Arteriovenous Fistula Stenosis: A Case Report

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ABSTRACT

Background: Arteriovenous fistula (AVF) has better rate of patency and lower rate of complication compared to other vascular access for hemodialysis. One priority to be concerned is access failure for hemodialysis access is common findings and correspond with high healthcare cost, morbidity and mortality.

Objective: This case report aimed to elaborate the proper management of patient with arterio fistula stenosis.

Case Illustration: A man, 64 years old, stage V CKD with AVF in his left arm for hemodialysis access was admitted to our hospital due to difficulty in cannulation during his last hemodialysis. He had AVF For Hemodialysis access for two years. About 1 month before, he undergone surgery for creation of AVF for hemodialysis access in his right arm, but AVF was failed to reach maturation. Based on vascular doppler ultrasound (DUS) done in AVF of the left arm revealed there was stenosis in the juxta-anastomosis site and cephalic venous stenosis. Angioplasty was done in anastomose AVF and implantation of venous stent in the left cephalic vein.

Conclusion: For patients on hemodialysis, vascular access is considered as the lifeline. Complications related to Vascular access is associated with morbidity and reduced quality of life. Surgery often difficult to do as readily as a percutaneous approach. In more than 80% of hemodialysis access underwent percutaneous interventions, flow was successfully restored. Based on this success rate, it has replaced surgical revision as the treatment of stenosis AVF.

1. Introduction

Complications related to vascular access is associated with morbidity and reduced quality of life. the main problem for patients undergoing hemodialysis is dysfunction of hemodialysis access. The common cause of this is venous stenosis. The site AVF tend to develop stenosis is at the juxta-anastomosis site and the outflow vein. The first line management of AVF stenosis is balloon angioplasty, with stent placement is only done is special circumstances.

2. Case Illustration

A 64 years old man with stage V CKD with AVF in his left arm for hemodialysis access was admitted to our hospital due to difficulty in cannulation during his last hemodialysis. He had AVF For Hemodialysis access since two years ago. About 1 month before, he undergone surgery for creation of AVF for hemodialysis access in his right arm, but AVF was failed to reach maturation. Based on vascular ultrasound done in AVF of the left arm revealed there was stenosis in the juxta-anastomosis site and cephalic venous stenosis. Angioplasty was done in anastomose AVF and implantation of venous stent in the left cephalic vein.

3. Discussion

3.1 Epidemiology

From 11th Indonesian Renal Registry 2018, patients with Stage 5 CKD show a consistent increase in the number of new and active patients.¹ Globally, in 2017, there were 697.5 million cases of CKD. In 2017, estimated prevalence of CKD was at 9·1% in the world’s population.² It was approximated that the total CKD patients would be doubled from 2010 to 2030 will received Renal Replacement Therapy (RRT). Asia will have the largest growth in the number of patients receiving RRT rising from almost one million patients in 2010 to slightly over 2 million patients by 2030.

3.2 Dysfunction of arteriovenous access: Pathophysiology

There is intricate process that involved in the pathogenesis of...
of vascular access dysfunction. The collective pathway is combination of neointimal hyperplasia, vascular remodeling inwardly, and impaired vessel vasodilation that has consequence of narrowing of the lumen and associated with formation of thrombosis. The most site in AVF failure is at the perianastomotic region. The pathophysiologic events leading to AVF failure was categorized into upstream events and downstream events.6,7,8

3.3 Diagnosing AVF Stenosis

The reasons for implementing vascular access monitor and surveillance routinely, are to find and repair AVF stenosis, to improve AVF access function, to reduced or avert dampen dialysis clearance, and also to lower the rate of thrombosis. Physical examination is one of the clinical monitoring strategies that ideally done when the patient is not on dialysis. This requires minimal training, takes minimal equipment and time, is cost-efficient, and readily available. When performed by experienced medical staff, physical examination of vascular access has high sensitivity and specificity (Table 1).10

The basis of vascular access surveillance is to better the patency of the vascular access and to find and repair stenosis within the
vascular access. Clinical parameter connected with vascular access stenosis (Table 2) including indicators on physical examination, high arterial and venous pressures at the specified blood flow, impaired dialysis clearance without known cause, and exaggerate bleeding after needle withdrawal. Surveillance procedures, with specialized equipment, have been considered effectively to find AVF stenosis before the growth of a clinical indicator.10

When routine monitoring suggested a clinically important AVF stenosis, the diagnostic approach is required to investigate underlying lesion (i.e., venous outflow, anastomosis, arterial inflow). DUS can be helpful to examine vascular access from arterial anastomosis to peripheral venous section and help deciding the causes of thrombotic flow-related complication. Percutaneous arteriography and venography can surely image from the anastomosis of AV access to the heart or peripheral venous section and help decide the causes of thrombotic flow-related complication. Percutaneous arteriography and venography can surely image from the anastomosis of AV access to the heart or peripheral venous section.

