The long-term impact of diabetes on graft patency after coronary artery bypass grafting surgery: A substudy of the multicenter Radial Artery Patency Study

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Objectives: The study objective was to determine the impact of diabetes on radial artery and saphenous vein graft occlusion and clinical outcomes more than 5 years after coronary artery bypass surgery in the multicenter Radial Artery Patency Study (NCT00187356).

Methods: A total of 529 patients aged less than 80 years with triple-vessel disease undergoing coronary bypass surgery participated in this study. Angiographic follow-up occurred more than 5 years after surgery with annual clinical follow-up. The primary objective was to compare the proportion of complete graft occlusion between radial artery and saphenous vein grafts among diabetic and nondiabetic persons. Additional objectives included determining predictors of complete graft occlusion and comparison of major adverse cardiac events defined by cardiac death, late myocardial infarction, and reintervention.

Results: There were 148 of 529 patients (27.8%) with diabetes; 269 patients (83/269 [30.9%] diabetic) underwent late angiography at mean of 7.7 ± 1.5 years after surgery. In diabetic patients, the proportion of complete graft occlusion was significantly lower in the radial grafts (4/83 [4.8%]) than in the saphenous grafts (21/83 [25.3%]) ($P = .0004$), and this was similar in nondiabetic patients ($P = .19$). Multivariate modeling showed that the use of the radial artery and high-grade target vessel stenosis were protective against late graft occlusion, whereas female gender, smoking history, and elevated creatinine were associated with an increased risk; interaction between diabetic status and conduit type also was significant ($P = .02$). Major adverse cardiac events were higher in diabetic patients (23/148 [15.5%] vs 35/381 [9.2%], $P = .04$).

Conclusions: The use of the radial artery should be strongly considered in diabetic patients undergoing coronary bypass surgery, especially with high-grade target vessel stenosis. (J Thorac Cardiovasc Surg 2014;148:1246-53)

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Abbreviations and Acronyms

CABG = coronary artery bypass grafting
CI = confidence interval
CTA = computed tomography angiography
ECG = electrocardiogram
ITA = internal thoracic artery
LVEF = left ventricular ejection fraction
MACE = major adverse cardiac events
MI = myocardial infarction
OR = odds ratio
PCI = percutaneous coronary intervention
RA = radial artery
RAPS = Radial Artery Patency Study
SV = saphenous vein

Diabetes mellitus currently affects more than 285 million adults in the world and is projected to increase to 439 million by 2030.[1] A large portion of deaths in diabetic patients are associated with ischemic heart disease.[2] Coronary artery bypass grafting (CABG) is considered the standard of care in diabetic patients with advanced multivessel disease. This was confirmed in the international multicenter randomized study (Future Revascularization Evaluation in Patients with Diabetes Mellitus: Optimal Management of Multivessel Disease),[3] which showed that in diabetic patients with multivessel disease, CABG resulted in a significantly reduced rate of major adverse cardiac events (MACE) (all-cause death, nonfatal myocardial infarction [MI], and nonfatal stroke) compared with percutaneous coronary intervention (PCI) at 5 years (18.7% CABG vs 26.6% PCI, $P = .005$); these findings were included in a recent systematic review that suggested CABG should be revised to a class I, level A recommendation in diabetic patients with multivessel disease in both the American and the European revascularization guidelines.[4]

An important predictor of long-term success in CABG is graft patency.[5] This is especially true in diabetic patients because they are prone to diffuse and rapidly progressive atherosclerosis.[2] Because of the excellent long-term patency rates and resistance to atherosclerosis of internal thoracic artery (ITA) grafts,[6,7] surgeons have turned to the radial artery (RA) as another potential arterial conduit. A recent meta-analysis showed that RA grafts were superior to saphenous vein (SV) grafts at midterm angiographic follow-up.[8] The Radial Artery Patency Study (RAPS) is a multicenter randomized trial comparing the patency of the RA with the SV (NCT00187356). The RAPS investigators reported that the proportion of RAs with complete graft occlusion was lower than SVs at 1 year (8.2% vs 13.6%, $P = .009$)[9] and more than 5 years (8.9% vs 18.6%, $P = .002$).[10] At 1 year, the RAs were superior to the SVs in the diabetic cohort with respect to graft patency.[11]

We report the long-term (>5years) impact of diabetic status on RA and SV graft patency. Specifically, the primary objective is to determine whether preoperative diabetic status differentially influences long-term complete occlusion between the RA and study SV grafts. The secondary objective is to determine the potential predictors of long-term complete graft occlusion. The tertiary objective is to determine whether diabetic status influences long-term, event-free survival after CABG.

METHODS

This is a secondary analysis of the RAPS, which is a longitudinal, multicenter, randomized, controlled clinical trial for which institutional research ethics approval was attained. All participants who were enrolled in the trial provided informed consent.

Population

Details of the RAPS protocol have been published.[12] Briefly, the RAPS included patients aged less than 80 years with left ventricular ejection fraction (LVEF) greater than 35% and triple-vessel coronary disease undergoing nonemergency isolated CABG. Angiographic inclusion criteria were target vessel stenosis of 70% or greater to decrease the likelihood of competitive flow from the native circulation, vessel diameter of 1.5 mm or greater, and target vessel deemed to be of acceptable quality. Exclusion criteria were contraindications to the use of the RA (ie, positive Allen's test, abnormal arterial upper limb duplex scan, or a history of vasculitis or Raynaud's syndrome) or the SV (ie, bilateral varicosities or vein stripping). Further exclusion criteria were factors limiting follow-up research angiography, which included creatinine greater than 180 μmol/L, severe peripheral vascular disease limiting femoral access, coagulopathy or obligatory use of anticoagulants, known allergy to radiographic contrast, pregnancy, and geographic inaccessibility.

Randomization

A within-patient randomization design was applied whereby the RA was randomized to the inferior (right coronary artery) or lateral (circumflex artery) region of the heart. The study SV graft would then be placed at the opposing territory (circumflex artery or right coronary artery). This technique allowed patients to receive both study grafts and serve as their own internal control. The ITA was used for the anterior wall (left anterior descending) distribution. The randomization schedule was obtained using a central computer random number sequence generator and was stratified by center in randomly varying blocks of 4-6. Randomization was concealed in a sealed opaque envelope and revealed to the surgeon only after the patient entered the operating room.

Surgical Technique and Perioperative Management

Both the RA and the SV were harvested using an open technique. The nondominant hand was used to harvest the RA. All operations were performed on-pump using cardiopulmonary bypass. Grafts were performed with a single distal and proximal aortocoronary anastomosis; sequential and composite grafts were not performed. Details of the harvesting technique have been published.[13] Each participating surgeon partook in a 2-day workshop held in Toronto, Canada, at the beginning of the study to learn the standard RA harvesting technique and could recruit patients after performing the operation in 3 patients.

Postoperative Management

Patients received 325 mg of aspirin within 6 hours postoperatively and daily thereafter; a lower dose of aspirin was used long-term according to institutional practice. Intravenous nitroglycerin was administered during