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Endovascular Treatment for Vascular Access Venous Hypertension with Complicated Venous Drainage Routes in a Hemodialysis Patient: A Case Report

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Female, 68-year-old
Final Diagnosis: Vascular access venous hypertension
Symptoms: Difficulties during hemodialysis
Medication: —
Clinical Procedure: —
Specialty: Cardiology • Nephrology • Radiology

Objective: Unusual clinical course

Background: Vascular access (VA) venous hypertension is a major complication for patients with long-term arteriovenous access in the upper extremities. Endovascular treatment (EVT) is the first option for treating it. A possible cause of VA venous hypertension is stenosis at a site downstream of the arteriovenous fistula. We report a case of VA venous hypertension with complex venous drainage routes.

Case Report: A 68-year-old woman had worsening VA venous hypertension that led to difficulties in the venous blood return during hemodialysis. The cephalic vein distal to the arteriovenous fistula branched into 3 routes. The most proximal branch was occluded just before the junction to the subclavian vein at the level of the first rib. The pressure gradient between the brachial artery and the VA vein was 30 mmHg. Therefore, we performed an EVT for the occlusion and deployed a 3.0-mm balloon-expandable bare-metal stent, achieving good vascular patency with favorable blood flow. When the outside of the implanted stent was stained with contrast media, the appearance suggested the formation of varices that could have lowered the pressure at that lesion. The pressure gradient between the brachial artery and the VA vein had increased to 80 mmHg, which indicated an improvement of the VA venous hypertension.

Conclusions: EVT was effective for an occluded cephalic arch in a hemodialysis patient showing VA venous hypertension, despite the presence of collateral venous routes. VA venous hypertension can be life-threatening for hemodialysis patients. Therefore, it is essential that physicians who use vascular access interventional therapy should determine the cause of the VA venous hypertension and resolve it.

Keywords: Axillary Vein • Case Reports • Endovascular Procedures • Venous Pressure

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/927625

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Background

Vascular access (VA) is essential for patients undergoing hemodialysis. VA venous hypertension is one of the major complications for patients with long-term arteriovenous access in the upper extremities. A possible cause is the stenosis at a site downstream of the arteriovenous fistula (AVF). We encountered a case of VA venous hypertension with complex venous drainage routes. Currently, endovascular treatment (EVT) is the first option for this kind of vascular stenosis or occlusion. However, maintaining long-term patency is a major issue after revascularization.

Case Report

A 68-year-old woman receiving long-term intermittent hemodialysis due to diabetic nephropathy had worsening venous hypertension that led to difficulties in venous blood return during hemodialysis. She had no other comorbidities or cardiovascular risk factors. She was transferred to our hospital for further examination of the etiology of the VA venous hypertension. The AVF showed a favorable tactile thrill. An ultrasonography of the vessels of the vascular access route showed neither obvious stenosis nor occlusion in the main vascular route. The flow volume and resistance index were 555 mL/min and 0.74, respectively. These findings suggested a stenosis or an occlusion at a site downstream of the AVF; therefore, we conducted an angiography of the VA routes to evaluate the cause of the venous hypertension.

We approached via the right femoral artery and advanced a 4-Fr multipurpose catheter to the left brachial artery. The control digital subtraction angiography (DSA) showed no remarkable stenosis around the AVF. However, the cephalic vein branched into 3 routes, and the most proximal of them was occluded just before the junction to the subclavian vein at the level of the first rib (**Figure 1A, 1B**). We punctured the shunt vein and inserted a 5-Fr 25-cm sheath downstream. The pressure gradient between the brachial artery and the VA vein was only 30 mmHg (**Figure 1C**).

We began the endovascular treatment (EVT) for the venous occlusion just before the junction to the subclavian vein (**Figure 2A**). First, we tried a 0.014-inch guidewire, Xtreme PV (ASAHI INTECC Co., Ltd., Aichi, Japan), and then a Wizard PV3 (Japan Lifeline Co., Ltd., Tokyo, Japan) to advance to the occluded vessel; however, they both failed. Next, we changed

