Equivalency of Saphenous Vein and Arterial Composite Grafts: 5-Year Angiography and Midterm Clinical Follow-Up

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Background. **We compared 5-year graft patency rates and midterm clinical outcomes of saphenous vein (SV) composite grafts with those of total arterial (TA) composite grafts in patients who underwent off-pump coronary artery bypass graft surgery (OPCAB).**

Methods. **Three hundred sixty-three patients who underwent OPCAB using composite grafts based on the left internal thoracic artery were studied. The SV was used as a second (connected to the left internal thoracic artery) or a third (connected to the second arterial graft) composite graft in 90 patients (SV group); TA composite grafting was performed in 273 patients (TA group). Follow-up was complete in 96.4% of patients (350 of 363), with a median follow-up of 82 months. Five-year graft patency rates and long-term clinical outcomes were compared. A propensity score-matched analysis was also performed to minimize differences in preoperative and intraoperative variables (n = 69 in each group).**

Results. **There were no differences in operative mortality and postoperative complications between the SV group and TA group. Actuarial 5-year patency rates of the venous and arterial composite grafts were 89.3% and 89.5%, respectively ($p = 0.958$). Those were also similar between the two propensity score-matched SV and TA groups (90.5% and 89.3%, respectively; $p = 0.759$). Five-year overall survival and freedom from major adverse cardiac and cerebrovascular events were 88.5% and 85.6%, respectively. Those were similar between the two groups before and after propensity score matching.**

Conclusions. **The SV composite grafts were equivalent to arterial composite grafts in terms of 5-year graft patency rates and midterm clinical outcomes.**

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A composite graft based on the in situ left internal thoracic artery (LITA) has advantages in coronary artery bypass graft surgery (CABG) because it avoids aortic manipulation and allows efficient conduit utilization [1, 2]. Safety and efficacy of a LITA-based composite graft CABG using arterial conduits (such as right internal thoracic artery [RITA], radial artery, or right gastroepiploic artery) have been well demonstrated [3–6]. However, saphenous vein (SV) composite grafts have not been widely used, and only a few studies have reported the results of CABG using SV composite grafts [7–9]. In previous studies, we demonstrated that patency rate and clinical outcomes of SV composite grafts were comparable with those of arterial composite grafts early and at 1 year after CABG [9–11]. However, long-term outcomes of the SV composite grafts have not been elucidated yet.

The aim of this study was to compare 5-year angiographic patency rates and long-term clinical outcomes in off-pump CABG (OPCAB) patient groups who received the SV as an additional composite graft versus total arterial composite grafts.

Material and Methods

The study protocol was reviewed by the Institutional Review Board and approved as a minimal risk retrospective study (approval number H-1401-040-548) that did not require individual consent based on the institutional guidelines for waiving consent.

Patient Characteristics

Of 453 patients who underwent isolated CABG between October 2006 and December 2008 at our institution, OPCAB was performed in 451 patients (99.6%). Among those, 384 patients (85.1%) underwent OPCAB using composite grafts based on the in situ LITA. After excluding 21 patients who were also enrolled in a randomized controlled clinical trial [10], 363 patients were included in the present study. The SV was used to construct a composite grafting as a second or third conduit (SV group; n = 90), or exclusively arterial conduits such as RITA and right gastroepiploic artery were used to construct a total arterial (TA) composite graft

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Abbreviations and Acronyms

CABG = coronary artery bypass graft surgery
ITA = internal thoracic artery
LITA = left internal thoracic artery
MACCE = major adverse cardiac and cerebrovascular events
MDCT = multidetector computed tomography
OPCAB = off-pump coronary artery bypass graft surgery
RITA = right internal thoracic artery
SV = saphenous vein
TA = total arterial

(TA group; n = 273). There were no differences in demographic data and preoperative risk factors between the two groups, except a higher proportion of three-vessel disease in the SV group than in the TA group (p = 0.002; Table 1). A propensity score model was constructed to adjust differences in preoperative characteristics and intraoperative data between the two groups, and 69 patients in each group were extracted by 1:1 matching. There were no differences in demographic data and preoperative risk factors between the two propensity score-matched groups (Table 1).

