

Reoperative Coronary Artery Bypass Surgery: Avoiding Repeat Median Sternotomy

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Background. Mortality and morbidity in reoperative coronary artery surgery are considered to be higher than those for initial surgery. Contributing factors include cardiac injury and damage to patent grafts in repeat median sternotomy. To avoid these complications, reoperative cases were performed off pump to avoid repeat median sternotomy.

Methods. The study subjects were 79 patients who underwent reoperations while utilizing off-pump coronary artery bypass grafting to avoid the need for repeat median sternotomies. All operations were performed by the same surgeon in the period from January 1996 to December 2010.

Results. The mean duration from initial surgery to reoperation was 6 years and 5 months. Reported reasons for reoperation were de novo coronary lesion in 16 patients, graft failure in 33 patients, and de novo coronary lesion plus graft failure in 47 patients. All cases underwent sur-

gery off pump. The approach was left anterior small thoracotomy (35 patients), transdiaphragmatic approach (21 patients), left posterolateral thoracotomy (9 patients), left anterior small thoracotomy plus transdiaphragmatic approach (9 patients), left posterolateral thoracotomy plus transdiaphragmatic approach (4 patients), and small median sternotomy plus left anterior small thoracotomy (1 patient). There were no deaths among the 79 patients in whom repeat median sternotomy was avoided, and all grafts were patent.

Conclusions. Reoperative coronary artery surgery that avoids repeat median sternotomy can prevent cardiac injury and damage to patent grafts. Furthermore, it does not require blood transfusion. Thus, it is an effective method of reducing mortality and morbidity even in reoperative cases.

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Coronary artery bypass graft surgery (CABG) is an established therapy for treating ischemic heart disease [1, 2]. However, there are an increasing numbers of patients who require reoperation as time passes after the initial procedure. Vein grafts are often used in early stage bypass cases, and the deterioration of these grafts results in stenosis and occlusion over time, which can then result in an indication for reoperation. However, there are many reports indicating that early mortality and morbidity are high with reoperation as compared to initial surgery [1, 3–7]. This report describes the effectiveness of reoperation performed without repeat median sternotomy in an effort to avoid these significant complications.

Patients and Methods

Seventy-nine patients who underwent reoperative coronary artery bypass grafting avoiding repeat median sternotomy, performed by the same surgeon during the period from January 1996 to October 2011 when off-pump CABG (OPCABG) was adopted at our center, were studied. During the same period, 17 patients underwent reoperation with median sternotomy, also with the same surgeon. The patients who underwent reoperation through repeat median sternotomy were early cases from

the period when our off-pump protocol had just been started. With the addition of these patients, the study covers a total of 96 patients. The Internal Review Board of our hospital approved this study.

The patients who underwent reoperation through repeat median sternotomy were early cases from the period when our off-pump protocol had just been started. Reoperation was performed once for 91 patients, twice for 4, and three times for 1 patient. The male to female ratio was 70:26. The subjects' ages ranged from 46 to 87 years, with a mean age of 67.0 years. Fifty-two patients (54.2%) had diabetes mellitus, 27 (28.1%) had decreased cardiac function with an ejection fraction of less than 30%, 35 (36.5%) had renal dysfunction with a creatinine of 2.0 or higher, and 18 (18.8%) were receiving dialysis (Table 1). Regarding the surgical methods employed for the 79 patients for whom we avoided a repeat median sternotomy, a left anterior small thoracotomy was performed under differential lung ventilation to access the left anterior descending artery (LAD), and a left posterolateral thoracotomy was similarly performed under differential lung ventilation to access the circumflex artery (Cx). Bypass to the right coronary artery was anastomosed to the posterior descending artery. The posterior descending artery was accessed intraperitoneally through a transdiaphragmatic approach. Left subclavicular artery inflow was established from cases with anastomosis to the LAD and Cx. Inflow can also be established from the descending aorta with partial clamping if calcification is