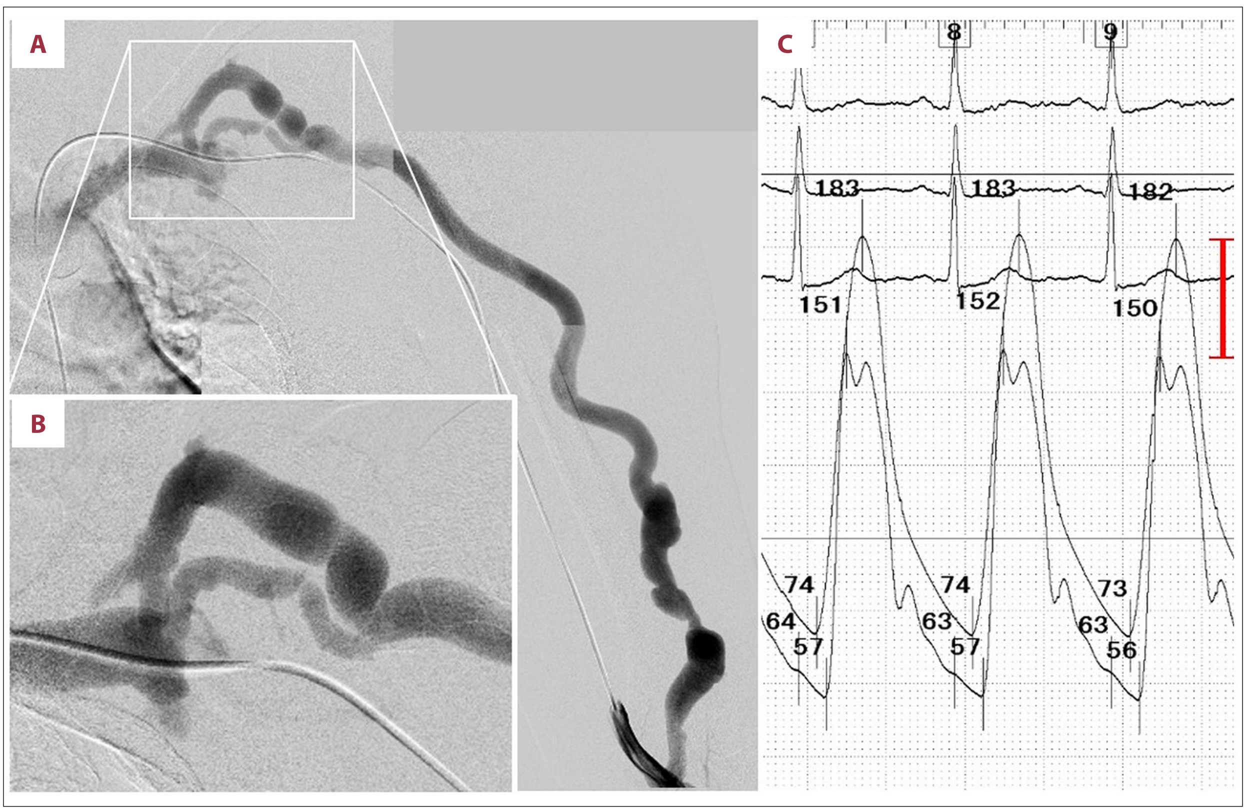

Figure 1. (**A**) Controlled digital subtraction angiography of the left upper limb. (**B**) A magnified image of the distal site of the vascular access vein. (**C**) Simultaneous measurement of blood pressure in the brachial artery and the vascular access vein before the endovascular treatment.

