Use of a fluoropolymer-based paclitaxel-eluting stent for arteriovenous graft outflow vein stenosis in hemodialysis patients

Yuki Matsuoka, MD, MBA, Osamu Iida, MD, Kotaro Suemitsu, MD, PhD, Kanako Oka, MD, Naomi Ota, MD, and Masaaki Izumi, MD, PhD. Amagasaki, Japan

ABSTRACT

We report our first experience with the use of a fluoropolymer-based paclitaxel-eluting stent (FP-PES) in four hemodialysis patients with refractory outflow venous stenosis of arteriovenous grafts. The mean observation period after FP-PES implantation was 11.5 ± 4.7 months (range, 7.0-18.0 months). After FP-PES implantation, the patients were evaluated by ultrasound every 3 months. No patient experienced neointimal hyperplasia in the stents during the observation period, and no reintervention was performed. FP-PESs could be an attractive alternative to percutaneous transluminal angioplasty for patients with refractory outflow venous stenosis of arteriovenous hemodialysis grafts. (J Vasc Surg Cases and Innovative Techniques 2021;7:326-31.)

Keywords: Arteriovenous shunt; Drug-eluting stents; Hemodialysis; Paclitaxel; Stenosis

Worldwide, the number of patients with chronic kidney disease requiring renal replacement therapy has been dramatically increasing. The creation and maintenance of vascular access (VA) is mandatory to conduct hemodialysis as the main method of renal replacement therapy. An arteriovenous fistula (AVF) is generally recommended owing to the low risk of infection and durable patency. An arteriovenous graft (AVG) is a second-line option when an AVF cannot be created. Several studies have revealed that the 1-year primary patency rate after AVG placement is lower than that for AVFs. Although percutaneous transluminal angioplasty (PTA) is the treatment of choice for failed AVGs, the 1-year secondary patency after standard PTA has been far from satisfactory.

We report our first experience with the use of a fluoropolymer-based paclitaxel-eluting stent (FP-PES) for the treatment of outflow vein stenosis of AVGs. At our institution, patients with AVGs undergo routine ultrasound examinations every 3 months. The indication for treatment is determined comprehensively by a flow volume <500 mL/min or clinical symptoms such as elevated venous pressure or recirculation. Formerly, plain balloon angioplasty was routinely conducted, with bare metal stents implanted for AVG outflow vein stenosis only at early retreatment failure. After FP-PES became available, it was used for the early retreatment cases. In the present case series, the flow volume, measured by ultrasound, and the clinical symptoms determined the decision to treat, and serial ultrasound scans were performed 3 months after drug-eluting stent (DES) implantation. In all cases, statins were not used, and only patient 3 was taking an antiplatelet before and after DES implantation. We did not add dual antiplatelet therapy owing to the bleeding effect with repeated dialysis sessions. In Japan, drug-coated balloons and stent-grafts were not available during the study period.

CASE REPORT

Patient 1. An 86-year-old woman with hypertension had required hemodialysis for 4 years. A 4.0- to 6.0-mm tapered expanded polytetrafluoroethylene loop graft (inflow, proximal radial artery; outflow, basilic vein) had been implanted in her left forearm for VA at the initiation of dialysis. After 3 years, axillary vein stenosis with left arm swelling developed. PTA was performed; however, restenosis occurred 3 months later. After unsuccessful balloon angioplasty, an 8.0- x 60-mm bare metal stent was placed. After 6 months, a new stenosis between the graft outflow and the bare metal stent had developed (Fig 1a and b). Because of concerns regarding short-term restenosis with plain balloon angioplasty or a bare metal stent, we decided to use a 7.0-mm x 120-mm FP-PES (Eluvia; Boston Scientific, Marlborough, Mass), which had become available at our institution (Fig 1c). After implantation, the graft was still patent at 18 months (Fig 1d and e).

From the Division of Kidney and Dialysis, Department of Internal Medicine, and Cardiovascular Center, Kansai Rosai Hospital.

Author conflict of interest: none.

