JACC: CARDIOVASCULAR INTERVENTIONS VOL. 7, NO. 7, 2014

ISSN 1936-8798/$36.00
PUBLISHED BY ELSEVIER INC. http://dx.doi.org/10.1016/j.jcin.2014.01.164

Native Coronary Artery Patency After Coronary Artery Bypass Surgery

David Pereg, MD,* Paul Fefer, MD,*† Michelle Samuel, BA, MPH,* Rafael Wolff, MD,* Andrew Czarnecki, MD,* Saswata Deb, MD,‡ John D. Sparkes, MSc,* Stephan E. Fremes, MD,‡§ Bradley H. Strauss, MD, PhD*‖

Toronto, Ontario, Canada; and Tel Aviv, Israel

Objectives The aim of the study was to determine native coronary artery patency 1 year after coronary artery bypass grafting and to identify clinical and angiographic predictors for the development of a chronic total occlusion (CTO).

Background In contrast to the large body of information regarding graft patency, data regarding atherosclerosis progression and vessel patency in surgically bypassed native coronary arteries are less clear.

Methods Of the 440 patients who underwent 1-year follow-up angiography as part of the multicenter RAPS (Radial Artery Patency Study), included in our study were 388 patients (88%) for whom angiograms were available for review. Angiograms were reviewed for native coronary artery patency in an independent blinded manner.

Results On the pre-operative angiogram, CTO of at least 1 native coronary vessel was demonstrated in 240 patients (61.9%) having 305 occluded vessels. At 1 year after coronary artery bypass grafting, at least 1 new native coronary artery CTO occurred in 169 patients (43.6%). In 7.5% of patients, the native artery and the graft supplying that territory were both occluded. A new CTO was almost 5 times more likely to occur in coronary vessels with a pre-operative proximal stenosis >90% compared with vessels with proximal stenosis <90% (45.5% vs. 9.5%, respectively, $p < 0.001$). Patients with a new CTO had significantly more baseline Canadian Cardiovascular Society class 4 angina compared with patients without a new CTO. A new CTO was less likely to occur in the left anterior descending artery (18.4%), supplied by the left internal thoracic artery. When comparing radial artery and saphenous vein grafts, neither the type of graft nor graft patency had any association with native coronary artery occlusion.

Conclusions CTO of surgically bypassed coronary arteries 1 year after coronary artery bypass grafting is extremely common. (J Am Coll Cardiol Intv 2014;7:761–7) © 2014 by the American College of Cardiology Foundation

From the *Division of Cardiology, Schulich Heart Program, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada; †Leviev Heart Center, Sheba Medical Center, Tel Aviv University, Tel Hashomer, Israel; ‡Division of Cardiovascular Surgery, Schulich Heart Program, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; §Bernard S. Goldman Chair in Cardiovascular Surgery, Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada; and ‖Reichmann Chair in Cardiovascular Sciences, Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received October 23, 2013; revised manuscript received December 18, 2013, accepted January 4, 2014.

Coronary artery bypass grafting (CABG) remains the most common revascularization mode for patients with multivessel coronary artery disease. Several studies have demonstrated better long-term patency and improved survival after CABG with internal thoracic artery (ITA) grafts (1–4). Therefore, the left ITA has traditionally been used to bypass the anterior coronary circulation. Furthermore, the multicenter RAPS (Radial Artery Patency Study) demonstrated that radial artery grafts are associated with a lower rate of graft occlusion at 1 year than are saphenous vein grafts (SVGs) (5). These findings have been supported by several smaller studies (6–8). Unlike the large body of information regarding graft patency, data regarding atherosclerosis progression in surgically bypassed native coronary arteries are less clear and derived mainly from studies conducted >3 decades ago, before the use of the left ITA and radial grafts and widespread statin use. The available studies have demonstrated accelerated atherosclerosis progression that was as much as 10 times as frequent in bypassed arteries as in comparable arteries that were not bypassed (9–13). Nevertheless, in most of those studies, follow-up angiograms were obtained several years after CABG using saphenous vein bypass grafts, and data regarding native coronary artery disease progression and especially the rate of postoperative complete occlusion are not clear. The status of the native coronary circulation and especially the prevalence of chronic total occlusion (CTO) in patients post-CABG are clinically important when considering revascularization after graft failure. A recent multicenter registry of CTO percutaneous coronary intervention (PCI) demonstrated lower technical success rates in patients with previous CABG compared with patients without previous CABG (14). The purposes of the current study were to determine native coronary artery patency 1 year after CABG and to identify clinical and angiographic risk factors for native coronary vessel occlusion using data from the RAPS database.

