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How to Do It

Reconstruction of right ventricular outflow tract with severe calcification: Lantern procedure

Takahiro Ishigaki^{1,2}, MD, PhD., Satoru Wakasa², MD, PhD, Koji Sato³, MD, PhD, Nobuyasu Kato², MD, PhD, Yasuhiro Kamikubo¹, MD, PhD

1. *Department of Cardiovascular Surgery, Kushiro City General Hospital, Kushiro, Japan*

2. *Department of Cardiovascular Surgery, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Sapporo, Japan*

3. *Department of Cardiovascular Surgery, KKR Sapporo Medical Center, Sapporo, Japan*

Corresponding author:

Satoru Wakasa, MD, PhD

Professor and Chairman of the Department of Cardiovascular and Thoracic Surgery,

Faculty of Medicine and Graduate School of Medicine, Hokkaido University

Kita-15, Nishi-7, Kita-ku, Sapporo 060-8638, Japan

Tel: +81-11-706-6042

Fax: +81-11-706-7612

E-mail: wakasa@med.hokudai.ac.jp

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Abstract

Right ventricular outflow tract reconstruction is repeatedly required after the Rastelli procedure. However, standard right ventricular outflow tract reconstruction using direct anastomosis on the posterior right ventricular outflow tract wall is unfeasible in cases with severe calcification. Herein, we present a novel technique called the “lantern procedure,” which can fix the prosthetic pulmonary valve without anastomosis to the calcified right ventricular outflow tract wall.

Introduction

As surgical outcomes for congenital heart disease improve, a growing number of patients require repeated right ventricular outflow tract (RVOT) reconstruction after the Rastelli procedure. In such cases, severe calcification and adhesion around the previous conduit preclude the adoption of procedures using direct anastomosis of the prosthetic valve on the RVOT wall. Therefore, we developed a novel technique called the “lantern procedure” to place a prosthetic pulmonary valve in the RVOT without direct anastomosis.

Technique

1 The surgery was performed under general anesthesia. After a successful resternotomy,
2 standard cardiopulmonary bypass with ascending aortic perfusion and bicaval venous
3 drainage was established. After cardiac arrest was achieved, a longitudinal incision was made
4 on the anterior wall of the RVOT and the calcified anterior wall was resected. A short valved
5 composite graft was anastomosed to the distal end of the pulmonary trunk using a 4-0
6 polypropylene suture (Fig. 1a). The composite graft was then covered using a prosthetic graft
7 patch, which was anastomosed to the remnant tissues of the previous RVOT conduit or patch
8 using a 4-0 polypropylene suture for the reconstruction of the anterior wall of a new RVOT
9 (Fig. 1b). A small patch size was selected to tightly fix the proximal side of the composite
10 graft in the new RVOT (Fig. 1c).

11 The lantern procedure was initially developed to reduce complexity and risk of RVOT
12 reconstruction in the patient who underwent RVOT reconstruction, simultaneously with mitral
13 valve repair, tricuspid repair, and ascending aortic replacement using hypothermic circulatory
14 arrest. The patient featured was born with transposition of the great arteries with a ventricular
15 septal defect and pulmonary valve stenosis. He had undergone RVOT reconstruction twice at
16 the age of 7 and 16 years (using an equine pericardial conduit and autologous pericardial patch,
17 respectively) and required the third RVOT reconstruction, due to heart failure. Preoperative
18 computed tomography revealed severe calcification on the posterior RVOT wall and the left

coronary artery behind the proximal RVOT (Fig. 1d). Intraoperatively, severe calcification was also observed on the posterior wall of the RVOT and direct anastomosis was abandoned. We decided to adopt the lantern procedure, which required a single suture on the distal RVOT wall to implant the bioprosthesis. To date, this procedure has been successfully performed in two patients in their 30s with severe calcification on the posterior RVOT wall. In both patients, there were no difficulties in the distal anastomosis because no calcification was found on the distal end of the pulmonary trunk. The composite graft was created using a 25-mm and 27-mm bioprosthetic valves (Epic Supra, Abbott Vascular, Chicago, IL, USA) and a 28-mm (Triplex, Terumo Corporation, Tokyo, Japan) and 30-mm prosthetic grafts (J-graft, Japan Lifeline, Tokyo, Japan), respectively. Both patients recovered uneventfully. The composite graft fit well in the new RVOT without blood flow or thrombus around the graft on postoperative computed tomography (Fig. 1e).

Discussion

All options for procedures in a standard RVOT reconstruction (such as pulmonary valve replacement with a patch plasty of the anterior wall of the RVOT, conduit replacement using a prosthetic composite graft, a tissue graft, or a valved expanded polytetrafluoroethylene conduit [1–3]) require anastomosis on the posterior RVOT wall. However, the RVOT wall

sometimes has severe calcification, especially in patients who undergo repeated surgery, which disturbs the secure anastomosis. In contrast, aggressive dissection of the calcified posterior wall can injure the coronary artery behind the proximal RVOT. Therefore, we developed a novel technique called the lantern procedure to place a prosthetic valve in the RVOT without anastomosis to the calcified wall or extensive dissection of the calcified tissues. Using this procedure, the prosthetic valve was suspended and fixed in a new RVOT, similar to a lantern. Patients with pulmonary bioprosthesis will require redo surgery for valve deterioration in the future. After the lantern procedure, redo pulmonary replacement can be easily performed by suturing a new bioprosthesis on the vascular graft. In addition, transcatheter pulmonary valve replacement could be an alternative option in high-risk cases for cardiopulmonary bypass surgery [4]. In this procedure, it is important to attach the composite graft to the new RVOT wall tightly to prevent paravalvular leakage and thrombus formation around the graft. Although no paravalvular leakage and thrombus around the composite graft was found in the postoperative study in both cases, careful observation is required.

Conclusion

The lantern procedure is a secure option for repeated RVOT reconstruction, especially in cases with severe calcification.

Figure legends

Fig. 1 RVOT was reconstructed using the lantern procedure (a-c). Severe calcification was observed in the right ventricular outflow tract (RVOT) posterior wall made of the previous conduit (d). A composite graft fitted tightly in the new RVOT without blood flow or thrombus around the composite graft (e)

Red arrows indicate the calcification of the posterior wall. Blue arrows indicate the previous intraventricular re-routing patch.

RV, right ventricle; RVOT, right ventricular outflow tract; PA, pulmonary artery

Video legends

Video 1. Lantern procedure.

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