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A technique for reconstruction of complete circumferential aortic root allograft dehiscence without coronary re-implantation.

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Glossary of abbreviations:

AV: Aortic valve

LVOT: left ventricular outflow tract

STJ: sino-tubular junction

RCA: right coronary artery
Central message:
Ventriculo-aortic discontinuity is a difficult problem. The challenges are greater when the dehiscence is circumferential or when the root is hostile. We present a technique for management.

Central image legend:
Allograft root dehiscence with circumferential root-LVOT discontinuity before (left) and after (right) repair.

Abstract:
We present a patient with a complex problem of a circumferential and total dehiscence of an aortic root allograft from the left ventricular outflow tract. To our knowledge, the technique utilized in this patient’s successful management has not been described before.
**Introduction:**

Endocarditis of the aortic valve (AV) can lead to significant structural defects. In these situations, a homograft root replacement is a viable treatment option. Insufficient debridement or infection recurrence may lead to dehiscence of the allograft. This situation presents a number of challenges in exposure and reconstruction due to a hostile aortic root. This is even more treacherous if the dehiscence was circumferential. We present a technique for reconstruction that does not require homograft dissection or coronary mobilization.

**Case presentation:**

A 56-year-old male with histories of AV replacement, followed by tricuspid repair for endocarditis, then an aortic root allograft for prosthetic valve endocarditis presented to the hospital with shortness of breath. He had a permanent pacemaker for complete heart block. Tomography and echocardiogram showed a large circumferential crown-like pseudoaneurysm completely separating the homograft from the left ventricular outflow tract (LVOT). There was also a big hematoma outside the pseudoaneurysm compressing the right ventricle.

**Technique:**

Cardiopulmonary bypass was initiated prior to revision sternotomy via the right axillary artery and femoral vein. Sternotomy was performed uneventfully. The hematoma around the heart was carefully evacuated. There was a small communication between the hematoma and the pseudoaneurysm near the right atrial appendage. Finger pressure was applied there until the aorta was dissected. The aorta was then clamped and cardioplegic arrest was achieved.

The aorta was transected at the native aorta to allograft junction. The allograft was too small for adequate LVOT exposure through the annulus, even after leaflet excision (supplemental figures 1A and 1B). Excision of the allograft with coronary mobilization was considered to allow for LVOT reconstruction followed by a Bentall. However, limited dissection around the allograft and coronaries revealed them to be very densely adherent to the surrounding structures. The strategy was thus modified.

The allograft was incised longitudinally along its vertical axis, starting at the STJ, extending 5mm to the left of the right coronary ostium and into the annulus (similar to the Konno-Rastan incision) (supplemental figure 1C). Unlike the Konno-Rastan which leads into the muscular septum, this incision led into a large circumferential pseudoaneurysm cavity, with the cross section of the true LVOT seen 2 cms
deep to the level of the homograft annulus (supplemental figure 1C). The boundaries of the true LVOT were carefully identified, marked and sized (supplemental figure 1D). An appropriately sized aortic tube graft was parachuted down to the true LVOT using 3 sutures, then the graft was inverted towards the apex, to facilitate circumferential suturing (supplemental figure 1E). The graft was sewn to the true LVOT and then pulled back to now represent the neo-LVOT, with exclusion of the pseudo-aneurysm cavity (supplemental figures 2A and 2B).

The posterior 2/3 of the tube graft was inside the split allograft. Along this posterior 2/3, the graft was trimmed at the level of the allograft annulus, and the two were sewn together at that level (supplemental figure 2C). Valve sutures were placed in the standard fashion posteriorly, incorporating the allograft annulus and the graft together. In the anterior 1/3, valve sutures were placed outside-in on the tube graft alone. A mechanical valve was implanted (supplemental figures 2D and 2E).

A triangular piece of dacron was used anteriorly to bridge the tube graft anteriorly and to make-up the size difference between the new enlarged root and the native aorta (supplemental figure 2F). Figures 1 and 2 demonstrate the reconstruction. The remainder of the procedure was completed in the standard fashion.

The patient had initial vasoplegia that subsequently recovered. A follow-up CT scan showed a satisfactory result (figure 2B).

Comment:

This technique provides excellent LVOT exposure for complex reconstruction without the need to mobilize and reimplant the coronaries. An additional benefit is annular enlargement. In this patient, the annulus was enlarged from a 20mm allograft to a 27mm mechanical valve. It is critical to take time in identifying and marking the true LVOT since landmarks are distorted. The trigones and the anterior mitral leaflet serve as a guide. Graft inversion into the apex facilitates sewing, keeping the graft out of the line of vision. Obviating the need to dissect and reimplant the coronary in a densely scarred root is an advantage that makes this technique less hazardous. It is crucial however to maintain constant awareness of the orientation of the coronaries. Aggressive annular enlargement may potentially lead to rightwards RCA displacement and kinking. Minimal dissection of the dense scar may however be protective.

It is important to note that this technique represents a bail-out strategy in the situation where adequate sub-annular LVOT exposure is required, but in the setting of a precariously hostile root that makes coronary mobilization unsafe. It is also important to note that active infection should still be identified, and devitalized tissues debrided without compromise. In the setting of active infection, a sheet of bovine
pericardium fashioned into a tube may be used instead of the dacron tube graft to minimize synthetic material. Other reports of left ventricular-aortic discontinuity have either described non-circumferential focal defects, or did involve coronary mobilization and implantation.\textsuperscript{1-5} In addition, these reports addressed native and prosthetic valve endocarditis, but not a previous allograft with a hostile root. Our described longitudinal allograft split to expose the pseudoaneurysm without mobilizing the coronaries has, to our knowledge, not been previously reported.

References:


IRB approval not required (Does not meet DHHS definition of “research”). Patient provided informed written consent.

Figure legends:

**Figure 1.** CT scans, (A); preoperative showing a 9cms crown-link pseudoaneurysm (red solid arrow) separating the allograft annulus (yellow interrupted arrow) and the LVOT (yellow solid arrow). This also shows a large hematoma (red interrupted arrow) compressing the right heart. (B); post-operative CT scan showing the reconstructed LVOT.

**Figure 2.** An illustrative diagram of the reconstruction before (A) and after (B).

**Supplemental figure 1.** (A and B): Inspection after opening the allograft and leaflet excision showing limited LVOT exposure but showing dehiscence of the allograft from the aortomitral curtain. (C): yellow dashed arrows show the
cut edges of allograft, yellow solid arrows show the coronary ostia. Blue solid arrow shows the pseudoaneurysm cavity, and the blue dashed arrow shows the true LVOT. (D): Identification of true LVOT and marking (the camera is below the homograft annulus in the pseudoaneurysm cavity). (E): Tube graft secured to the LVOT with 3 interrupted sutures and inverted towards the apex.

Supplemental figure 2. (A and B): Graft sewn to LVOT circumferentially and then pulled back, excluding the pseudoaneurysm (blue arrow) and creating the neo-LVOT). (C): The posterior 2/3 of the graft trimmed and sewn to the homograft’s divided annulus. (D): Valve sutures are placed into allograft annulus/graft posteriorly, and to graft anteriorly and a valve is seated and secured (E). (F): The anterior root is reconstructed with another piece of graft to compensate for the enlarged annulus and divided allograft and close the aorta.