aeruginosa**	Cefoperazone Sulbactam, Ceftazidime, Cefepime, Meropenem, Gentamycin, Ciprofloxacin, Amikacin	2 (4.8)
*Enterococcus faecalis**	Ciprofloxacin, Levofloxacin, Linezolid, Tigecycline, Amicillin, Ampcillin Sulbactam ,Moxifloxacin	1 (2.3)
*Acinetobacter baumannii**	None was sensitive	2 (4.8)
Pantoea.sp	Tigecycline, Cefoperazone Sulbactam	1 (2.3)
Candida parapsilosis	Micafungin, Fluconazole, Amphotericin-B	1 (2.3)
Staphylococcus haemolyticus	None was sensitive	1 (2.3)
*Staphylococcus coagulase-negative**	Flucloxacillin, Oxacillin, Cefalotin, Cefazolin, Cefuroxime, Ceftriaxone, Cefepime, Gentamycin, Ciprofloxacin, Levofloxacin, Erytromycin, Clindamycin, Naffcillin, Amoxicillin Clavulanic Acid, Amoxicillin Sulbactam, Moxifloxacin, Tetracycline, Tigecycline, Cotrimoxazole	10 (23.8)
No growth	Not applicable	17 (40.5)

*combined

hemodialysis patients was 35-62%. In the study of Astor *et al*, the incidence of *Staphylococcus aureus* in hemodialysis patients was 35–62%. Jean *et al* showed that blood flow infections associated with *Staphylococcus aureus* CBRSI were most common in patients with nasal colonization of germs (more than 50% of infected patients).[16]

Most of the culture results were obtained without germ growth (40.5%, n=17). This could possibly be due to the administration of antibiotics before taking culture materials, and the sampling procedures that did notmeet the requirements. Culture material can be obtained from double lumen exit site swabs, double lumen tips, blood from each lumen and subject blood taken from different places with double lumen insertions. Culture results with *Staphylococcus coagulase negative* growth, a normal skin flora germ, were obtained from a double lumen exit site culture. Confirmation with blood culture results shows that these germs were not the cause of infection.

A total of 33.3% of the study subjects were obtained with a history of type 2 diabetes. Vascular access infections were increasing in patients with diabetes according to the study of Ratnaja and Susan who reported that daibetes was an important risk factor for the incidence of infection.[17] Diabetes mellitus is the most common risk factor for vascular failure (17%) according to the study of Garlo et al (2015).[18] Chiou et al and Gupta et al showed that diabetes mellitus is a risk factor for hemodialysis catheter infection.[19,20]

A limitation of this study is the limited number of samples. The difference in the results of this study and previous results can be caused by differences in the proportions of the type of DLC used, as well as the completeness of the available data. These limitations should be the focus of attention and development in future studies

CONCLUSION

Nearly thirty percent of patients undergoing hemodialysis at Sanglah Hospital experience hematogenous infections related to catheter use. Staphylococcus coagulase negative is the most isolated bacteria from the patient's blood culture. Precautions to reduce the risk of infection are needed and the proper blood culture samples must be carefully taken.

CONFLICT OF INTEREST

The author states the original work, and there is no conflict of interest in doing this research.

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