Fate of Grafts Bypassing Nonischemic Versus Ischemic Inducing Coronary Stenosis

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There is a lack of evidence regarding the efficacy of ischemia-guided coronary artery bypass grafting. We compared the incidence of graft failure between grafts bypassing ischemia-inducing and nonischemia-inducing stenoses. Between 1997 and 2011, 2,304 patients for whom baseline coronary angiography and myocardial perfusion imaging were available were identified from a single-center coronary artery bypass grafting registry. According to baseline myocardial perfusion imaging, each graft was assigned to either graft bypassing ischemia-inducing or nonischemia-inducing stenoses (ischemia-related grafts, n = 4,904; ischemia-unrelated grafts, n = 2,709). Graft failure was defined as total occlusion on coronary computed tomography angiography, performed at the discretion of the treating physician. The incidence of graft failure was compared on a per-graft basis. At 5 years, the incidence of graft failure was significantly higher in the ischemia-unrelated grafts (4.2% vs 2.9% in ischemia-related grafts; p = 0.003). Ischemia-related graft was an independent determinant of graft patency (adjusted hazard ratio 0.61; 95% confidence interval 0.44 to 0.84; p = 0.002). Increased risk of graft failure associated with ischemia-unrelated graft was observed only in the internal thoracic artery (3.3% vs 2.0%, p = 0.021) and arterial grafts (6.5% vs 4.3%, p = 0.020), but not in the venous grafts (2.7% vs 2.7%; p = 0.99). In terms of major adverse cardiac and cerebrovascular events, 5-year incidences were comparable between the patients with and without ischemia-unrelated grafts (219, 19.3% vs 160, 18.0%; p = 0.61). In conclusion, ischemia-unrelated grafts became dysfunctional more frequently than ischemia-related grafts, and were not preventive of adverse events. **(Am J Cardiol 2018;122:1148–1154)**

Clinical outcomes of ischemia-guided percutaneous coronary intervention have been shown to be superior than those of angiography-guided percutaneous coronary intervention.[1] However, for coronary artery bypass grafting (CABG), target coronary arteries are largely selected on the basis of anatomical severity of stenoses because of the lack of evidence regarding ischemia-guided CABG. Bypassing nonischemia-inducing coronary stenosis potentially causes competitive flow (CF) from native coronary arteries, which renders the hemodynamic environment in the graft prone to failure.[2,3] However, studies that have reported a higher incidence of graft failure in the presence of CF have employed the anatomic severity of proximal stenotic lesions as a surrogate marker for CF.[4,5] In this setting, the aim of the present study was to compare the incidence of graft failure between the grafts bypassing nonischemic versus ischemic inducing coronary stenosis.

Methods

To achieve the aim, we identified the patients from a prospective single-center CABG registry who underwent

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myocardial perfusion image (MPI) within 1 year preoperatively. The incidence of graft failure was evaluated by follow-up coronary computed tomography angiography (CCTA), and compared between the grafts bypassing MPI-defined ischemia-inducing and nonischemia-inducing stenoses.

All patients who underwent cardiac surgery are prospectively registered in the database of Asan medical center, which includes data on baseline patient characteristics, detailed information on surgery, and perioperative outcomes. From the database, 4,951 adult patients, who underwent CABG between November 1997 and November 2011, were identified.

This study was approved by the institutional Ethics Committee/Review Board at the Asan medical center, Seoul, Korea. The board waived the requirement for informed patient consent because of the retrospective nature of the study

The surgical procedures are detailed elsewhere.[6] Briefly, the left internal thoracic artery (ITA) was used to bypass the left anterior descending artery (LAD) whenever possible. Choices of conduits and their configurations for other coronary territories were determined on the basis of conduit availability, number of distal targets, the target territory (right coronary [RCA] vs left circumflex artery [LCX] territories), and the surgeon's preference.

Statins and aspirin were routinely prescribed to all patients starting from postoperative day 1 or 2 and were continued, if not contraindicated, throughout the 6-month-interval outpatient clinic visits. The dose of statins was adjusted for a target low-density lipoprotein level of <100 mg/dl.

