Comparison of perfusion and thickening between vein and right internal thoracic artery composite grafts from a randomized trial substudy

Ho Young Hwang, MD, PhD,[a] Jin Chul Paeng, MD, PhD,[b] Hong Chul Oh, MD,[a] Yong Han Kim, MD,[a] and Ki-Bong Kim, MD, PhD[a]

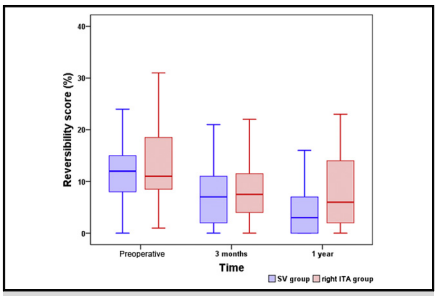
ABSTRACT

Background: Improvements in myocardial perfusion and thickening were compared in coronary artery bypass grafting patients who received saphenous vein (SV) Y-composite grafts versus those who received right internal thoracic artery ([R]ITA) Y-composite grafts.

Methods: Of the 224 patients enrolled in a randomized clinical trial, 116 patients (SV group, n = 65; RITA group, n = 51) in whom myocardial single-photon–emission computed tomography was performed preoperatively, and at 3 months and 1 year postoperatively, were retrospectively studied. A 20-segment model was adopted, and a total of 792 ischemic myocardial segments (SV group, n = 443; RITA group, n = 349) were analyzed. The reversibility score (rest minus stress perfusion value) as an indicator of ischemic myocardium, and Z-values for segmental myocardial thickening, were calculated.

Results: Compared with preoperative values, both myocardial perfusion and segmental myocardial thickening had improved significantly at 3 months and 1 year postoperatively (reversibility scores [mean ± SD] were, respectively: 13.5 ± 8.0 vs 5.8 ± 6.2 and 5.1 ± 6.2, $P < .001$; Z-values were −1.13 ± 1.53 vs −0.62 ± 1.40 and −0.67 ± 1.35, $P < .001$). Mixed-effect model analyses showed no differences in improvements in myocardial perfusion and segmental myocardial thickening between the 2 groups 1 year after revascularization. Separate analysis demonstrated less improvement of myocardial perfusion in the right coronary artery territory of the RITA group than the SV group, with marginal significance ($P = .056$).

Conclusions: Improvements in myocardial perfusion and segmental myocardial thickening were similar between the 2 groups at 1 year after revascularization. The SV, versus the right ITA, composite graft may be more beneficial in perfusion improvement of the right coronary artery territory. (J Thorac Cardiovasc Surg 2015;150:1187-94)



Improvement of myocardial perfusion (reversibility scores) in the right coronary artery territory.

Central Message

Improvements in myocardial perfusion and thickening at 1 year were similar after CABGs using the SV and right ITA as Y-composite grafts.

Perspective

An SV Y-composite graft was shown to be sufficient for CABG, in improvement in myocardial perfusion and thickening during the first postoperative year. The SV, versus the right ITA, composite graft may be more beneficial for perfusion improvement of the RCA territory.

See Editorial Commentary page 1195.

The saphenous vein (SV) remains a conduit commonly used for coronary artery bypass grafting (CABG). However, low long-term patency rates and poor clinical outcomes after CABG using aortocoronary SV grafts have been limitations in the use of SV conduits.[1-3] Recent studies have revealed that using the minimal manipulation technique during SV harvesting improved the long-term patency of SV grafts by preserving the SV wall structure, particularly the endothelial layer.[4,5]

A recent randomized clinical trial[6,7] (a comparison of the SV vs right internal thoracic artery ([R]ITA) as a Y-composite graft [SAVE RITA]), designed to compare the SV (SV group, n = 112) with the right ITA (RITA group, n = 112) used as a Y-composite graft based on the in situ left ITA in off-pump CABG patients, further demonstrated that minimally manipulated SV composite grafts were not

From the Departments of [a]Thoracic and Cardiovascular Surgery, and [b]Nuclear Medicine, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Republic of Korea.

Received for publication April 7, 2015; revisions received July 29, 2015; accepted for publication Aug 1, 2015; available ahead of print Sept 15, 2015.

Address for reprints: Ki-Bong Kim, MD, PhD, Department of Thoracic and Cardiovascular Surgery, Seoul National University Hospital, Seoul National University College of Medicine, 101 Daehak-ro, Chongno-gu, Seoul 110-744, Republic of Korea (E-mail: kimkb@snu.ac.kr).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2015.08.009

Abbreviations and Acronyms

CABG = coronary artery bypass grafting
CI = confidence interval
LAD = left anterior descending coronary artery
LCX = left circumflex coronary artery
MIBI = methoxyisobutylisonitrile
RCA = right coronary artery
RITA = right internal thoracic artery
SAVE RITA = saphenous vein versus right internal thoracic artery as a Y-composite graft
SPECT = single-photon–emission computed tomography
SV = saphenous vein

inferior to right ITA composite grafts in either graft patency rate at 1 year or midterm clinical outcomes.[6,7] The aim of the current study was to compare improvements in segmental myocardial perfusion and thickening after off-pump CABG, using SV and right ITA Y-composite grafts in a subgroup of patients who were enrolled in the SAVE RITA trial.

