The Heart Surgery Forum #2004-1064
7 (5), 2004 [Epub September 2004]
doi:10.1532/HSF98.20041064

Online address: www.hsforum.com/vol7/issue5/2004-1064.html

The Right Internal Thoracic Artery and Right Gastroepiploic Artery: Alternative Sites for Proximal Anastomosis in Patients with Atherosclerotic Calcified Aorta

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ABSTRACT

Background: Atherosclerotic or calcified ascending aorta is an important predictor of adverse cerebrovascular events. Using off-pump coronary artery bypass (OPCAB) with composite and in situ arterial grafting to avoid aortic manipulation and clamping may reduce the risk of stroke related to aortic atheroembolism. When the aorta is calcified and cannot serve as a safe site for proximal anastomosis, this anastomosis can be performed on the proximal segment of the right internal thoracic artery (ITA) and right gastroepiploic artery (RGEA). Four such cases are described.

Methods: In 2 patients, the proximal right ITA was used as the site for proximal saphenous vein graft (SVG) anastomosis. Chronic obstructive lung disease in one patient and insulin-dependent diabetes in the other precluded performance of OPCAB with bilateral ITA. In addition, positive Allen test precluded performance of composite T-graft with radial artery (RA) on ITA. Both SVGs were anastomosed distally to the posterior descending artery. In 2 other patients, RA was connected end-to-side to the proximal segment of the RGEA. Both of these patients had repeat operations. The distal end of the RGEA was too small, and concerns regarding the future flow to a very large coronary bed precluded its use as an in situ graft.

Results: All patients underwent the operative procedures without any neurological or cardiovascular adverse effects, and all are midterm, symptom-free survivors. Postoperative graft patency was confirmed intraoperatively with flow measurements and postoperatively with control angiography or coronary imaging computed tomography.

Conclusions: The RITA and proximal RGEA can serve safely as sites for proximal anastomosis in patients with atherosclerotic calcified aorta undergoing OPCAB.

Presented at the 10th Annual CTT Meeting 2004, Miami Beach, Florida, USA, March 10-13, 2004.

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INTRODUCTION

Severe atherosclerotic disease of the ascending aorta is a major risk factor for stroke after coronary artery bypass grafting (CABG) [Roach 1996]. The use of off-pump coronary artery bypass (OPCAB) with in situ and composite arterial grafting (with radial artery [RA] or right internal thoracic artery [ITA] connected end to side to the left ITA) eliminates the need for aortic manipulation with its associated risk of atheroemboli-related stroke [Sharony 2004]. We routinely use the OPCAB approach in patients with heavily atheromatous or calcified aortic involvement; however, in some cases, when it is not possible to use the no-touch technique, an alternative site for proximal anastomosis is required. In this report we describe 4 such cases, for which we used the proximal right ITA and the proximal segment of the right gastroepiploic artery (RGEA) as sites for proximal anastomoses of RA or saphenous vein grafts (SVG).

MATERIALS AND METHODS

Patients

During 2003, 26 patients with moderate-to-severe atherosclerotic or calcified involvement of the ascending aorta (untouchable aorta) [Stamou 2000, Cheng 2002, Sabik 2002] underwent OPCAB at the Tel-Aviv Sourasky Medical Center. In 4 patients it was not possible to achieve complete arterial revascularization based on in situ ITAs or composite T-grafts with left ITA as a site for proximal anastomosis, and alternative sites were used.

In 2 patients we used the proximal right ITA as the site for proximal SVG anastomosis. The first patient was a 74-year-old man with severe chronic obstructive pulmonary disease (COPD). COPD precluded the use of OPCAB with 2 ITAs. He underwent CABG with the left ITA to the LAD and diagonal arteries and SVG (from the right ITA) to the posterior descending branch of the right coronary artery (RCA) (Figure 1).

