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An Alternative Technique of Proximal Anastomosis in Patients with an Atherosclerotic Ascending Aorta

Noyan Temucin Ogus, MD, Halide Ogus, MD, Tekin Yıldırım, MD, Ozer Selımoglu, MD, Murat Basaran, MD

Cardiovascular Surgery, Goztepe Safak Hospital, Istanbul, Turkey

ABSTRACT

Coronary artery bypass grafting operations in patients with an atherosclerotic ascending aorta are still associated with an increased risk of cerebral embolism and mortality despite previously described techniques. Here we present an alternative technique for the construction of a proximal anastomosis avoiding aortic clamping and deep hypothermic circulatory arrest.

INTRODUCTION

The occurrence of a major neurologic event after coronary artery bypass grafting (CABG) operation is a devastating complication that significantly increases morbidity and mortality rates, the length of intensive care unit stay, and hospital cost [Roach 1996; Gold 2004]. Atherosclerotic disease of the ascending aorta is the main cause of intraoperative cerebral embolism. To prevent this devastating complication, various techniques including internal endoaortic occlusion, modification of cannulation and proximal anastomotic sites and techniques, deep hypothermic circulatory arrest, aortic endarterectomy and replacement of the ascending aorta, intra-aortic filtration, and off-pump coronary artery bypass (OPCAB) grafting have been proposed [Wareing 1992; Liddicoat 1998; Sharony 2004; Dikmengil 2005; Girardi 2005]. However, even these described techniques have some inherent disadvantages that negatively influence the surgical results, and some patients require significant modifications of the conventional methods. Here we describe our current surgical approach for patients with an atherosclerotic ascending aorta who require multivessel CABG operation.

SURGICAL TECHNIQUE

The diagnosis of an atherosclerotic aorta and the location of atheromatous plaques are determined intraoperatively by using epiaortic echocardiography (7.5 Mhz probe, Vivid 3, Pro Echo; General Electric, Piscataway, NJ, USA). The surgical strategy is modified according to the location of the patchy atheromatous plaques. In all patients, cardiopulmonary bypass (CPB) is instituted by cannulation of the axillary artery and the right atrium. A vent is inserted into the left ventricle through the right superior pulmonary vein. Five to 10 mg esmolol hydrochloride (Brevibloc; Baxter Healthcare, Marion, NC, USA) are added to the cardiotomy reservoir and CPB is established. The patients are cooled to a nasopharyngeal temperature of 26°C. Following hypothermic spontaneous fibrillation, the distal anastomosis of the right and left circumflex coronary arteries is performed using saphenous vein grafts. Aortic cross clamping and cardioplegia are not used during the construction of the distal anastomosis, and the mean arterial pressure is maintained between 60 and 70 mmHg. With the completion of the distal anastomosis, the lengths of the saphenous veins and disease-free areas of the ascending aorta are determined for the construction of the proximal anastomosis. The flow of CPB and mean arterial pressure are then reduced to obtain a blood pressure of 20 to 25 mmHg. While on low-flow bypass, the proximal anastomotic holes are opened by a 4.4-mm punch, and the saphenous vein grafts are anastomosed with continuous 6.0 polypropylene suture. The subsequent vein grafts are anastomosed to other disease-free areas of the ascending aorta. Between each proximal anastomosis, the CPB flow and mean arterial pressure are increased to normal values to reduce the duration of low flow bypass. Rewarming is started at the completion of all proximal anastomosis, and the left internal thoracic artery (LITA) graft is anastomosed to the left anterior descending artery during the rewarming phase. The heart is defibrillated, and the completion of the operation is performed in the usual fashion.

DISCUSSION

With the increased use of stenting of multivessel disease by cardiologists, cardiac surgeons deal more frequently with elderly patients who have more extensive coronary artery disease and preoperative risk factors such as atheromatous ascending aorta. The incidence of significant atheromatous disease of the ascending aorta in patients undergoing cardiac

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Address correspondence and reprint requests to: Dr. Noyan Temucin Ogus, Caferaga Mh. Bahariye C.54/1 Kadikoy, Istanbul, Turkey; 90532-612-86-89; fax: 90216-44-99-133 (e-mail: togus@superonline.com).

