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VASCULAR ACCESS EMERGENCIES IN THE DIALYSIS PATIENT IN NTB PROVINCIAL GENERAL HOSPITAL: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Hemodialysis (HD) is the most common renal replacement therapy modality in patients with CKD with a prevalence of up to 89%. One method to gain access to hemodialysis quickly is central venous catheterization using a double lumen catheter (CDL). However, the use of temporary CDLs increases the risk of complications such as thrombosis and infection. Currently, data related to CDL in NTB General Hospital is not available in full, both the incidence, germ patterns and antimicrobial sensitivity, causes of CDL emergencies and dysfunction. Researchers are interested in examining the factors that contribute to the incidence of emergency CDL insertion in HD patients at NTB General Hospital.

Method: This study was a retrospective observational study. The samples of this study were patients who performed double lumen hemodialysis catheter vascular access measures in the OK CITO room of the NTB Provincial Hospital taken was from January to March 2024.

Results and Conclusions: The total sample consisted of 60 (65.9%) males and 31 (34.1%) females. The majority of the samples were from the adult age group with 59 (64.8%) people. The location of CDL insertion was the dextra internal jugular vein 86 (94.5%), sinistra internal jugular vein 3 (3.3%) and femoral vein 2 (2.2%). The most common risk factor indicating CDL insertion was due to CDL detachment 24 (26.4%). it is necessary to recognize the signs of complications from kidney disease so that CDL insertion is carried out immediately as access to hemodialysis. In addition, CDL maintenance is also very required to ensure the smooth delivery of therapy and prevent complications that can complications that may arise from CDL use, especially in patients with long-term use and and to consider the use of other vascular access options.

Keywords: HD, CD

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INTRODUCTION

According to the National Institute of Diabetes and Digestive and Kidney Diseases, approximately 468,000 people in the United States are on dialysis-a number that continues to grow each year.1 Globally, the estimated number of individuals affected by CKD is 843.6 million. Recent data shows that globally the incidence and prevalence of CKD during 1990-2016 increased by 89 and 87% respectively, and reached 100% in countries with middle and low sociodemographic indices. There has been an estimated doubling in the number of deaths due to CKD in the last 3 decades, shifting CKD from the 18th leading cause of death in 1990 to the 11th in 2016.2 In addition, the rate of hemorrhagic complications due to arteriovenous fistula (AVF) in 1 year is estimated to be 0.4%. A study conducted by Ellingson et al. reported 1,654 deaths from fatal vascular access bleeding over a 6-year period, accounting for 0.4% of all hemodialysis (HD) patient deaths in the study.[3]

Hemodialysis (HD) is the most common renal replacement therapy modality in patients with CKD with a prevalence of up to 89%.4,5 In Indonesia, the Report of Indonesian Renal Registry reported that the number of new and active patients in Indonesia undergoing HD in 2018 has doubled. In 2017, there were 30,831 new patient cases and 77,892 active patients, while in 2018 there were 66,433 new patient cases and 132,142 active patients.[6]

Adequate hemodialysis relies on access to a large blood vessel capable of providing rapid and stable blood flow.7 Autogenous arteriovenous fistula (AVF) is the first choice as a permanent vascular access, but it requires a minimum period of six weeks to be used.8 One method to gain access to hemodialysis quickly is central venous catheterization using a double lumen catheter (CDL). CDLs are widely used for acute purposes as well as a bridge to more permanent vascular access such as a mature AVF.9 The use of temporary CDLs has several advantages, including practicality, quick insertion, allowing immediate use, and painlessness during dialysis.[10]

However, the use of temporary CDLs increases the risk of complications such as thrombosis and infection. CDL infections can cause catheter dysfunction and increase mortality by more than 50% and cause significant morbidity in the dialysis population.[1,7] Patients with CDL infections have been reported to have comorbid diseases, such as hypertension (58%), diabetes (21.7%), and other comorbidities.[11]

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In general, CDL infections are characterized by redness of the skin at the catheter insertion site, tenderness around the insertion site, and fever, but these symptoms and signs lack the specificity and sensitivity to diagnose catheter-related infections. Blood cultures taken from peripheral veins and central venous catheter tip cultures can be used to diagnose CDL-related infections.[1,9]

