What is the best material for extracardiac Fontan operation?

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Despite significant improvements in the outcomes of modified Fontan operations for the treatment of single ventricle cardiac anomalies over the past several decades, this operation is still considered palliative and noncurative.¹ Complications commonly cited as being related to the use of synthetic conduits in extracardiac total cavopulmonary connection include thromboembolic complications, somatic overgrowth, and the development of stenosis relative to the vessel growth in the graft.²⁻⁵ Long-term studies related to Fontan outcomes are still limited to retrospective,

TEVG: 13 years after implantation (patient number 10).

Central Message

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The patient 22, (Fontan 2/1/2004)

		4/24/2006	10/7/2015
PA side	Diameter	15.36	15.62
	Area	219.35	207.45
Mid	Diameter	18.80	16.41
	Area	312.63	223.59
IVC side	Diameter	17.38	20.77
	Area	239.72	320.16
Graft Length		43.36	60.43

FIGURE 1. Two angiographic findings in the same patient demonstrate the growth of TEVG. PA, Pulmonary artery; IVC, inferior vena cava.

nonrandomized single institutional investigations. There also exists variability in postoperative management and follow-up, which leads to significant variability in the reported incidence of many types of postoperative complications. This is especially true for any silent complications (a complication that does not cause symptoms), which can be detected only with appropriate screening. The significance, prevention, and proper management of silent complications remain areas of active debate and investigation.⁶ In the past decades, many surgeons used a variety of materials or techniques for extracardiac Fontan operations, such as Dacron, expanded polytetrafluoroethylene, homograft, autologous pericardium, and xenopericardium. Many articles reported excellent midterm results up to 10 years after using an extracardiac Fontan conduit. However, there is no longer-term follow-up of these materials. We have to remember that our patients have 50 to 60 years ahead. Nobody knows the fate of expanded polytetrafluoroethylene graft 30 to 40 years after implanted in pediatric patients.

In this issue of the *Journal*, Dr Bockeria and colleagues⁷ from Switzerland have provided human data in their clinical experience of new bioabsorbable vascular grafts in the Fontan circulation. The authors are to be congratulated on the successful clinical outcomes (5 patients followed for 1 year) documented in Russia with novel materials, although I have a small concern about long-lasting foreign body reaction against their slow bioabsorption materials because the histology at 53 weeks after implantation in an animal model still showed that abundant polymer materials remained in the vascular tissue. This reaction might include earlier calcification or intimal thickening of the conduit.

I would briefly like to introduce our 10-year outcomes of a clinical trial of tissue-engineered vascular graft (TEVG) (rapidly bioabsorbable scaffold with bone marrow cell seeding). Between September 2001 and December 2004, 25 patients underwent an extracardiac Fontan using TEVG in Tokyo.⁸ The most updated follow-up data showed that the median patient age at operation was 5.5 years, and the follow-up period was 11.9 and 14.9 years.⁹ No graft-related mortality occurred. There was no evidence of aneurysmal formation, graft rupture, graft infection, or calcification. Seven of 25 patients developed stenosis and underwent at least 1 balloon angioplasty. None of the grafts needed to be surgically revised or replaced. Angiographic assessment in patient 22 shows the growth of graft (Figure 1). On the basis of our animal experimental data, higher dose cell seeding on the graft could reduce the stenosis rate.¹⁰ Therefore, we are moving forward to the second-generation TEVG trial to reduce the stenosis rate. Figure 2 shows that the later-term (13 years) histologic

FIGURE 2. Autopsy finding of TEVG 13 years after implantation shows similar structure as the native vein or pulmonary artery. LPA, Left pulmonary artery; SVC, superior vena cava; RPA, right pulmonary artery; TEV, tissue-engineered vessel.

characteristics of human TEVG suggest the usefulness of the TEVG strategy in the repair of congenital heart disease.¹¹ This technique allows for the development of a biological conduit, including a right ventricle–pulmonary artery conduit with adequate histologic maturation in vivo and better long-term results.

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