Correspondence: Yuki Matsuoka, MD, Division of Kidney and Dialysis, Department of Internal Medicine, Kansai Rosai Hospital, 3-1-69 Inabaso, Amagasaki 660-8511, Japan (e-mail: yuki110580@gmail.com).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287 © 2021 The Author(s). Published by Elsevier Inc. on behalf of Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

https://doi.org/10.1016/j.jvscit.2021.03.007
Patient 2. A 63-year-old man with hypertension, hyperlipidemia, and abdominal aortic aneurysm had required regular hemodialysis for 2 years. He had had a 5.0-mm polyurethane (PU) loop graft (inflow, proximal radial artery; outflow, basilic vein) implanted in his right forearm at the initiation of dialysis. After 12 months, outflow vein stenosis had developed and was treated with PTA. A second PTA for the same area was required 11 months later; however, the patency period was only 3 months (Fig 2, a and b). At that time, the recoil was strong during attempted balloon angioplasty. Therefore, a 6.0-mm × 40-mm FP-PES (Eluvia; Boston Scientific) was implanted at the restenosis (Fig 2, c). After implantation, the graft was still patent at 11 months (Fig 2, d).

Patient 3. A 66-year-old man with hypertension had required regular hemodialysis for 17 years. He had had a 5.0-mm PU loop graft (inflow, brachial artery; outflow, cephalic vein) implanted in his right forearm after 7 years of dialysis. At 4.5 years after graft implantation, PTA was performed for outflow vein stenosis. Restenosis had occurred at the same area at 3, 6, and 9 months. After the last restenosis (Fig 4, a and b), a 6.0-mm × 120-mm FP-PES (Eluvia; Boston Scientific) was implanted at the restenosis (Fig 4, c). However, 3 months later, the graft–venous puncture site became infected. A portion of the infected graft was removed and partially replaced with a PU graft. The outflow venous anastomosis remained patent, and the DES was not infected. At 7 months after implantation of the FP-PES, the outflow vein was still patent (Fig 4, d).

DISCUSSION
In the present case series, FP-PESs were successfully implanted in four patients with outflow vein stenosis in
During the mean observation period of 11.5 ± 4.7 months (range, 7.0-18.0 months) after FP-PES implantation, no neointimal hyperplasia occurred in any stent. In all four cases, no significant blood flow reduction was observed, and dialysis could be performed without any reinterventions.

PTA is still considered the first-line treatment for VA failure, with a 1-year secondary patency rate of 50% for AVFs and 25% for AVGs, which is clinically suboptimal. The outflow vein stenosis of AVGs is mainly caused by intimal hyperplasia or vasoconstriction due to adventitial contraction, or a mixture of both. Bare metal stents have been used in patients with refractory restenosis after PTA and have been effective for restenosis due to vasoconstriction but have not been satisfactory for restenosis caused by neointimal hyperplasia or the mixed types. Drug-coated balloons might be effective for treating intimal hyperplasia restenosis but provide no scaffolding against adventitial contraction. The efficacy of stent-grafts compared with PTA has been reported in patients with AVG outflow vein stenosis, with a 1-year secondary patency rate of 47.6% compared with 24.8% for PTA; however, edge stenosis and thrombotic occlusion remain clinical issues.

In our case series, we used a FP-PES reported to be effective for AVFs in the treatment of outflow vein stenoses of AVGs and have confirmed a favorable clinical outcome. The newer DESs with fluoropolymer coating (eg, Eluvia; Boston Scientific) releases drugs for longer and more sustainably than previous DESs. We hypothesized that the stent would inhibit
recoil, the drug would inhibit intimal hyperplasia, and the polymer would contribute to the sustained drug release and antithrombotic effects, resulting in a favorable outcome. A previous meta-analysis suggested an association between paclitaxel and increased mortality when used in association with femoropopliteal disease. A randomized controlled trial of paclitaxel-coated devices and a meta-analysis of their use in AV graft access showed no differences in mortality. More clinical studies are needed to confirm the effects and safety of the use of FP-PESs.

The present study had several limitations. The study included a small number of cases from a single-center experience with follow-up of ≤18 months. Randomized controlled trials are needed to determine whether this treatment is truly an improvement. In addition, the sustainable effect of a DES, especially after the complete elution of the paclitaxel is unknown.

