Case reports

Arterial switch operation after multiple-stage left ventricular retraining

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Right ventricular dysfunction and tricuspid valve incompetence after atrial repair for transposition of the great arteries is an increasingly frequent problem. Left ventricular retraining to convert an atrial switch to an arterial switch is a well-known surgical option but can require a multiple-stage surgical approach. We report our successful multiple-stage experience with a 5-year-old girl.

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Right ventricular dysfunction plus tricuspid valve incompetence is a well-known complication after atrial switch particularly in patients with transposition of the great arteries plus ventricular septal defect (VSD)[1].

Attempts to "retrain" the morphological left ventricle (LV) in order to convert an atrial switch to an arterial switch have been rarely reported and can present some technical difficulties.

We report our successful multiple-stage experience with a 5-year-old patient in whom 4.5 years after a Mustard procedure, we performed an arterial switch operation after left ventricular retraining.

Case report

A 4.5-year-old girl was referred to our hospital from abroad because of reduced exercise tolerance, failure to thrive and congestive heart failure. She was known to have transposition of the great arteries and VSD. She had undergone pulmonary artery banding at 3 months of age and a Mustard operation plus VSD closure in another Institution when she was 7 months old. Because of progressive right ventricular dysfunction, tricuspid valve incompetence and a residual VSD, she underwent patch closure of the residual VSD, semicircular annuloplasty for tricuspid valve repair and pulmonary artery banding when she was 3.6 years old.

At 4.2 years of age she was admitted to our Department in conditions of heart failure.

Echocardiographic evaluation showed massive tricuspid valve regurgitation with a hypokinetic right ventricle (RV). Cardiac catheterization confirmed the echocardiographic findings with a systemic pressure in the morphological LV equal to half the pressure in the RV (LV 55 mmHg, RV 110 mmHg).

It was clear that the only two possible surgical options were heart transplantation or better left ventricular retraining with a more tightened pulmonary artery banding.

We checked the wall thickness and that of the septum during systole and diastole (Table I). Through a midline sternotomy, we tightened the pulmonary artery banding so as to better prepare the LV for a possible arterial switch operation achieving a left ventricular pressure of 85 mmHg and a right ventricular pressure of 90 mmHg.

The postoperative course was uneventful and echocardiographic evaluation prior to discharge of the patient showed an improved LV and RV, a decreased tricuspid valve incompetence, a shift of the previously left-sided ventricular septum towards the midline, and a systolic LV/RV pressure ratio of 0.90 with an increased left ventricular posterior wall thickness (Table I).

Eight months later the patient was again admitted to our Department.

Through a fifth midline sternotomy, on cardiopulmonary bypass, moderate hypothermia (25°C) and aortic cross clamping, the intra-atrial Mustard patch was removed and a new intra-atrial septum was constructed with a heterologous pericardial

Table I. Preoperative and postoperative echocardiographic data.

	Pre-rePAB (mm)	Post-rePAB (mm)	Pre-arterial switch (mm)
LVPWs	6	10	11
LVPWd	3	5.5	7.5
IVSs	4	6	7.4
IVSd	3	5	7

IVSd = diastolic interventricular septum; IVSs = systolic interventricular septum; LVPWd = diastolic left ventricular posterior wall; LVPWs = systolic left ventricular posterior wall; PAB = pulmonary artery banding.

patch. The pulmonary artery banding was removed and an arterial switch operation was performed.

The postoperative course was uneventful and the patient was discharged on postoperative day 11 in good clinical conditions, sinus rhythm, and on oral therapy with diuretics and ACE-inhibitors.

A pre-discharge two-dimensional echocardiography and color flow Doppler showed mild left ventricular enlargement, mild tricuspid valve incompetence, satisfactory biventricular function and an estimated peak right ventricular pressure of 30 mmHg.

Discussion

The incidence and progression of right ventricular dysfunction and tricuspid valve incompetence after an atrial switch operation is higher in patients with transposition of the great arteries and VSD after concomitant atrial baffle and VSD closure[1,2]. The development of these complications constitutes a significant clinical problem and their treatment is difficult.

Three possible surgical options are available. Tricuspid valve replacement alone resolve the problem only partially, particularly in case of an already well-established right ventricular dysfunction. Heart transplantation is the second surgical option. The remaining alternative is to convert the atrial repair into an arterial switch but the LV needs to be retrained. Left ventricular retraining may be achieved by means of a prior pulmonary artery banding necessary for adequate withstanding of the systemic load.

In 1986, Mee[3] reported the first 2 cases of a successful conversion of an atrial to an arterial switch repair after left ventricular retraining.

Cochrane et al.[4] suggest that the systolic LV/RV pressure ratio should be at least 0.8 at the time of conversion. It could be technically difficult to immediately achieve a good systolic LV/RV pressure ratio and an adequate increase in the left ventricular myocardial mass.

In the rapidly growing neonate and infants, it is known that left ventricular hypertrophy after pulmonary artery banding can develop very rapidly but such an event is unlikely in the older child in whom we cannot rely on the growth of the patient for natural tightening of the band. Consequently, as in our case, rebanding of the pulmonary artery should be taken into consideration if the retraining process is to be accelerated and the LV well-prepared.

In conclusion, we believe that the conversion of an atrial to an arterial switch is the procedure of choice for patients with a documented progression of right ventricular dysfunction and tricuspid valve incompetence after the Mustard or Senning operation.

The necessary well-retrained LV can be difficult to achieve and sometimes requires a multiple-stage surgical approach.

References

1. Mee RBB. Arterial switch for right ventricular failure following Mustard or Senning operation. In: Stark J, Pacifico AD, eds. Reoperations in cardiac surgery. New York, NY: Springer-Verlag, 1989: 217-32.
2. Hagler DJ, Ritter DG, Mair DD, Davis GD, McGoon DC. Clinical, angiographic, and hemodynamic assessment of late results after Mustard operation. Circulation 1978; 57: 1214-20.
3. Mee RBB. Severe right ventricular failure after Mustard or Senning operation. Two-stage repair: pulmonary artery banding and switch. J Thorac Cardiovasc Surg 1986; 92: 385-90.
4. Cochrane AD, Karl TR, Mee RBB. Staged conversion to arterial switch for late failure of the systemic right ventricle. Ann Thorac Surg 1993; 56: 854-62.