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Percutaneous transluminal angioplasty procedure for central venous stenosis inpatient undergoing hemodialysis in Pelni Hospital: case series



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ABSTRACT

Introduction: Many causes leads to kidney impairment. This does not rule out the increasing number of patients undergoing hemodialysis. The common vascular access used during hemodialysis is an arteriovenous fistula (AVF). The arteriovenous fistula was preferred because it lasts longer and has a lower risk of infection for vascular access, meanwhile central venous stenosis or occlusion in the vein that carries the blood from the extremities to the heart often occur. If vascular access is still used during hemodialysis in which central venous stenosis is formed, it needs to make a new vascular access option. Percutaneous transluminal angiography (PTA) main objectives are to dilate the venous lesion that has occlusion more than 50% and extending the lifespan of arteriovenous fistula. In this case, we report six patients hemodialysis with central venous stenosis treated with percutaneous transluminal angiography. This procedure has benefits that are arteriovenous fistula can be used again to reach hemodialysis adequacy optimally and reduce pain and swelling in the arms.

Case description: There six cases who were 45,48,57,58,63 and 66 years old who underwent percutaneous transluminal angioplasty procedures for central venous stenosis. Several past illnesses of the patients underlying the kidney impairment such chronic hypertension, chronic coronary heart complications, and/or diabetes. Several patients felt AVF swollen and/or painful. Minimal residual stenosis after balloon angioplasty was performed.

Conclusion: According to our cases, patients that underwent the hemodialysis felt swollen or/and pain due to stenosis ballooning angioplasty help minimize the residual stenosis.

Keywords: Central venous stenosis, hemodialysis, percutaneous transluminal angioplasty.

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INTRODUCTION

The main of kidney function is to filter the water and wastes in the body. Impairment of the kidney such as chronic kidney diseases (CKD) stages four (GFR, 30 mL/min/1.73 m²) leads the kidney to not function normally. Interestingly, appropriate management should be approach to prevent the disease progression to end-stage of renal disease (ESRD). Thus hemodialysis is needed to help. More over, life-threatening hyperkalemia, hypervolemia causing end-organ complications (e.g., pulmonary edema), refractory acidosis or any toxic ingestion are other condition to initiate the hemodialysis.¹ Many causes leads to kidney impairment. This does not rule out the

increasing number of patients undergoing hemodialysis. Evaluation of Gaipov study since 2014-2018 revealed 98,7% patients with hemodialysis management related ESRD.² Other study established 201 patients underwent hemodialysis with diabetic and hypertension previous story.³

The vascular access for hemodialysis patient is the formation of arteriovenous fistula (AVF) or arteriovenous graft (AVG). An AVF is usually used as the first vascular access option when a patient requires hemodialysis because it lasts longer and reduces the risk of infection compared to AVG.⁴ An AVF is widely used for the best vascular access in hemodialysis patient. For non tunneled catheter access is used in patients who need urgent hemodialysis

or when an AVF cannot be matured. The result of AVF creation is suboptimal, but one-third of case may occurred primary failure or maturation failure. Preoperative assessment by ultrasonography or venography of the upper limb reduces failure of the fistula creation. An AVF access will be used continuously as long as the patient routinely takes the hemodialysis program, so it needs to be maintained and reduced complications. Complications that can occur such as stenosis, thrombosis, infection, ischemia in the fingers, heart failure, and aneurism. An AVF in the form of stenosis more than 50 percent are usually corrected by percutaneous transluminal angiography (PTA).⁴

This continuous cannulation of the central vein may lead to the formation of central venous stenosis. The formation of stenosis is initiated by endothelial cell injury which leads to smooth muscle proliferation and neointimal hyperplasia. The following factors may lead to endothelial injury: shear stress from turbulent blood flow, mechanical trauma from venipuncture, and angioplasties. The most common site for stenosis in grafts occurs at the graft-vein anastomosis in 80% to 85% of the time followed by intragraft stenosis 11% to 15% and the graft-artery anastomosis 2% to 5% of the time. Fistulas tend to develop stenosis most commonly either at the juxta-anastomotic site and the outflow vein (70%-85%). In the remaining 15% to 30% of the time, the lesion develops on the arterial site, which includes the feeding artery and anastomosis.⁵

