Minimally Invasive Direct Coronary Artery Bypass Surgery with Right Gastroepiploic Artery for Redo Patients

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Coronary artery bypass grafting (CABG) has been widely performed for coronary artery disease. Therefore, cases requiring reoperative CABG are increasing. We performed a minimally invasive direct coronary artery bypass (MIDCAB) procedure on four patients, as reoperative CABG surgery for the right coronary artery (RCA), employing the right gastroepiploic artery (RGEA). The target sites were the distal RCA in two patients and the posterior descending (PD) branch in the other two. Complete revascularization was accomplished in all patients without sternotomy, cardiopulmonary bypass (CPB), or blood transfusion. The mean operative time was 3.0 h (range: 2.4–3.7 h). Postoperative coronary angiography showed all grafts to be patent. All patients were discharged without postoperative complications and remained free from cardiac events during a mean follow-up period of 1.5 years (range: 0.5–3.0 years). MIDCAB for the RCA, employing the RGEA via a subxiphoid incision showed excellent revascularization in redo CABG cases. This technique is a safe and effective method for redo cases.

Keywords: minimally invasive coronary artery bypass grafting, redo cases, right gastroepiploic artery

Introduction

CABG has been widely performed for coronary artery disease. Therefore, cases requiring reoperative CABG are increasing. However, reoperative CABG surgery reportedly increases both mortality and morbidity rates.1) The problems that impact surgical mortality and morbidity involve the risks inherent to a second sternotomy and using cardiopulmonary bypass (CPB).2) For this reason, percutaneous coronary interventional (PCI) revascularization has usually been chosen to avoid these risks in such cases. However, these problems cannot be resolved in certain cases with target vessels showing severe stenosis, complete occlusion, and/or severe meandering. Performing minimally invasive direct coronary artery bypass (MIDCAB) without sternotomy or CPB can prevent these problems in patients requiring reoperative myocardial revascularization.3,4) MIDCAB for the left anterior descending (LAD) artery or the left circumflex (Lcx) artery using the left anterior descending (LITA) or a saphenous vein graft (SVG) via a left anterolateral thoracotomy is reportedly an effective and safe technique in reoperative cases.5–7) Moreover, a few reports have described a unique MIDCAB technique for only the right coronary artery (RCA) using the right gastroepiploic artery (RGEA).8)

In this report, we describe four patients undergoing reoperative MIDCAB for the RCA, employing the RGEA, and we also evaluate effectiveness of this procedure.
Between April 2011 and April 2014, we performed 12 MIDCAB for the RCA with the RGEA or a RGEA-SVG composite graft. Eight of these patients underwent primary MIDCAB and four received redo MIDCAB. All four redo patients were men. The mean age of the redo patients was 70.3 years (range: 58–78 years). Reoperation was necessitated by progression of a new lesion in all patients. The mean interval between the first operation and the reoperation was 10.3 years (range: 5–16 years). The RGEA was anastomosed to the RCA in all patients. The target sites were the distal RCA in two patients and the posterior descending (PD) branch in the other two. Revascularizations for the RCA were achieved in all four patients. The major preoperative risk factors were hypertension in three patients, hyperlipidemia in four, smoking in three, diabetes in two, and previous myocardial infarctions in two. The patients’ left ventricular ejection fractions ranged from 0.51 to 0.72 (mean: 0.58) (Table 1).

A midline epigastric incision approximately 12 cm caudal to the xiphoid was made to harvest the RGEA, with semi-skeletonization, under direct vision using electro-cautery. The diaphragm and pericardium were incised lengthwise to expose the diaphragm side of the left ventricular wall. Adhesions between the pericardium and epicardium were carefully dissected and the distal RCA or the PD branch was identified. After heparinization and stabilizer placement, the RGEA was anastomosed to the target vessel using the parachute technique with a 7-0 or 8-0 polypropylene suture. An intraluminal shunt was used during the anastomosis procedure. There were no marked changes in the hemodynamic state or electrocardiographic monitoring during the anastomosis procedure. The chest was closed in layers, leaving a 24 Fr drainage tube. Continuous administration of heparin was initiated approximately 12 h after the operation and oral administration of aspirin was maintained thereafter.

### Ethical Considerations

The study design was approved by our institutional review board, and all patients provided written informed consent.

### Results

We performed redo MIDCAB for the RCA in all patients, employing the RGEA, without sternotomy, CPB, intra-aortic balloon pumping, or blood transfusion. The mean operative time was 3.0 h (range: 2.4–3.7 h). Neither postoperative myocardial infarction nor any other complications occurred. Postoperative 64-multidetector row computed tomographic angiography demonstrated all grafts, including the RGEA, to be patent (Fig.1). All patients were subsequently discharged uneventfully. During a mean follow-up period of 1.5 years (range: 0.5–3.0 years), all four patients remained alive without cardiac events (Table 2).

