Lateral (left–right commissural) root enlargement may reduce risk of coronary artery obstruction from transcatheter aortic valve-in-valve implantation

Daniel R. Wong, MD, MPH, a,b Jessica G. Y. Luc, MD, a Quynh Nguyen, MD, a and Timothy B. Latham, MD, a,b Vancouver and New Westminster, British Columbia, Canada

We propose a novel surgical technique for lateral root enlargement, wherein a patch splits the left–right (LR) commissure. This technique borrows heavily from root enlargement techniques described by Nicks and colleagues,1 Manouguian and colleagues, 2 and Yamaguchi and colleagues.3 In addition to enlarging the annulus, this technique modifies the shape of the root in ways that may reduce risk of coronary artery obstruction and sinus sequestration during future transcatheter aortic valve implantation (TA VI).

Technique

The aorta is opened anteriorly 1 cm above the sinotubular junction (STJ), and extended leftward, to curve down through the STJ, to the top of the LR commissure. The aortic leaflets are excised. After separating the aorta from the pulmonary artery behind the LR commissure, the aortotomy is extended further, splitting the LR commissure along its length, into the subcommissural triangle, stopping 3 mm before entering septal myocardium (Figure 1).

A patch is sewn into the divided LR commissure, using 4–0 polypropylene suture, similar to a Nicks root enlargement. The patch suture lines are continued past the STJ, before sewing in the valve. The valve sutures should traverse the patch well above its nadir, where the patch is at least 6 mm wide to upsize the valve. Once seated, there should be a few millimeters of space behind the tip of the LR strut and the patch. The aortotomy is closed, incorporating the patch whilst permitting it to bulge outward slightly when the aorta is pressurized.

COMPUTED TOMOGRAPHY ANALYSIS

To simulate future valve-in-valve TAVI and assess risk for coronary obstruction, a virtual TAVI valve was superimposed on 3-dimensional multiplanar reconstructed postoperative computed tomography images with Horos version 4.0.0 DICOM image viewer for MacOSX (Horos Project). Risk of TAVI-induced coronary artery obstruction is considered high if the virtual transcatheter valve to STJ distance over a coronary ostium is <2 mm and if virtual transcatheter valve to coronary distance is <4 mm.3 As shown in Figure 2, D, the virtual transcatheter valve to STJ distance over the left main and right coronary arteries were 1 mm and 9 mm, respectively. The billowing patch material provides ample room (9 mm) for blood flow from the tubular aorta...
into the right sinus. Critically, it also establishes a new route (up to 6 mm measured between the LR strut and patch) for flow behind the LR strut into the left sinus, thus mitigating risk of left main coronary obstruction. Virtual transcatheter valve to coronary distance was 5 mm for both coronary ostia. As shown in Figure 2, a balloon-expandable TAVI valve, a tall self-expandable TAVI valve, and even a TAVI-in-TAVI implant would be predicted to be safe for valve-in-valve implant, with flow into the left and right sinuses supplied almost exclusively via the billowing patch.

**DISCUSSION**

There are several advantages to this novel technique. First, a surgeon can easily visualize the LR commissure and suture high at the commissure rather than deep within the nadir of the posterior annulus. Second, this technique...
may lend itself to younger patients in whom a future valve-in-valve (and even subsequent valve-in-valve procedures) may otherwise lead to sinus sequestration. Compared with other root enlargement techniques, there is little risk of distorting the mitral valve and inducing mitral regurgitation as with the Manouguian technique; rotation of any of the coronary arteries, as with the Y incision technique, is not necessary; and it does not require patching of the ventricular septum and is easier to perform than the Konno and Yamaguchi techniques. Unlike root replacement, there is no need to reattach coronary buttons, and the elastic properties of the root are maintained.

Finally, for concomitant mitral and aortic valve surgery, there is no interference from the mitral prosthesis, another potential limitation of posterior techniques. Potential pitfalls include extension of the enlargement into septal myocardium, which risks bleeding from friable tissue. Second, it is unlikely that this technique will permit up sizing by more than 1 to 2 valve sizes, although it may be possible to perform concurrent lateral and posterior (bilateral) root enlargements. Finally, this technique is not advisable in the presence of anomalous coronaries between the great vessels, or in patients with pulmonary hypertension, pulmonary artery dilatation, or existing or planned surgical or percutaneous pulmonic valve replacements which can compress the patch.

With increasing use of TAVI to treat failing surgical bioprostheses, technical considerations at the initial operation play a role in the lifetime management of aortic valve disease. Lateral (LR-commissural) root enlargement is a simple method for enlarging the aortic annulus and modifying the risk of future TAVI-induced coronary artery obstruction and sinus sequestration.

**References**


