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COMPLETE REVASCULARIZATION USING ARTERIAL ONLY GRAFTS WITHOUT CARDIOPULMONARY BYPASS

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Abstract :
Background: Off-pump coronary artery bypass graft (CABG) using arterial conduits has been performed in our institute to improve postoperative outcomes. In this study, we analyzed the outcomes in patients who underwent total arterial off-pump CABG.
Methods: Between 03/01/1999 and 7/30/2002, a total of 349 patients (263 males and 86 females, mean age of 66.3 ± 9.5) underwent isolated off-pump CABG using arterial grafts. Perioperative and follow-up data were entered into a structured database, and their results were analyzed.
Results: The mean number of bypass grafts was 3.5 ± 1.1. There was no intraoperative conversion from off-pump to on-pump surgery. The mean intubation period, ICU stay, and postoperative hospital stay were 9.0 hours, 2.3 days, and 12.7 days, respectively. There were 4 (1.1%) hospital deaths. Postoperative myocardial infarction was observed in 4 (1.1%), postoperative congestive heart failure in 5 (1.4%), stroke in 7 (2.0%) and mediastinitis in 5 (1.4%). During the follow-up period of 2.2 ± 0.9 years, there were 3 deaths and 13 cardiac events. The actuarial 3-year survival rate was 99.7% and the actuarial event-free rate was 95.9%.
Conclusion: Off-pump CABG using total arterial grafts provides good clinical outcomes.

Key words: coronary artery disease, off-pump bypass, prospective study, follow-up study

Introduction

Off-pump coronary artery bypass grafting (CABG) is known to be less invasive and to provide earlier recovery than on-pump CABG [1]. Arterial bypass has provided better outcomes than saphenous vein bypass [2]. The left internal mammary artery (LIMA), the right internal mammary artery (RIMA), the gastroepiploic artery (GEA), and the radial artery are frequently utilized arterial conduits. With improved stabilizing devices and techniques, off-pump multivessel CABG has been performed in our institution [3]. A combination of off-pump CABG and arterial bypass may optimize patient's recovery and postoperative long-term results [4]. We report here prospectively collected and analyzed data of patients who underwent off-pump CABG using arterial conduits alone.

Method

Patients: The perioperative and remote data of patients who underwent off-pump CABG using arterial bypass alone at the Shin-Tokyo Hospital Group were prospectively entered into a structured database. Patients who underwent combined valvular or ventricular surgery, and who underwent combined surgery with major vascular or general surgery, were excluded from this study. The patients consisted of those who underwent minimally invasive direct coronary artery bypass for single vessel revascularization via small thoracotomy. The study was begun after the suction type of coronary stabilizer became available to our institution in March 1999. Between March 1, 1999 and June 30, 2002, a total of 855 consecutive isolated CABG were performed, and 543 cases (63.5%) were off-pump CABG. The study group consisted of 349 patients (64.3%), who underwent complete revascularization using exclusively arterial off-pump bypass. The study patients were 263 males and 86 females with a mean age of 66.3 ± 9.5 years.

CABG: Indications for total arterial bypass were fully deepening on the availability of the grafts. The bilateral IMA harvest was avoided for patients with uncontrolled diabetes or weak sternum. The radial artery was not used in patients with serum creatinine above 1.5 mg/dl [5]. The GEA was not harvested for the patients who had a history of upper abdominal surgery, obesity, or presence of stomach mass [6].

Most isolated CABG were performed under off-pump CABG in our institute [3]. The patients with poor left ventricular function, mild mitral regurgitation, and preexisting atrial fibrillation preferably underwent on-pump CABG. Patients with calcified coronary arteries, small (diameter less than 1.5 mm), or intramyocardial coronary arteries were also underwent on-pump CABG. The remanding isolated CABG were performed under off-pump CABG via midline sternotomy. Exposure of the target coronary artery was performed using retropericardial sutures (Figure 1), and use of a suction-type coronary stabilizer (Octopus-2 or 3 coronary stabilizer, Medtronic, Minneapolis, MN, Figure 2) [7].

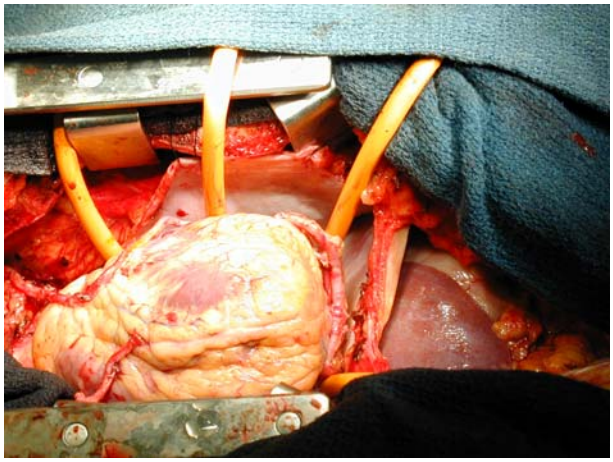

Figure 1: The heart is elevated with retropericardial sutures.