3.4 Upper Extremity DUS for evaluation of AVF dysfunction

In dysfunction of hemodialysis vascular access, decreased blood flow in main finding. DUS evaluation of AVF was performed to detect stenosis, flow limitation within AVF, and progression of thrombosis.

First evaluation with DUS is using greyscale imaging to measure diameter of fistula and stenosis. Significant stenosis is defined as narrowing of lumen. >50% compared with normal vascular segments situated upstream from stenosis segment. Continuum with color and spectral Doppler imaging in long axis plane, peak systolic velocity (PSV) at anastomosis is compared with PSV that was taken in feeding artery 2 cm upstream from anastomose. Ratio of PSV taken from anastomose and artery 2 cm upstream, above 2:1 was proposed as the growth of a clinical indicator.

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Table 2. Clinical Indicators (Signs and Symptoms) Suggesting Underlying Clinically Significant Lesions During Access Monitoring.10

| Procedures | Clinical Indicators |
|------------|---------------------|
| Physical examination or check | Alterations in the pulse, with a weak or resistant pulse, difficult to compress, in the area of stenosis |
| | Abnormal thrill (weak and/or discontinuous) with only a systolic component in the region of stenosis |
| | Abnormal bruit (high pitched with a systolic component in the area of stenosis) |
| | Failure of the fistula to collapse when the arm is elevated (outflow stenosis) and lack of pulse augmentation (inflow stenosis) |
| | Excessive collapse of the venous segment upon arm elevation |

| Dialysis | Aspiration of clots |
|----------|---------------------|
| | New difficulty with cannulation when previously not a problem |
| | Inability to achieve the target dialysis blood flow |
| | Prolonged bleeding beyond usual for that patient from the needle puncture sites for 3 consecutive dialysis sessions |
| | Unexplained (>0.2 units) decrease in the delivered dialysis dose (Kt/V) on a constant dialysis prescription without prolongation of dialysis duration |

3.5 Treatment of Clinically Significant AV Access Stenosis

If there was thrombosis occurred or imminent, suggested from findings done in monitoring or surveillance, angiographic evaluation is usually recommended. Referral for urgent angiographic can be done if access thrombosis is found. Contraindications of angiographic procedure are infected access, pulmonary hypertension, surgical revision less than 30 days before referral, and presence of right to left shunt.9

Endovascular treatment of AVF stenosis is both safe and effective. When performed in dedicated center, has high success rates and low complication rates, and has better of primary and secondary patency rate. The Society of Interventional Radiology (SIR) and Kidney Disease Outcomes Quality Initiative (K-DQI) have guidelines in angiography procedure for acceptable success and patency rates in AVF. Stenosis is regarded as significant if there is more than 50% stenosis of diameter vessel, anatomical success is determined when there are less than 50% residual stenosis, and functional success is decided if there is success using the AVF for HD, or the AVF is mature by DUS examination.13

Based on the available evidence, there is an algorithm attempt to define practical factors of each individual technology. Figure 4 outlines the primary steps for salvage management of dysfunctional or thrombosed AVF access using percutaneous intervention. Percutaneous catheter-directed thrombolysis, and thrombectomy with the AngioJet or another catheters, is management of choice for re-define flow in AVF thrombosis. In case of patent but failing circuits, after blood flow has been successfully restored, any unmarked or identified AVF stenosis need to be attend to repair functional adequacy of hemodialysis.14,15

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3.6 Management of Antithrombotic after Venous Stenting

There is still no consensus or guideline for management therapy of antithrombotic after venous stent placement to prevent stent thrombosis (ST) or in stent restenosis (ISR). In the post-procedural setting, anticoagulant and/or antiplatelet are used to reduced the ST/ISR and recurrent stent thrombosis. There is wide variability of prescribing pattern in choosing antithrombotic regimens and the duration of therapy. There is possible benefit of triple therapy compared to antiplatelet or dual antiplatelet alone in lowering ST/ISR rate, although the comparison of bleeding risk between these treatments is not yet been investigate.

Application of anticoagulant practice in this setting was adopted from experience in managing venous thromboembolism with tendency to choose low molecular weight heparin and vitamin K antagonist. The practice of antiplatelet agents is extrapolated from experience with implantation of arterial stents. Nevertheless, there is difference in underlying mechanism of luminal stenosis that occurs in venous stent and arterial stent. Stenosis of venous stents occurs in low flow and low shear systems, while stenosis of arterial stents is in high flow and high shear systems.16

To date there still no guidelines consensus to regulate use of anticoagulation after venous stenting. However, a recent study showed a consensus that the use anticoagulation is prefer for the first 6–12 months post venous stenting. For those who have history of multiple deep venous thromboses, a lifelong anticoagulation is recommended. For practice considering use of anticoagulation and antiplatelet therapy after venous stenting was based of experience with arterial stenting. As
previously described, vessel characteristic and flow hemodynamics difference between vein and arterial systems, are factors that distinguish underlying pathophysiology.

