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Infection of Double Lumen Catheter as Hemodialysis Access

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Abstract

Introduction. One of the most common complications in vascular access was bacteremia or bloodstream infection. The purpose of this study was to know the infection rate in dialysis double lumen catheter (DLC) and it's relating factors.
Method. This was a cross–sectional analytical study that was carried out by enrolling all ≥18–year–old subjects who underwent surgical insertion of DLC for hemodialysis during 2015 in Cipto Mangunkusumo General Hospital, Jakarta. Variables of bloodstream infection, age, gender, diabetes mellitus, history of previous DLC infection, history of catheter related bacteremia, site of insertion and duration were subjected to statistical analysis. Significance achieved if p value <0.05.
Results. Out of all subjects, there were 19 (17.6%) subjects with bacteremia. Whereas, 5 (9.4%) subjects were those with tunneled DLC, and the remaining 14 (26.4%) were those with non–tunneled DLC. Factors found to be related with infection were the use of non–tunneled DLC (p = 0.043) and no history of previous DLC insertion (p = 0.038).
Conclusion. Tunneled DLC was found superior to non–tunneled one to prevent catheter related bacteremia. The use of non–tunneled DLC should be avoided as hemodialysis access.

Keywords: *Double lumen catheter, infection, influencing factors, hemodialysis access*

Introduction

When hemodialysis must be conducted immediately, a good stable vascular access is needed. Non–tunneled double lumen catheter (DLC) becomes the catheter of choice when the option for long–term access is not available.[1,2,3] The most common complication after the application of DLC is bloodstream infection and dysfunction due to formation of the thrombus.4 Studies in Turkey and the Netherlands reported that the complication of bloodstream infection or bacteremia after DLC insertion reached up to 23.9% and 22%, respectively.[5,6] In the United States of America, more than 300.000 individuals are dependent on hemodialysis, with the majority of them was caused by late stage kidney disease.[7] In Indonesia, there is no data describes the distribution of complication incidence of bloodstream infection related to DLC insertion, either tunneled or non–tunneled, as well as other related factors. This includes in dr. Cipto Mangunkusumo General Hospital, Jakarta, as a national referral hospital. Although during 2015 there were about 270 DLC insertion in our center. This study aimed to find out the incidence of infection as complication related to tunneled DLC compared to non–tunneled one and other related factors.

Method

This research designed as a cross sectional study to find out incidence of infection and factors related to those with DLC applied, either tunneled or non–tunneled; which was conducted from January 2016 to January 2017 in dr. Cipto Mangunkusumo General Hospital, Jakarta. The population targets in this research were those who underwent DLC insertion in dr. Cipto Mangunkusumo General Hospital, Jakarta. Accessible population was all subjects who underwent DLC insertion within the year of 2015.

Those aged ≥18–years–old were included, and those ≥18–years–old and insufficient medical records or no blood culture were excluded. The samples enrolled through a total sampling. The variables were infection, age, gender, diabetes mellitus, hypertension, body mass index, previous history of DLC for hemodialysis, previous history of bloodstream infection or bacteremia, site of insertion, type of DLC used, and duration of catheter use were analyzed using Chi–square and Fisher tests and were considered significant if p–score <0,05. The Ethical committee of Faculty of Medicine, Universitas Indonesia approved the research No. 792/UN2.F1/ETIK/2016. We also found authoritative license from research bureau of dr. Cipto Mangunkusumo General Hospital, Jakarta No. LB.02.01/X.2/1092/2016.

Results

There were 106 subjects met the inclusion criteria of the study. Out of all subjects with DLC, there were 19 (17.6%) subjects who developed catheter–related bacteremia. Among subjects who had tunneled DLC, there were 5 (9.4%) subjects who developed bacteremia. Meanwhile, among subjects who had non–tunneled DLC, there were 14 (26.4%) subjects who developed bacteremia

In the recent research, the majority of bloodstream infections were found in subjects with no previous history of DLC insertion (31.3%), subjects aged of >60 years–old (30.4%), those with history of diabetes mellitus (26.7%), those who had non–tunneled DLC

(26.4%), male (24.6%), those with catheter located on femoral vein (23.5%), those with history of hypertension (19.6%), history of previous catheter–related bacteremia (19%), those who had use the catheter for longer than two weeks period (18.8%) and those with total BMI between 18.5–25 and >25 (18.5%). Bivariate analysis between factors of bloodstream infections related to DLC application resulted in significant relationships for the non–tunneled DLC (p = 0.043) and no previous history of double–lumen catheter insertions (p = 0.038).