The second patient was a 69-year-old man with peripheral vascular disease (PVD), hypertension, insulin-dependent diabetes mellitus, chronic renal failure, and severe left ventricular dysfunction. Ten days after acute anterior wall myocardial

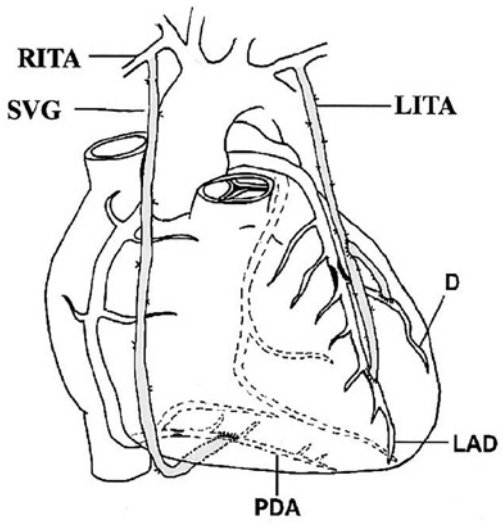

Figure 1. Scheme of off-pump coronary artery bypass procedure performed in patient 1: left internal thoracic artery (LITA) to left anterior descending (LAD)-diagonal artery (small Y-graft) and saphenous vein graft (SVG) to posterior descending artery (PDA).

infarction, he underwent surgery with grafts of the left ITA to the LAD, and SVG to the posterior descending artery (PDA).

In both of these patients, the RA could not be harvested because of bilateral positive Allen test, and in both patients the SVG was connected proximally end to side to the right ITA. In the second patient, the ITA was blocked distally to the anastomosis with a metal clip.

In the 2 other patients, the RA was harvested as a free graft, and connected end-to-side to the proximal segment of the RGEA (at the level of the gastric pylorus). The third patient was a 56-year-old man who was referred for repeat operation 5 years after bilateral ITA grafting. His right ITA

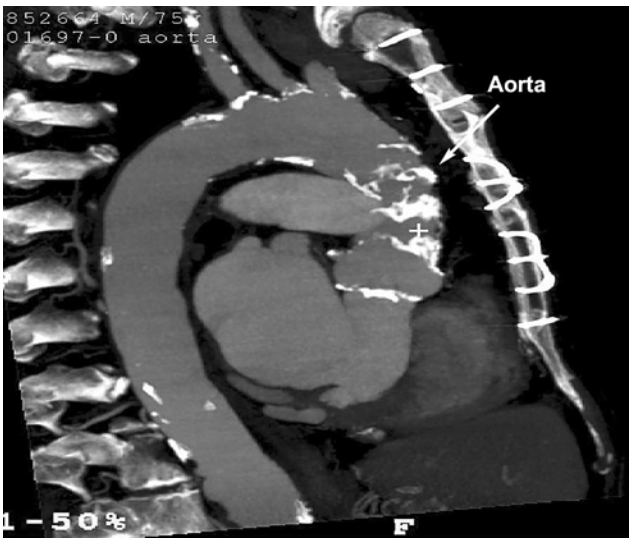

Figure 2. Sagittal oblique MIP (maximal intensity projection) image demonstrating the heavily calcified aorta of patient 4.

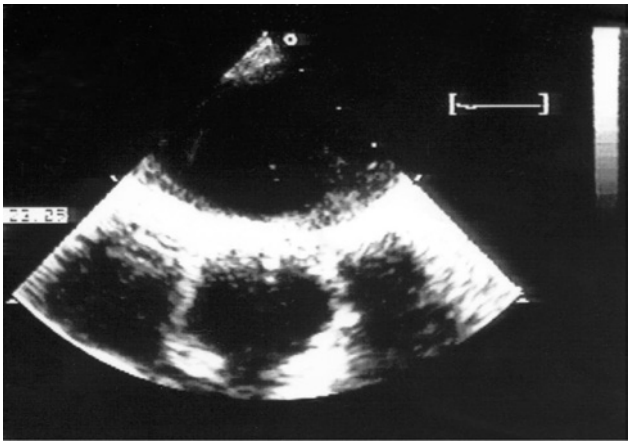

Figure 3. Epiaortic ultrasonography of patient 1.

to the LAD was occluded, and repeat operation included a single graft (RA) that was anastomosed distally to the old anastomotic site of the right ITA on the LAD.