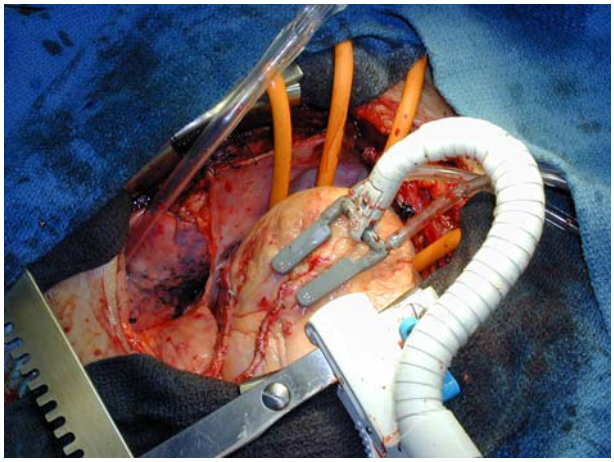

Figure 2: Suction type of coronary stabilizer is applied and anastomosis has been performed.

A carbon oxide gas blower was used to facilitate anastomosis by providing a blood-free operating field. Intracoronary shunt was used for high flow coronary artery, or the patients who developed ischemia during the snaring of the target artery. Distal coronary anastomoses were made using 8-0 polypropylene sutures. Proximal free-graft anastomosis to the ascending aorta was performed using 6-0 polypropylene sutures with a side-biting clamp applied to the ascending aorta.

The left anterior descending artery was bypassed with one of the IMAs, and the distal right coronary artery was selectively bypassed with the GEA. The circumflex artery was bypassed with the radial artery or the IMA.

Postoperative Angiography: Postoperative angiography was obtained within 3 months of surgery if the patients agreed to the procedure. If the patient remained angina free, a repeat coronary angiogram was not routinely performed.

Data collection: Postoperative data were prospectively collected. Outpatient follow-up was completed by the end of January 31, 2003. Remote myocardial infarction, angina, arrhythmia requiring hospitalization, congestive heart failure requiring hospitalization, coronary re-intervention, and sudden death were counted as cardiac events. Results are expressed as mean ± standard deviation. Long-term survivals and event-free rates of the in-hospital survivors were calculated by the Kaplan-Meier method.

Results

Operative results: The number of distal anastomoses was 3.5 ± 1.1. All in-situ grafting was performed in 144 patients (41.3%, aorta-non touch surgery).

Postoperative results: There were 4 hospital deaths (1.1%); 2 patients died of complicated pneumonia, 1 patient died of mediastinitis and another died of stroke. Because of the small number of hospital deaths the risk analysis of predictors of hospital death was not conclusive. Postoperative myocardial infarction, defined by elevated cardiac myo-emzyme more than 5%, was observed in 4 patients. All patients underwent angiography; however, grafts were all patent without stenosis.

Angiographic results: Angiographic control was obtained for 244patients (69.9%) before discharge or within 3 months of surgery. The stenosis-free patency rate of the LIMA, RIMA, radial artery and GEA were 95.2%, 92.9%, 92.8%, and 95.4%, respectively.

Follow-up results: Excluding hospital mortalities, the collection of long-term data was completed for all patients with a mean follow-up period of 2.2 ± 0.9 years. The actuarial 3-year survival rate was 99.0%, and the event-free rate was 95.9%.

Comments

Off-pump CABG has been proven to be less invasive, and provides earlier recovery than on-pump CABG. The creation of steady and hemodynamically stable operative field for distal anastomosis is the one of key points when performed multivessel off-pump CABG. We believe that local coronary stabilization, suction type of stabilizer, play a important role in off-pump CABG. The posterior wall of the heart used to be a contraindication of off-pump CABG because of difficulty of maintaining blood pressure. However, using the suction type of coronary stabilizer and retropericardial suspension, the anastomoses of the posterior wall can be completed without hemodynamics change under heart-beating condition. Complete revascularization under off-pump CABG is feasible. The contraindications of off-pump CABG are now limited to intramyocardial coronary arteries and severely calcified coronary arteries. An recent large study of off-pump CABG demonstrated a complete revascularization rate of 82% under on-pump and 69% under off-pump [8]; however, our complete revascularization rates (82.3%)

were almost as high as that study of on-pump CABG. We believe that all graftable coronary arteries were bypassed adequately with arterial conduits.

The mortality rate of off-pump CABG from the study of the Society of Thoracic Surgery Database was reported to be 2.31% [9]. The mortality rate by a multicenter trial of off-pump CABG in the US was 2.54%, with a postoperative stroke rate of 1.33%, and a mediastinitis rate of 1.10% [10]. The mortality rate of off-pump CABG using arterial grafts was 1.1% reported by Haase [11]. Our observed mortality rate was lower than in those reports and the other morbidity rates were within the ranges of those reports, although direct comparison of the results is not feasible.

The reported graft patency of the in situ LIMA was 97% at 5 years and 89% at 10-years [12, 13]; that of the in-situ RIMA was 93% at 5 years; [11] that of the GEA was 90% at 7-10 years; [2] and that of the radial artery was 93% at 5 years [14]. These arterial graft patency rates are superior to those for saphenous vein graft, which were 88% at early after surgery, 75% at 5 years, and 50% at 12.5 years [15]. The patients receiving complete arterial bypass can expect better long-term freedom from cardiac events, a reflection of good graft patency. However, the difference of cardiac events between saphenous vein grafting and arterial bypass grafting may not be observed 5-7 years after surgery. Thus, to confirm the benefit of off-pump arterial bypass further follow-up is necessary, although mid-term results were excellent.

Summary: This study was limited to single institution, non-randomized clinical experiences. However, our observation supports that off-pump total arterial bypass provides good clinical outcomes within the limited follow-up.

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