Modified Damus—Kaye—Stansel procedure using aortic flap technique for systemic ventricular outflow tract obstruction in functionally univentricular heart

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Received 5 January 2006; received in revised form 8 March 2006; accepted 10 March 2006; Available online 4 May 2006

Abstract

Damus—Kaye—Stansel procedure is a useful method to relieve the systemic ventricular outflow tract obstruction in functionally univentricular heart. Regurgitation of pulmonary valve and recurrence of systemic ventricular outflow obstruction are the major concerns at the late phase of this procedure. Modification of original Damus—Kaye—Stansel procedure that can prevent the use of prosthetic materials is evaluated. The modified Damus—Kaye—Stansel procedure using aortic flap technique was performed in eight patients with functionally univentricular heart. Patients' ages ranged from 3 to 28 months (mean 14 months). Follow-up period was 37 months as a mean (9—71 months), and the follow-up was complete. There was no operative mortality and no late death. In addition, there was no recurrence of systemic ventricular outflow tract obstruction throughout the follow-up period. Regurgitation of the pulmonary valve estimated by echocardiography at the latest follow-up was none to trivial in seven patients and mild in one. The modified Damus—Kaye—Stansel procedure using aortic flap technique is a safe, useful and reproducible technique to solve systemic ventricular outflow tract obstruction in functionally univentricular heart, and it can be an alternative for original technique or the so-called double-barrel modification.

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Keywords: Damus—Kaye—Stansel procedure; Systemic ventricular outflow tract obstruction; Univentricular heart

1. Introduction

The Damus—Kaye—Stansel (DKS) procedure, connection of the pulmonary trunk to the ascending aorta, is one of the most effective methods to relieve systemic ventricular outflow tract obstruction in functionally univentricular heart [1—6]. The development of pulmonary valve regurgitation due to distortion of the pulmonary valve and recurrence of systemic ventricular outflow obstruction, in case of prosthetic material use for anastomosis, are considered as the two major sequelae in the original DKS procedure [1—3,7]. Modification of procedure using bivalved technique has reduced the incidence of these complications [1,3,5], while adjustment of big discrepancy of the size between the new proximal root and the distal part of the ascending aorta remains a technically demanding issue.

Mimicking the trap door technique in arterial switch operation for the transposition of the great arteries, we have introduced aortic flap technique as a modification of the original DKS procedure.

2. Patients and methods

The modified DKS procedure using aortic flap technique was performed in eight patients with functionally univentricular hearts. The mean age of patients at the time of operation was 14 ± 9.6 months (ranged from 3 to 28 months). The mean body weight was 8.1 ± 2.9 kg (ranged from 4.5 to 12.6 kg). As prior procedures, pulmonary artery banding (PAB) was performed in all patients at the mean age of 1 ± 0.7 months.

All patients underwent surgery through median sternotomy using cardiopulmonary bypass. The pulmonary artery was transected at the site of PAB and was trimmed to remove the tissue with fibrous change caused by PAB (Fig. 1). The pulmonary artery trunk was dissected completely from the surrounded tissue to increase its mobility. A transverse incision of the ascending aorta was made at the opposite site of the transected pulmonary trunk, just above the sinotubular junction. Meticulous attention was paid not to extend the incision into the sinus of Valsalva and not to injure the orifice of the coronary artery. Oblique longitudinal incision was added to make the triangular aortic flap like a trap door. The inferior margin of the opened aorta is then sutured to the adjacent edge of the transected pulmonary artery with...
continuous running suture using absorbable materials. The inferior margin of the aortic flap is then sutured to the posterior aspect of the transected pulmonary artery. As the pulmonary artery trunk is dilated after the pulmonary artery banding and is mobilized maximally, the anterior aspect of the transected pulmonary artery can be anastomosed easily to the aorta without any tension and torsion of the pulmonary trunk and valve.

3. Results

There was no operative mortality and no late mortality. All patients received cardiac catheterization study after the DKS operation and were followed with echo-Doppler examination at our outpatient clinic. No patient was lost during follow-up period with complete follow-up rate of 100%. The mean follow-up period was 37 months (ranged from 9 to 71 months).

No patient had systemic ventricular outflow tract obstruction estimated by follow-up catheterization and echocardiography. Regurgitation of the pulmonary valve estimated by echocardiography before the DKS procedure was observed none in seven patients and trivial in one. After the DKS procedure, regurgitation progressed from trivial to mild in one patient; however, it remained stable afterwards. In the remaining seven patients, regurgitation of the pulmonary valve remained none to trivial at the recent follow-up echocardiography.
Regurgitation of the aortic valve was also estimated by echocardiography. At the recent follow-up, five patients had no leak and three patients had trivial regurgitation.

4. Discussion

The DKS procedure is now the most popular and useful method to relieve systemic ventricular outflow tract obstruction in functionally univentricular heart. As over-distension and/or torsion of the pulmonary trunk and pulmonary valve may cause future pulmonary valve regurgitation, some modifications of the original DKS procedure have been made. The hood technique facilitates the construction of a tension-free DKS anastomosis without distortion of the pulmonary valve [1], while this technique needs prosthetic materials, which might be a cause of future recurrence of systemic outflow tract obstruction. The ‘bivalved’ technique [1], which is recently called double-barrel anastomosis [5], is a choice of operation in many centers because this method might reduce the possibility of over-distention and distortion of the pulmonary trunk and pulmonary valve. However, adjustment of a big discrepancy between the new proximal stump (bivalved artery) and the ascending aorta is a technically demanding issue, especially in case of previous PAB, which is always associated with dilated pulmonary trunk. Requirement of prosthetic materials to enlarge a small ascending aorta might increase the possibility of future systemic outflow obstruction.

Although Laks et al. [8] had reported the aortic flap technique as a modification of DKS procedure, they limited its indication only to the cases with short pulmonary trunk where the pulmonary artery banding was placed proximally and they needed patch to roof the anastomosis. We had extended the indication of this technique to the cases of pulmonary artery banding, which is appropriately placed. This technique can avoid the use of prosthetic material for anastomosis without the tension of the pulmonary trunk. Our clinical mid-term results of this technique were satisfactory.

Acknowledgement

We thank Dr T. Shirota for his help to make a figure.

References