Bilateral internal thoracic artery grafting: Does graft configuration affect outcome?

J. Trent Magruder, MD, Allen Young, BA, Joshua C. Grimm, MD, John V. Conte, MD, Ashish S. Shah, MD, Kaushik Mandal, MD, Christopher M. Sciortino, MD, PhD, Kenton J. Zehr, MD, Duke E. Cameron, MD, and Joel Price, MD, MPH

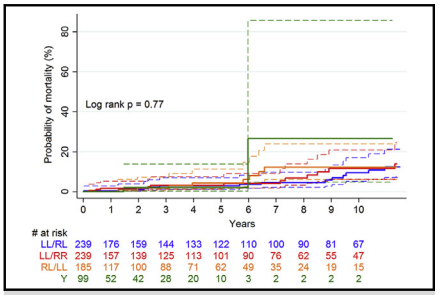
ABSTRACT

Background: Despite evidence that bilateral internal thoracic arteries (ITAs) improve long-term survival after coronary artery bypass grafting (CABG), uptake of this technique remains low. We directly compared bilateral ITA graft configurations and examined long-term outcomes.

Methods: We reviewed 762 patients who underwent CABG using bilateral ITA grafts at our institution between 1997 and 2014. The outcomes were mortality and a composite revascularization end point defined as need for percutaneous coronary intervention or repeat CABG. Adjusted subgroup analyses were performed using propensity score-adjusted Cox proportional hazards modeling.

Results: The cohort was divided into 4 groups: in situ (left ITA [LITA] anastomosed to the left anterior descending artery [LAD] with in situ right ITA [RITA] anastomosed to the left coronary circulation [239 patients]); in situ LITA-LAD and in situ RITA-right coronary circulation (239 patients); in situ RITA-LAD with in situ LITA-left coronary circulation (185 patients); and in situ LITA-LAD with a free RITA as a composite graft with inflow from the LITA or a saphenous vein graft (99 patients). Over a median follow-up of 1128 days, there were 47 deaths, 58 late percutaneous coronary interventions, and 7 repeat CABG procedures. Unadjusted Kaplan-Meier analysis revealed a difference in need for repeat revascularization among the 4 groups (log rank $P = .049$). However, after statistical adjustment, graft configuration was not an independent predictor of repeat revascularization or death.

Conclusions: Bilateral ITA graft configuration has no independent effect on need for repeat revascularization or long-term survival. Therefore, the simplest technique, determined by individual patient characteristics, should be selected. (J Thorac Cardiovasc Surg 2016;152:120-7)



Unadjusted time-to-event curves showing risk of repeat revascularization and/or mortality in patients with a left internal thoracic artery–left anterior descending artery versus right internal thoracic artery–left anterior descending artery anastomosis.

Central Message

There is no advantage to any particular configuration of bilateral internal thoracic artery graft in terms of mortality or the need for repeat revascularization.

Perspective

Despite evidence that bilateral internal thoracic arteries improve long-term survival after coronary artery bypass grafting, uptake of this technique remains low. We analyzed 4 different graft configurations with respect to outcomes. We found no adjusted differences in the need for repeat revascularization or death among the configurations.

See Editorial Commentary page 128.

Evidence continues to accumulate that the use of bilateral internal thoracic arteries (BITA) in coronary artery bypass grafting (CABG) positively affects long-term survival. It has been very well established that anastomosing the left internal thoracic artery (LITA) to the left anterior descending artery (LAD) improves graft patency and overall survival.[1-3] Several authors have documented improved long-term survival with BITA as opposed to single internal thoracic artery (ITA) use in large cohorts undergoing CABG.[4-6] A number of other groups have found that BITA use improves survival in specific subgroups.[7-12] Other authors contend

From the Division of Cardiac Surgery, Johns Hopkins University School of Medicine, Baltimore, Md.

Received for publication Sept 25, 2015; revisions received Feb 8, 2016; accepted for publication March 1, 2016.

Address for reprints: Joel Price, MD, MPH, Division of Cardiac Surgery, Johns Hopkins University School of Medicine, 1800 Orleans St, Zayed 7107, Baltimore, MD 21287 (E-mail: jprice@jhmi.edu).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2016.03.022

Scanning this QR code will take you to the article title page.

