Open Aortic Arch Reconstruction After Coronary Artery Bypass Surgery: Worth the Effort?

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Open aortic arch surgery after coronary artery bypass grafting (CABG) is considered a high-risk operation. We reviewed our surgical approach and outcomes to establish the risk profile for this patient population. In methods, from 2000-2014, 650 patients underwent aortic arch surgery with circulatory arrest. Of these, 45 (7%) had previous CABG. Complete medical record was available for review including all preoperative coronary angiograms and detailed management of myocardial protection. In results, the mean interval from previous CABG to aortic arch surgery was 6.8 ± 7.1 years. At reoperation, 33 (73%) patients had hemiarch replacement and 12 (27%) had a total arch replacement. The following were the indications for surgery: fusiform aneurysm in 20 (44%), pseudoaneurysm in 6 (13%), endocarditis in 4 (9%), valvular disease in 5 (11%), and acute aortic dissection in 10 (22%). There were 6 perioperative deaths (13%) and 1 stroke (2.2%). Selective antegrade cerebral perfusion was used in 13 patients (28.9%) and retrograde perfusion in 6 (13.3%). Survival was 74%, 65%, and 52% at 1, 3, and 5-year follow-up, respectively. Only predictors of early mortality were age (odds ratio = 1.20, CI: 1.01-1.44; $P = 0.04$) and nonuse of retrograde cardioplegia for myocardial protection (odds ratio = 6.80, CI: 1.06-43.48; $P = 0.04$). Intermediate survival of these patients was significantly lower than those of a sex-matched and age-matched population ($P < 0.001$). In conclusion, aortic arch surgery after previous CABG can be performed with acceptable early and midterm results and low risk of stroke. Perfusion strategies and myocardial protection contribute to successful outcomes.

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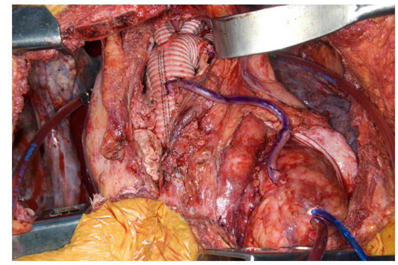

Surgical image of open reconstruction involving ascending, arch, and descending aorta after previous heart surgery through a transverse thoracosternotomy.

Central Message

Aortic arch surgery after CABG can be performed with acceptable early and midterm results and low risk of stroke.

Perspective

Aortic arch surgery after coronary artery bypass grafting is a challenging operation. Such patients may be denied surgery or referred to endovascular procedures that are considered to be theoretically less invasive. Complex open reoperations involving the aortic arch after previous CABG are to be considered the standard of care to which endovascular approaches should be compared.

See Editorial Commentary pages 36–37.

INTRODUCTION

Aortic arch surgery with or without concomitant repeat revascularization after coronary artery bypass grafting (CABG) is a challenging operation. Despite the widespread use of transcatheter valve implantation in patients with aortic stenosis, there are growing data supporting that conventional aortic valve replacement after previous CABG is safe.[1] Although aortic arch stenting after CABG implies a completely different clinical arena, the debate on whether endovascular approaches (when feasible) are advantageous in such patients is becoming a reality. There are no paralleled studies pointing at the same safety profile, as in conventional aortic valve replacement after CABG, applied to aortic arch surgery after CABG. Based on the conception that those are high-risk operations, patients may be denied an open surgical solution.

Hence, this study looks specifically at this subgroup of patients. In particular, we focused on the effect that perfusion strategies and myocardial protection have on the outcomes of these operations.