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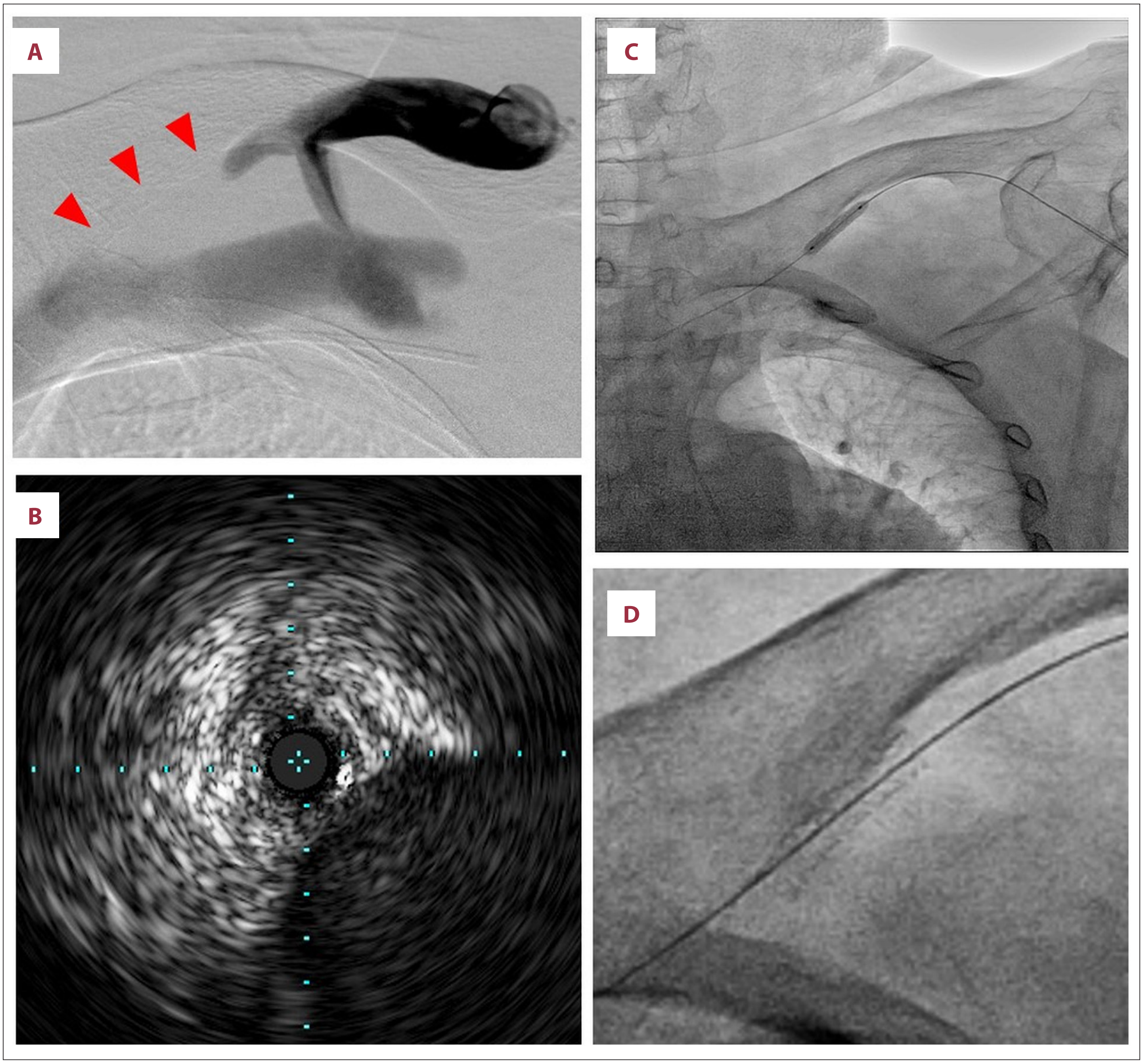

Figure 2. The endovascular treatment for a branch occlusion of the axillary vein. (**A**) The most proximal vessel out of 3 branches was occluded just before the junction to the subclavian vein (arrowheads). (**B**) An intravascular ultrasound showing an intimal thickening with fibrous plaques in the entire circumference of the occlusion. (**C**) Deployment of a balloon-expandable bare-metal stent. (**D**) A magnified image of the implanted stent.

the guidewire to a Treasure XS (ASAHI INTECC Co., Ltd., Aichi, Japan), but it could not penetrate the distal cap of the occlusion. Then, we performed a looped guidewire technique using a Cruise guidewire (ASAHI INTECC Co., Ltd., Aichi, Japan) and successfully advanced to the subclavian vein. An intravascular ultrasound (IVUS) showed intimal thickening with fibrous plaques around the entire circumference of the occlusion (**Figure 2B**). The vessel diameter was approximately 4.0 mm. A 2.0-mm balloon catheter inflation restored favorable blood flow, although a vascular recoil occurred soon after the inflation. Therefore, we deployed a 3.0-mm balloon-expandable bare-metal stent at the occlusion (**Figure 2C, 2D**) and the final angiography demonstrated good vascular patency and blood flow. After staining outside the implanted stent by contrast media, the angiographical image suggested varices formation (**Figure 3A, 3B**). The IVUS showed a circular expansion of the bare-metal stent (approximately 3.3 mm in diameter) and an enlarged luminal space spreading externally beyond the stent's luminal area (**Figure 3C-3E**). After the procedure, the pressure gradient between the brachial artery and the VA vein was 80 mmHg, which indicated an improvement in the venous hypertension (**Figure 3F**). The next day, the patient could undergo hemodialysis without complications and was safely discharged on that day.

