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ORIGINAL ARTICLE

Surgical Relief of Left Ventricular Outflow Tract Obstruction in Adults With Congenital Aortic Stenosis and Associated Aortic Annulus Hypoplasia and/or Subaortic Obstruction

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Background In children and adolescents, a Ross/Konno operation is commonly done to both enlarge the aortic root and provide a competent aortic valve with relief of left ventricular outflow tract obstruction (LVOTO). Optimum management is not so straightforward in adults.

Methods Between 1995 and 2014, 16 patients of mean age 39.4 years (18–57 years) with hypoplastic aortic annulus (AA) measuring 20 mm and less, and mean aortic valve/LVOT gradient of 61 mmHg (30–70 mmHg) presented for surgery.

Results Eight patients with mean LVOT/AA diameter 19.6 mm (18–20 mm) underwent an ''inclusion- cylinder'' type Ross procedure (RP). Eight patients with more severe LVOT/AA obstruction, with mean diameter 0f 17.4 mm (16–19 mm) underwent mechanical aortic valve replacement (AVR) with standard Konno-type aortoventriculoplasty. There was zero early and late mortality; with mean follow-up of 11.6 years (3–21 years) in the Ross group and 6 years (2–10 years) in the Konno-AVR group. One patient in the Konno-AVR group had reoperation after two years for RVOT obstruction. The postoperative echocardiograms of these patients at last follow-up show residual mean gradient across LVOT/AA of 4.4 mmHg (2–6 mmHg) after RP, and 11.9 mmHg (8–17 mmHg) after Konno-AVR.

Conclusions In adults, the ''inclusion-cylinder'' Ross-procedure is a good alternative for mild to moderate aortic root hypoplasia. However, for cases with severe LVOT obstruction, a Ross-Konno is not possible with the same method of autologous support used in a non-Konno RP, and this could be expected to have an impact on late durability and the need for further intervention, in a group that has already undergone multiple procedures in childhood. Both methods of RP and Konno-AVR lead to excellent early and late results.

Keywords Ross/Konno procedure • Mechanical AVR/Konno operation • Konno aortoventriculoplasty • Severe LVOTO obstruction • Konno-AVR

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Background

Hypoplastic aortic annulus (measuring 20 mm and less) and small aortic root are challenging problems in congenital heart surgery, especially in adults. In children and adolescents, a Ross/Konno operation is commonly done to both enlarge the aortic root and provide a competent aortic valve with relief of left ventricular outflow tract obstruction (LVOTO). Optimum management of severe LVOTO with hypoplastic aortic annulus is not so straightforward in adults. The Ross procedure [1] (RP) is a good alternative for mild to moderate aortic root hypoplasia. However, in adults with severe obstruction, with complex multilevel LVOTO, Konno aortoventriculoplasty [2] with mechanical aortic valve replacement (K-AVR) is preferred. We present a series of adult patients with hypoplastic aortic annulus and small aortic root who underwent RP and Konno-AVR for associated severe subaortic obstruction.

Methods

Between December 1995 and August 2014, eight adult patients with small aortic annulus and mild to moderate aortic root hypoplasia had a RP and another eight adult patients, underwent Konno-AVR for associated more severe subaortic obstruction, all operations were performed by a single surgeon.

Patient data were analysed retrospectively from hospital records and our cardiac database. Data included preoperative diagnosis, investigations, operative reports, postoperative course and follow-up. Eight patients in the first group had an inclusion-cylinder type of Ross procedure (RP). One patient had a previous AVR with 19 mm St Jude Medical (SJM) mechanical prosthetic valve eight years previously (St. Jude Medical Inc., St. Paul, MN), which had stenosed severely due to pannus ingrowth along with dilated ascending aorta. Three of these eight patients had aortic root enlargement using the posterior aortic root enlargement technique as described by Nicks and colleagues [3].

The second group consisted of eight patients (four males and four females) who had a Konno aortoventriculoplasty with mechanical aortic valve replacement (K-AVR).

The underlying preoperative diagnoses are presented in Table 1. The principal diagnosis in both groups was congenital aortic stenosis with LVOTO. Twelve of the 16 patients had operations before and previous interventions are summarised in Table 2. Additional concomitant procedures performed along with the RP and K-AVR operation are listed in Table 3.

Operative technique included standard cardiopulmonary bypass with moderate hypothermia and multidose retrograde and antegrade blood cardioplegia. In both groups, the aortic valve was inspected. After it was clear that it was not repairable, it was excised. In the Konno-AVR patients, to relieve subvalvar obstruction and implant a larger prosthesis, an incision was made in the right ventricular outflow tract across the aortic annulus into the ventricular septum as described by Konno and colleagues [2] (Figure 1).

Table 1 Preoperative Diagnoses.

DIAGNOSIS	ROSS PROCEDURE	KONNO-AVR
Severe aortic regurgitation	1	2
Severe aortic stenosis	1	2
Bicuspid aortic valve and aortic stenosis	4	3
Unicuspid aortic valve and aortic stenosis	1	0
Mechanical aortic valve stenosis	1	1
Small aortic root	3	6
Sub-valvar stenosis	1	2
Tunnel subaortic stenosis	0	5
Supravalvulvar stenosis	0	2
Aneurysmal ascending aorta	1	2
Coronary artery disease	1	1
Anomalous coronary artery origin from pulmonary artery	1	0

A Dacron patch (Boston Scientific Company, Oakland, NJ) was then used to enlarge the subvalvular area as well as the aortic annulus (Figure 2). The new valve prosthesis was generally secured in place using pledgetted horizontal mattress (Figure 2). The Dacron patch was further used to close the aortotomy with or without additional enlargement of the ascending aorta (Figure 3). Typically, the incision in the right ventricular outflow tract (RVOT) was enlarged with a patch of bovine pericardium (Figure 4).

In the Ross patients, after excising the aortic valve, the pulmonary trunk was opened distally through a transverse incision. The pulmonary valve was inspected. If normal, it was explanted as a pulmonary autograft (Figure 5). The posterior root enlargement was done when needed using

Table 2 Previous Operations.

PREVIOUS OPERATION	ROSS PROCEDURE	KONNO-AVR
Open aortic valvotomy	1	2
Subaortic membrane	1	2
Subaortic resection	0	5
Coarctation repair	2	1
Patent ductus arteriosus closure	1	0
Aortic valve replacement	1	1
Ventricular septal defect closure	1	1
Interrupted aortic arch repair	1	1
Mitral valve replacement (MVR)	0	1
Permanent pacemaker	0	1

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