It also occurred if the central catheter is placed ipsilaterally to the arteriovenous fistula access. The repeated cannulation of vascular access can cause injury to the intimal vessel wall associated with focal endothelial damage, increased smooth muscle cells, and thickening of the vein wall. The rapid flow of blood with a hemodialysis catheter can create turbulence, increasing endothelial proliferation, leading to venous stenosis. Early placement of arteriovenous fistula access for hemodialysis access can reduce catheter access and reduce the incidence of central venous stenosis.⁶ Thus, in this case report we would like to the percutaneous transluminal angioplasty procedure for central venous stenosis inpatient undergoing hemodialysis in Peln Hospital.

CASE DESCRIPTION

We report the first patient 63 years old male with central venous stenosis. Our patient has a history of chronic hypertension so in the end the patient falls into stage 5 chronic renal failure and requires hemodialysis. The patient had dialysis since 2015, initially the vascular access used was left arteriovenous fistula for 4 years. But lastly, when the patient undergo dialysis the arteriovenous fistula (AVF) thrill disappeared and auscultation was not heard. Finally, in March 2019, the

patient was given temporary access to the right jugular non tunneled catheter, and the right arteriovenous fistula (AVF) was created. Arteriovenous fistula (AVF) has been created since 5 months, but thrill is still small and the patient has complaints of swollen hands and intermittent pain. Then we decided to perform a venography procedure and found total occlusion of the subclavian vein (Figure 1.A). During the procedure, percutaneous transluminal angiography (PTA) was performed with balloon and performed an inflation of 10 atm / 124 seconds (Figure 1.B). Then we evaluated the results of venoplasty are good, there is no residual stenosis (Figure 1.C). Afterwards, evaluation by Doppler ultrasound showed a good veno fistula, and the diameter of the veins was 8.1mm and 10.3mm in size. After that the

arteriovenous fistula can be used.

The second patient, 57 years old male. The patient had a history of chronic hypertension, continues to the complications of kidney failure and the patient need hemodialysis. The patient has been undergoing hemodialysis since 4 years ago, arteriovenous fistula (AVF) has also been used since 2017. In June 2019, the patient felt the arteriovenous fistula (AVF) swollen and painful. Venography was performed on the central vein, revealed stenosis in the subclavian-innominate junction (Figure 2.A). Subsequently, a balloon venoplasty was performed, inflated gradually around 4-8 atm for 60 seconds- 100 seconds each (Figure 2.B). Re-venography after ballooning did not revealed any residual stenosis (Figure 2.C). In August 2019, a vascular

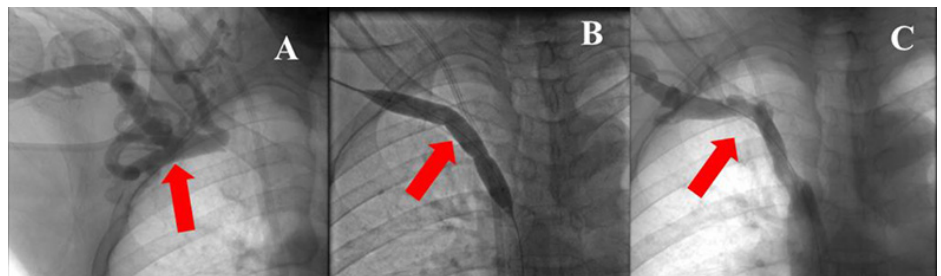


Figure 1. (A) There is complete occlusion of the subclavian vein. (B) The balloon is inserted by guiding the area of stenosis (PTA). (C) Results of venography after PTA.

