Alternative Strategies for Central Venous Stenosis and Occlusion in Patients Requiring Haemodialysis Access

Dear Editor,

The use of tunnelled dialysis catheters (TDCs) in patients awaiting permanent dialysis access creation has resulted in a rise in the prevalence of central venous stenosis and occlusion (CVSO) in up to 50% of cases.[1,2]

CVSO is a difficult problem to manage. The mainstay of treatment for CVSO includes percutaneous transluminal angioplasty (PTA) and stenting. These are, however, prone to recurrence, with primary patency rates of not more than 50% at 1 year.[3-6] Potential long-term complications of CVSO include venous hypertension leading to recirculation and failure of vascular access, symptomatic limb swelling, and superior vena cava syndrome. Alternative vascular access techniques such as lower extremity arteriovenous grafts (AVGs) have high infection rates (27%), limited patency and are associated with other morbidities such as lower limb ischaemia.[7,8]

Two novel hybrid surgical options have been described in literature, but are rarely used in the local setting. The Haemodialysis Reliable Outflow (HeRO) graft circumvents the site of central obstruction, while the GORE® hybrid vascular graft allows deployment of an integrated stent to treat the stenotic central vein. Multicentre studies on the HeRO graft have shown superior patency (88% vs 37%) and infection rates (0.14 vs 2.3 infection/1000 days) when compared with TDC, and similar patency rates with conventional AVG (90% vs 65%).[9,10]

We introduce the first 2 local patients receiving the aforementioned vascular grafts and discuss these alternative options for patients with CVSO.

Case 1

A 45-year-old male became dialysis-dependent in 2006 and underwent multiple upper limb arteriovenous fistulas (AVF) from 2006 to 2011, all of which ultimately failed. He required a total of 4 TDCs for temporisation of access during this period. This resulted in bilateral jugular and subclavian vein occlusions with multiple tortuous collateral veins draining into the superior vena cava (Fig. 1A). He was deemed not a candidate for further upper extremity haemodialysis access until 2015 when the HeRO graft became available in Singapore.

A left upper limb HeRO graft was subsequently inserted. Ultrasound-guided percutaneous access of a collateral vein was performed, followed by advancement of a guide wire and 4 Fr micropuncture catheter. Direct injection of contrast was used for roadmap fluoroscopy and guidance of wire and catheter into the left brachiocephalic vein (Fig. 1B). The catheter was then exchanged for an 8 Fr sheath prior to deployment of the catheter portion of the HeRO graft in the superior vena caval-atrial junction (Fig. 1C). He had an uneventful recovery and was discharged home the following day.

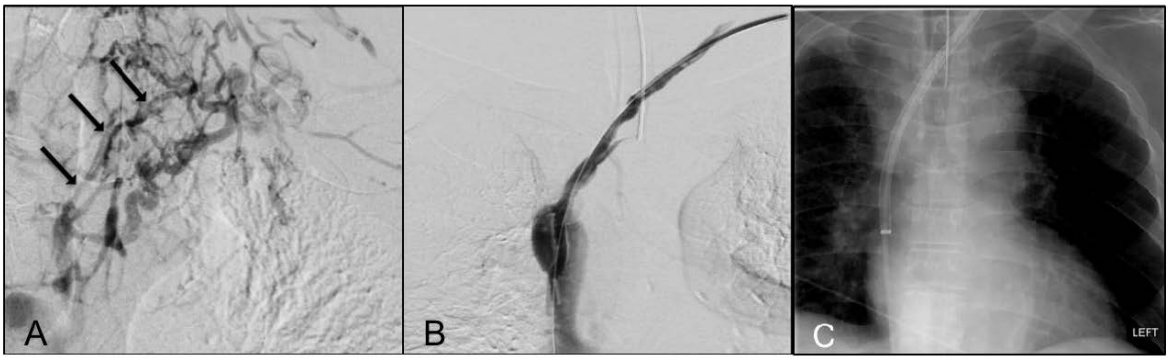

Fig 1. (A) Multiple well formed collaterals. Arrows showing the vein that was accessed for TDC and subsequently HeRO graft insertion. (B) Angiogram of collateral vein accessed. (C) HeRO graft advanced to the junction of superior vena cava and right atrium.

Case 2

A 56-year-old female initiated haemodialysis in 2013. She subsequently underwent a series of failed left upper limb AVFs and an AVG. This was followed by recurrent left brachiocephalic vein occlusions (Fig. 2A) and thrombosis of the AV graft, for which thrombectomy attempts were unsuccessful due to poor central venous outflow. She required 3 TDC insertions during this time.

A left upper limb GORE® hybrid vascular graft was tunnelled subcutaneously and inserted via the left subclavian vein. The integrated stent was deployed in the brachiocephalic vein to treat the area of stenosis (Fig. 2B). She was discharged well on postoperative day 3.

