Avoiding sternotomy in repeat coronary artery bypass grafting: Feasibility, safety, and mid-term outcome of the transabdominal off-pump technique using the right gastroepiploic artery

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Objectives: Repeat sternotomy is associated with a substantial risk of cardiovascular injury. We evaluated the feasibility and clinical outcome of a transabdominal approach without sternotomy and without cardiopulmonary bypass in repeat coronary artery bypass grafting, using the right gastroepiploic artery to graft vessels of the inferior wall of the heart.

Methods: From July 1999 to October 2010, 22 patients presenting with only right coronary artery disease underwent reoperation using the transabdominal approach and a skeletonized gastroepiploic artery graft. In all patients but 1, a patent graft to the anterior wall was present. The mean EuroSCORE was 6.4 ± 2.5.

Results: All patients had adequate surgical exposure, and no conversion to sternotomy or the use of cardiopulmonary bypass was required. There was no in-hospital mortality. Hospital morbidity included pneumothorax in 1 patient and atrial fibrillation in 2 patients. The median hospital stay was 5 days. Follow-up was complete, and the median follow-up time was 6 years. There were 2 late deaths. Four patients experienced recurrence of angina, of whom three required percutaneous coronary intervention. The estimated freedom from major cardiovascular and cerebrovascular events rate was 70.2% at 6 years. Fourteen patients underwent an exercise stress test at a median interval of 2 years, with all showing no signs of myocardial ischemia.

Conclusions: Transabdominal off-pump coronary artery bypass grafting using the right gastroepiploic artery is a safe and effective procedure with low in-hospital mortality and morbidity and favorable mid-term outcome. In redo operations, this technique excludes the risk of cardiovascular injury. (J Thorac Cardiovasc Surg 2012;144:124-9)

Reoperation for coronary artery bypass grafting (CABG) can be performed with acceptable mortality and morbidity but is still a surgical challenge. Repeat median sternotomy is associated with a significant risk of cardiovascular injury, which, in turn, carries a substantial risk of in-hospital death. The structures likely to be injured during either the sternal division itself or during dissection include the right ventricle, innominate vein, aorta, saphenous vein grafts (SVGs), and internal thoracic artery (ITA) grafts. Patients with patent ITA grafts are at particular risk, with an incidence of injury to the ITA of 4.9% to 5.3%.[1-3] Injury to an ITA has been associated with a mortality rate of 17.9%.[3]

Because the technical challenge of resternotomy in patients with patent ITA grafts is well recognized, several less-invasive alternatives have been advocated. In particular, when the culprit vessels are located in one region, a small and directed incision without cardiopulmonary bypass (CPB) could be used. Left thoracotomy has been described as a suitable and safe technique in patients who need grafting to the lateral wall of the left ventricle.[4,5] When the right coronary artery (RCA) or the right posterior descending artery (PDA) is the only vessel involved, a small laparotomy with or without a T-shaped incision of the lower third of the sternum has been shown to be a useful alternative.[6-8]

Despite the first successful experiences, reports of redo CABG without sternotomy and without CPB remain limited. In this study, we describe a 10-year experience with the transabdominal off-pump technique using the right gastroepiploic artery (GEA) involving 22 redo patients, emphasizing the feasibility and safety of this approach and its mid-term clinical outcomes.

METHODS

Patient Population

From July 1999 to October 2010, 22 patients with previous CABG underwent a reoperation with the transabdominal off-pump CABG technique using an in-situ GEA. Surgery was performed by 1 surgeon (G.T.) at two institutions in two consecutive periods, following the same protocol. During these periods, all patients requiring repeat CABG with isolated high-grade stenosis (>75%) or occlusion of the RCA or the PDA and significant myocardial ischemia confined to the inferior wall of the heart were selected

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Abbreviations and Acronyms

CABG = coronary artery bypass grafting
CPB = cardiopulmonary bypass
GEA = gastroepiploic artery
ITA = internal thoracic artery
MACCE = major cardiovascular or cerebrovascular event
PCI = percutaneous coronary intervention
PDA = posterior descending artery
RCA = right coronary artery
SVG = saphenous vein graft

for this technique. The patients were not considered proper candidates for percutaneous coronary intervention (PCI). The exclusion criteria for the technique included previous upper abdominal surgery and the target vessel being the posterolateral branch of the RCA. The patients were not excluded on the basis of age or major comorbidities.

All patients had a patent graft to the anterior wall of the heart but 1 (Table 1). This patient received single venous grafting to the marginal branch and aortic valve replacement during the primary procedure performed elsewhere. In an attempt to control a bleeding event at the aortotomy, the ostium of the RCA was accidentally closed. The patient experienced a posterior wall myocardial infarction and postoperative angina (patient 16; Table 1).

The demographic and preoperative characteristics of the patients are summarized in Table 2. The mean age was 64.5 ± 8.1 years. There were 21 men. Two patients underwent a second reoperation. The mean interval from the previous operation to the index repeat CABG was 11.6 ± 5.9 years. The mean additive EuroSCORE was 6.4 ± 2.5, with 14 patients at high risk (additive EuroSCORE of ≥6). The mean logistic EuroSCORE was 7.9 ± 6.8. The study was approved with a waiver of consent by the ethics committee of each institution.