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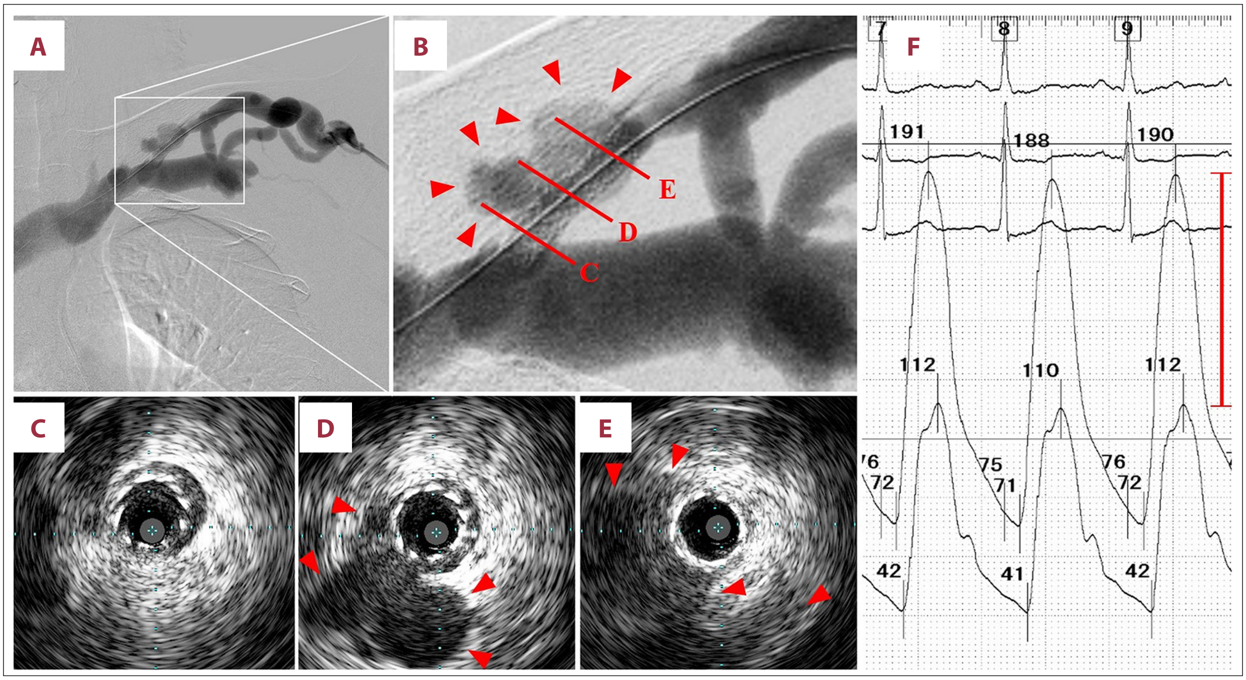

Figure 3. (**A**) Good vascular patency with favorable blood flow in the final digital subtraction angiography. (**B**) A magnified image of the treated lesion. Varices-like formations were observed (arrowheads). (**C–E**) Cross-sectional intravascular ultrasound images after stent implantation. These **C–E** images correspond to the cross-sections in Figure **3B**. An enlarged luminal space spreading externally beyond the stent's luminal area (arrowheads). (**F**) Simultaneous measurement of blood pressure in the brachial artery and the vascular access vein after the endovascular treatment.

However, a similar worsening VA venous hypertension recurred 6 months after the initial procedure. The angiography showed an in-stent total occlusion at the junction with the subclavian vein (**Figure 4A**). An obvious stent fracture was not seen (**Figure 4B**). We performed a re-intervention and fully inflated a 4.0-mm diameter scoring balloon at the rated burst pressure (**Figure 4C**). The final angiography showed a favorable lesion dilation and a recovered blood stream (**Figure 4D**). The IVUS showed the minimum stent diameter to be approximately 4.0 mm, which was significantly larger than the final image in the previous session, leading to a favorable stent apposition on the vessel wall (**Figure 4E**). Currently, the patient is being followed up regularly. After this EVT, the patient has not had any complications at hemodialysis and no VA venous hypertension for over 30 months.

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. The study was performed in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Board of Kyoto Chubu Medical Center.