Both grafts were anastomosed to the ipsilateral brachial artery distally. They underwent successful haemodialysis through the subcutaneous grafts from 2 weeks after insertion. No immediate or medium-term complications were reported to date (1-year post implant).

Discussion

End-stage renal disease is increasing over the past decade, resulting in a rise in patients requiring haemodialysis. The Singapore Renal Registry reported increased prevalence of chronic kidney disease stage 5 (CKD5) from 2466 patients in 1999 to 5912 patients in 2014. The vast majority of CKD5 patients (88.4%) underwent haemodialysis, making this population group vulnerable to potential complications of CVSO.

CVSO remains a significant problem in patients requiring vascular access for haemodialysis, and is mainly attributed to prior central venous catheter placements.[1,11] Up to 41% of patients presenting with vascular access-related issues have evidence of significant CVSO on venogram.[1]

The mainstay of treatment is currently limited to endovascular options. PTA remains the simpler approach, but with a reported 12-month primary patency rates ranging from 12% to 50%.[3-5,12] Bare metal and covered stenting have shown to improve initial patency rates, but are associated with risks of migration, fracture, in-stent stenosis, and ultimately occlusion.[3]

The HeRO graft comprises 3 components (Fig. 3A): First, a nitinol-reinforced venous outflow component is tunnelled subcutaneously, entering the right atrium via the subclavian or internal jugular vein. This is connected by a titanium connector to an expanded polytetrafluoroethylene (ePTFE) AVG, completing the 3-component device (venous outflow component, titanium connector and ePTFE AVG). This is then tunnelled subcutaneously and anastomosed to the ipsilateral brachial artery. A 4-centre review showed primary and secondary patency rates of 48.8% and 90.8%, respectively, at 1-year, with access-related infection rates of 0.14 per 1000 days.

The GORE® hybrid vascular graft (Fig. 3B) is an ePTFE AVG with a nitinol covered stent at the venous outflow section. The luminal surface of the hybrid graft and stent is bonded with a bioactive substance consisting of reduced-molecular-weight heparin to prevent thrombosis. An integrated stent addresses the outflow stenosis, potentially improving re-intervention rates.[13,14] Initial published

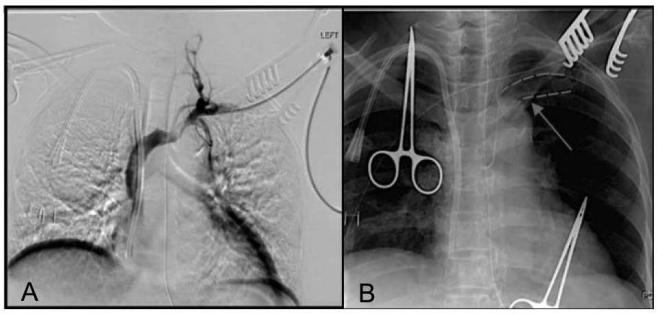

Fig 2. (A) Preoperative central venogram showing stenosis of the left brachiocephalic vein. (B) Stent deployed in the left brachiocephalic vein (outline indicated by arrow).

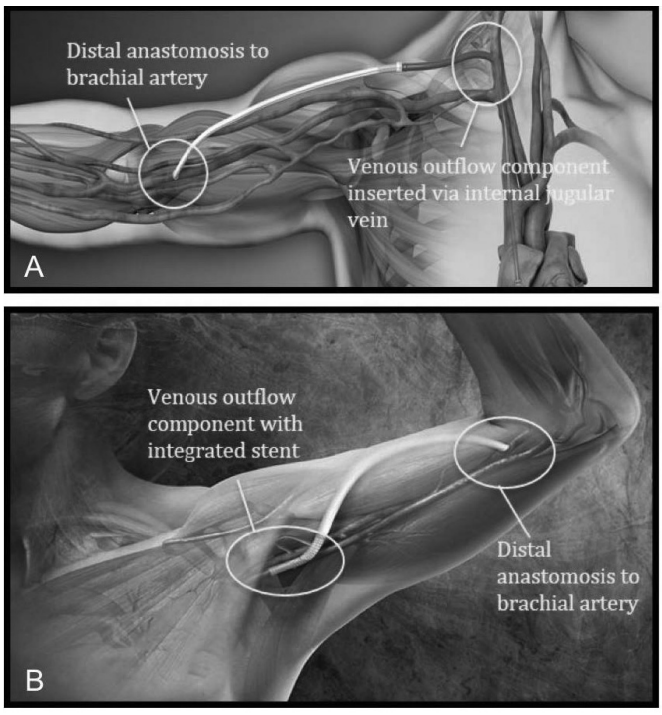

Fig 3. (A) Haemodialysis Reliable Outflow (HeRO) graft comprising 3 components – a nitinol-reinforced venous outflow component, a titanium connector, and an ePTFE AVG. (B) GORE® hybrid vascular graft – an ePTFE AVG with an integrated nitinol covered stent at the venous outflow section.

experiences have shown promising benefits, with no reported problems locally or internationally.