Table 1 Incidence of catheter–related bacteremia

Variable	Infection		No Infection		p	*OR (CI95%)*
Type of DLC	n	%	n	%		
• Non–tunneled	14	26.4	39	73.6	0.043	3.446 (1.141–10.406)
• Tunneled	5	9.4	48	90.6	1.00	
Total incidence of DLC	19	17.9	87	82.1		

Table 2. Factors related to bacteremia after double lumen catheter insertion

Variable	Infection		No Infection		P	*OR (CI95%)*
Type of double–lumen catheter	n	%	n	%		
• Non–tunneled						
• Tunneled	14	26.4	39	73.6	0.043	3.446 (1.141–10.406)
Gender	5	9.4	48	90.6	1.00	
• Male	14	24.6	43	75.4	0.095	2.865 (0.950–8.644)
• Female	5	10.2	44	89.8	1.00	
Age						
• >60 years old	7	30.4	16	69.6	0.076	2.589 (0.880–7.611)
• 18–60 years old	12	14.5	71	85.5	1.00	
Diabetes Mellitus						
• Yes	8	26.7	22	73.3	0.233	2.149 (0.766–6.025)
• No	11	14.5	65	85.5	1.00	
Hypertension						
• Yes	11	19.6	45	80.4	0.815	1.283 (0.471–3.499)
• No	8	16.0	42	84.0	1.00	
Body Mass Index						
• <18.5	2	14.3	12	85.7	0.552	0.735 (0.150–3.594)
• 18.5– 25 and >25	17	18.5	75	81.5	1.00	
History of previous catheter insertion for hemodialysis						
• Yes	9	12.2	65	87.8	1.00	
• No	10	31.3	22	68.8	0.038	0.305 (0.110–0.847)
History of previous bloodstream infections						
• Yes	4	19	17	81	0.550	1.098 (0.323–3.733)
• No	15	17.6	70	82.4	1.00	
Site of insertion						
• Femoral	12	23.5	39	76.5	0.232	2.110 (0.758–5.871)
• Jugular and Sub clavicular	7	12.7	48	87.3	1.00	
Duration of use						
• >2 weeks	16	18.8	69	81.2	0.450	1.391 (0.365–5.302)
• ≤2 weeks	3	14.3	18	85.7	1.00	

Discussion

The use of tunneled DLC was better than non–tunneled catheter due to lower number of complications of bloodstream infections or bacteremia. There were 14 (26.4%) subjects found with bloodstream infections after non–tunneled DLC insertion, while there were only 5 (9.4%) subjects who had catheter–related bacteremia. This result was consistent as was found in literature sources which stated that the incidence of infections after non–tunneled DLC insertion was higher compared to tunneled DLC insertion.[5,8,9,10] Per literatures, this was because the "cuff" on tunneled DLC. Dacron cuff is used as the anchor to place the catheter subcutaneously, where catheter will then be bound to connective tissue, making it more stable and there will be lesser chance for it to be displaced. The cuff also functions as the border wall to prevent migrations of microorganisms.[3]

The pathogenesis of bloodstream infections after catheter insertion is as following: after the catheter is applied, the surface of catheter is covered by plasma protein, especially fibrin. Bacteria migrates from the skin along the catheter and or from the catheter connectors and become engulfed in protein membrane, this process is known as colonization.[11] The criteria of bloodstream infections in this study was based on the criteria by KDOQI, which is positive blood culture result with or without clinical signs or symptoms.[12] This is because when observed from available medical records, the most common examination procedure was blood culture.