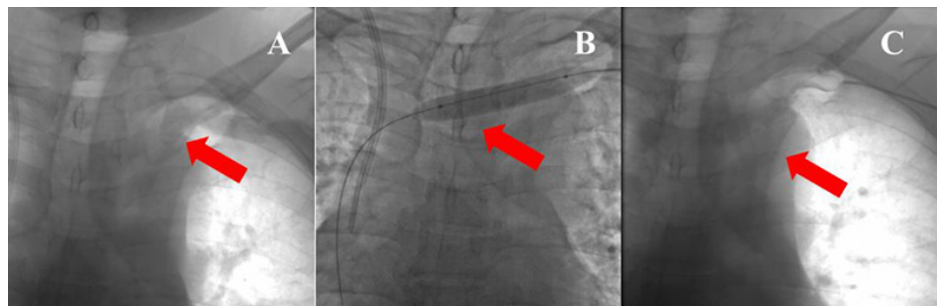


Figure 2. (A) Shows stenosis venography at the subclavian-innominate junction. (B) Performed ballooning in that location. (C) Contrast filling towards the central vein after ballooning.

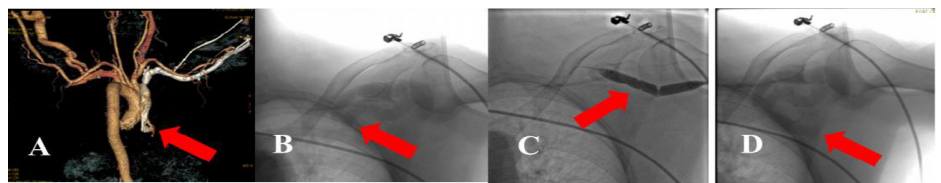


Figure 3. (A and B) Shows CT angiography and venography imaging revealed stenosis in the subclavian vein. (C) Performing ballooning in the stenosis location. (D) Contrast filling towards the central vein after ballooning.

ultrasound evaluation was revealed, the draining vein flow at the proximal AVF: 4656 ml / minute, and the diameter of the AP draining vein was approximately 2: 8.7 mm and 7.8 mm. There was no sign of thrombus on the draining vein. After that an arteriovenous fistula (AVF) can be used.

The third patient, 58 years old, female. The patient has a history of chronic coronary heart complications and hypertension. The patient has been using the arteriovenous fistula (AVF) since 2017. In early January 2020, the patient complained of swelling of the hands, and the thrill of the arteriovenous fistula (AVF) had become weak. The patient felt her face was getting swollen on the side of the arteriovenous fistula (AVF). On CT scan angiography and venography found

stenosis of about 70% in the left subclavian vein (Figure 3.A&B). Furthermore, balloon angioplasty is performed on the stenosis area in the left subclavian vein and inflated with a pressure of 4-6 atm / 120 seconds (Figure 3C). Venographic evaluation revealed that the subclavian vein was distended, with minimal residual stenosis (Figure 3D).

The fourth patient, 48 years old, female. The patient has history of diabetes and chronic hypertension. The patient has been using an arteriovenous access fistula (AVF) since 1 year ago. Patients were routinely controlled every month. When control in August 2020, there was a decrease in the fistula arterial venous flow (AVF) from 798 ml / minute (June 2020) to 339ml / minute (August 2020). From ultrasound, there was no obstruction in the

draining vein. Finally, it was decided that the patient would performed venography procedure. The venography procedure showed 80% proximal stenosis of the left subclavian vein (Figure 4A). Wiring was performed and continued with balloon angioplasty with a pressure of 8-16 atm / 10-60 seconds (Figure 4B). Venographic evaluation revealed that the left subclavian vein was dilated, with minimal residual stenosis (Figure 4C & D).

The fifth patient is 45 years female, the patient has a history of chronic hypertension and diabetes. This patient has been using an arteriovenous fistula (AVF) since 2 years ago. As February 2021 during the routine control schedule, the patient had complaints of swelling of one side of the body ipsilaterally from vascular access. Swelling is felt spread from the right arm, neck, to the patient's right breast (Figure 5A). From venography it was revealed total occlusion in the right innominate vein (Figure 5B). Wiring is performed and the balloon venoplasty is inflated with a pressure of 6-10 atm / 17-30 seconds (Figure 5C). Followed by balloon venoplasty with smaller balloons, developed with a pressure of 14 atm / 17 seconds of draining the blood vessels. Evaluation innominate veins appear to be enlarged, residual stenosis is minimal (Figure 5D).

