LETTER TO THE EDITOR

Modified Procedure of Minimally Invasive Direct Coronary Artery Bypass Grafting Using the Left Internal Thoracic Artery -Radial Artery Composite Graft

Minimally invasive direct coronary artery bypass grafting (MIDCAB) procedure has been widespread for surgical revasculization of the left ventricle, and it has benefits such as small surgical wound and avoidance of cardiopulmonary bypass. However, full mobilization of left internal thoracic artery (LITA) through the limited small thoracotomy is very difficult, and there is the risk of LITA injury when it is harvesting. To avoid a LITA injury, we made a LITA-Radial artery (RA) composite graft and performed a LITA-left anterior descending (LAD) artery bypass. This procedure consists of the following concepts: (1) LITA dissection should be minimized to avoid injury. (2) Adequate bypass graft length can be obtained with extension conduit using RA. (3) Arterial graft should be used if possible.

We herewith introduce the surgical technique of this procedure and report the surgical results with 7 consecutive patients.

Surgical Technique

The anesthetized, supine patient had a single-lumen endotracheal tube placed inside and the Swan-Ganz catheter (Baxter International Inc.) was routinely used. A short thoracotomy (8cm) over the fourth rib medial to the left lateral was performed, and the fourth costal cartilage was removed. The LITA lies immediately beneath the cartilage and it was dissected about 2 cm length. Several branches of the LITA were ligated and LITA was freely moved from the thoracic wall. Simultaneous to thoracotomy, an assistant harvested an RA for a distance of 3 cm. Generous papaverine irrigation was used to prevent spasm. Before the pericardium was opened, LITA was cut on the distal site and heparin solution and papaverin irrigation were infused to the edge of LITA. We used the mechanical retractor to improve the surgical view, but the retractor may cause the dissection of LITA which is extended, therefore we preferred to cut LITA before using the mechanical retractor. The pericardium was opened and LAD identified, systemic heparin was given (100 units/kg). Free RA was anastmosed to the end of LITA with running 8-0 polypropylene. This made LITA-RA composite graft had enough length to reach the target LAD lesion. To obtain static surgical view, a mechanical stabilizer (Koros Stabilizer: T. Koros Surgical Instruments Corp. USA) was attached around the target LAD. An arteriotomy was fashioned in the target vessel, and a blood free operative field was maintained with a commercial CO_2 blower and a snared silicone-elastic vessel loop (elastic, Matsuda suture), which was placed around the native LAD only on the proximal site. The LITA-RA composite graft was anastmosed to LAD end-to-side fashion with running 8-0 polypropylene on the beating heart (Figure 1). A soft tube drain was placed into the pericardium and the pleural cavity, if it had been opened during dissection for exposure.

From November 1999 to May 2001, 7 patients underwent coronary artery bypass grafting to LAD by LITA-RA composite graft as mentioned previously (Patients data are shown Table 1). No patients required intraoperative conversion to conventional bypass. No postoperative death or myocardial infarctions occurred.

In all cases, it was possible to avoid a LITA injury. Five patients with normal renal function underwent postoperative coronary angiography that demonstrated the wide patency of bypass graft with rapid filling of LAD. All patients underwent the transthoracic Doppler velocity method (Acuson Sequia 512) of LITA or distal LAD under continuous intravenous infusion of adenosine triphosphate disodium (ATP) and the coronary flow reserve (CFR) calculated to evaluate the graft patency. It demonstrated good patency with the increase of CFR in all cases.

Some authors have described using such composite graft method like, which is called “H graft MIDCAB” or “T-MIDCAB”, and its good surgical results have been reported [Cohn 1998, Coulson 1998, Coulson 2000]. The different point of “H graft MIDCAB” or “T-MIDCAB” is that LITA is cut before the pericardium opening. We use the mechanical retractor and stabilizer to improve the surgical view, but we have experience of a LITA dissection case, which was caused by the mechanical retractor extension.

We prefer to use the radial artery as an extension graft. The radial artery is easily harvested and discrepancy of the LITA diameter is little compared with sapeneous vein. However, the disadvantages of this procedure are considerable. Long patency of RA graft with recent vasospasm management has not been demonstrated although a good early result has been achieved.

The most intriguing possible disadvantage is that the intact branches of LITA can cause a coronary steal syndrome. Coulson et al described that by using direct pressure measurements with T-MIDCAB procedure, the perfusion pressure was consistently higher in LITA than in the coronary artery graft for most of the cardiac cycle, thus eliminating any possibility of coronary steal phenomenon [Coulson 1998]. Cohn et al. described that with the H graft MIDCAB, postoperative thallium stress tests suggested that the graft flow insufficiency was not a clinical problem during exercise. We use the transthoracic Doppler method and calculated the CFR to evaluated the graft patency. CRF is a frequently used parameter for evaluating the epicardial stenosis and microvascular function [Fukata 1999]. Preoperative measurement of the CFR demonstrated 1.0 or less except in 1 case, and postoperative measurement showed an increase to 1.64~3.33 (Table 2). This proved the good patency of the bypass grafting and eliminates coronary steal phenomenon.

In conclusion, the MIDCAB procedure using the LITA-RA composite graft is safe and useful to obtain the adequate bypass graft length with RA and to avoid LITA injury.