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Table 1. Preoperative Characteristics of Patients Undergoing Reoperative and Initial Coronary Artery Bypass Graft Surgery in the Same Period

| Characteristics | Re-CABG | | Initial CABG | | p Value |
|---|-----------------|----------------|--------------|------|---------|
| | n | % | n | % | |
| Patients, n | 96 | 1,552 | | | |
| Off-pump | 87 | 90.6 | 1,338 | 86.2 | <0.08 |
| Sex | | | | | |
| Male | 70 | 72.9 | 1,037 | 66.8 | 0.008 |
| Female | 26 | 27.1 | 515 | 33.2 | 0.085 |
| Age, years, mean \pm SD | 67.0 \pm 10.3 | 65.0 \pm 8.4 | < 0.001 | | |
| \leq 60 | 18 | 18.8 | 313 | 20.2 | <0.001 |
| 60-69 | 40 | 41.7 | 652 | 42.0 | <0.001 |
| 70-79 | 30 | 31.2 | 461 | 29.7 | <0.001 |
| \geq 80 | 8 | 8.3 | 126 | 8.1 | <0.001 |
| Smoking | 48 | 50.0 | 935 | 60.2 | <0.001 |
| Diabetes mellitus | 52 | 54.2 | 586 | 37.8 | 0.002 |
| Cerebrovascular accident | 22 | 22.9 | 125 | 8.1 | 0.024 |
| Peripheral vascular disease | 38 | 39.6 | 260 | 16.8 | 0.015 |
| Hypertension | 60 | 62.5 | 1,024 | 66.0 | <0.001 |
| COPD | 12 | 12.5 | 46 | 3.0 | <0.001 |
| Cancer | 3 | 3.1 | 14 | 0.9 | <0.001 |
| Obesity, BMI \geq 25 | 10 | 10.4 | 305 | 19.7 | <0.001 |
| Renal dysfunction, Cr \geq 2 | 35 | 36.5 | 105 | 6.8 | 0.019 |
| Dialysis | 18 | 18.8 | 60 | 3.9 | 0.02 |
| Myocardial infarction | 39 | 40.6 | 423 | 27.3 | 0.08 |
| Unstable angina | 28 | 29.2 | 539 | 34.7 | <0.001 |
| Left ventricular function (ejection fraction) | | | | | |
| \geq 50% | 21 | 21.9 | 874 | 56.3 | 0.052 |
| \leq 30 | 27 | 28.1 | 363 | 23.4 | 0.002 |
| >30 to <50 | 48 | 50.0 | 315 | 20.3 | 0.016 |
| Status | | | | | |
| Urgent | 19 | 19.8 | 119 | 7.7 | <0.001 |
| Elective | 77 | 80.2 | 1433 | 92.3 | <0.001 |

BMI = body mass index; CABG = coronary artery bypass graft; COPD = chronic obstructive pulmonary disease; Cr = creatinine; Re-CABG = repeat coronary artery bypass graft surgery.

minor. If the gastroepiploic artery (GEA) was inappropriate for use as a graft, a vein, radial artery, or a free GEA was used to establish inflow from the intraabdominal arteries.

Bypass Technique for the LAD and Cx

A field of view of the LAD is established. Anesthesia is controlled with a differential lung ventilation tube. The patient should be in the left semisupine position. When the left internal thoracic artery (LITA) is used, a fourth or fifth intercostal thoracotomy (left anterior small thoracotomy) is performed after making an approximately 6-cm incision along the medial inferior edge of the left mammary gland. The left lung is collapsed, and the LITA is detached approximately 6 cm to 7 cm proximal to this incision. After detaching the LITA, bypass is performed to the LAD. However, in many cases, the LITA has already been used in reoperation, and so we often use the saphenous vein or radial artery as a free graft to establish inflow from the left subclavicular artery.

If the intended artery is the LAD, the heart is reached by left anterior small thoracotomy and the pericardium is

incised to open the LAD. Anastomosis for inflow takes precedence, and so the graft is first anastomosed end to side. This graft is then introduced into the thoracic cavity so that the distance from the second intercostal space to the intended coronary artery is minimized while the graft is filled with blood to avoid kinking. The distal anastomosis to the LAD is then performed (Fig 1).

If the intended target coronary artery is the Cx, then a large posterolateral thoracotomy incision is extended to the dorsal area. The left lung is then collapsed, and a transverse incision is made to the pericardium on the dorsal side of the phrenic nerve to bring the obtuse marginal branch or posterolateral branch of the Cx into the field of view. Because a stabilizer can be used, the graft is anastomosed to the coronary artery in a partially static field of view. Anastomosis for inflow is made under partial clamping, provided that the descending aorta has few sclerotic changes and can be anastomosed. If there are sclerotic changes and partial clamping needs to be avoided, then the Enclose II (Vitalitec International, Plymouth, MA) may be used. Inflow

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