The sixth patient is 66 year old male. Patient came to the clinic with complaints it had been 2 months since the arteriovenous fistula was created, the thrill was still weak and could not be used for vascular access. From the venography procedure it was revealed stenosis of 80% of the left innominate vein (Figure 6A), then followed by balloon venoplasty (Figure 6B) procedure to the left innominate vein with a 12.0x80 mm balloon. Evaluation after procedure revealed thrill of arteriovenous fistula is available (Figure 6C).

DISCUSSION

Angioplasty performed on patients with stenosis of the AVF was reported to have been performed for the first time in 1981. The technique used by Gruntzig Ballon Catheter at that time gave good results in 3 out of 5 patients. Since 1981, the angioplasty procedure of the AVF has been significantly advanced. Indication

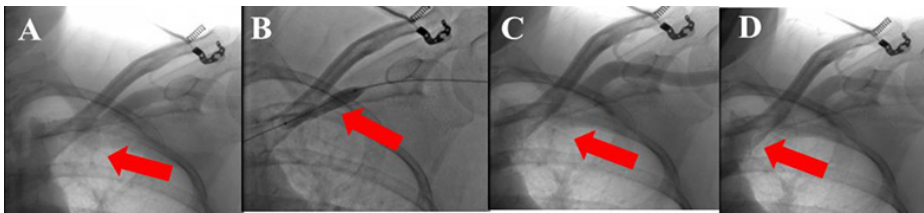


Figure 4. (A) Shows stenosis venography in 80% of the proximal left subclavian vein. (B) Performed ballooning in that stenosis location. (C and D) Venography results after PTA procedure.

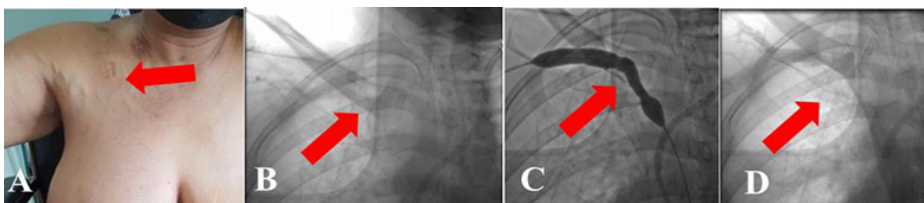


Figure 5. (A) The patient complains of swelling on one side of the arm, neck to the patient's right breast. (B) Shown on the right innominate vein total stenosis venography. (C) ballooning is performed in the area. (D) Venography results after PTA action looks dilating

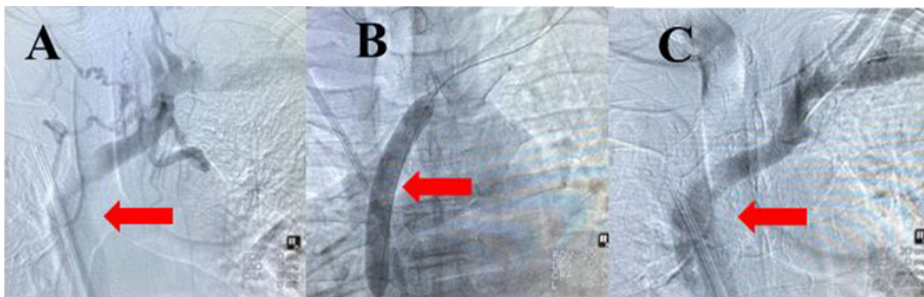


Figure 6. (A) Shows obstruction in the innominate vein causing collateral in the area. (B) Performed venoplasty. (C) It appears that the collateral vein is reduced after venoplasty.

of angioplasty procedure to AVF is when venography reveals obstruction more than 50 percent. This obstruction is formed due to the previous thrombosis, increased venous pressure during hemodialysis, and worsening laboratory results such as hyperkalemia.⁴

Many study centers around the world prefer the PTA procedure than surgical procedure. Angioplasty is a quick intervention with a lower risk of infection. There is no need for non tunneled catheter replacement, and hemodialysis can still be performed after the PTA procedure. In studies, angioplasty is the preferred treatment for stenosis in the arterial access to fistula veins. Then a surgical procedure is performed when an angioplasty fails.⁴ The prevalence of central venous stenosis in America was by 29%, for Cipto Mangunkusumo hospital was by 7.53%, while in Pelni hospital prevalence rate was by 13.5%.⁷