Overall, there were 17.6% subjects who had bloodstream infections after DLC insertion. This number is not so much different compared to the number of infections reported by a study in England in the year 2001 (16%); however, it differs with the results of the study in China in the year 2014, which stated that the number of catheters–related bloodstream infections was 38.6%. The difference was because larger proportion of elderly patients whose age over 60 years old and patients was diagnosed with diabetes mellitus in the study. Elderly patients and patients with diabetes mellitus had organs that function less well, more likely to suffer from malnutrition, and immunity disorders, which may increase the risks for infections.[11,13]

Meanwhile, factors associated with infection included non–tunneled DLC (p = 0.043) and no history of previous DLC application (p = 0.038). Subjects who had non–tunneled double lumen had 3.4 times higher possibility of catheter–related bacteremia than subjects who had tunneled DLC. Subjects with no history of previous DLC insertion had 0.3 times (protective factors) higher possibility of catheter–related bacteremia than subjects with previous history of DLC insertion. A study in the Netherlands in 2004 concluded non–tunneled DLC as the risk factor of infection, with possibility of three times higher than tunneled DLC with CI 95% range of 1.54–5.94.[14] Range of CI 95% in this research was 1.141– 10.406, therefore attention needed to be given. There was no previous research which explained the history of DLC insertion as the risk factors for infection, which unable the authors from making a comparison. The longest duration of infection in this study was more than two weeks. However, in this study, there was no significant relationship between the duration of infections and catheter application, which differed from another study which stated that duration of catheter use more than two weeks, was a risk factor for infection. Guidelines from KDOQI recommended the use of non–tunneled DLC for less than one week. Non–tunneled catheter was meant to be used for less than two weeks and must be replaced after reaching the time limit.[14] The difference was related to the small number of samples included in this study.

Double lumen catheter application related with incidence of infections was mostly found in subjects over 60 years old (30.4%). This result was like the previous study which reported that subjects with older age had higher risks for catheter–related bacteremia. Majority of infections occurred for catheter applied at femoral (23.5%). This result is consistent with the results of the study by Reyna (2014) and Borges (2015) which found that femoral location of catheter was related to higher rate of infections compared to jugular and subclavian sites. This was due to the amount of sweat accumulation and humidity of the area of application.[9,15,30] The same results also applied to combined location of application between internal jugular vein and subclavian vein, since femoral vein in theory was a factor for infection.[9,15]

On the other hand, there has not been a randomized clinical trial which had clearly studied the superiority of one location for application over the others. However, a few multivariate analyses mentioned that femoral locations represented higher rate of infections compared to jugular locations, and the risk of infections from jugular locations were higher than subclavian site. However, the articles failed to evaluate which variable was the most significant.[17,18] Older age, diabetes mellitus, hypertension, and BMI <18.5 were associated with irregular mechanism of body immunity in subjects diagnosed with late stage kidney disease.[8] Other variables such as gender, age, diabetes mellitus, hypertension, BMI, previous history of infections, and location of catheter application did not have significant relationships with the incidence of infections. These results were different with the results of a few previous studies which mentioned that risk factor of infections after DLC insertion included gender, obesity, diabetes mellitus, and previous history of infections.[8,10,19,20] Diabetes mellitus, which was generally believed as a risk factor for infections, were not proven as one.[12] Other researches mentioned that poor nutritional status and age were also independent risk factors for infections.[4,20] These differences in results was caused by different numbers of total samples with previous researches.

The limitations of this study were the limited numbers of samples and only observed infections in one period. The differences between this study and previous study was caused by different proportions of the type of DLC used, which depended on the number of a complete data. This limitation should become a focus of attention and improvements for further studies.

Conclusion

The incidence of acute DVT of lower extremity in our center is 65.88%. The highest sensitivity and negative predictive value of 100%found in combination score II and IV. The highest specificity of 89.66% and positive predictive value of 92.68% found in combination score III. The scores with balanced diagnostic value (sensitivity of 87.50%; specificity of 72.41%) found in Wells score 3 level I. Wells score showed efficacy comparable to VDUS in detection of acute DVT of lower extremity. It is necessarily to run validation of such a score in population of a primary health care.

Conflict of interest

Author disclose no conflict of interest.

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