Discussion

We report a case of venous hypertension with complicated venous drainage routes in a hemodialysis patient. By recanalizing 1 occluded branch of the cephalic arch, we achieved a marked improvement in the venous hypertension. VA venous hypertension is one of the major complications for patients with long-term arteriovenous access in the upper extremities. The severity of this pathology depends on various factors, including the blood flow volume via the AVF, extent of stenosis in the venous outflow, branching patterns of the central veins, and vascular permeability. Only stenosis that has a hemodynamic effect (≥70% decrease in the luminal area), which results in decreased flow, elevated venous pressures, or an abnormal physical examination should be treated [1,2]. Our case showed remarkable elevated venous pressure that caused clinical impairment, and 1 occluded branch of the cephalic arch was thought to be the only cause for this pathological entity. Hemodynamically significant stenosis is often seen in the cephalic arch due to its perpendicular junction with the deeper veins, which account for 30% to 55% of all VA stenoses in the upper arm [3].

This kind of lesion is treated by endovascular procedures. The endovascular management includes balloon angioplasty and primary stenting. Balloon inflation alone is preferred as the treatment for simple stenotic lesions. On the other hand, stent deployment is required either for the occlusive lesions or for the lesions with external compression. Two types of stents are available for peripheral revascularization: balloon-expandable stents and self-expandable stents. Due to the small diameter of the

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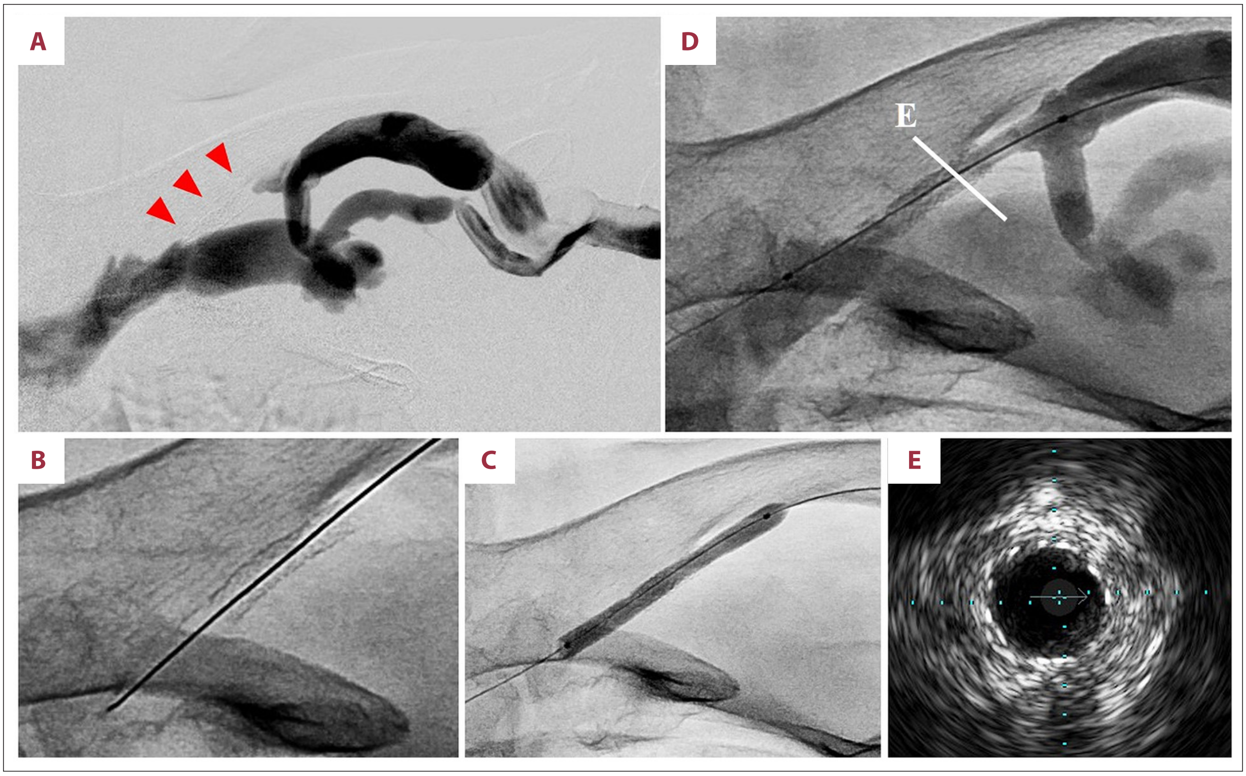

Figure 4. (**A**) In-stent total occlusion at the junction with the subclavian vein 6 months after the initial endovascular treatment (arrowheads). (**B**) Stent fracture was not apparent. (**C**) A 4.0-mm scoring balloon inflated in the occluded stent. (**D**) Final angiography showed a favorable lesion dilation and the recovered blood flow. (**E**) A cross-sectional intravascular ultrasound image corresponding to the section in Figure **4D**.

occluded vein in the present case, we chose a balloon-expandable stent with a 3.0-mm diameter. However, the balloon-expandable stents have a lower radial force than the self-expandable stents, and they are more susceptible to mechanical compression and can result in stent deformation in the chronic phase.