Previous studies revealed that the mortality rate was 4 times higher in patients with renal failure when surgery was performed. This is due to the comorbid conditions that accompany patients with renal failures, such as systemic arteriosclerosis, chronic inflammation, malnutrition. PTA procedure is preferred as the principal procedure because it is less invasive than surgical procedures in patients with chronic kidney disease.⁸ The long-term results of the PTA procedure are still entirely acceptable in patients with comorbidities such as coronary heart disease. PTA is also beneficial as a therapeutic strategy in renal failure patients with peripheral arterial disease.⁸

Patients with central venous stenosis rarely are diagnosed immediately until they have a complaint of impaired access during intra-hemodialysis using their vascular access or sometimes severe swelling of their hands which interferes with the patient's daily activities. Central venous stenosis is defined as obstruction of more than 50 percent stenosis or complete occlusion of the blood vessels, where blood flow in the veins is completely blocked before PTA procedure. Blood flow with high pressure in the AVF of patients with central venous stenosis causes dilation of the veins and the formation of collateral veins on the ipsilateral side of the

upper arm, neck, and chest area. In severe cases, this high venous blood pressure causes edema with pain and discomfort complaint.⁹

Patients with hemodialysis dependence need temporary access continued with permanent access. Vascular access option depends on the severity of the disease, the quality of the blood vessels, and vascular access complications. The three selected accesses were arteriovenous fistula, arteriovenous graft (using a prosthesis), short-term and long-term hemodialysis catheters. The initial option for permanent access that is usually used is an AVF. Vascular access using tunneled or non tunneled catheter is usually used in acute or where the quality of the venous arteries is deficient or has not matured AVF or there are medical contraindications. This venous access can be used on the femoral, subclavian, and jugular parts. If the patient has a catheter placed in the subclavian part, it can increase the risk of developing subclavian vein stenosis. Complications that occur such as infection and thrombosis.⁶ The AVF access has better adequacy than catheter access because the Kt / v value is achieved as determined when starting hemodialysis (care plan). This is because the fistula AVF can support a higher blood flow rate (qb) than catheter access. If there is stenosis revealed at AVF, it is necessary to perform PTA action or surgery to reduce stenosis so that the prescribed care plan can achieve adequate hemodialysis.¹⁰

It is essential to continuously perform PTA procedures in central venous stenosis lesions because it maintains stable hemodialysis access. However, if a new large thrombus is revealed, it is a contraindication to PTA, which is preferable to thrombectomy or other methods. Balloon angioplasty is the most basic procedure in PTA that functions to correct central venous stenosis in hemodialysis patients. A stent is required if the balloon has not developed sufficiently in the area of the lesion. In a patient with subclavian central venous stenosis, the hand swells rapidly.¹¹

Few studies expected the AVF flow patency after six months or one year to be 50%. However, it is necessary to repeat angioplasty because sometimes unexpected

hyperplasia of the blood walls occurs due to balloons. In Bountouris *et al.*, study repeated PTA action resulted in patency of 85% to 91% at one year. The common complication of the PTA procedure is a rupture that is treated conservatively. In some cases, it is sometimes necessary to insert a stent. Blood transfusion is rarely necessary after the procedure. Choosing the correct size of the balloon before the procedure will reduce the risk of rupture. Physical examination performed on the AVF every three months. Several studies have also suggested preventive measures for angioplasty in asymptomatic stenosis.⁴

CONCLUSION

Our patient complained of pain symptoms in their hand and felt swollen following the symptoms of central venous stenosis and was successfully treated with balloon angioplasty. Central venous stenosis is a problem that occurs in hemodialysis patients and is getting worse if the hemodialysis catheter access is the exact location (ipsilaterally) as the insertion of AVF. The PTA achieves optimal hemodialysis adequacy, reduces pain and swelling in the arms, and uses arteriovenous fistula access (AVF) again (if previously had an issue).

DISCLOSURE

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Ethical Approval

The study is exempt from ethical approval in our institution.

Conflict of Interest

Author declare no conflict of interest for this article.

Author Contributions

Both of author contributed to design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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