Case report

Immunohistological findings for an extracardiac conduit in Fontan pathway constructed with pedicled autologous pericardium

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Abstract

Although autologous pericardium has been used in pedicled fashion for various reconstructive procedures in congenital cardiovascular surgery with the expectation that it will be able to grow and remain viable after implantation, no clinical study has evaluated the histological characteristics of implanted pedicled pericardium long after previous implantation. We describe herein histological findings of pedicled pericardium, which had been used for three years as an extracardiac conduit in Fontan pathway. A four-year-old boy with a history of Fontan operation using pedicled autologous pericardial roll required conduit replacement three years after the previous operation, and resected pericardial tissue was examined immunohistologically. Staining for CD34 revealed abundant microvasculature, suggesting preservation of viability. Staining for factor VIII demonstrated the presence of endothelium on the luminal surface of the conduit. Elastica-van Gieson staining revealed a band of elastic tissue, which is generally found not in the native pericardium but in the vascular wall structures. These findings suggested that the pedicled pericardium thus appeared to have remained viable and might have differentiated to resemble tissue of the vascular wall after having been used in Fontan pathway.

Keywords: Fontan operation; Extracardiac conduit; Pedicled pericardium; Histopathology

1. Introduction

Autologous pericardium is widely accepted for use as a material for various reconstructive procedures in congenital cardiovascular surgery, and has been used in pedicled fashion with the expectation that it will be able to grow and remain viable after implantation [1—5]. However, no clinical study has evaluated the histological characteristics of implanted pedicled pericardium long after previous implantation, although some experimental animal studies have clearly demonstrated preservation of viability and growth ability of pedicled pericardium [6,7]. We describe herein histological findings of pedicled pericardium which had been used for three years as an extracardiac conduit in Fontan pathway.

2. Case report

The patient was a four-year-old boy who had double-outlet right ventricle with pulmonary atresia and right aortic arch in the setting of apicocaval juxtaposition, and underwent extracardiac Fontan operation with pedicled autologous pericardial roll (PAPR) at one year of age. We have described the details of Fontan operation with PAPR conduit in our previous report [4,8]. In brief, after median sternotomy, a rectangular flap of pericardium was cut, leaving it pedicled to preserve its vascular connections. The flap was then rolled into a tubular shape using a running suture of 6-0 polypropylene with minimal tension and relatively rough pitch to maintain the blood supply to the pericardium. After bidirectional Glenn anastomosis with the azygos vein left patent, an extracardiac Fontan pathway was created by interposition of PAPR conduit between the inferior vena cava and the pulmonary artery. Postoperatively, the patient had been placed on anticoagulation with warfarin sodium for one year, with a goal of achieving an international normalized ratio of 2.0.

His postoperative course was uneventful, and he had been otherwise healthy without symptoms except for the presence of mild hepatomegaly. As the blood flow through the PAPR conduit could not be detected on echocardiography, the patient was catheterized three years after the Fontan operation, and angiography confirmed occlusion of the PAPR conduit due to external compression between the vertebral bodies and the ventricle. The PAPR conduit was replaced using a ringed Gore-Tex graft. Intraoperative examination revealed no evidence of conduit thrombosis. The resected PAPR tissue was examined postoperatively.
Staining for CD34 revealed abundant microvasculature in PAPR tissue. Staining for factor VIII yielded positive cells, confirming the presence of endothelium on the luminal surface of the PAPR conduit. Elastica-van Gieson staining revealed a band of elastic tissue near the luminal surface of the PAPR conduit (Fig. 1). Neither calcification nor fibrosis was observed on hematoxylin–eosin staining.

3. Comment

Since Senning [1] used pedicled pericardium for repair of transposition of the great arteries in 1975, it has been applied to various reconstructive procedures in congenital cardiovascular surgery because of its structure, proximity, accessibility and, most importantly, the possibility of preservation of viability with avoidance of progressive shrinkage [2,3]. However, no clinical investigation has demonstrated long-term preservation of viability after previous implantation, although some authors have demonstrated preservation of viability of pedicled pericardium in experimental animal studies [6,7].

On immunohistological examination, staining for CD34 revealed the presence of extensive microvasculature in PAPR tissue. The density of microvasculature in the tissue was clearly greater than that in the implanted, non-pedicled pericardial patch described in a previous report [9]. Preservation of abundant microvasculature was probably the result of maintenance of vascular connections, and unequivocally indicates preservation of viability. However, it is possible that pedicled pericardium will not remain viable in high-pressure systems, in which surrounding pressure exceeds the capillary pressure of the pericardium, since such pressure will deprive it of its arterial supply and venous drainage [6].

Staining for factor VIII revealed complete endothelialization of the luminal surface of the PAPR, suggesting that the conduit may have been nonthrombogenic. In fact, no thrombus was present in the PAPR conduit at reoperation despite complete occlusion. Elastica-van Gieson staining revealed a band of elastic tissue near the luminal surface of the PAPR conduit. This type of band is generally found not in the native pericardium but in the vascular wall structures [9]. Pedicled pericardium might thus differentiate to resemble the tissue of the vascular wall after having been used as a vascular substitute.

The obvious limitation of the present investigation is that the specimen presented here was obtained from not patent conduit but occluded one. Conduit occlusion is a rare complication for PAPR conduit in Fontan pathway; the incidence is 3.6% (1/28) in our series [4], and 1.9% (1/54) in another report [5]. Therefore, it remains unclear whether or not the pathological characteristics observed in the present case can be extrapolated to the remaining whole patients with patent PAPR conduit. Further examinations would be warranted to clarify the natural properties of pedicled pericardium used for Fontan pathway.

Reference