Single-photon-emission computed tomography using Thallium-201 as a perfusion tracer was the default stress MPI during the study period. Images were acquired using a standardized protocol.[7] Stress and redistribution MPI were semiquantitatively scored using a 17-segment model of the left ventricle, and a 5-point scale as described previously.[8] Global summed stress score, summed rest score, and summed difference score were calculated. Perfusion defects were assigned to coronary territories using the American Heart Association myocardial segment model (Figure 1).[7] MPI result was considered reversible when summed difference score was ≥ 2 or fixed when summed difference score was <2, and allocated to the perfusion territory of the coronary artery of interest. Reversibility of perfusion defects was determined by experienced nuclear medicine physicians at the time of MPI. The grafts bypassing the coronary stenoses, which induced reversible perfusion defects on MPI, were defined as the ischemia-related grafts. Those bypassing the coronary stenoses related to normal perfusion or fixed perfusion defect were classified as ischemia-unrelated grafts.

The findings of coronary angiograms were collected from the catheterization reports.

The incidence of graft failure was also compared between the grafts bypassing angiographically significant stenoses and those bypassing insignificant stenoses. Angiographic significance was determined by the visually estimated diameter stenosis of the proximal native coronary lesion, and the grafts were dichotomously categorized according to the 3 reference points (diameter stenosis 50%, 70%, and 100%).

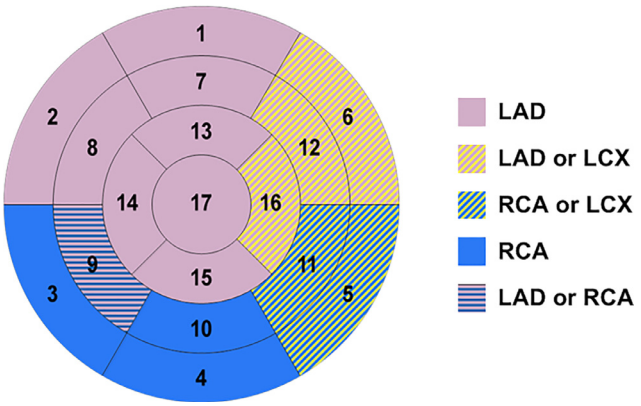

Figure 1. 17 Myocardial segments and their assignment to coronary arteries.
LAD = left anterior descending coronary artery; LCX = left circumflex coronary artery; RCA = right coronary artery.

Follow-up CCTAs were performed at the discretion of the attending physician, using a 16-slice computed tomography, or first- or second-generation dual-source computed tomography scanner (SOMATOM Sensation 16 or SOMATOM Definition or Definition Flash, Siemens Medical System, Forcheim, Germany). The detailed protocol for CCTA performance has been described elsewhere.[9] The computed tomography images of best cardiac phase with the least motion artifact were transferred to a dedicated workstation (Syngo VIA, Siemens Medical Solutions, Forchheim, Germany) for analysis. Curved or multiplanar reformations and maximal intensity projection were applied for graft failure evaluation. The CCTA images were independently reviewed by 1 experienced radiologist.

Total occlusion involving a graft on CCTA image was defined as graft failure. The primary outcome of interest was the per-graft incidence of graft failure estimated in the overall grafts. In circumstances where not all of the patients underwent follow-up CCTA, to calculate graft failure rate for the overall grafts, we assumed that graft failure did not occurred in the patients without follow-up CCTA, risking under-report of asymptomatic graft failure. Therefore, as a sensitivity analysis, graft failure rates were also compared in the grafts with follow-up CCTA.

Data on clinical outcomes were obtained at patients' clinic visit, and through telephone interviews. The definitions of clinical outcomes were detailed in the supplemental appendix.

Results of descriptive analysis are presented as mean $\pm$ standard deviation or as frequencies (proportion). Continuous variables were compared using t test or Wilcoxon rank sum test; categorical variables were compared using chi-square statistics or Fisher's exact test, as appropriate. Time-to-event data, such as graft failure, were censored at a fixed time of 5 years. The number of events and their cumulative incidence are presented as frequency (percentage), with the latter estimated using the Kaplan−Meier method and compared between the 2 groups using the log-rank test. To estimate hazard ratio (HR) and 95% confidence interval (CI) for per-graft analyses, the proportional hazards mixed effect