The Konno-Rastan Procedure for Anterior Aortic Annular Enlargement

Mark E. Roeser, MD

An anterior aortoventriculoplasty, known as the Konno-Rastan procedure, is a useful tool for the cardiac surgeon. Originally, described for congenital aortic stenosis secondary to small annular size, it relieves subvalvar, valvar, and supravalvar stenosis. We show a step by step, illustrated, and safe approach to perform this operation. Although this is unusual anatomy outside the congenital arena, it is a relatively safe and straight-forward procedure. When compared with a homograft or xenograft root replacement, the Konno-Rastan has the benefit of not having to mobilize the coronaries as well as ease of valve replacement. Operative Techniques in Thoracic and Cardiovascular Surgery 20:219-233 © 2016 Elsevier Inc. All rights reserved.

KEYWORDS Konno, Konno-Rastan, aortic annular enlargement

Introduction

An anterior aortoventriculoplasty, known as the Konno-Rastan procedure, is a useful tool for the cardiac surgeon. Originally, described for congenital aortic stenosis secondary to small annular size, it relieves subvalvar, valvar, and supravalvar stenosis. There is usually some intrepidity about the procedure, as it involves opening the right ventricular outflow tract and then cutting through the aortic annulus and ventriculo infundibular fold into the ventricular septum. Although this is unusual anatomy outside the congenital arena, it is a relatively safe and straight-forward procedure. The Ross-Konno is more popular, but may not be the best in older patients or if the pulmonary valve has prohibitive pathology. We are also seeing patients who present with aortic stenosis after mitral valve replacement, and are no longer candidates for a Nicks or Manouguian procedure. When compared with a homograft or xenograft root replacement, the Konno-Rastan has the benefit of not having to mobilize the coronaries as well as ease of valve replacement (Figs. 1-11).
Operative Technique

Figure 1 We prefer bicaval cannulation to have a bloodless field in the right ventricle during the case. We also place a left ventricular vent via the right superior pulmonary vein and a retrograde coronary sinus perfusion catheter. The aorta is cannulated just below the take off of the innominate artery to gain as much length as possible on the ascending aorta. Both the root and proximal ascending aorta will be enlarged with a patch. Therefore, the antegrade perfusion catheter should also be placed distal on the aorta. LV = left ventricle; PV = pulmonary valve; SVC = superior vena cava; IVC = inferior vena cava.
Figure 2 The ascending aorta is opened longitudinally on the anterior aspect. This incision is carried into the right coronary sinus to the left of the right coronary and very close to the right/left commissure. The valve leaflets are debrided and a sizer is used to see if a root enlargement needs to be performed. The RVOT can be incised with a knife making sure that no branches of the right coronary are injured and that the pulmonary valve is safely above the incision. RVOT = right ventricular outflow tract; a = artery.
Figure 3 The pulmonary valve lies superior to the aortic valve annulus. The level of the aortic annulus, corresponds to the infundibulum of the right ventricular outflow tract. The dotted line shows the path of the incision. By staying close to the right/left commissure, the conduction system is protected. SVC = superior vena cava.
Figure 4  Pledged 3-0 prolene sutures are used to retract the right ventricle and expose the septum. Sharp scissors are used to incise the ventriculo infundibular fold and the aortic annulus. This incision is made between the right coronary and right/left commissure, staying closer to the right/left commissure as shown in Figure 3. The septal incision is usually around 10-15 mm in length and allows the aortic annulus to separate nicely. A sizer can be placed to estimate the patch width and decide if the septal incision is adequate. The width of the patch will equal the additional annular circumference.
Figure 5 A patch of knitted gelatin sealed dacron is used. The inferior aspect of the patch will be used to close the defect created in the ventricular septum. The imaginary ridge demonstrates where the neo-annulus would be. The superior aspect of the patch will be used to augment the aortic sinus and sinotubular junction. A total of 2 patches are cut. The second patch (outer) will be used to augment the RVOT later. The inferior aspect of this patch will be discarded. RVOT = right ventricular outflow tract.
Figure 6 (A) The inside patch will augment the subvalvar, valvar, and supravalvar aspects of the left ventricular outflow tract. RVOT = right ventricular outflow tract.
A running 4-0 prolene suture is used to sew the patch to the ventricular septum. Deep, full thickness bites should be taken. If the septum is exceedingly thick, a 3-0 prolene suture may be a better choice. At the conclusion, the annulus should be resized and prosthetic valve be selected.
Sutures placed in debrided aortic annulus for securing replacement valve