Operative and Postoperative Data*

Age, mean	71 ± 9.5 y
Male/female	98/76
Diabetus mellitus, n	124 (71.2%)
COPD, n	104 (59.8%)
Peripheral arterial disease, n	34 (19.5%)
Previous myocardial infarction, n	76 (43.7%)
Left ventricle ejection fraction	40 ± 9 (range, 21-55)
Emergency/elective	9/165
Duration of CPB, min	68 ± 21.2 (range, 43-98)
Number of grafts	3.7/patient (range, 2-5 grafts)
Use of LITA	167 (96%)
Postoperative IABP	13 (7.5%)
Prolonged mechanical ventilation (>24 h)	15 (8.6%)
Stroke	—
Minor neurologic event	4 (2.3%)
Mortality	6 (3.4%)

*COPD indicates chronic obstructive pulmonary disease; CPB, cardiopulmonary bypass; LITA, left internal thoracic artery; IABP, intra-aortic ballon pump.

surgery has been reported to vary 14% to 29% [Leyh 1999]; therefore, some modifications to the standard surgical techniques may be required to achieve complete myocardial revascularization.

Although various techniques have been described, there is no reliable method for each patient that totally avoids aortic manipulation in this subgroup of patients with atherosclerotic disease. Internal endoaortic occlusion and intra-aortic filtration methods have been tried, but intraluminal aortic manipulation can also dislodge particles due to the shedding of intimal debris. With OPCAB techniques, complete myocardial revascularization may not be achieved in a significant number of patients because of the intramyocardial course of the coronary arteries, diffuse narrowing, and possible hemodynamic deterioration during anastomosis.

Another drawback of the "no-touch" OPCAB technique may be the dependence of all coronary circulation on the single inflow (LITA or right internal thoracic artery). Additionally, with the OPCAB method, the use of the bilateral internal thoracic artery and/or the gastroepiploic artery may be considered alternatives to avoid single coronary blood flow, but the high incidence of diabetus mellitus, chronic obstructive pulmonary disease, or diffuse systemic atherosclerosis in this subgroup may preclude the use of these surgical options.

Aortic endarterectomy and replacement of the ascending aorta is another surgical option that has been tried. This technique increases the operative time and requires the establishment of deep hypothermic circulatory arrest, which is also associated with increased mortality and morbidity rates, especially in elderly patients. In our surgical technique, we sought to avoid the systemic side effects of deep hypothermia by keeping the temperature at 26°C. Although the mean arterial pressure was kept at 20 to 25 mmHg during the construction of the proximal anastomosis, in our experience, the duration of low-flow bypass at this time depends on the number of anastomoses. The proximal anastomosis has been constructed by using a continuous suture technique on the disease-free portions of the ascending aorta. Therefore, each anastomosis is usually performed in less than 3 minutes. We believe that this period is relatively short and easily tolerated by our patients. The continuation of low-flow bypass offers another advantage over total circulatory arrest, which is the prevention of the entrance of any air into the systemic circulation due to back bleeding from the punch hole. The use of a punch may be problematic in cases with extensive atherosclerosis; however, we succesfully found disease-free portions in every patient for the construction of the proximal anastomosis. In some patients requiring the placement of the proximal anastomosis on the right or left lateral aspect of the aorta, extreme caution has been taken to acheive an accurate geometrical position and angulation of the saphenous veins. While on low-flow bypass, back bleeding did not significantly impair the vision and we did not require any specific maneuver to prevent back bleeding. However, in cases with significant back bleeding, a 12 F venting catheter may be introduced into the aorta through the punch hole during the construction of the anastomosis to establish a less bloodless field.

From 1997 to 2006, we used the described technique in 174 patients with atherosclerotic disease of the ascending aorta who were considered unsuitable for OPCAB. All operations were performed by the same surgeon (N.T.O.). This patient group represented 6% of patients who have undergone CABG operation during the same time period. The patients undergoing axillo-coronary bypass grafting, concomitant carotid artery interventions, or OPCAB with or without Tector's "T" anastomosis of the proximal graft on the LITA were excluded from this technical report. The mortality rate in the entire cohort was 3.4%. Six patients died postoperatively because of low cardiac output. Permanent major stroke has not been observed in the entire cohort, and the incidence of minor neurologic events was 2.3% (Table).

In conclusion, for patients with an atherosclerotic aorta and in whom OPCAB is not suitable, hypothermia with low-flow CPB should be considered a safe alternative that reduces the risk of postoperative stroke. With the described technique, complete myocardial revascularization can be achieved without increasing the risk of cerebral embolization.

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