Several studies have shown that patients with CDL have higher mortality compared to patients undergoing dialysis with natural fistulas.12 In addition to increased mortality, it has been shown in several studies that HD patients with central venous catheter-associated infections suffer a huge economic burden due to prolonged and repeated treatment.9 Data shows that at least 80,000 cases are reported with central line-associated bloodstream infection (CLABSI) occurring in intensive care units every year.13 Bloodstream infections are the leading cause of readmission and the second leading cause of death in patients undergoing HD.[14]

Increased readmission rate is one of the impacts of CDL dysfunction in patients undergoing HD. Data from the US Renal System in 2011 showed that CDL infection increased the readmission rate to more than 43% with readmission rate increasing to 33%.[15]

Documentation related to CDL dysfunction is needed, especially in the hemodialysis unit, to provide an overview and reference for preventive strategies for the management of CDL-related infection cases. Currently, data related to CDL in NTB General Hospital is not available in full, both the incidence, germ patterns and antimicrobial sensitivity, causes of CDL emergencies and dysfunction as well as an analysis of the financing burden due to CDL-related infections and the high morbidity, mortality, and economic burden caused by catheter-related infections, researchers are interested in examining the factors that contribute to the incidence of emergency CDL insertion in HD patients at NTB General Hospital.

METHODS

This study was a retrospective observational study. The research was conducted at the NTB Provincial Hospital, especially in the OK CITO Room. The samples of this study were patients who performed double lumen hemodialysis catheter vascular access measures in the OK CITO room of the NTB Provincial Hospital. The sample time span taken was from January to March 2024. The sample size required was 91 people selected by consecutive sampling. Samples were taken from the register book of OK CITO at NTB Provincial Hospital. All patients who

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underwent temporary vascular access using CDL were included in this study.

This study assessed the association of risk factors present in patients with emergency and urgent vascular access using CDL. Patients who had been given CDL vascular access and recorded in the register were retrospectively reviewed for risk factors for emergencies and indications for vascular access in the emergency department.

RESULTS

The total sample consisted of 60 (65.9%) males and 31 (34.1%) females. The majority of the samples were from the adult age group with 59 (64.8%) people, followed by the elderly group with 31 (34.1%) people and there was only 1 (1.1%) from the adolescent group. The location of CDL insertion was the dextra internal jugular vein 86 (94.5%), sinistra internal jugular vein 3 (3.3%) and femoral vein 2 (2.2%). The most common risk factor indicating CDL insertion was due to CDL detachment 24 (26.4%). (Table 1)

Tabel 1. Karakteristik Sampel

Karakteristik	Rincian
Jenis Kelamin, N (%)	
Laki-laki	60 (65.9)
Perempuan	31 (34.1)
Usia, N (%)	
Remaja (13-19 tahun)	1 (1.1)
Dewasa (20-59 tahun)	59 (64.8)
Lansia (≥60 tahun)	31 (34.1)
Tempat insersi CDL, N (%)	
V. Jugularis Interna Dextra	86 (94.5)
V. Jugularis Interna Sinistra	3 (3.3)
V. Femoralis	2 (2.2)
Faktor Risiko, N (%)	
CDL terlepas	24 (26.4)
CDL macet	16 (17.5)
Infeksi CDL	7 (7.7)
Penurunan Kesadaran	14 (15.4)
General Weakness	12 (13.2)
Syok	9 (9.9)
Edema	6 (6.6)
Ketiadaan Akses Vaskuler Pro HD	3 (3.3)

DISCUSSION

In this study, the number of CDL pairings based on gender was 60 men and 31 women. This is similar to the prevalence of the 2018 Riskesdas which states that chronic kidney disease is more prevalent in men than women with a ratio of 3:1.[49]

In addition, based on age group, most of the patients who were fitted with CDL were elderly compared to adults and adolescents. This is associated with the diagnosis of kidney disease such as Chronic Kidney Disease (CKD) or End State-Renal Disease (ESRD). Epidemiologic data shows that chronic kidney disease can be found at any age, but elderly ≥ 60 years old

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have a higher risk of suffering from chronic kidney disease. The most common chronic kidney disease patients in Indonesia according to the Riskesdas report are in the age group of 65-74 years, with a higher incidence in men.[49]