Masashi Kano, MD, Yoshio Fukata, MD,
Kazuya Horike, MD, Atsushi Kurushima, MD

Department of Cardiovascular Surgery, National Zentsuji Hospital, Kagawa, Japan

Address correspondence and reprint requests to: Masashi Kano, MD, 2-1-1 Senyu-cho, Zentsuji, Kagawa, 765-0001, Japan, Phone: +81(877) 62-2211, Fax: +81(877) 63-1601, Email: kanocvs@jun.ncvc.go.jp

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Figure 1. 1- left internal thoracic artery
2- radial artery
3- left anterior descending artery

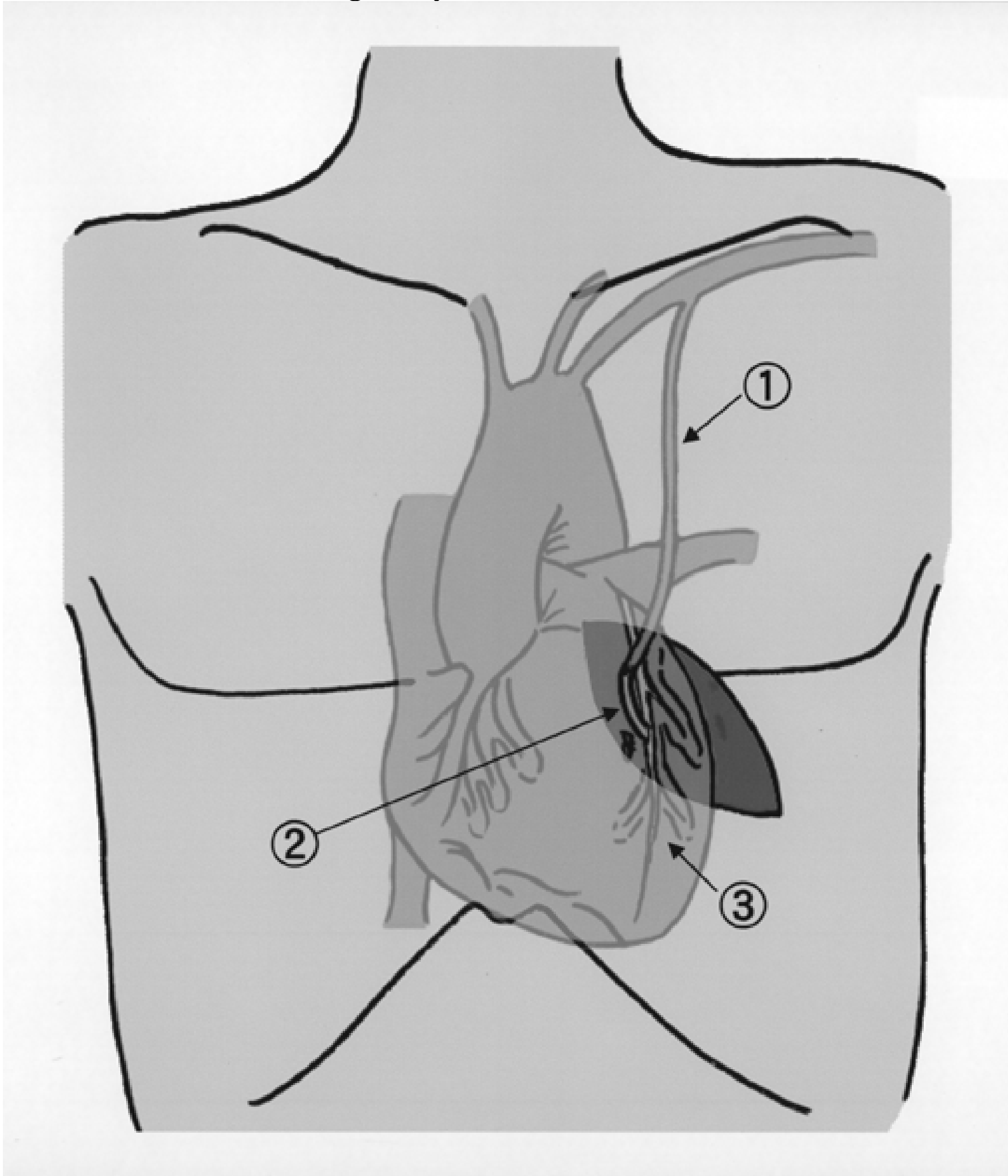

Table 1. Patients' data

Patients Data

Patient	Age	Sex	Lesion	Previous CABG	CFR
1	83	M	LAD	+	0.51
2	70	M	LAD	+	0.94
3	80	M	LMT	-	not measured
4	67	M	LAD	-	0.65
5	65	F	LAD	-	1.04
6	68	M	LAD	-	1.71
7	79	M	LAD	+	0.89

LMT: left main trunk
LAD: left anterior descending artery
CFR: coronary flow reserve

Table 2. Coronary flow reserve

Results

Patient	Graft flow(1) (ml/min.)	Graft flow(2) (cm/sec.)	CAG	CFR	Complication
1	110	57	**patent**	3.33	none
2	54	26	**patent**	2.40	none
3	60	17	**N.A.**	1.64	gastric hemorrage
4	54	48	**patent**	2.07	none
5	36	5	**N.A.**	1.86	none
6	48	38	**patent**	2.90	none
7	54	10	**patent**	1.93	none

Graft flow(1): Bleeding volume was measured from the edge of LITA-RA composite graft.
Graft flow(2): Intraoprative flow velocity was mesaured using a Doppler flow probe.
CAG: Coronary angiography after coronary artery bypass grafting.
N.A.: not available

ATP (80mg) was dissolved in 20 ml physiological saline and continuously infused at 0.14mg/kg/min. CFR was calculated by the following equations:

$CFR = DVTI_{ATP} / DVTI_B$.

$DVTI_{ATP}$= diastolic velocity time integral under ATP loading,

$DVTI_B$= baseline diastolic velocity time integral.