Abbreviations and Acronyms

CABG = coronary artery bypass grafting
CCS = Canadian Cardiovascular Society
CTO = chronic total occlusion
ITA = internal thoracic artery
LAD = left anterior descending artery
LCX = left circumflex artery
PCI = percutaneous coronary intervention
RCA = right coronary artery
SVG = saphenous vein graft

Methods

Study population. The study population consisted of patients enrolled in the multicenter RAPS between November 1996 and January 2001, which mandated 1-year follow-up angiography. The primary objective of the RAPS was to compare the longitudinal patency of the radial artery and saphenous vein. Details of the study protocol were previously published (5). Briefly, patients enrolled were younger than 80 years of age undergoing nonemergent primary isolated CABG for triple-vessel disease with an estimated left ventricular ejection fraction of >35%. The left ITA was used to bypass the left anterior descending artery (LAD) circulation, and patients were randomly assigned to 1 of 2 graft strategies: (1) the radial artery was used to graft the left circumflex artery (LCX) territory and an SVG was used for the right coronary artery (RCA) or (2) the radial artery was directed to the RCA territory and an SVG was used for the LCX system. The target vessels for the radial artery and study saphenous vein were deemed to be at least 1.5 mm in diameter with a proximal stenosis of at least 70% by visual inspection. The primary study endpoint was the proportion of radial arteries and study saphenous veins that were completely occluded at 1 year after surgery. Complete occlusion was defined as the absence of opacification of the target coronary artery (i.e., Thrombolysis In Myocardial Infarction flow grade 0). Of the 440 participants who underwent 1-year follow-up angiography, included in our study were only 388 patients for whom coronary angiograms were still available for review at the time of our study.

Study endpoints. The primary endpoint of our study was the occurrence of a new complete native coronary artery occlusion at 1 year post-surgery. In the present study, we focused only on the 3 main coronary vessels (i.e., LAD, LCX, and RCA). Therefore, diagonal branches, even if grafted, were excluded.

Perioperative management. The surgical technique used in this study was previously described (5). Patients were given 325 mg of aspirin daily within 6 h postoperatively and continued indefinitely. Oral nifedipine was initiated on the first postoperative day and continued to 6 months for prophylaxis against radial artery spasm.

Follow-up angiography. Patients underwent follow-up coronary angiography 8 to 12 months after surgery. The protocol required injection of each study graft with at least 2 orthogonal views. Analysis of baseline angiograms were conducted at enrollment to the RAPS by the local study investigators. The 1-year angiograms were reviewed by 2 interventional cardiologists who were blinded to the baseline interpretation. Coronary arteries were determined to be occluded if no contrast dye injected into it opacified the distal vessel (i.e., Thrombolysis In Myocardial Infarction flow grade 0).

Ethical considerations. Institutional research ethics board approval was obtained for this study. All patients provided informed consent.

Statistical analysis. The primary objective was to determine the patency of native coronary arteries at 8 to 12 months after CABG and to identify clinical and angiographic predictors of CTO. Student's *t* test was used to compare continuous variables with creatinine normalized by a log transformation. A chi-square, Fisher exact, or a Mann-Whitney *U* test was used where appropriate to compare categorical variables between patients with and without new