Operative Techniques and Revascularization Strategy

The basic surgical procedures and strategies of OPCAB have been previously described [6]. Our surgical strategies during the study period were as follows: (1) total arterial revascularization was performed if possible, using a free right gastroepiploic artery anastomosed to the in situ LITA as either a Y- or I-shaped composite graft in most patients between October 2006 and September 2008; (2) either the RITA or the SV was harvested when the right gastroepiploic artery was unusable or when the LITA or right gastroepiploic arterial graft was too short to reach the target vessels; and (3) aortic manipulation was avoided. After September 2008, however, the SV has been used as a preferred second conduit of choice for constructing composite grafts. Saphenous vein harvest was initiated after systemic heparin treatment, and was performed using a "minimally manipulative technique" [9], in which the manipulation and tension of the SV were minimized during harvest, and manual intraluminal dilation was avoided. Immediately after the harvest, the reversed SV was anastomosed to the in situ LITA or other arterial grafts in either an I or Y shape. After the composite graft was constructed, in almost all the patients, the left anterior descending coronary artery territory was revascularized first by using the LITA while the SV graft was left to be dilated spontaneously by the native flow and pressure of the LITA. The valve of the spontaneously dilated SV was then destroyed by inserting a 2-mm sized vessel dilator into the reversed vein lumen, thus preventing blood stagnation in the event of flow competition.

All patients took aspirin (200 mg/d) until the day of surgery and resumed taking it as soon as possible after surgery, usually 1 day postoperatively. Ticlopidine hydrochloride (200 mg/d) was used simultaneously with aspirin for 2 months during the early postoperative period. If the patient had a high blood level of low-density lipoprotein cholesterol (>100 mg/dL), statin medication was started.

Operative Data

In the SV group, the SV was used as a second limb conduit (directly connected to the LITA [n = 50]) and as a third conduit (connected to the second arterial conduit in an I shape for lengthening of the conduit [n = 40]). In the TA group, the right gastroepiploic artery was used as a composite conduit in the majority of the patients (n = 255, 93.4%) and the RITA was used in 22 patients. Construction of composite grafts was Y-shaped in 258 patients (n = 67 [74.4%] in the SV group versus n = 191 [70.0%] in the TA group; p = 0.416), and I-shaped in 157 patients (n = 67 [74.4%] in the SV group versus n = 90 [33.0%] in the TA group; $p < 0.001$). Those configurations were not statistically different between the two groups after propensity score matching (p = 0.169 and p = 0.815, respectively; Table 2).

The average number of distal anastomoses per patient was larger in the SV group than in the TA group (SV group 3.4 ± 0.9 versus TA group 3.1 ± 0.8, p = 0.009). The number of distal anastomoses using arterial conduits other than the LITA were 0.8 ± 0.9 and 2.2 ± 0.7 in the SV and TA groups, respectively. In the SV group, an additional number of 1.8 ± 0.9 distal anastomoses were performed using the SV conduit. The average number of distal anastomoses in the left anterior descending and left circumflex coronary artery territories were similar between the two groups; however, larger numbers of distal anastomoses were constructed in the right coronary artery territory in the SV group than in the TA group ($p < 0.001$; Table 1).

Evaluation of Graft Patency

Early, 1-year, and 5-year follow-up coronary angiograms were performed regardless of angina symptoms, based on the patient's consent (Fig 1). Patients who died, refused angiographic evaluation, or had renal function impairment were excluded from angiographic follow-up. However, patients with renal replacement therapy were included in angiographic follow-up. Early (1.9 ± 2.6 days) and 1-year (12.3 ± 3.9 months) postoperative coronary angiograms were performed in 99.2% (360 of 363) and 88.4% (321 of 363) of all patients and in 98.6% (136 of 138) and 82.6% (114 of 138) of the propensity score-matched patients. At 5 years (59.6 ± 8.4 months) postoperatively, 73.0% of all patients (265 of 363) underwent graft evaluation by coronary angiograms (n = 217) or multidetector computed tomography (MDCT) angiograms (n = 48). Of patients who underwent graft evaluation at 5 years, 15 patients (5.7%) underwent symptom-driven angiograms. In the matched patients, 68.1% (94 of 138) underwent 5-year graft evaluation (coronary angiograms in 76 patients and MDCT in 18 patients).

One physician initially reviewed all coronary angiograms and another radiologist initially reviewed all the