History moves in a spiral: Turn to aneurysm prevention of tissue-engineered vascular graft

Guriy Popov, MD, PhD, *St. Petersburg, Russia*

The next stage in the evolution of vascular surgery, similar to the endovascular spurt, might be the creation of an artificial vessel devoid of the known vascular prostheses' disadvantages. The key to success would be to reproduce the original vascular wall structure. Thus, the newly created tissue-engineered vascular graft (TEVG) will be safe, thrombosis resistant, mechanically reliable, and, as a result, a welcome guest in each operating room all over the world.

Spiral reinforcement of expanded polytetrafluoroethylene grafts is essential for kinking resistance. Matsushita et al[1] applied such a method for a TEVG to prevent aneurysm formation of arteriovenous (AV) shunts. The requirements for novel AV graft materials include adequate flow rates, easy assessment and cannulation, cost-effectiveness, long-term patency, and minimal complications.[2] Considering the relative safety and feasibility of AV placement, several TEVGs have already been evaluated in the clinic, including sheet-based TEVGs,[3] "biotube" vascular grafts,[4] and scaffold-based TEVGs.[5] The latter method implies the use of a biodegradable scaffold that should be kink resistant before surgery and will not lead to aneurysm formation after complete resorption. Matsushita et al[1] solved these preexisting issues by reinforcement of corrugated PCL/PLCL [poly ε-caprolactone/poly (L-lactide-co-ε-caprolactone)] grafts with 2-0 polypropylene suture or a PET/PU (polyethylene terephthalate/polyurethane) outer layer. These grafts were implanted in a U-shape as an AV shunt. After 3 months, no signs of dilatation were found, unlike in the control group or the group with PDO (polydioxanone) suture.

The authors also focused on the inverse ratio between cell invasion into the scaffolds and their mechanical properties. Thus, an additional layer of nonabsorbable polymer (PET/PU) prevents graft dilatation. However, this layer also blocks the cells' migration into the scaffold wall. The solution for this problem was reinforcing thread, which does not inhibit cell migration, although it prevents graft kinking and dilatation. The use of a nonresorbable thread has remained controversial, because this creates a potential problem for graft remodeling, such as in a growing child.

The graft patency rates and short-term follow-up in this study limit translation into the clinic; however, the issue of aneurysm prevention was solved. Therefore, long-term observation is required to determine the achievement of total polymer resorption, primarily to assess the safety and structure of the newly formed vascular wall. Thus, the eventual introduction of TEVGs into the clinical practice is around the corner, although the existing problems remain as limiting factors. Further clinical studies with long-term follow-up might answer these questions.

The opinions or views expressed in this commentary are those of the authors and do not necessarily reflect the opinions or recommendations of the JVS—Vascular Science or the Society for Vascular Surgery.

REFERENCES

1. Matsushita H, Hayashi H, Nurminsky K, Nelson K, Johnson J, Hibino N, et al. Novel reinforcement of corrugated nanofiber TEVG to prevent aneurysm formation for AV shunts in an ovine model. J Vasc Surg Vasc Sci 2022;3:182-91.
2. Lok CE, Huber TS, Lee T, et al; KDOQI Vascular Access Guideline Work Group. KDOQI clinical practice guideline for vascular access: 2019 update. Am J Kidney Dis 2020;75(suppl 2):S1-164.
3. McAllister TN, Maruszewski M, Garrido SA, et al. Effectiveness of haemodialysis access with an autologous tissue-engineered vascular graft: a multicentre cohort study. Lancet 2009;373:1440-6.
4. Nakayama Y, Kaneko Y, Okumura N, Terazawa T. Initial 3-year results of first human use of an in-body tissue-engineered autologous "Biotube" vascular graft for hemodialysis. J Vasc Access 2020;21:110-5.
5. Lawson JH, Glickman MH, Ilzecki M, et al. Bioengineered human acellular vessels for dialysis access in patients with end- stage renal disease: two phase 2 single-arm trials. Lancet 2016;387:2026-34.

From the Department of Vascular Surgery, First Pavlov State Medical University of St. Petersburg.

Author conflict of interest: none.

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

JVS—Vascular Science 2022;3:192

2666-3503

https://doi.org/10.1016/j.jvssci.2022.03.001