A retrospective study showed better stent patency in patient take anticoagulant along with antiplatelet versus anticoagulation alone. Another retrospective study, measures effectiveness of triple therapy (anticoagulant and DAPT) versus DAPT only, exhibit fewer rate of ST/ISR in triple therapy group, with similar major bleeding events between these groups.17

4. Conclusion

In treating hemodialysis patient with AVF dysfunction, literature strongly support percutaneous salvage over surgery as preferable treatment. The advantages of percutaneous intervention are minor discomfort, immediate post-operative use of the AVF, lower infection rates, and reduced operating times and days in the hospital. AVF dysfunction is still prevalent in patient undergone salvage procedure, although several differential percutaneous intervention approach have already been established.

5. Declarations

5.1. Ethics Approval and Consent to participate

This study was approved by local Institutional Review Board, and all participants have provided written informed consent prior to involve in the study.

5.2. Consent for publication

Not applicable.

5.3. Availability of data and materials

Data used in our study were presented in the main text.

5.4. Competing interests

Not applicable.

5.5. Funding source

Not applicable.

5.6. Authors contributions

Idea/concept: SW. Design: DW. Control/supervision: NK, SW, AR. Data collection/processing: SW. Extraction/Analysis/interpretation: SW, NK, SW, AR. Literature review: NK, SW, AR. Writing the article: SW, NK, SW, AR. Critical review: NK, SW, AR. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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References

1. PERNEFRI. (2018). 11th Report Of Indonesian Renal Registry 2018 Pendahuluan. Irr, 1–46. Retrieved from https://www.indonesian-renalregistry.org/data/IRR 2018.pdf

2. Bikbov, Boris, et al. "Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017." The Lancet 395.10225 (2020): 709-733.

3. Liyanage, Thaminda, et al. "Worldwide access to treatment for end-stage kidney disease: a systematic review." The Lancet 385.9981 (2015): 1975-1982.

4. Schmidli, Jürg, et al. "Vascular Access: 2018 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS) 5." European Journal of Vascular and Endovascular Surgery (2018).
5. Thabet, Bahgat Abd El-Hamed, et al. "Complications of arteriovenous fistula in dialysis patients at Assiut University Hospital." Journal of Current Medical Research and Practice 2.2 (2017): 119.

6. Hudson, Rebecca, David Johnson, and Andrea Viecelli. "Pathogenesis and Prevention of Vascular Access Failure." Vascular Access Surgery-Tips and Tricks. IntechOpen, 2019.

7. Duque, Juan C., et al. "Dialysis arteriovenous fistula failure and angioplasty: intimal hyperplasia and other causes of access failure." American Journal of Kidney Diseases 69.1 (2017): 147-151.

8. Roy-Chaudhury, Prabir, Vikas P. Sukhatme, and Alfred K. Cheung. "Hemodialysis vascular access dysfunction: a cellular and molecular viewpoint." Journal of the American Society of Nephrology 17.4 (2006): 1112-1127.

9. Bitri, John A. "Catheter interventions for hemodialysis fistulas and grafts." JACC: Cardiovascular Interventions 3.1 (2010): 1-11.

10. Lok, Charmaine E., et al. "KDOQI clinical practice guideline for vascular access: 2019 update." American Journal of Kidney Diseases 75.4 (2020): S1-S164.

11. Beathard, Gerald A., Techniques for angioplasty of the arteriovenous hemodialysis access. (2017)

12. AIUM Practice Parameter for the Performance of Vascular Ultrasound Examinations for Postoperative Assessment of Hemodialysis Access. (2020). Journal of Ultrasound in Medicine

13. Abreo, Kenneth, Mary Buffington, and Bharat Sachdeva. "Angioplasty to promote arteriovenous fistula maturation and maintenance." The journal of vascular access 19.4 (2018): 337-340.

14. Agarwal, Shiv Kumar, et al. "Comparison of cutting balloon angioplasty and percutaneous balloon angioplasty of arteriovenous fistula stenosis: A meta-analysis and systematic review of randomized clinical trials." Journal of interventional cardiology 28.3 (2015): 288-295.

15. Vasanthamohan, Lakshman, Prasaanthan Gopee-Ramanan, and Sriharsha Athreya. "The management of cephalic arch stenosis in arteriovenous fistulas for hemodialysis: a systematic review." Cardiovascular and interventional radiology 38.5 (2015): 1179-1185.

16. Lin, C., Martin, K. A., Wang, M., Stein, B. L., & Desai, K. R. (2018). Long-term antithrombotic therapy after venous stent placement. Blood, 132(Supplement 1), 1249-1249.

17. Xiao, N. and Desai, Kush R. Antithrombotic Therapy after Venous Stent Placement. Vascular & Endovascular Review 2020;5:e10.