Surgical Technique

The patients were placed in the standard supine position. A dry air warming system was placed around each patient to preserve a normal body temperature. Above the xiphoid, an 8- to 10-cm median incision was made on the scar of the previous sternotomy. This incision was long enough to excise the xiphoid process, position a standard sternal retractor, obtain adequate exposure of the inferior wall of the heart, and allow for easy access to the upper abdomen for harvesting the GEA, making an additional lower sternotomy superfluous in all cases. The diaphragmatic surface of the heart was then dissected free from the diaphragm to facilitate exposure of the inferior wall of the heart. The RCA and PDA were identified to choose the target coronary artery for the anastomosis. Dissection of adhesions was limited, just enough to permit exposure of the target coronary artery. The remaining adhesions were kept intact, because such adhesions act as stabilizers.

At this stage, the peritoneum was opened, the stomach was pulled gently out of the abdomen, and harvesting of the GEA was performed in a skeletonized manner. In the first patients, the GEA was skeletonized using hemoclips to separate its branches from the stomach and omentum. Thereafter, an ultrasonic scalpel (Harmonic Scalpel; Ethicon, Johnson & Johnson, New Brunswick, NJ) was used. After heparinization (1.5 mg/kg), the distal part of the GEA was divided and 3 to 4 mL of a nitroprusside hydrochloride solution (20 mg of nitroprusside hydrochloride diluted in 50 mL of physiologic saline) was injected intraluminally to relieve spasm. A hemoclip was placed at the distal end of the GEA; the graft was put in a warm gauze imbedded in dilute nitroprusside and was then placed back into the abdominal cavity, together with the stomach. This handling of the GEA allowed the artery to vasodilate both by the pharmacologic effect of the nitroprusside and by its own blood pressure.

Next, a hole in the right hemidiaphragm was made to route the GEA intrapericardially. The site of the opening was chosen according to the intended location of the anastomosis. The GEA was always routed antegastrically and in front of the liver. Once the GEA was placed intrapericardially, an Octopus suction stabilizer (Medtronic, Minneapolis, MN) was fixed cranially on the retractor, and the suction branches were placed as close as possible to the target coronary artery. The suction device acted not only as a coronary stabilizer, but also allowed us to push back and to pull up the inferior wall of the heart for an optimal surgical view. In patients with deep chests, exposure of the surgical field was improved by either suturing the diaphragm to the caudal end of the skin incision or placing a deep abdominal retractor, pulling caudally the diaphragm, liver, and other abdominal organs.

An incision of approximately 4 mm in the target coronary artery was made, and an intracoronary shunt was placed whenever possible. The anastomosis was performed with a continuous 8-0 or 7-0 polypropylene suture on the beating heart. After completion of the anastomosis, 1 cm^3 of fibrin glue (Tissucol; Baxter, Deerfield, Ill) was injected around the anastomosis to avoid any torsion of the GEA graft. Heparin was antagonized with protamine (half the dose of the administered heparin). At the end of the procedure, a small drainage tube was placed into the pericardium, and the incision was routinely closed.

Data Collection

The preoperative, operative, and in-hospital outcome variables were extracted from the patients' medical records and entered into a dedicated database on the discharge of the patients from the hospital. Follow-up information was obtained from the attending cardiologists as a part of routine care and by regular telephone interviews with the survivors. The questions addressed cardiac-related rehospitalizations and reinterventions, the patients' Canadian Cardiovascular Society class, stroke, and, if applicable, the cause and date of death. For the patients who underwent follow-up coronary angiography or repeat revascularization, the medical reports were reviewed, with special attention to GEA patency. The results of exercise stress testing were examined, if conducted. A major cardiovascular or cerebrovascular event (MACCE) was defined as all-cause death, new myocardial infarction, repeat revascularization, or stroke. The closing interval for follow-up was October 2010 to December 2010.

Statistical Analysis

Continuous variables are presented as the mean ± standard deviation or as the median and range, as appropriate. Categorical variables are expressed as the frequencies and percentages. Estimates of overall survival and freedom from MACCE were obtained using the Kaplan-Meier method. All statistical analyses were performed using the Statistical Package for Social Sciences software program for Windows, version 16.0.2 (SPSS, Chicago, Ill).

RESULTS

Operative Characteristics

The GEA was suitable as a conduit in all patients, independent of age, peripheral arterial disease, and diabetes mellitus. The graft was anastomosed to the PDA in 12 patients and to the RCA in 9 (Table 1). In 1 patient (patient 4), the GEA was grafted to a patent SVG between the PDA and the posterolateral branch of the RCA. Thrombus endarterectomy of the PDA was necessary in 1 patient (patient 5) and a concomitant thrombus endarterectomy of a carotid artery in another patient (patient 3). The mean