In this study, almost all patients who underwent CDL insertion had a diagnosis of Chronic Kidney Disease (CKD) or End State-Renal Disease (ESRD). This is due to the use of CDL which is a temporary vascular access required for CKD or ESRD patients to undergo HD. According to guidelines from the National Kidney Foundation Dialysis Outcomes Quality Initiative (NKFDOQI)21,36, the recommended approach for CKD patients undergoing hemodialysis is to provide options with arteriovenous (AV) fistulas, as they can be used for longer periods of time, require fewer maintenance interventions, and provide lower infection rates. Even so, a significant number of patients have been fitted with CDLs mainly because hemodialysis can be started immediately after insertion. CDLs may be used in short-term applications, such as in emergency situations, or in long-term scenarios. The latter is indicated for patients with no other viable access options.21,36

In terms of vascular access emergencies with CDL insertion in patient, several risk factors as well as the patient's alarming clinical conditions indicate the need for immediate vascular access. In this study, the authors In this study, the authors categorized the patient's risk factors indicating CDL insertion to include, CDL detachment, CDL jamming, CDL infection, decreased consciousness, general weakness, shock, edema and absence of a CDL.

CDLs are thin, flexible tubes with two channels that are inserted into the central vein. There are several risk factors that may increase the chances of a double lumen catheter dislodging:

- Catheter size and type: If the catheter is too large for the vein, there is a high chance that the catheter will move and dislodge. Catheter material and catheter tip design also play a role.
- Improper insertion: If the catheter is not inserted correctly, there is a high chance that the catheter will come out.
- Patient movement: Patients who are agitated or coughing frequently are more likely to dislodge the catheter.
- Catheter infection: Infection can cause inflammation around the catheter, so it is catheter is more likely to come out.
- Tension on the catheter: If the tension on the catheter is too great, the catheter may be slip out of place. This can happen if the

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dressing is too tight, the patient's arm or leg moves too much, or if the patient coughs or vomits. the patient's arms or legs move too much, or if the patient coughs or vomits vigorously.

A thrombus can obstruct the CDL in several ways, thereby inhibiting its function and potentially cause complications. Several factors can trigger clot formation inside the catheter. These include: Catheter material: Certain catheter materials may be more prone to triggering clot formation than others. The insertion process itself can irritate the vein wall, creating a surface for platelets (blood clotting cells) to stick to and initiate clot formation. In addition, if the blood flow through the catheter slows down, the blood flow becomes stagnant. Stagnant blood clots more easily than flowing blood. This may occur due to dehydration or underlying conditions that affect blood flow. Location and impact of the blood clot: The location of the blood clot inside the catheter determines the specific way it hinders function: Lumen blockage: A clot can form and completely block one or both catheter lumens. This prevents the withdrawal of fluids, medications, or blood through the blocked lumen. One-way valve effect: Sometimes, the clot acts like a one-way valve. This may allow fluid flow into the vein through the catheter but block the flow of blood or medication out. This can impede blood flow in the vein and put pressure on it.

When examined closely, most of the risk factors that indicate CDL insertion are complications of CKD. Indicating CDL insertion are complications of CKD. Some of the complications highlighted in this study are decreased consciousness (especially due to uremic encephalopathy), general weakness, shock (especially sepsis shock), and edema.50 As kidney function deteriorates and more metabolic waste products accumulate in the blood, people may feel tired and generally weak and become less mentally alert. Some people lose their appetite and have shortness of breath. Anemia also contributes to general weakness. Uremic encephalopathy occurs in patients with acute or chronic renal failure once the estimated GFR (eGFR) decreases and remains below 15 mL/min. It is important to recognize signs and symptoms early, as untreated uremic encephalopathy can progress to unconsciousness to coma, while dialysis can quickly reverse symptoms.[50]

Regarding CDL insertion site selection, 86 patients had CDL insertion performed in the dextra internal jugular vein, 3 patients in the sinistra internal jugular vein and 2 patients in the femoral vein. As recommended in KDOQI, the most common catheter placement site is the internal jugular vein.

However, the literature mentions left subclavian stenosis as the most frequent alteration, as a result of the interaction between the subclavian vein and local bony structures.