CONCLUSIONS
In the present retrospective case series of four patients, we used a FP-PES for outflow vein stenosis of AVGs and obtained good early results. More studies are needed to assess the long-term effectiveness and safety of this treatment.
REFERENCES

1. Kitty JJ, Csaba K, Robyn L, Mark R, Vivekanand J, Carmine Z. A single number for advocacy and communication worldwide: more than 850 million individuals have kidney diseases. Kidney Int 2019;96:1048-50.

2. Lok CE. Fistula first initiative: advantages and pitfalls. Clin J Am Soc Nephrol 2007;2:1043-53.

3. Dixon BS, Novak I, Fangman J. Hemodialysis vascular access survival: the upper arm native arteriovenous fistula. Am J Kidney Dis 2002;39:92-101.

4. Pisoni RL, Young EW, Dykstra DM, Greenwood RN, Hecking E, Gillespie B, et al. Vascular access use in Europe and in the United States: results from the DOPPS. Kidney Int 2001;61:305-16.

5. Lilly RZ, Carlton D, Barker J, Saddeke S, Hamrick K, Oser R, et al. Predictors of arteriovenous graft patency after radiologic intervention in hemodialysis patients. Am J Kidney Dis 2001;37:945-53.

6. Turnel-Rodrigues L, Penglo J, Baudin S, Testou D, Abaza M, Dahdah G, et al. Treatment of stenosis and thrombosis in haemodialysis fistulas and grafts by interventional radiology. Nephrol Dial Transplant 2000;15:2029-36.

7. Roy-Chaudhury P, Sukhatme VP, Cheung AK. Hemodialysis vascular access dysfunction: a cellular and molecular viewpoint. J Am Soc Nephrol 2006;17:1112-27.

8. Yamamoto Y, Nakamura J, Nakayama Y, Hino H, Kobayashi H, Sugui T. Relationship between the outcomes of stent placement and the presence of diabetes mellitus in hemodialysis patients. J Am Soc Nephrol 2005;16:561-7.
and the properties of arteriovenous graft outflow vein stenotic lesions. J Vasc Access 2012;13:426-31.

9. Haskal ZJ, Saad TF, Hoggard JC, Cooper RI, Lipkowitz GS, Gerges A, et al. Prospective, randomized, concurrently-controlled study of a stent graft versus balloon angioplasty for treatment of arteriovenous access graft stenosis. 2-year results of the RENOVA study. J Vasc Interv Radiol 2016;27:1105-14.e3.

10. Schmelter C, Raab U, Lazarus F, Ruppert V, Vorwerk D. Outcomes of AV fistulas and AV grafts after interventional stent-graft deployment in haemodialysis patients. Cardiovasc Intervent Radiol 2015;38:878-86.

11. Krystal D, Shannon DT, Tae C, John S, Phillip C, Ramon LV. Use of paclitaxel eluting stents in arteriovenous fistulas: a pilot study. Vasc Spec Int 2019;35:225-31.

12. William AG, Koen K, Yoshimitsu S, Andrew B, Anvar B, Yoshiaki Y, et al. A polymer-coated, paclitaxel-eluting stent (Eluvia) versus a polymer-free, paclitaxel-coated stent (Zilver PTX) for endovascular femoropopliteal intervention (IMPERIAL): a randomised, non-inferiority trial. Lancet 2018;392:1541-51.

13. Krishna JR, Sue D, Michael RJ, Peter AS, Gary MA, Sean PL, et al. Mortality and paclitaxel-coated devices: an individual patient data meta-analysis. Circulation 2020;141:1859-69.

14. Joakim N, Stefan J, Manne A, Mattias A, Peter D, Peter G, et al. Mortality with paclitaxel-coated devices in peripheral artery disease. N Engl J Med 2020;383:2538-46.

15. Krystal D, Alexandra ML, Sharath CVP, Shannon DT, Michael HB, Andrew H, et al. Mortality after paclitaxel-coated device use in dialysis access: a systematic review and meta-analysis. J Endovasc Ther 2019;26:600-12.

Submitted Dec 6, 2020; accepted Mar 25, 2021.