### Discussion

Reoperative coronary artery bypass is increasingly being performed. Because surgeons prefer to use the ITA and other arterial conduits for CABG, more patients in the future will present for reoperation requiring a variety of arterial conduits, SVG, or both. When redo CABG is necessary, the presence of a patent LITA-LAD graft creates specific risks, including the possibility of intraoperative injury to the graft and potential difficulties with myocardial protection.9,10) The incidence of LITA injury during resternotomy reportedly ranges from 5% to

<table>
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<th>Case</th>
<th>Age(y)</th>
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<th>Previous Procedure</th>
<th>Interval(y)</th>
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<th>HL</th>
<th>Smoking</th>
<th>DM</th>
<th>CRF</th>
<th>MI</th>
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<td>−</td>
<td>−</td>
<td>−</td>
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<td>M</td>
<td>LITA-LAD-P</td>
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<td>+</td>
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<td>51</td>
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M: male; LITA: left internal thoracic artery; LAD: left anterior descending coronary artery; SVG: saphenous vein graft; IEA: inferior epigastric artery; RITA: right internal thoracic artery; D1: diagonal branch 1; AV: atrioventricular nodal branch; P: patent; HT: hypertension; HL: hyperlipidemia; DM: diabetes mellitus; CRF: chronic renal failure; MI: myocardial infarction; EF: ejection fraction of left ventricle
38%. Moreover, it has been reported that second-time CABG procedures are associated with increased mortality and morbidity rates.\textsuperscript{1)}

In recent studies, the mortality rates in redo-CABG varied between 4.2% and 12.3%.\textsuperscript{13–16} The main risks involve the possibilities of injury to the right ventricle, native coronary arteries, and the old patent grafts during dissection of adhesions from the heart, and difficulties controlling bleeding and blood loss when a full sternotomy is performed.

Recently, various approaches for redo CABG have been introduced, such as left thoracotomy with or without cardiopulmonary bypass.\textsuperscript{5–7} To avoid severe adhesions and injury to patent grafts, we have developed a strategy for optimizing this approach. The left thoracotomy in redo CABG has been described as a useful approach for patients requiring revascularization of the LAD, the Lcx area, or both.\textsuperscript{5–7} However, we select this approach only when patients have single-vessel disease of the LAD, the diagonal or the Lcx artery, or two-vessel disease involving the left coronary artery regions.

Revascularization of the RCA via the sub-xiphoid approach, employing the RGEA, is one of the optimal strategies for redo CABG. Several studies have documented successful results of off-pump CABG, employing the RGEA, via the sub-xiphoid approach.\textsuperscript{17,18} As previously reported, nearly all patients undergoing the procedure by this approach can be managed without CPB.\textsuperscript{17,18}

We performed anastomosis of the RGEA to the RCA via a sub-xiphoid incision. The application of this strategy is effective for avoiding both resternotomy and CPB, and it is particularly advantageous in patients who have patent ITA and SV grafts. Moreover, our technique has the advantages that operative time and the amount of bloodloss are consistently reduced. The mean operative time was 3.0 h (range: 2.4–3.7 h). None of our patients required blood transfusions either during or after surgery.

These results suggest MIDCAB via a sub-xiphoid incision to be an effective and safe technique for revascularization of the RCA in redo cases. Furthermore, the RGEA can serve as a useful graft for the RCA. However, the RGEA is not always a suitable graft for the RCA. In cases with mild or minimal stenotic lesions of the RCA, a GEA graft should not be selected because there is a possibility of causing competition between RCA flow and the flow of the RGEA graft. However, this technique still might be the best solution in certain relatively difficult cases. Although PCI would be the simplest option for post-CABG acute coronary syndrome (ACS) patients, redo CABG might be the best option in a complex ACS case lacking a suitable region for PCI. The four patients described herein were typical of such cases in which PCI was difficult or unsuccessful.
This study has several limitations. First, the number of patients was very small. Second, we did not assess the longterm results of our strategy. All patients have not undergone postoperative angiography since discharge. However, all four patients returned to their normal daily lives without cardiac events.

Conclusion

We performed MIDCAB procedures for the RCA on four patients undergoing redo CABG via a sub-xiphoid incision. It is important to choose the optimal approach designed to avoid all possible risks encountered during redo CABG, such as injury of patent grafts and blood loss. Our operative approach is a safe and effective method for redo CABG patients with PCI-resistant lesions limited to the RCA.

Disclosure Statement

The authors have no conflicts of interest to disclose.

References