Moreover, there are controversies regarding the standard EVT strategy for venous regions downstream of the AVF, including how to deal with frequent re-stenosis or re-occlusion, and the optimal treatment for thoracic outlet syndrome. The primary patency rate at 6 months after balloon angioplasty is often poor (42%) and several sessions are often needed for maintaining luminal patency [4]. On the other hand, a randomized prospective study demonstrated that a VIABAHN™ (W.L. Gore & Associates, Inc., DE, USA) stent graft was superior to a balloon angioplasty in treating cephalic arch stenosis [5]. Moreover, the use of stent grafts for recurrent cephalic arch stenosis is reported to significantly improve the short-term restenosis rates and long-term patency compared to the use of bare-metal stents [6].

In the present case, the in-stent occlusion 6 months after the initial EVT caused recurrent venous hypertension. The occlusion was due to increased plaque volume in the stent. One of the causes of plaque progression was thought to be the reduced expansion of the stent's luminal area. The luminal gain by stent deployment in the initial session was relatively small compared to the size of the vessel diameter. Therefore, by obtaining more stent area with the use of the scoring balloon inflation in the second session, we could accomplish independent, clinically-driven target lesion revascularization for as long as 30 months. Although the use of stent grafts was demonstrated to be superior to the bare-metal stents in this field, it is off-label use in Japan.

As there were several venous drainage routes distal to the VA in addition to the occluded cephalic arch, we could not determine the effectiveness of the EVT procedure for improving the venous hypertension by recanalizing the targeted occluded vessel. However, the vascular reconstruction eventually brought marked pressure unloading by 50 mmHg. The angiographical images after the EVT showed a pooling of contrast media around the implanted stent, and the IVUS clearly demonstrated an enlarged luminal space spreading externally beyond the stent's luminal area. These findings suggest that a richer vascular bed than expected had been recanalized. In a vessel model, the pressure inversely decreases as the total vascular area increases, which could explain the improved venous hypertension.

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Conclusions

We used an EVT for an occluded cephalic arch distal to the VA in a hemodialysis patient showing venous hypertension despite the presence of some other collateral venous routes. Although VA venous hypertension is not very common, it can cause difficulties in venous blood return during hemodialysis and can become life-threatening for hemodialysis patients. Therefore, it is essential that physicians who perform VA interventional therapy determine the precise cause of the venous hypertension.

Department and Institution Where Work Was Done

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Conflicts of Interest

None.

References:

1. Schmidli J, Widmer MK, de Donato G, et al. Editor's choice – Vascular access: 2018 clinical practice guidelines of the European society for vascular surgery (ESVS). Eur J Vasc Endovasc Surg, 2018;55:757-818
2. Ravani P, Quinn RR, Oliver MJ, et al. Pre-emptive correction for haemodialysis arteriovenous access stenosis. Cochrane Database Syst Rev, 2016;1:CD010709
3. Rajan DK, Clark TWI, Patel NK, et al. Prevalence and treatment of cephalic arch stenosis in dysfunctional autogenous hemodialysis fistulas. J Vasc Interv Radiol, 2003;14:567-73
4. Hemodialysis 2006 Work Group. Clinical practice guidelines for hemodialysis adequacy, update 2006. Am J Kidney Dis, 2006;48(Suppl. 1):S2-90
5. Rajan DK, Falk A: A randomized prospective study comparing outcomes of angioplasty versus VIABAHN stent-graft placement for cephalic arch stenosis in dysfunctional hemodialysis accesses. J Vasc Interv Radiol, 2015;26:1355-61
6. Shemesh D, Goldin I, Zaghal I, et al. Angioplasty with stent graft versus bare stent for recurrent cephalic arch stenosis in autogenous arteriovenous access for hemodialysis: A prospective randomized clinical trial. J Vasc Surg, 2008;48:1524-31

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