One-stage treatment of aortic coarctation associated with coronary heart disease, ascending aortic aneurysm, and aortic valve stenosis with an extra-anatomic ascending-descending aortic bypass

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The surgical treatment for aortic coarctation associated with coronary artery disease and valvular disease is a difficult decision. We describe the case of a 64-year-old man with coronary heart disease, aortic coarctation, aneurysm of the ascending aorta, and bicuspid aortic valve. The surgical therapy included total arterial revascularization, placement of a mechanical valve, supracoronary aortic replacement, and extra-anatomic ascending aortic–to–descending aortic bypass in one session.

Clinical Summary

A patient with hypertension and angina pectoris that increased over a 2-month period underwent a cardiac catheterization attempt through the right femoral artery. However, it was impossible, and fluoroscopy showed coarctation with a peak-to-peak pressure gradient of 50 mm Hg (mean, 29 mm Hg) distal to the left subclavian artery. Cardiac catheterization through the right brachial artery revealed coronary artery disease with 90% stenosis of the left anterior descending coronary artery, 70% stenosis of the circumflex artery, and subtotal stenosis of the right coronary artery. The left ventricular ejection fraction was reduced to 45%. A computed tomographic scan confirmed the aortic coarctation, with a 1.2-cm lumen about 2 cm distal to the left subclavian artery. The ascending aorta was dilated to 5 cm in diameter. A transthoracic echocardiogram revealed a bicuspid aortic valve with slight stenosis (maximum pressure gradient, 23 mm Hg; mean pressure gradient, 13 mm Hg; effective aortic valve area, 1.8 cm^2).

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Surgical Technique

After a median sternotomy, the left internal thoracic artery was exposed, and a T-graft anastomosis with the radial artery was performed. Cardiopulmonary bypass was established through cannulation of the distal aortic arch and the right atrium. The arterial cannula did not traverse the coarctation site distally. Mean arterial pressure in the femoral artery was about 5 mm Hg lower during cardiopulmonary bypass. During induction of hypothermia (30°C), the segment of the descending aorta distal to the coarctation was mobilized after the pleura was opened and clamped tangentially, and an end-to-side anastomosis with a woven Dacron graft (diameter, 14 mm) was performed. After cardioplegic arrest and incision of the ascending aorta, the bicuspid aortic valve was excised, and a mechanical prosthesis in an intra-annular position was inserted. Afterward, the supracoronary ascending aorta was replaced with a 30-mm woven Dacron graft by an end-to-end technique. Thereaf-

Figure 1. Postoperative magnetic resonance angiography showing the patent ascending-descending bypass surrounding the apex of the heart and the coarctation.

ter, complete arterial myocardial revascularization was accomplished with an end-to-side anastomosis of the radial artery and the right coronary artery, and a side-to-side anastomosis to the posterolateral branch was performed, as well as an anastomosis of the left internal thoracic artery to the left anterior descending coronary artery. A final end-to-side graft-to-graft anastomosis between the bypass graft to the descending aorta and the encircling aortic graft completed the repair. This bypass ran retrocardially near the right atrium through a pericardial window (behind the phrenic nerve) to the right side of the ascending aorta.[1,2] With the given anatomy in this particular patient, it was easier to obtain control of the anastomotic site at the descending aorta through the opened pleura rather than a pericardial window. After rewarming, the patient was weaned from cardiopulmonary bypass with minimal inotropic support. The further course was uneventful, and the patient was discharged on postoperative day 14.

Discussion

The multiple abnormalities, including aortic coarctation, aortic ascending aneurysm, aortic valve stenosis, and ischemic heart disease, posed a tactical challenge. A 2-stage surgical repair with total arterial revascularization, mechanical valve replacement, and supracoronary ascending graft in a first-stage procedure and surgical treatment of the aortic coarctation in a second-stage procedure a few weeks later would have carried a considerable risk because of the need for temporary exclusion of the left subclavian artery and, for this reason, the potential threat of myocardial perfusion through a left internal thoracic artery. The 1-stage surgical repair with 2 separate approaches would be a long and high-risk procedure because of the same reason. The treatment through a median sternotomy and repair of the aortic coarctation through the opened aortic arch would have been extremely demanding.[1,2] Therefore, this patient underwent a single-stage procedure through a median sternotomy and total arterial revascularization, mechanical valve replacement, creation of a supracoronary ascending graft, and extra-anatomic ascending-descending bypass. The postoperative magnetic resonance angiography showed a patent ascending-descending bypass (Figure 1) after the approach that is described in this report. This procedure might therefore be a useful treatment alternative in selected patients with this rare combination of diagnoses.

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Aorta-coronary graft anastomosis marker: More than 30 years of experience

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Radiographic identification of the aorta-coronary graft anastomosis might be difficult and time consuming if the coronary graft is not widely patent. Previous reports indicate that the success rate of detecting coronary graft conduits is inferior to the rate of detecting native coronary arteries by catheterization.[1,2] To facilitate the spatial localization of the coronary artery bypass graft ostium at the ascending aorta, we have been using the described technique since 1970 in every patient who had an arterial or venous graft directly anastomosed to the ascending aorta. Early results with this method were first described in 1972 by Gopalrao and Ford.[3] Despite the simplicity of this technique, there are no reports in the literature of long-term use of these homemade markers. We believe this technique is not used in most cardiac surgery centers in the world. This article describes our long-term experience with this marking method, which was used beginning in the early days of coronary surgery at our university and continues to this day.

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Technique

After completion of each proximal aorta-coronary graft anastomosis, a portion (3 cm) of the radiopaque nontoxic barium sulfate–impregnated monofilament thread from a 4 × 4-inch gauze patch (Ray-Tec, Johnson & Johnson Medical) is removed and is placed around the anastomosis. The filament is secured by 2 knots from the ends of the suture used in the anastomosis, and a vascular stainless-steel clip (LIGACLIP, Ethicon Endo-Surgery) is used to secure the knots (Figure 1).