Patency rates of endoscopically harvested radial arteries one year after coronary artery bypass grafting

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Objectives: To improve patients' acceptance of the radial artery as a graft for coronary revascularization, we introduced an endoscopic harvesting technique. The aim of this study was to assess graft quality 1 year after the operation.

Methods: In 50 patients who underwent endoscopic radial artery harvesting for coronary artery bypass grafting, 64-slice computed tomography, electrocardiography, and echocardiography were utilized to assess graft patency and left ventricle function at a 1-year follow-up. In addition, the influencing factors of radial artery graft patency were evaluated. Radial artery patency was compared with a control group from our database.

Results: Any patency of endoscopically harvested radial artery grafts was 78% (39/50) and perfect patency was 72% (36/50) 1 year after coronary revascularization. The implanting surgeon and graft harvester, patient factors, graft properties, medication, and target territory did not influence the patency rates of the radial artery graft. The only significant and strong parameter to predict perfect graft patency was the severity of the target vessel stenosis ($P < .001$). In patients with a target vessel stenosis of 90% or greater, radial artery graft patency was 90.3% (28/31). Patency rates of endoscopically (72%) and conventionally (74%) harvested radial arteries were not different ($P = .822$).

Conclusions: Patency rates 1 year after endoscopic radial artery harvesting are comparable to the open technique. On the basis of our results, we attempt to use the radial artery as a bypass graft only for target coronary arteries with 90% or greater stenosis. We recommend endoscopic harvesting as the technique of choice to harvest the radial artery.

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Since the reintroduction of the radial artery (RA) as a coronary artery bypass graft in the 1990s, harvesting techniques and antispasmodic therapy have been advanced.[1-3] It has been hoped that the RA will maintain greater late patency than has the saphenous vein (SV).[4] Consequently, we offer total arterial revascularization to patients aged less than 70 years. To further improve patients' acceptance of the RA as a bypass graft, we established a method of endoscopic RA harvesting in March of 2004.[5]

To evaluate the graft patency of the endoscopic technique, we consecutively followed up our first series of patients who underwent endoscopic RA harvesting.

Materials and Methods

Patients

Of 1403 patients who underwent coronary artery bypass grafting at our institution between March 2004 and July 2005, 397 received an RA graft. The RA was chosen as a bypass graft in patients aged less than 70 years and in the absence of contraindications such as carpal tunnel syndrome, Dupuytren disease, severe arterial obstructive disease, dialysis, pathologic Allen test or Doppler examination, small RA diameter, or visible calcification. A total of 71

Abbreviations and Acronyms

LITA = left internal thoracic artery
MSCT = multislice computed tomography
NYHA = New York Heart Association
PI = pulsatility index
RA = radial artery
RCA = right coronary artery
RITA = right internal thoracic artery
SV = saphenous vein

patients underwent coronary artery bypass grafting with an endoscopically harvested RA during the above-mentioned time period. Twelve patients were lost to follow-up (10 patients live abroad and 2 patients refused follow-up). Of 59 patients, 6 refused the investigation with a multislice computed tomograph (MSCT), and 3 patients had contraindications for the application of the contrast agent (elevated creatinine or suppressed thyroid-stimulating hormone). Thus, evaluation of bypass patency after endoscopic RA harvesting at 1 year was performed in 50 patients. In these patients, a 12-lead electrocardiogram was recorded and an echocardiographic investigation was performed.

Endoscopic Radial Artery Harvesting

The nondominant arm was chosen for RA harvesting. Preoperative Allen test and Doppler examination were routinely performed to confirm adequate ulnar blood flow.

The RA was harvested through a single 3-cm skin incision. This technique is performed with an endoscope inserted into a retractor and a harmonic scalpel for the dissection of the artery. Transection of the artery is carried out with a pre-tied Endoloop. A detailed description of the technique has been published.[5]

Antispasmodic prophylaxis was carried out by intravenous application of 6 to 12 μg diltiazem/kg/min starting during extracorporeal circulation and continuing for 24 hours after the operation. We also recommended the administration of amlodipine as an antispasmodic agent in an oral dose of 5 mg/d for 3 months after the operation.

Intraoperative Assessment

Assessment of the bypass grafts was carried out after weaning from cardiopulmonary bypass and establishment of stable hemodynamic conditions with a transit time flowmeter (Medi-Stim ASA, Oslo, Norway). Mean graft flow and pulsatility index (PI) were obtained directly from the flowmeter.

Assessment of the Target Vessel Stenosis

Data concerning the severity of the target vessel stenosis for bypass grafting were collected from the preoperative angiograph, from which native coronary artery stenosis was determined by visual assessment.

Multislice Computed Tomographic Angiographic Analysis

A computed tomographic angiographic scan is routinely performed 1 year after coronary artery bypass grafting. Contrast-enhanced computed tomographic angiographic data (Sensation 64 Cardiac, Siemens Medical Solutions, New York, NY) were acquired with the use of a spiral scan with 32 $\times$ 0.6-mm collimation, 330 ms gantry rotation, pitch of 0.2, and tube voltage at 120 kV. The scanning range included the entire course of venous grafts and the most proximal part of internal thoracic artery grafts at their subclavian origin, if these arterial grafts had been used for bypass surgery.

All bypass grafts were independently evaluated by 2 investigators who were aware of the initial coronary artery bypass grafting procedure. The investigators independently evaluated the contrast-enhanced MSCT scans by assessment of the axial slices, multiplanar reformations, and 3 thin-slab maximum intensity projections. Lumen narrowings were classified by the maximal luminal diameter stenosis seen in any plane. Because localized bypass stenoses were not seen in the present cohort, the bypass grafts were classified as perfectly patent, patent, or occluded. All patients signed an informed consent.

Echocardiographic Analysis

All echocardiographic examinations were performed by an experienced investigator. Echocardiographic scanning was carried out under resting conditions using an image Point Hx ultrasound system with a 2.5-MHz transducer (Hewlett-Packard, Palo Alto, Calif). Measurements of left ventricular dimensions were performed in the long parasternal axis. Left ventricular function and wall motion abnormalities were evaluated by visual assessment.[6]

Control Group

To compare RA graft patency rate after endoscopic harvest (ENDO group) with the conventional open technique (OPEN group), 50 patients who had undergone coronary artery bypass grafting with a conventionally harvested RA in the above-mentioned time period were randomly and retrospectively selected from our database and served as controls. The patient characteristics and type of grafts implanted in the ENDO and OPEN groups are summarized in Tables 1 and 2. Assessment of the target vessel stenosis and antispasmodic prophylaxis were performed in the control group as described above. Assessment of bypass graft patency was performed by MSCT in 33 patients of the control group and by angiography in 17 patients who had been followed up in an external clinic.

Statistics

Data are presented as mean $\pm$ standard deviation or as percentages. Differences between groups were tested with the Student t test for continuous variables and the chi-square test or Fisher exact test for dichotomous variables as appropriate. Eighteen variables (patient characteristics, graft and target vessel properties) were tested for their influence on RA patency.

We performed a logistic regression analysis for patency of the RA after endoscopic harvest. We used forward selection and the likelihood ratio test for model selection. Included were age, gender, and all variables with a P value less than .10 in the univariate tests. Because normal distribution and homogeneity of variances were not given, a P value of less than .01 was considered statistically significant. Data analysis was performed with the Statistical Package for the Social Sciences version 14.0.1 (SPSS Inc, Chicago, Ill).