CONCLUSION

A CDL is a thin, flexible tube with two channels that is inserted into the into a central vein and is used to deliver fluids, medications, and nutrients directly into the bloodstream. CDLs provide the temporary vascular access needed to undergo hemodialysis in patients with kidney disease. As the majority of CDL users are patients diagnosed with kidney diseases such as Chronic Kidney Disease (CKD) or End State-Renal Disease (ESRD), it is necessary to recognize the signs of complications from kidney disease so that CDL insertion is carried out immediately as access to hemodialysis. In addition, CDL maintenance is also very required to ensure the smooth delivery of therapy and prevent complications that can complications that may arise from CDL use, especially in patients with long-term use and and to consider the use of other vascular access options.

REFERENCES

1. National Institute of Diabetes and Digestive and Kidney Diseases. Kidney disease statistics for the United States. https://www.niddk.nih.gov/healthinformation/health-statistics/Pages/kidneydiseasestatistics-united-states.aspx. Accessed August 24, 2017.
2. Xie Y, Bowe B, Mokdad AH, et al. Analysis of the Global Burden of Disease study highlights the global, regional, and national trends of chronic kidney disease epidemiology from 1990 to 2016. Kidney Int. 2018;94(3):567-581. doi:10.1016/j.kint.2018.04.011
3. Ellingson KD, Palekar RS, Lucero CA, et al. Vascular access hemorrhages contribute to deaths among hemodialysis patients. Kidney Int. 2012;82(6):686-692. doi:10.1038/ki.2012.185
4. Thurlow JS, Joshi M, Yan G, et al. Global epidemiology of end-stage kidney disease and disparities in kidney replacement therapy. Am J Nephrol. 2021;52(2):98-107. doi:10.1159/000514550
5. Himmelfarb J, Vanholder R, Mehrotra R, Tonelli M. The current and future landscape of dialysis. Nat Rev Nephrol. 2020;16(10):573-585. doi:10.1038/s41581-020-0315-4
6. PERNEFRI. 11th Report Of Indonesian Renal Registry 2018.; 2018.

https://www.indonesianrenalregistry.org /data/IRR 2018.pdf

7. Hamid RS, Kakaria AK, Khan SA, et al. Safety and complications of doublelumen tunnelled cuffed central venous dialysis catheters: Clinical and radiological perspective from a tertiary centre in Oman. Sultan Qaboos Univ Med J. 2015;15(4):e501-e506. doi:10.18295/squmj.2015.15.04.010

8. Aydin Z, Gursu M, Uzun S, et al. Placement of hemodialysis catheters with a technical, functional, and anatomical viewpoint. Int J Nephrol. 2012;2012. doi:10.1155/2012/302826

9. Ali M, Das B, Kumar S, Memon R, Dayu B, - B. Catheter related infection in hemodialysis patients with double lumen catheter. Prof Med J. 2019;26(08):1278-1282. doi:10.29309/tpmj/2019.26.08.3869 4 5

10. Ribeiro DF, Cesarino CB, Ismael M, Aparecida S. WCN 2007 / Nursing Meeting Survey about infection at the site of a double-lumen catheter insertion Rita de Cássia Helú Mendonça Ribeiro 1 , Graziella Allana Serra Alves de Comittee of the Medical Faculty of São José do Rio. 2008;21:212-215.

11. Schwanke AA, Danski MTR, Pontes L, Kusma SZ, Lind J. Central venous catheter for hemodialysis: incidence of infection and risk factors. Rev Bras Enferm. 2018;71(3):1115-1121. doi:10.1590/0034-7167-2017-0047

12. Van Der Meersch H, De Bacquer D, Vandecasteele SJ, et al. Hemodialysis catheter design and catheter performance: A randomized controlled trial. Am J Kidney Dis. 2014;64(6):902-908. doi:10.1053/j.ajkd.2014.02.017

13. Mermel LA, Allon M, Bouza E, et al. Clinical Practice Guidelines for the Diagnosis and Management of Intravascular Catheter-Related Infection. ClinInfectDis. 2014;49(1):1-45. doi:10.1086/599376.Clinical

14. Menegueti MG, Betoni NC, Bellissimo-Rodrigues F, Romão EA. Central venous catheter-related infections in patients receiving short-term hemodialysis therapy: Incidence, associated factors, and microbiological aspects. Rev Soc Bras Med Trop. 2017;50(6):783-787. doi:10.1590/0037-8682-0438-2017

15. Soi V, Moore CL, Kumbar L, Yee J. Prevention of catheter-related bloodstream infections in patients on hemodialysis: Challenges and management strategies. Int J Nephrol Renovasc Dis. 2016;9:95-103. doi:10.2147/IJNRD.S76826

16. Dixon BS, Dember LM. Vascular Acces. In: Chandraker A, Mehrotra R,

O'Hare AM. Chronic Kidney Disease, Dialysis, and Transplantation. 3rd ed. Philadelphia: Elsevier Saunders; 2010.p.303-19.

