Extensibility of autologous pericardium roll conduit in non-confluent pulmonary artery: a case report

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Abstract

Background: There is great discussion about non-confluent pulmonary artery (PA) reconstruction, and several materials have been used. Autologous pericardium is considered feasible for infectious resistance, autoimmune response, extensibility, and growth potential.

Case presentation: The patient was born at 39 weeks (body mass = 2550 g). He was diagnosed with tetralogy of Fallot, pulmonary atresia, non-confluent PA, and bilateral patent ductus arteriosus. Right and left Blalock-Taussig shunts with patent ductus arteriosus ligations were placed on day 27 and 3 months, respectively.

At 19 months (8.8 kg), definitive repair was performed with tricuspid valved conduit concurrent with PA reconstruction using an autologous pericardium roll conduit. The autologous pericardium was treated with glutaraldehyde (autologous pericardium fixed with 0.4% glutaraldehyde for 7 min and rolled as conduit – 12 mm in diameter and 30 mm in length). Following an incision on the visceral side of the PAs before the 1st branch, the autologous pericardial roll conduit was anastomosed. Follow-up angiographies on postoperative months 9 and 57 demonstrated that the PA, including the autologous pericardium roll conduit, had spontaneously enlarged.

Conclusion: Particularly for non-confluent PA, the patients require increased pulmonary beds at an early age because of hypoplastic PA. While size mismatch between the graft and native PA develops as the child grows, size-adjustable extensibility of the PA graft should be noted.

Keywords: Autologous pericardial roll conduit, Non-confluent pulmonary artery, Tetralogy of Fallot

Background

There is extensive discussion regarding non-confluent pulmonary artery (PA) reconstruction, and several materials have been used [1, 2]. Autologous pericardium is considered reasonable for infectious resistance, autoimmune response, extensibility, and growth potential [3]. Herein, we present a case of tetralogy of Fallot that underwent a definitive procedure concurrent with PA reconstruction using an autologous pericardial roll conduit for non-confluent PA; the case demonstrated an enlarged PA post-procedure.

Case presentation

The patient (born at 39 weeks; weight = 2550 g) was diagnosed with tetralogy of Fallot, pulmonary atresia, non-confluent PA, and bilateral patent ductus arteriosus. Despite intubation on day 19, desaturation progressed even with prostaglandin administration. Right and left Blalock-Taussig shunts with patent ductus arteriosus were ligated on day 27 and 3 months, respectively. The interrupted pulmonary arterial portion was so long (20 mm) that unifocalization of bilateral PAs was impossible.

At age 19 months (8.8 kg), definitive repair was performed with tricuspid valved conduit concurrent with PA reconstruction using an autologous pericardium roll conduit. Cardiopulmonary bypass was achieved, and the previous bilateral Blalock-Taussig shunts were removed. After inducing cardiac arrest, ventricular septal defect
was closed with a polytetrafluoroethylene patch. There-
after, the autologous pericardium was treated with glu-
таральдегида (autologous pericardium fixed with 0.4% 
glutaraldehyde for 7 min and rolled as a conduit – 12 
mm in diameter and 30 mm in length). Following an in-
cision on the visceral side of the PAs before the 1st 
branch, the autologous pericardial roll conduit was anas-
tomosed. Finally, the tricuspid valved conduit was anas-
tomosed between the right ventricular outlet and the pericardial conduit (Fig. 1).

The postoperative course was uneventful. The patient 
was discharged on postoperative day 20. Follow-up angi-
ographies at postoperative months 9 and 57 demonstrated 
that the PA, including the autologous pericardium roll 
conduit, had spontaneously enlarged (Additional file 1: 
Video S1, Table 1 and Fig. 2).

**Discussion and conclusions**

Autologous pericardium is frequently used in pediatric 
cardiac surgery. Compared to other materials such as 
artificial graft [1] and xenopericardia [2], an autologous 
pericardium is resistant to infection and calcification 
and free from autoimmune response and has the poten-
tial for extensibility and growth. Hibino et al. demon-
strated that autologous pericardium could differenti-
ate into the vascular wall, because of the effect of stem cells 
and the surrounding environment after implantation in 
the PA [3]. Although we could not confirm the histo-
logic evidence, the enlarged autologous pericardium roll 
conduit in our case might suggest the growth potential.

Autologous pericardium is often treated with glutaral-
dehyde. Glutaraldehyde treatment is accessible to tech-
nical handling and reinforces the pericardium strength 
while maintaining its configuration. Non-ringed artificial 
grafts or xenografts may be compressed by other struc-
tures. Lee et al. demonstrated that the most feasible glu-
taraldehyde treatment method was that with 0.5–0.6% 
glutaraldehyde for 20 min [4], and indicated the import-
ance of the treatment-associated mechanical properties, 
degree of fixation, and resistance to enzymatic 
degradation. Conversely, in our case, glutaraldehyde was 
more diluted (0.4%) and treatment duration was shorter 
(7 min) than those in other reports. Our treatment 
method might suggest the pericardial roll’s extensibility 
and growth potential. In addition, pulsatile pressure and 
flow might intermittently expand the pericardial roll, 
leading to its “adjustable” size as native PA, which ac-
commodates the individual’s body size and age.

**Table 1** Follow-up angiography data

| Diameter (mm) | Postoperative 9 mo | Postoperative 57 mo |
|--------------|--------------------|---------------------|
| Right proximal PA | (A) 8.8 | (A) 13.5 |
| Right distal PA before 1st branch | (B) 8.8 | (B*) 14.4 |
| Right basal trunk PA | (C) 8.7 | (C) 10.4 |
| Left proximal PA | (D) 6.8 | (D') 11.3 |
| Left distal PA before 1st branch | (E) 6.8 | (E) 8.3 |
| Left basal trunk PA | (F) 9.1 | (F') 11.9 |
| Blood Pressure, systolic/diastolic (mean) (mmHg) | | |
| Main PA | 25 / 7 (14) | 21 / 6 (13) |
| Right PA | 17 / 7 (11) | 17 / 6 (11) |
| Left PA | 17 / 6 (11) | 16 / 7 (11) |
| PA index (mm²/m²) | 206 | 330 |
| Rp (WU/m²) | 2.3 | 1.9 |

PA pulmonary artery, Rp pulmonary resistance, WU Wood units
Continuous low pressure, including Glenn and Fontan circulation, might not affect the size of the pericardium roll conduit.

Particularly for non-confluent PA, the patient requires increased pulmonary beds at an early age because of hypoplastic PA. While size mismatch between the graft and native PA develops as the child grows, size-adjustable extensibility of the PA graft should be noted. Long-term outcomes are unclear; therefore, careful observation is needed in the future.

Additional file

Additional file 1: Video S1. Postoperative pulmonary angiography series. Pulmonary arteries, including autologous pericardium roll, have enlarged. (MP4 24477 kb)

Abbreviation
PA: Pulmonary artery

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Authors’ contributions
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Authors' information
Not applicable.

Fig. 2 Postoperative pulmonary angiography series. Pulmonary arteries, including autologous pericardium roll, have enlarged. A and A’ = right proximal PA; B and B’ = right distal PA before 1st branch; C and C’ = right basal trunk PA; D and D’ = left proximal PA; E and E’ = left distal PA before 1st branch; F and F’ = left basal trunk PA