Conclusion

The HeRO graft and GORE® hybrid vascular graft are 2 novel alternatives that can be safely considered in patients who have exhausted conventional means to attain haemodialysis access. The former circumvents the CVSO in more proximal or extensive lesions up to the right atrium, while the latter allows deployment of an integrated stent to treat an area of central venous stenosis. Patients who were previously considered to have exhausted all upper extremity haemodialysis vascular access may yet have 1 or 2 more options with these newer treatment modalities.

REFERENCES

1. MacRae JM, Ahmed A, Johnson N, Levin A, Kiaii M. Central vein stenosis: a common problem in patients on hemodialysis. ASAIO J 2005;51:77-81.
2. Agarwal AK, Patel BM, Haddad NJ. Central vein stenosis: a nephrologist's perspective. Semin Dial 2007;20:53-62.
3. Kundu S. Central venous obstruction management. Semin Intervent Radiol 2009;26:115-21.
4. Shi YX, Ye M, Liang W, Zhang H, Zhao YP, Zhang JW. Endovascular treatment of central venous stenosis and obstruction in hemodialysis patients. Chin Med J (Engl) 2013;126:426-30.
5. Bakken AM, Protack CD, Saad WE, Lee DE, Waldman DL, Davies MG. Long-term outcomes of primary angioplasty and primary stenting of central venous stenosis in hemodialysis patients. J Vasc Surg 2007;45:776-83.
6. Thwaites S, Robless PA. Central vein stenosis in an Asian hemodialysis population. Asian Cardiovasc Thorac Ann 2012;20:560-5.
7. Geenen IL, Nyilas L, Stephen MS, Makeham V, White GH, Verran DJ. Prosthetic lower extremity hemodialysis access grafts have satisfactory patency despite a high incidence of infection. J Vasc Surg 2010;52:1546-50.
8. Harish A, Allon M. Arteriovenous graft infection: a comparison of thigh and upper extremity grafts. Clin J Am Soc Nephrol 2011;6:1739-43.
9. Gage SM, Katzman HE, Ross JR, Hohmann SE, Sharpe CA, Butterly DW, et al. Multi-center experience of 164 consecutive Hemodialysis Reliable Outflow [HeRO] graft implants for hemodialysis treatment. Eur J Vasc Endovasc Surg 2012;44:93-9.
10. Katzman HE, McLafferty RB, Ross JR, Glickman MH, Peden EK, Lawson JH. Initial experience and outcome of a new hemodialysis access device for catheter dependent patients. J Vasc Surg 2009;50:600-7.
11. Schillinger F, Schillinger D, Montagnac R, Milcent T. Post catheterisation vein stenosis in haemodialysis: comparative angiographic study of 50 subclavian and 50 internal jugular accesses. Nephrol Dial Transplant 1991;6:722-4.
12. Kovalik EC, Newman GE, Suhocki P, Knelson M, Schwab SJ. Correction of central venous stenoses: use of angioplasty and vascular Wallstents. Kidney Int 1994;45:1177-81.
13. Ross JR. Percutaneous venous anastomosis with a hybrid vascular graft. Available at: http://evtoday.com/2012/06/percutaneous-venous-anastomosis-with-a-hybrid-vascular-graft/. Accessed on 1 February 2016.
14. Kakisis JD, Avgerinos E, Giannakopoulos T, Moulakakis K, Papapetrou A, Liapis CD. Balloon angioplasty vs nitinol stent placement in the treatment of venous anastomotic stenoses of hemodialysis grafts after surgical thrombectomy. J Vasc Surg 2012;55:472-8.

Keith Koh, [1]*MBBS (Aus), MRCS (Edin)*, Ye Xin Koh, [1]*MBBS (S'pore), MRCS (Edin)*, Edward TC Choke, [2]*MBBS (Hons), PhD (London), FRCS (UK)*, John CC Wang, [2]*MBBCh BAO, LRCPI & SI, MSc*, Jack Kian Ch'ng, [2]*MBBCh BAO, LRCP & SI (NUI), FRCS*

[1]Department of General Surgery, Singapore General Hospital, Singapore
[2]Department of Vascular Surgery, Singapore General Hospital, Singapore

Address for Correspondence: Dr Keith Koh, 70B Telok Blangah Heights, #10-525, Singapore 102070.
Email: Keith.koh@mohh.com.sg