17. Abbas SA, Haloob IA, Taylor SL, Curry EM, King BB, Van der Merwe WM, Marshall MR: Effect of antimicrobial locks for tunneled hemodialysis catheters on bloodstream infection and bacterial resistance: a quality improvement report. Am J Kidney Dis 2009, 3: 492–502

18. Cho S K, Shin S W, Do Y S, Park K B, Choo S W, Choo I W. Use of the right external jugular vein as the preferred access site when the right internal jugular vein is not usable. J Vasc Interv Radiol. 2006;17(5):823–829.

19. Mai H, Zhao Y, Salerno S, et al. Citrate versus heparin lock for prevention of hemodialysis catheter-related complications: updated systematic review and metaanalysis of randomized controlled trials. Int Urol Nephrol. 2019;51(6):1019-1033. doi:10.1007/s11255-019-02150-0

20. Jain G, Allon M, Saddekni S, Finkel JB, Maya ID. Does Heparin Coating Improve Patency or Reduce Infection of Tunneled Dialysis Catheters?. Clin J Am Soc Nephrol 2009;4: 1787–90

21. Lok CE, Huber TS, Lee T, et al. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020;75(4):S1-S164. doi:10.1053/j.ajkd.2019.12.001

22. Saran KA, Sabry A, Alghareeb A, Molhem A. Central Venous CatheterRelated Bacteremia in Chronic Hemodialysis Patients : Saudi Single Center Experience. J Nephrol Therapeutic 2011; 1:105. doi:10.4172/2161-0959.1000105

23. Feely T, Coppley A, Bleyer AJ: Catheter lock solutions to prevent blood stream infections in high risk HD patients. Am J Nephrol 2007; 27: 24–29

24. Holden RM, Harman GJ, Wang M, Holland D, Day AG. Major bleeding in hemodialysis patients. Clin J Am Soc Nephrol. 2008 Jan;3(1):105-110. doi:10.2215/CJN.01810407.

25. Elliott MJ, Zimmerman D, Holden RM. Warfarin anticoagulation in hemodialysis patients: a systematic review of bleeding rates. Am J Kidney Dis. 2007;50(3):433-440. doi:10.1053/j.ajkd.2007.06.017.

26. Jubelirer SJ. Hemostatic abnormalities in renal disease. Am J Kidney Dis. 1985;5(5):219-225.

27. Salvati F, Liani M. Role of platelet surface receptor abnormalities in the bleeding and thrombotic diathesis of uremic patients on hemodialysis and peritoneal dialysis. Int J Artif Organs. 2001;24(3):131-135.

28. Kaw D, Malhotra D. Platelet dysfunction and endstage renal disease. Semin Dial. 2006;19(4):317-322. doi:10.1111/j.1525-139X.2006.00179.x.

29. Hedges SJ, Dehoney SB, Hooper JS, Amanzadeh J, Busti AJ. Evidence-based treatment recommendations for uremic bleeding. Nat Clin Pract Nephrol. 2007;3(3):138-153. doi:10.1038/ncpneph0421.

30. Thekkedath UR, Chirananthavat T, Leypoldt JK, Cheung AK, Mohammad SF. Elevated fibrinogen fragment levels in uremic plasma inhibit platelet function and expression of glycoprotein IIb-IIIa. Am J Hematol. 2006;81(12):915-926. doi:10.1002/ ajh.20720

31. Padberg FT, Calligaro KD, Sidawy AN. Complications of arteriovenous hemodialysis access: recognition and management. J Vasc Surg. 2008;48(5 Suppl):S55-S80. doi:10.1016/j.jvs.2008.08.067.

32. Lohr JW, Schwab SJ. Minimizing hemorrhagic complications in dialysis patients. J Am Soc Nephrol. 1991;2(5):961-975.

33. Yang TH, Lee CH, Tsai CS, Tsai YT. Successful surgical treatment of a rupture to an arteriovenous fistula aneurysm. Cardiovasc J Afr. 2009;20(3):196-197.