The fourth patient was a 68-year-old woman with severe COPD and PVD who had undergone CABG 9 years previously and carotid endarterectomy 1 year prior to her current admission for repeat CABG. She had severe unstable angina. Coronary angiography revealed patent left ITA to the LAD and 99% stenosis of the old SVG to the second marginal of the circumflex artery. A big PDA was filled through collaterals. During her repeat operation, the RA was connected end-to-side to the RGEA and its distal end was anastomosed to the PDA.

In both the third and the fourth patients, the distal portion of the RGEA was very small, and concerns regarding the future flow to a very large coronary bed precluded the use of the RGEA as an in situ graft. Only a short (3-cm) segment of the proximal RGEA was exposed, mobilized, and isolated between 2 clamps in order to enable performance of the anastomosis. The RGEA distal to the site of RA anastomosis was blocked with a metal clip to ensure complete routing of proximal RGEA blood flow to the PDA.

Preoperative Assessment of the Aorta

Diagnosis was performed preoperatively in only 1 of the 4 patients (patient 4). The calcification involvement of the ascending aorta was diagnosed very clearly on plain chest x-ray, and fluoroscopy performed during cardiac catheterization. This result was verified using 16-slice computed tomography (CT) (M x 8000 IDT; Philips Medical Systems, Best, The Netherlands) (Figure 2).

All patients were screened intraoperatively by manual digital palpation and epiaortic ultrasound with a 7.5 MHz probe (5500; Hewlett-Packard, Seattle, WA, USA). For the view of the anterior aortic wall, a custom-designed spacer, a surgical glove filled with saline, was used (Figure 3).

Postoperative Graft Patency Assessment

Intraoperative graft flow was assessed in all 4 patients immediately after completion of the distal anastomosis, using transit time flow measurements (CM4008 Medistim-AS;

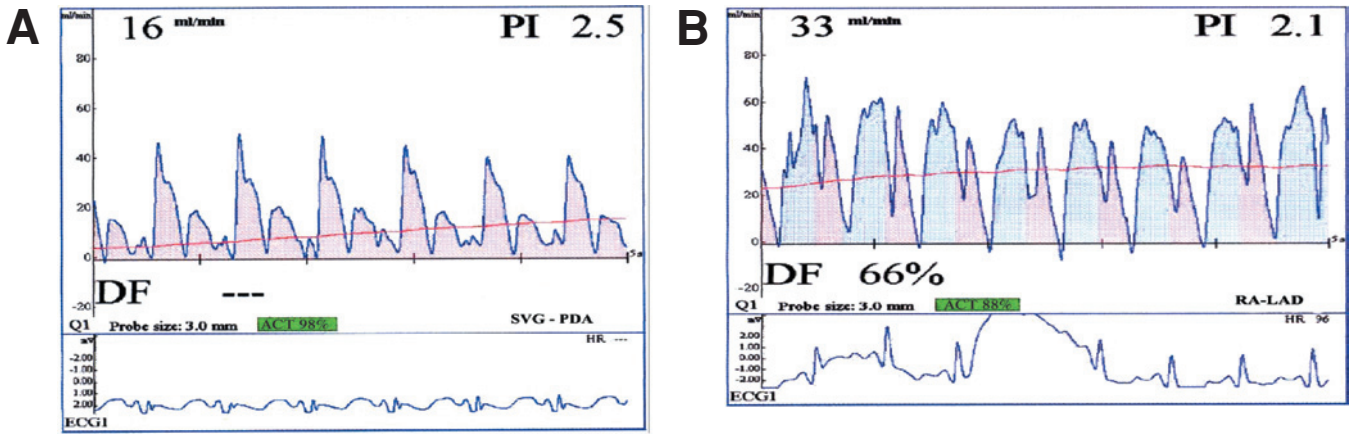

Figure 4. Transit time flow measurements demonstrating adequate flow and patent anastomoses: A, patient 1, saphenous vein graft to posterior descending artery (PDA); B. patient 3, radial artery (RA) to LAD; C, patient 4, RA to PDA. PI indicates pulsatility index; DF, damping factor; ACT, <<to be added>; ECG, electrocardiogram.

