Bilateral Internal Mammary Artery Use in Diabetic Patients: Friend or Foe?

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Background. **Bilateral internal mammary artery (BIMA) grafting in diabetic patients undergoing coronary artery bypass grafting remains controversial. Our study compared morbidity and mortality between (1) diabetic and nondiabetic BIMA patients and (2) diabetic BIMA versus diabetic patients who underwent left internal mammary artery (LIMA) grafting only.**

Methods. **Patients who underwent isolated coronary artery bypass grafting from July 2011 to June 2016 at any of the 10 Maryland Cardiac Surgery Quality Initiative centers were propensity scored across 16 variables. Diabetic BIMA patients were matched 1:1 by nearest neighbor matching to nondiabetic BIMA patients and were separately matched 1:1 to diabetic LIMA patients. We calculated observed-to-expected (O/E) ratios for composite morbidity/mortality, operative mortality, unplanned reoperation, stroke, renal failure, prolonged ventilation, and deep sternal wound infection and compared ratios among matched populations.**

Results. **During the study period, 812 coronary artery bypass grafting patients received BIMA grafts, including 302 patients (37%) with diabetes. We matched 259 diabetic and nondiabetic BIMA patients. O/E ratios were higher in matched diabetic (versus nondiabetic) BIMA patients when comparing composite morbidity/mortality, reoperation, stroke, renal failure, and prolonged ventilation (all O/E ratios >1.0); however, the O/E ratio for operative mortality was higher in nondiabetic BIMA patients. We additionally matched 292 diabetic BIMA to diabetic LIMA patients. Diabetic BIMA patients had a higher O/E ratio for composite morbidity/mortality, operative mortality, stroke, renal failure, and prolonged ventilation.**

Conclusions. **In this statewide analysis, diabetic patients who received BIMA grafts (compared with diabetic patients with LIMA grafts or nondiabetic patients with BIMA grafts) had higher O/E ratios for composite morbidity/mortality as a result of higher O/E ratios for major complications.**

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Coronary artery bypass grafting (CABG) is superior to percutaneous coronary intervention for 3-vessel coronary artery disease (CAD) or disease of the left main coronary artery, with a significantly lower rate of major adverse cardiac or cerebrovascular events after CABG [1–3]. This remains true even in diabetic patients, where a significantly lower rate of combined death, stroke, or myocardial infarction is seen at 5 years [4], and a significantly lower rate of major adverse cardiac or cerebrovascular events and need for repeat revascularization has been observed in diabetic patients treated with CABG rather than percutaneous coronary intervention [5].

Use of the left internal mammary artery (LIMA) during CABG increased exponentially after Loop and colleagues [6] demonstrated superior survival at 10 years among patients who received an internal mammary artery graft

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versus saphenous vein grafting alone. In fact, use of the LIMA has been deemed a class I recommendation by The Society of Thoracic Surgeons in patients with disease of the left anterior descending coronary artery [7].

More recently, bilateral internal mammary artery (BIMA) grafting has received considerable attention, as several observational studies have suggested improved survival and freedom from repeat CABG in patients receiving 2 mammary grafts rather than 1 [8, 9]. Although the 5-year results of the first randomized controlled trial of BIMA compared with single internal mammary artery grafting failed to demonstrate a survival difference between groups [10], the preponderance of evidence suggests BIMA grafting will continue to receive advocacy.

Critics of BIMA grafting share concerns over increased sternal wound complications that may be linked to sternal devascularization during BIMA harvesting [11, 12]. Diabetes has historically served as a relative contraindication to BIMA grafting due to an increased incidence of deep sternal wound infections [13, 14]. However, accumulating evidence suggests BIMA grafting may be safely undertaken in diabetic patients and may be associated with improved long-term survival [15].

The purpose of this study was to compare operative mortality and major postoperative morbidity among diabetic patients receiving BIMA versus LIMA grafts within a statewide collaborative database.

Patients and Methods

The Maryland Cardiac Surgery Quality Initiative

The Maryland Cardiac Surgery Quality Initiative (MCSQI) was founded in 2013 as a nonprofit consortium of 10 cardiac surgery programs across the state of Maryland. Deidentified Society of Thoracic Surgeons (STS) databases are shared among the 10 programs and maintained by an appointed information officer. This composite database has been used to assess statewide outcomes. Quality-improvement proposals are reviewed by the MCSQI Research and Writing Committee and MCSQI Board of Directors, who ultimately granted permission to pursue this study. The MCSQI data set does not include patient-identifying information and thus meets the definition of a "limited data set" of the Health Insurance Portability and Accountability Act Privacy Rule, which provides exemption from Institutional Review Board approval when used for quality-improvement research.

Study Population

The study included adult cardiac surgery patients who underwent isolated CABG from July 2011 to June 2016 at any of the 10 centers in the MCSQI. All patients who received BIMA grafts, with or without a saphenous vein graft(s), during the study period were first identified and divided into those with and without diabetes mellitus. Separately, all patients with diabetes mellitus were captured and divided into those who received BIMA grafts versus a LIMA graft, with or without saphenous vein graft(s).

Personal identifiers were removed from the data set. E ach of the 10 unique cardiac surgery centers included in the MCSQI were randomly assigned a number to differentiate institutions.

Outcomes

Observed-to-expected (O/E) ratios are one of the Agency for Healthcare Research and Quality's Quality Indicators. O/E ratios are calculated by summing the total number of events that occurred and dividing this numerator by the sum of events expected to occur. Our primary outcomes were the O/E ratios for operative mortality and five major morbidities: unplanned reoperation, stroke, renal failure, prolonged ventilation, deep sternal wound infection, along with composite morbidity/mortality. These complications are well-defined by the STS. O/E ratios for each major morbidity and mortality are used as indicators of quality in comparing institutions that perform CABG. O/E ratios were calculated and compared in two separate but similar study populations. First, O/E ratios were compared among BIMA patients with and without diabetes. Next, O/E ratios were compared among diabetic patients who received BIMA versus LIMA grafts.

Statistical Analysis

Propensity score matching was used to estimate causal effects within the observational data. To account for treatment effect, patients were propensity scored across 16 STS variables: age, sex, body mass index, history of hypertension, history of peripheral vascular disease, preexisting lung disease, previous myocardial infarction, congestive heart failure, baseline glomerular filtration rate, left ventricular ejection fraction, urgent/emergent operative status, number of diseased vessels, preoperative antiplatelet therapy, cardiopulmonary bypass time, aortic cross-clamp time, and need for intraaortic balloon pump support. Patients with missing data pertaining to any of these variables were not propensity scored and thus not included in the matched analysis.

Diabetic BIMA patients were matched to nondiabetic BIMA patients 1:1, without replacement by nearest neighbor matching, with a caliper of 0.1. Separately, diabetic BIMA patients were matched 1:1 to diabetic LIMA patients with a caliper of 0.1. Balance among covariates included in the propensity score was assessed by absolute standardized difference of means. O/E ratios for each of the outcomes were compared among propensity score–matched groups.

Descriptive statistics for continuous variables are reported as mean ± SD for parametric data or median and interquartile range (IQR) for nonparametric data and were compared using the Student *t* test or Wilcoxon rank sum test, respectively. Categoric data are reported as number (%) and were compared using χ^2 testing. Significance was defined by a p value of less than 0.05. STATA 12.0 software (StataCorp, College Station, TX) was used for the statistical analysis.