34. Caksen HH, Odabaş D, Arslan S, Kaya A. Spontaneous rupture of arteriovenous fistula in a chronic dialysis patient. J Emerg Med. 2003;24(2):224-225. doi:10.1016/S0736-4679(02)00744-8.

35. Saeed F, Kousar N, Sinnakirouchenan R, Ramalingam VS, Johnson PB, Holley JL. Blood loss through AV fistula: a case report and literature review. Int J Nephrol. 2011;2011:350870. doi:10.4061/2011/350870.

36. NKFKDOQI Guidelines. Clinical practice guidelines for vascular access. Guideline 5. Treatment of fistula complications. Available at http://www2.kidney.org/professionals/kdoqi/guideline_uphd_pd_va/va_guide 5.htm. Accessed August 24, 2017.

37. Gill JR, Storck K, Kelly S. Fatal exsanguination from hemodialysis vascular access sites. Forensic Sci Med Pathol. 2012;8(3):259-262. doi:10.1007/s12024- 011-9303-0

38. Salman L, Beathard G. Interventional nephrology: physical examination as a tool for surveillance for the hemodialysis arteriovenous access. Clin J Am Soc Nephrol. 2013;8(7):1220-1227. doi:10.2215/CJN.00740113

39. Schild AF, Perez E, Gillaspie E, Seaver C, Livingstone J, Thibonnier A. Arteriovenous fistulae vs. arteriovenous grafts: a retrospective review of 1,700 consecutive vascular access cases. J Vasc Access. 2008;9(4):231-235.

40. Maya ID, Oser R, Saddekni S, Barker J, Allon M. Vascular access stenosis: comparison of arteriovenous grafts and fistulas. Am J Kidney Dis. 2004;44(5):859-865.

41. Ocak G, Verduijn M, Vossen CY, et al. Chronic kidney disease stages 1-3 increase the risk of venous thrombosis. J Thromb Haemost. 2010;8(11):2428-2435. doi:10.1111/j.1538-7836.2010.04048.x.

42. Asif A, Leon C, Orozco-Vargas LC, et al. Accuracy of physical examination in the detection of arteriovenous fistula stenosis. Clin J Am Soc Nephrol. 2007;2(6):1191-1194. doi:10.2215/CJN.02400607.

43. Tessitore N, Bedogna V, Melilli E, et al. In search of an optimal bedside screening program for arteriovenous fistula stenosis. Clin J Am Soc Nephrol. 2011;6(4):819-826. doi:10.2215/CJN.06220710.

44. Dhamija R, Nash SK, Nguyen SV, Slack K, Tadeo J. Monitoring and surveillance of hemodialysis vascular access using StenTec and physical exam. Semin Dial. 2015;28(3):299-304. doi:10.1111/sdi.12311.

45. Lafrance JP, Rahme E, Lelorier J, Iqbal S. Vascular access-related infections: definitions, incidence rates, and risk factors. Am J Kidney Dis. 2008;52(5):982-993. doi:10.1053/j.ajkd.2008.06.014.

46. Benrashid E, Youngwirth LM, Mureebe L, Lawson JH. Operative and perioperative management of infected arteriovenous grafts. J Vasc Access. 2017;18(1):13-21. doi:10.5301/jva.5000613

47. Lazarides MK, Georgiadis GS, Argyriou C. Aneurysm formation and infection in AV prosthesis. J Vasc Access. 2014;15 Suppl 7(Suppl. 7):S120-S124. doi:10.5301/jva.5000228.

48. Al-Thani H, El-Menyar A, Al-Thani N, et al. Characteristics, management, and outcomes of surgically treated arteriovenous fistula aneurysm in patients on regular hemodialysis. Ann

LOMBOK HEALTH and SCIENCE JOURNAL
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Published in July 2024, included in Vol.1 (2024) : LHSJ July 2024 (32-43)

Vasc Surg. 2017;41:46-55. doi:10.1016/j.avsg.2016.08.046

49. Kementerian Kesehatan RI. Laporan Riskesdas 2018 Nasional. 2018. http://repository.bkpk.kemkes.go.id/3514/1/Laporan%20Riskesdas%202018%20Nasional.pdf

50. GBD Chronic Kidney Disease Collaboration. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395:709–33 DOI:https://doi.org/10.1016/S0140-6736(20)300453