METHODS

Patient Characteristics

The study protocol was reviewed by the institutional review board and approved as a minimal-risk retrospective study (approval no. H-1308-034-509) that did not require individual consent according to the institutional guidelines for waiving consent. Five of the 224 eligible patients who were enrolled in the SAVE RITA trial were withdrawn immediately because of an intraoperative protocol violation. Of the 219 patients who underwent operation as planned for the SAVE RITA trial, 116 patients were studied (65 in the SV group; 51 in the RITA group) in whom myocardial single-photon–emission computed tomography (SPECT) tests were performed preoperatively, and at 3 months and 1 year postoperatively. Inclusion criteria included (1) patients whose graft patency was confirmed by means of coronary angiography performed 1 year postoperatively, and (2) patients in whom both the resting and stress myocardial SPECT were performed preoperatively, and at 3 months and 1 year postoperatively. Coronary angiograms were performed at 1 year, according to the protocol of the randomized trial.[6]

Serial myocardial SPECT studies were not included in the protocol of our randomized controlled trial but were performed as a part of the routine postoperative evaluation protocol at our institution. Patients were excluded who did not receive both the resting and stress myocardial SPECT (n = 52), received a conduit in addition to the SV or right ITA (n = 37), or either refused to undergo the 1-year angiographic follow-up examination or showed occluded grafts at follow-up angiography (n = 14; Figure 1). More patients in the RITA group were men and had a history of stroke than in the SV group, with marginal significances ($P = .069$ and $P = .051$, respectively) (Table 1). Demographic data of the patients who were enrolled in the present study were not statistically different from those of the other 108 patients who were excluded (Table 2).

Operative Techniques and Revascularization Strategies

The basic surgical procedures and principles of off-pump CABG and the technique for harvesting the SV have been previously described.[7] The left and right ITAs were both harvested using a skeletonization technique. The SV was harvested from a lower leg after systemic heparinization. The manipulation and tension of the SV were minimized during harvest, and manual dilatation and intraluminal flushing were avoided. Immediately after the second limb conduit (SV or right ITA) was harvested, it was anastomosed to the side of the left ITA in a Y fashion.

The left anterior descending coronary artery (LAD) territory was revascularized first, using the left ITA in all study patients. Next, the left circumflex coronary artery (LCX) territory was revascularized, followed by the right coronary artery (RCA) territory. Both the LCX and RCA territories were revascularized using the second limb conduit (SV in the SV group and right ITA in the RITA group), using a sequential anastomotic technique. The average number of distal anastomoses per patient was similar for the SV versus ITA group, respectively: (3.5 ± 0.9 vs 3.5 ± 0.7; $P = .635$); for both the left ITA (1.3 ± 0.5 vs 1.3 ± 0.5; $P = .779$), and the second limb conduit (2.2 ± 0.8 vs 2.1 ± 0.6; $P = .523$).

The patients were given an initial dose of heparin (1.5 mg/kg) and periodic supplemental doses, to maintain an activated clotting time of >300 seconds. All patients took aspirin until the day of surgery and resumed it as soon as possible, usually at 1 day postoperatively. If the patient had a high blood level of low-density lipoprotein cholesterol (>100 mg/dL), statin medication was started.

Myocardial Single-Photon–Emission Computed Tomography

Thallium-201 rest/adenosine stress technetium-99m-methoxyisobutylisonitrile (MIBI)–gated SPECT was performed in all study patients.[8] Thallium-201 (111 MBq) was injected at rest, and SPECT was performed. Coronary perfusion reserve was assessed by infusing adenosine (0.84 mg/kg) for 6 minutes, to induce stress; technetium-99m-MIBI (370 MBq) was injected 3 minutes after the start of adenosine infusion. Gated technetium-99m-MIBI SPECT was performed 90 minutes after stress, using a dual-head camera equipped with low-energy, high-resolution collimators (CardioMD; Philips Medical Systems, Milpitas, Calif). Thallium-201 rest/adenosine stress technetium-99m-MIBI–gated SPECT was repeated 3 months (92 ± 16 days) and 1 year (13.9 ± 2.1 months) after off-pump CABG, as a follow-up examination, by using the same protocol as that used for the preoperative study.

Quantification of Myocardial Regional Perfusion and Thickening

A 20-segment model was adopted for regional analysis: 10 segments were subtended to the LAD territory, 6 to the LCX territory, and 4 to the RCA territory (Figure 2).[9] The reconstructed images were analyzed using an automatic quantifying software package (AutoQUANT, Philips Medical Systems), after overall image quality was assessed by 2 experts. Resting and stress segmental myocardial perfusion was quantified by measuring radioactivity, and expressed as the percentage of the maximal radioactivity uptake.

The reversibility score, defined as a measure of rest minus stress perfusion values, was used as an indicator of the reversibility of perfusion impairment. The reversible myocardial segments were selected based on a cutoff value of 7, suggesting a viable segment in terms of perfusion reversibility.[8] A total of 792 ischemic myocardial segments (reversibility score ≥ 7) were analyzed (443 in the SV group; 349 in the RITA group). The average number of analyzed segments per patient was 6.8 ± 4.6 (3.5 ± 2.7 in the LAD territory, 2.4 ± 1.7 in the LCX territory, and 1.0 ± 1.2 in the RCA territory). No statistical differences were found in average number of myocardial segments analyzed between the 2 groups.