METHODS

Patient Selection

From March 2000-March 2014, 650 patients underwent aortic arch reconstruction with hypothermic circulatory arrest

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in our clinic. Of these, we identified 46 (7%) patients who underwent open aortic arch intervention after previous CABG and constitute the focus of our study. We included patients who had one or more previous operations through a median sternotomy. This clinical study was reviewed and approved by the Mayo Clinic College of Medicine Institutional Review Board, and 45 patients agreed to clinical research authorization before operation. For data capture related to this population, we used information from our database and electronic medical record. Follow-up was obtained from health assessment questionnaires sent to patients and families 1, 3, 5, and 10 years postoperatively and was supplemented by written correspondence from referral physicians or patients themselves as well as by checking the vital status from the Social Security Death Index. Operative mortality was defined as death within 30 days of initial operation or during the same index hospitalization. Emergent surgery was considered when patients were transferred immediately to the operating room after diagnosis was made, and urgent when performed within the same day of diagnosis.

Patient Management

Patients studied had preoperative echocardiogram and computerized tomographic scan defining proximity of previous grafts to the chest wall. All patients had updated coronary angiograms before surgery with appropriate injections defining native coronary anatomy as well as patency of previous bypass grafts. Patients were monitored with multiple arterial lines placed strategically in the upper and lower body to safely monitor perfusion pressure differences during the course of the operation. Central venous access, large bore peripheral vein access, and pulmonary artery catheter were used routinely. Bladder and nasopharyngeal temperatures were monitored. Operations were performed using standard methods for repeat median sternotomy or bilateral thoracosternotomy (Fig. 1) for one-stage extensive aortic repair (arch and descending aorta direct reconstruction)[2]; we employed cardiopulmonary bypass(CPB) with profound hypothermia. Cannulation strategies were tailored to the patient's anatomy and when possible central cannulation was our preferred method.[3,4] Peripheral inflow cannulation was achieved through indirect axillary[5] usually in dissection cases or in those where extensive arch reconstruction was anticipated, or femoral artery cannulation through an 8-10 mm Dacron chimney graft (nondissected aneurismal cases where long CPB runs were expected) or direct per arterial femoral cannulation using over the wire techniques (mainly in emergencies or nondissection cases). Central cannulation was instituted with conventional arterial cannulas, and if the dissected aorta was directly cannulated, this would be done over a wire with echocardiographic control to ensure position of the tip of the cannula in the true lumen. If anatomy constituted an increased risk for reentry, establishment of peripheral cannulation was selected as the first operative step. When the proximity of cardiovascular structures would preclude a safe reentry, we would use CPB as a mean to reduce possible damage. In cases where contained vascular ruptures were present in contact to the chest wall, deep hypothermic CPB would be established before resternotomy. Neuroinhibition was monitored by behavioral inhibition system or continuous electroencephalography or both. Strategies of neurologic protection vary depending on the extension of pathology and surgical repair and are bounded to the overall perfusion strategy. For extensive aortic repair cases, selective antegrade perfusion would be performed by means of individually cannulated supra-aortic vessels and flows at 10-15 cc/Kg/min with a perfusion pressure of 60 mm Hg.[6] For short periods used for aortic reconstruction, isolated circulatory arrest or retrograde cerebral perfusion was used.[7] Myocardial protection was achieved by means of cold blood cardioplegia 4:1 (blood to crystalloid solution) at 4°C. In general, an antegrade induction dose of 800-1000 cc would be administered in the aortic root when the aortic valve was competent. This was supplemented with repeated doses of antegrade or retrograde cardioplegia or both varying according to the patient's condition and surgeon's preferences. Concomitant cardiac procedures were performed during the cooling and rewarming process. CABG dependent circulation myocardial perfusion was defined as the presence of a patent coronary bypass graft as a sole supplier of blood to one of the 3 myocardial territories.

Whenever temporary left internal mammary artery occlusion was subjectively judged to be of potential benefit, the bypass graft was controlled either with vessel loop or small methalic clamp. When it was difficult to find the graft by direct surgical dissection, its location was identified with the use of mediastinal applied Doppler probe. The graft was either dissected free (regardless of previous skelonization or predicled harvesting) proximally if close to the midline or closer to the epicardial anastomosis if the proximal part of the graft was located laterally or in the pleural space.

Bypass graft reattachment was performed either using a small cuff of aortic wall, and this was implanted in the aortic graft conduit, or the coronary