Nydalen, Oslo, Norway) [Beldi 2000]. Postoperative control angiography was performed in 2 patients (patient 1 and patient 3), and cardiac CT was used to demonstrate the RA and anastomosis in 1 patient (patient 4). We decided to avoid both graft imaging techniques in 1 patient (patient 2) who had preoperative renal failure, because we were concerned about further renal damage by contrast-material injection.

RESULTS

All 4 patients underwent the operative procedures without any neurological or cardiovascular adverse effects, and all are midterm, symptom-free survivors (between 8 and 18 months). Transit-time flow measurements showed patent anastomoses and postoperative flows that ranged between 11 to 37 mL/min (Figure 4).

The RA graft to the PDA (patient 4) was demonstrated angiographically postoperatively (Figure 5). A good image of the RA connected to the PDA was also demonstrated with 16-slice CT (Figures 6 and 7). The RA that was anastomosed to the LAD could not be demonstrated because of technical difficulty in the intubation of the celiac artery. However, its patency was proved indirectly by demonstration of a significant amount of competitive flow in the LAD and the intraoperative transit-time measurements (Figure 4).

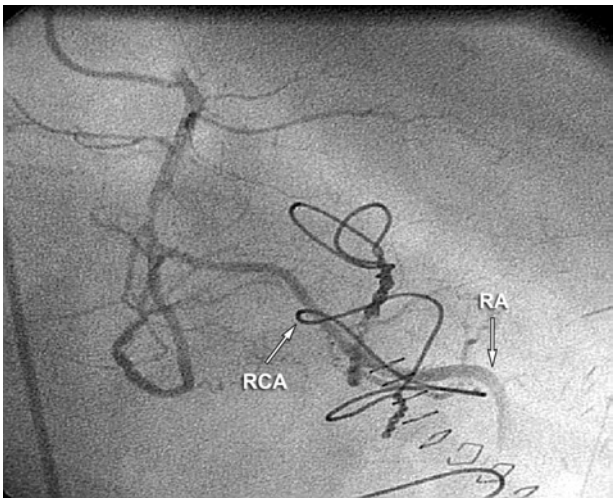

Figure 5. Postoperative angiography of the radial artery (RA) that was connected proximally to the right gastroepiploic artery and distally to the right coronary artery (RCA) (high take-off posterior descending artery).

DISCUSSION

The ITAs and RGEA are being used increasingly in CABG because of their superior patency compared to SVGs [Suma 2000, Lytle 2001]. We therefore assumed that using the ITAs and RGEA as a site for proximal anastomosis of a free graft would be an acceptable solution for patients with untouchable aorta. The clinical outcome of the 4 patients described, together with the intraoperative flow measurements and postoperative angiographic and coronary CT imaging results, support this notion.

In patients 3 and 4, we did not use the RGEA as an in situ graft because of concern regarding the limited flow capacity of this conduit [Ochi 2001] and its small diameter in its distal segment. On the other hand, the proximal RGEA in both of these patients had a diameter of 3 to 4 mm, which rendered it an adequate site for proximal radial anastomosis.

In the first 2 patients, COPD and insulin-dependent diabetes mellitus precluded the use of bilateral ITA [Lytle 2001], and positive Allen test was a contraindication for the use of the RA. We had to use SVGs, which we usually implant on the aorta. With the new mechanical connection it is now possible to anastomose SVG on the aorta without partial or total aortic clamping [Katariya 2004]. However, these connectors require some aortic manipulation. The experience with their use in severe atherosclerotic involvement of the aorta is limited, and early results with their use suggest increased rate (11%) of SVG occlusion [Katariya 2004].