Abbreviations and Acronyms

BITA = bilateral internal thoracic artery/arteries
CABG = coronary artery bypass grafting
ITA = internal thoracic artery
LAD = left anterior descending artery
LITA = left internal thoracic artery
LL/RL = in situ left LITA anastomosed to the LAD with in situ RITA anastomosed to the left coronary circulation
LL/RR = in situ LITA-LAD and in situ RITA anastomosed to the right coronary circulation
NYHA = New York Heart Association
PCI = percutaneous coronary intervention
RITA = right internal thoracic artery
RL/LL = in situ RITA-LAD with in situ LITA anastomosed to the left coronary circulation
Y = in situ LITA-LAD with a free RITA as a composite graft with inflow from the LITA or a saphenous vein graft

that the survival advantage of BITA use appears only over decades and exclusively in younger patients.[6,13]

Despite the evidence of benefit, BITA use in the United States remains relatively low. A contemporary survey of American cardiac surgeons reported BITA use in 4% of CABG procedures.[14] Slightly higher uptake of 12% has been reported in Europe.[15] There are a number of possible explanations for the modest uptake of this technique. Some note discrepant data suggesting BITA use is not associated with an overall survival advantage in many patients.[16-19] Another key concern is that BITA use may increase the incidence of sternal surgical site infections, particularly in subgroups that include diabetic patients, obese patients, and those with chronic obstructive pulomonary disease.[18,20,21] Finally, the harvesting and use of BITA increases the time and technical complexity of the operation and increases the potential for bleeding.

Given the paucity of comparative data on long-term outcomes of various BITA configurations, we sought to study differences in mortality and the need for repeat revascularization among patients receiving varying BITA graft configurations at our institution. Our hypothesis was that graft configuration does not affect these outcomes.

METHODS

Patient Population and Operative Details

Of 14,502 isolated CABG operations performed at our institution between 1997 and 2014, we performed a review of 822 patients who had CABG using bilateral ITA grafts (BITA use rate, 5.7%). Of these, 606 (73.7%) underwent LITA to LAD anastomoses (LITA-LAD), whereas 203 (24.7%) underwent right internal thoracic artery (RITA)-LAD anastomoses (RITA-LAD); the remainder had incomplete operative records. BITA patients were divided into 4 groups based on graft configuration: patients who had in situ LITA-LAD and in situ RITA anastomosed to the left coronary circulation (group LL/RL, n = 239; 31.4%); patients who had in situ LITA-LAD and in situ RITA anastomosed to the right coronary circulation (group LL/RR, n = 239; 31.4%); patients who had in situ RITA-LAD and in situ LITA anastomosed to the left coronary circulation (group RL/LL, n = 185; 24.3%); and patients who had in situ LITA-LAD and the RITA harvested as a free graft and anastomosed proximally as a composite graft from the LITA or a saphenous vein graft, and anastomosed distally to any part of the coronary circulation (group composite [Y], n = 99; 12.9%). A total of 762 patients were included in our study. Patients with unclear or missing operative records were excluded (60 patients; 7.3%).

Multiple surgeons were included in this series and conduit selection and configuration was always determined by the operating surgeon. In general, we have avoided BITA harvesting in patients who are obese, have diabetes, and/or have a history of pulmonary disease. Generally, BITA procedure was employed in younger, healthier patients with good life expectancy and at low risk of sternal complications. Our standard strategy was to direct ITAs to diseased coronary arteries serving the largest portions of myocardium. Techniques varied between surgeons but all CABG procedures were performed on cardiopulmonary bypass using cardioplegic arrest. The LITA was always harvested as a pedicled graft. In more recent years (predominantly since 2007), a significant proportion of RITA grafts have been harvested as skeletonized conduits (205 of 617 total RITA grafts; 33.2%).

Study Design

After obtaining appropriate institutional review board approval, we retrospectively examined patient charts to determine patient characteristics and demographic characteristics, operative details, and postoperative outcomes. Preoperative variables analyzed included age, gender, hypertension, hyperlipidemia, diabetes, ejection fraction, New York Heart Association (NYHA) class, preoperative atrial fibrillation, history of tobacco use, presence of chronic lung disease, presence of peripheral vascular disease, prior cerebrovascular accident, reoperative surgery, and operative status (elective vs urgent vs emergent). Operative variables analyzed included crossclamp and bypass times as well as the need for intraoperative blood products. Analyzed outcomes were mortality, obtained from medical records and confirmed by review of the Social Security Death Index and/or online obituary databases (in which case a mortality was only counted upon matching a patient's full name, date of birth, and hometown), and a composite revascularization end point defined as the need for repeat CABG or percutaneous coronary intervention (PCI) after the index CABG operation. We also examined the combined need for repeat CABG or PCI, or death, whichever occurred first.

Secondary outcomes included perioperative myocardial infarction, perioperative cerebrovascular accident, mediastinitis, and reoperation for bleeding. Mediastinitis was defined according to the Society of Thoracic Surgeons definition, which requires evidence of mediastinitis observed during a procedure or histopathologically positive mediastinal cultures, or fever, chest pain, or sternal instability; and the patient must have either purulent discharge, positive blood cultures, or mediastinal widening on imaging.

Statistical Analysis

Statistical analyses were performed using Stata 12 (StataCorp, College Station, Tex). Demographic data are presented as frequencies and percentages. Categorical univariable comparisons were performed using Fisher exact or χ^2 tests. Continuous variables were compared using analysis of variance with a Bonferroni correction. Unadjusted survival and time to repeat revascularization were analyzed using Kaplan-Meier methodology and log rank tests.