Angioplasty in CKD patients with immature AV fistula: A Case Report

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Background
Patients with end-stage chronic kidney disease (CKD) must undergo renal replacement therapy, such as hemodialysis. With chronic hemodialysis, patients must have proper vascular access; arteriovenous fistula (AVF) is the preferred type of access due high prevalence of infection and other complications and mortality for central venous catheter (CVC).\(^1\) Compared to arteriovenous graft (AVG), AFV provided longer lasting patency and lower morbidity and mortality.\(^2\) There are three aspects in the establishment of an AVF, which are AVF surgery, AVF maturation, and AVF function.\(^3\) The surgical procedure for AVF involves the anastomosis of the selected vein to adjacent artery.\(^3\) The maturation of AVF is evaluated using the rule of 6; after 4-6 weeks, diameter of 6 mm, less than 6 mm distance from body surface, and flow of over 600 ml/min.\(^3\) The success of AVF function is then evaluated through its ability to be used as dialysis vascular access and repeated cannulation.\(^3\) Primary AVF failure is defined as AVF that cannot be used or failed to be used as hemodialysis vascular access under 3 months post-surgery. Risk factors for primary AVF failure is advanced age, obesity, female gender, diabetes with or without peripheral arterial disease or coronary disease, and of African descent.\(^4\) The management of venous stenosis in AVF failure can be done through surgical procedure or percutaneous intervention. Percutaneous intervention has the advantage of lower risk of complication compared to surgical procedures; however, there’s still 15% risk of restenosis.\(^7\)
Case Illustration

A 59 year-old female patient was admitted with end-stage renal disease for 6 months and type 2 diabetes mellitus (T2DM). Patient had had T2DM for 20 years and blood glucose was controlled with oral anti-diabetics and switched to basal insulin three years ago. Immediately after diagnosed with ESRD, the patient had central vein access for dialysis. The patient had underwent surgery for left radiocephalic AVF 5 months prior, however upon examination using Doppler ultrasound the diameter of the fistula was 3 mm and the blood flow was 160 ml/minute, not adequate as a vascular access. The patient was then planned to have venography and angioplasty.

Figure 1. Doppler ultrasound imaging of AVF prior to angioplasty

Before the procedure, patient fasted for 4 hours and antihypertensive medications was administered as scheduled. The venography and angioplasty procedure was performed using local anesthesia. The procedure started with the insertion the venous segment of the AVF using intravenous cannula Abbocath 18 G. Afterwards, RADIOFOCUS™ Guidewire M 0.035 “ (0.89 mm) 50 cm was introduced through the cannula and aimed at the stenosis. After the cannula was released, PRELUDE® sheath introducer 6 French 11 cm was inserted through the guidewire. After the introducer was properly inserted, the guidewire was removed and the introducer was fixated. Contrast was then administered to visualize the lesion, which was a stenosis in the proximal venous limb adjacent to the fistula.

RADIOFOCUS™ Guidewire M 0.035 “ (0.89 mm) 150 cm was then inserted through the introducer sheath until it passed the location of stenosis. Balloon angioplasty using Boston scientific MUSTANG™ 4.0 mm x 40 mm 135 cm was inserted over guide wire and the balloon segment was placed in the middle of the lesion. Balloon dilatation was done with the pressure of 10 atm, 15 atm, and 20 atm, 3 minutes each.

Figure 2. Venography images prior to angioplasty
Figure 3. Baloon dilatation using a) 10 atm, b) 15 atm, and c) 20 atm pressure
Post angioplasty Doppler evaluation showed volume blood flow of 200 ml/min and venous diameter was 4 mm. Four weeks after the procedure, the AVF was evaluated clinically and showed dilated vein diameter with adequate thrill. When used as a vascular access for hemodialysis, the AVF produced Qb of 250 ml/min and the patient managed to achieve KT/V of 1.3.

Discussion

The patient had increased risk for AVF failure due to age, gender, and 20 years of T2DM. The use of Doppler ultrasound and venography was enough to provide the information needed for percutaneous angioplasty procedure, for these imaging modalities were proven to be economically efficient and clinically sensitive and effective. The balloon should be 20-30% larger than the normal vessel diameter judged by comparison with the vessel lumen adjacent to the lesion. The use of balloon with 4-8 mm diameter was deemed appropriate for the AVF stenosis. The balloon for radiocephalic fistula is usually 4-6 mm. When procedure was performed, in the radiology cathlab only available is a 4 mm diameter balloon catheter. But because this was a primary failure, where the AV shunt failed to mature, the dilation of the stenotic lesion was expected to make the outflow segment further dilated. A month afterwards the AV shunt matured and produced Qb of 200 ml/minute on the HD machine, despite being below 600 ml/min this blood flow was adequate for patient’s KT/V target of 1.3. The pressure administered for angioplasty ranges from 5 atm to 40 atm with mean pressure below 20 atm. Although according to previous studies there’s no significant difference between the duration of 1 minute and 3 minutes of pressure time, 3 minutes was used to ensure adequate dilatation.

The National Kidney Foundation (NKF/KDOQI) recommends the threshold of over 30% for post-procedural restenosis to be deemed as failure of angioplasty. In this case, the restenosis was minimal and thus the AVF managed to provide adequate diameter and blood flow for vascular access 4 weeks after the procedure.

This case might be a usual procedure in the case of AV shunt stenosis. However, this procedure is quite uncommon in Indonesia, especially in areas with limited access to necessary equipment for the procedure. Hopefully this case will encourage clinicians and stakeholders to embrace a new era of developing endovascular interventions for AV shunts in Indonesia.

Summary

A 59-year-old woman was diagnosed with end-stage CKD with failing AVF due to stenosis in the proximal venous limb of the left radiocephalic fistula. Angioplasty was then performed to repair the stenosis using 4 mm balloon dilatation with 10, 15, and 20 atm pressure, 3 minutes each. After the procedure, the fistula exhibit minimal restenosis. Upon evaluation 4 weeks after the procedure, the fistula showed clinically dilated vein and adequate thrill. The fistula produced Qb of 250 ml/min and the patient managed to achieve KT/V of 1.3.

References