**Figure 7** The 2-0 ethibond horizontal mattress sutures are then passed through the aortic annulus as per any aortic valve replacement. The patch can be lifted and a neoaortic-annular line should be chosen on it. At this time, the RVOT patch is trimmed. That patch, which should be identical to the first, is trimmed at the neoaortic annular line. The superior part of that patch will be used to augment the RVOT, whereas the inferior portion will be discarded. If both patches are moist, they stick together aiding the next step. RVOT = right ventricular outflow tract.
A pledgeted 2-0 ethibond horizontal mattress sutures are placed through both patches with the pledget on the RV side of the RV patch. This leaves an “inside” patch, that will be used to augment the aorta, and an “outside” patch, that will augment the RVOT. The transition from aortic annulus to patch is very important. A pledgeted 2-0 ethibond should bridge this area on each side. RVOT = right ventricular outflow tract; RV = right ventricle.
Aortotomy

Replacement aortic valve

Septal defect closed with inferior aortic patch

Inside patch

Outside patch

Pledged sutures through both patches & valve

Pledgeted sutures through both patches & valve

B

Figure 8  Continued (B) Explanation of the 2 patches. The inside patch has already been used to close the septal defect and “enlarge” the aortic annulus. The outside patch has been trimmed, so that it does not have its inferior portion, as the defect has already been closed by the inside patch. Pledged sutures are used to secure the 2 patches together, as well as to anchor the prosthetic valve to the patches. The repair is weakest where the 2 patches meet the true aortic annulus, and a pledgeted suture should bridge this area.
The selected valve is then parachuted into place and the sutures tied down.

Figure 9
At this point, the valve is in place and the aortotomy and right ventriculotomy need to be closed. The right ventriculotomy is addressed first. A 4-0 prolene running suture is used to sew the “outside” patch to the right ventricle. Special attention should be directed at the transition from the aortic annulus to the right ventricle. These corners are the weakest part of the repair and good/narrow bites should be taken in the area. The patch may be trimmed as needed, but care should be taken to maintain the natural contour of the RVOT. RVOT = right ventricular outflow tract.
The longitudinal aortotomy is then closed with the “inside” patch using a 4-0 prolene suture. Again, special attention should be placed at both corners, where the risk of hemorrhage is the greatest. RVOT = right ventricular outflow tract.
The Konno-Rastan procedure 233

Comments
Postoperative care should be similar to that of an aortic valve replacement with more concerns for bleeding, as there is more potential for misadventure. Transesophageal echo helps to visualize any residual VSD’s as well as biventricular function. We routinely have our patients on milrinone to help combat the initial right ventricular dysfunction that improves with time. Topical thrombotic agents are helpful on the right ventricular suture line, but any bleeding from a systemic suture line would likely need an additional suture.

Suri et al. reported a 24-year experience at the Mayo clinic in which 53 patients underwent a Konno-Rastan procedure. A total of 77% were re-do operations with an 8% 30-day mortality, and 86% 10-year survival. They also reported an 11% incidence of heart block requiring a pacemaker. Sakamoto et al. reported a 23-year experience at the Heart Institute of Japan in which 64 patients underwent a Konno procedure. They reported a rate of 91.9% and 87.7% at 10-year and 15-year survival, respectively. A new complete right bundle branch block is reported in 22% of their patients, but they do not report a case of new atrioventricular block. They believe this low rate is achieved by making the septal incision of 5 mm proximal to and parallel to the pulmonary artery annulus.

References