As described in this report, the proximal RGEA is especially attractive as an alternative site for proximal anastomosis in patients undergoing repeat operation when both ITAs were used in the first CABG procedure or in repeat opera-

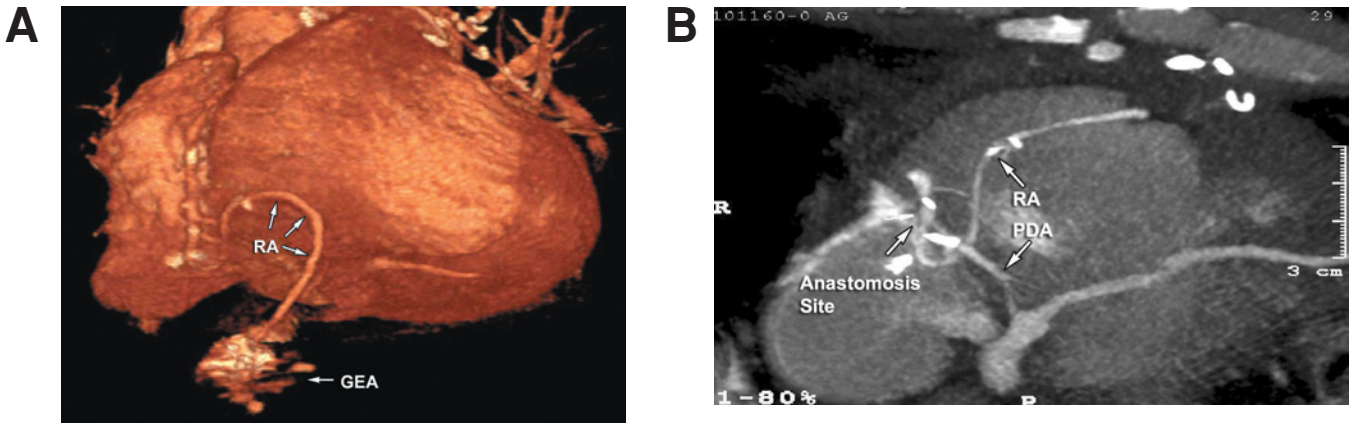

Figure 6. Three-dimensional volume rendered computed tomographic image of the heart showing the new free radial artery (RA) connected proximally to the right gastroepiploic artery (RGEA).

tions with contraindication or inaccessibility of the second (usually the right) ITA.

Our report showed that the right ITA and proximal RGEA can serve safely as sites for proximal anastomosis. However, the follow-up of our patients is too short to draw any conclusions regarding long-term results of the technique described. Further experience and longer follow-up are required to prove the clinical importance for patients with untouchable aorta.

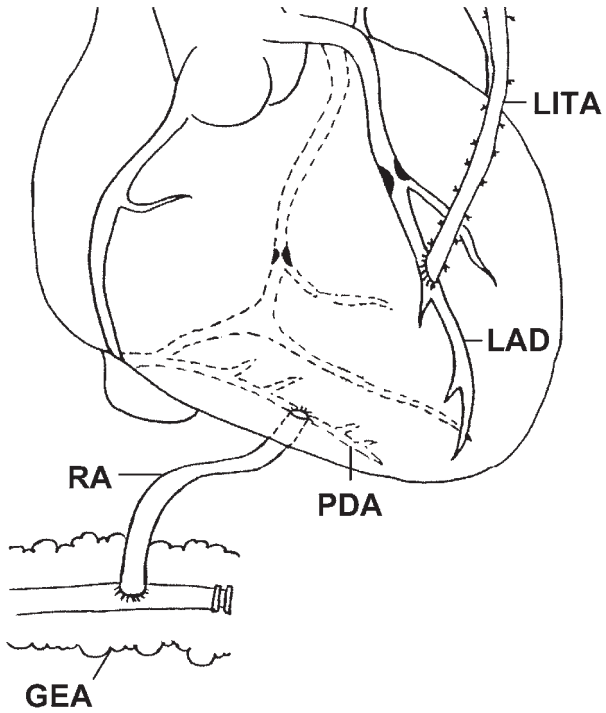

Figure 7. Scheme of the off-pump coronary artery bypass graft procedure performed in a patient with free radial artery (RA) connected end-to-side to the right gastroepiploic artery (RGEA) and distally end-to-side to the posterior descending artery (PDA). LITA indicates left internal thoracic artery; LAD indicates left anterior descending artery.

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