Does a third arterial conduit to the right coronary circulation improve survival?

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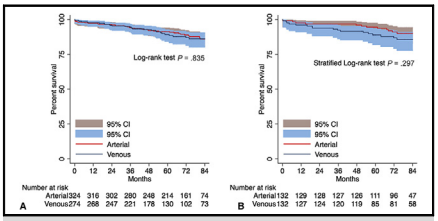
ABSTRACT

Background: The long-term benefits of a third arterial conduit to the right circulation in triple-vessel disease remain debatable. This retrospective, single-center, propensity-matched study investigates the impact of a third arterial conduit to the right circulation on early and intermediate survival after coronary artery bypass grafting.

Methods: Data were retrospectively collected from 2004 to 2014 for all surgical revascularizations for triple-vessel disease with at least 2 arterial conduits to the left circulation and a third arterial or venous conduit to the right circulation. A total of 167 pairs were propensity matched to arterial versus venous third conduit to right circulation. Hazard functions were obtained with Cox multivariate regression and Kaplan-Meier survival curves were compared between the matched cohorts.

Results: Extracardiac arteriopathy, logistic euroSCORE, and left main stem disease were significant predictors of adverse survival. A third arterial conduit to the right circulation was not a significant predictor of improved survival in multivariate analysis (HR, 0.72; 95% CI, 0.34-1.55; $P = .411$). 30-day mortality was 0.6% in both groups. There was no significant difference in early or intermediate survival in the propensity-matched groups (venous vs arterial, 99.2% vs 99.2%; $P = 1.000$ at 1 year; 85.2% vs 88.8%; $P = .248$ at 5 years and 69.2% vs 88.8%; $P = .297$ at 7 years)

Conclusions: The use of a third arterial versus a venous conduit to the right circulation does not improve early or intermediate survival up to 7 years in triple-vessel coronary artery disease in this study. Longer follow-up and larger cohorts may be needed for differences to emerge. (J Thorac Cardiovasc Surg 2017;■:1-6)



Overall survival by addition of a third arterial or venous conduit to the right coronary circulation.

Central Message

The use of a third arterial versus a venous conduit to the right circulation does not improve early or intermediate survival up to 7 years in triple-vessel coronary artery disease.

Perspective

The use of an arterial conduit has traditionally been associated with better patency rates and better clinical outcomes during revascularization of left coronary territories; however, the clinical usefulness to the right circulation remains debatable. In this study, we compare early and intermediate survival by the type of conduit to the right circulation during triple-vessel disease revascularization.

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Arterial conduits have better patency rates and have been associated with a survival benefit in surgical revascularization. The choice of additional conduit to the right coronary circulation has been a radial artery (RA), right internal thoracic artery (ITA) or rarely a right gastroepiploic artery. Patency rates for right-sided grafts have generally been lower than those for left-sided grafts both for arterial and for venous grafts.[1,2] There has been a call for additional arterial grafts to improve survival.[3,4] Additional arterial grafting has not been shown to provide survival benefits from revascularization of the right coronary territory.

The aim of this study was to assess the early and intermediate survival benefit of a third arterial graft to the right coronary circulation as opposed to venous grafts.

METHODS

Data for isolated coronary artery bypass grafting (CABG) were retrospectively collected from 2004 to 2014 from the New Cross Hospital database (PATS [Dentrite Clinical Systems Ltd, Henley-on-Thames,

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Abbreviations and Acronyms

CABG = Coronary artery bypass grafting
CI = Confidence interval
HR = Hazard ratio
ITA = Internal thoracic artery
LAD = Left anterior descending artery
LVEF = Left ventricular ejection fraction
MI = Myocardial infarction
RA = Radial artery
RIMA = Right internal mammary artery
SVG = Saphenous vein graft

United Kingdom]). We included all patients with triple-vessel disease with arterial grafts to left anterior descending artery (LAD) and circumflex circulation and a third venous or arterial graft (ITA or RA) to the right coronary circulation (right coronary artery or posterior descending or posterior ventricular artery) (Figure 1). Patients with a venous graft to the circumflex system, single-vessel/double-vessel disease and those with other concomitant procedures were excluded. The use of radial arteries to the right or left circulation was restricted to vessels with severe lesions. The hospital database is reviewed, audited, and validated monthly by audit officers and linked to a national UK database. Consent for individual use of data was waived because of the nature of the study and previous approval for use of such data at the time of operative consent. Long-term survival statistics were collected from the NICOR (National Institute of Cardiac Outcomes Research, United Kingdom) database (release June 2015).

Data Analysis

Baseline demographic characteristics for CABG were stratified for arterial versus venous third conduit to the right coronary circulation after at least 2 other arterial grafts to the left circulation. Distributions from each variable were visually inspected and normality was tested by a Shapiro-Wilcoxon *W* test. Continuous variables were compared using a Mann-Whitney test and categorical variables by χ^2 test. $P \leq .05$ was considered significant.

Propensity Score Matching

Propensity matching was used to balance the covariates in the nonrandomized, observational data. The following covariates were included in the propensity match: age, logistic euroSCORE (European System for Cardiac Operative Risk Evaluation), body mass index, gender, hypercholesterolemia, pulmonary disease, neurologic disease, renal disease, hypertension, left main stem disease, diabetes, left ventricular ejection fraction (LVEF), New York Heart Association classification, previous percutaneous coronary intervention, and previous myocardial infarction. The definitions used for these risk factors were as previously described for calculation of euroSCORE by Roques et al.[5,6]

The propensity score for use of a third arterial conduit to the right coronary circulation was estimated by logistic regression. Variables included in the propensity match model were chosen by clinical relevance and included in the model by an iterative process until almost all variables were successfully balanced. The treated observations were posteriorly matched in a 1:1 ratio using the nearest-neighbor method with a caliper width of 0.2 of the standard deviation of the propensity score logit. Means, standard deviations, and proportions of baseline demographic characteristics were compared to ensure appropriate balance among groups and statistical significance was tested by comparing standardized bias among each of the variables; those with a standardized bias within ± 10% were considered appropriately balanced (Figure 2). Despite

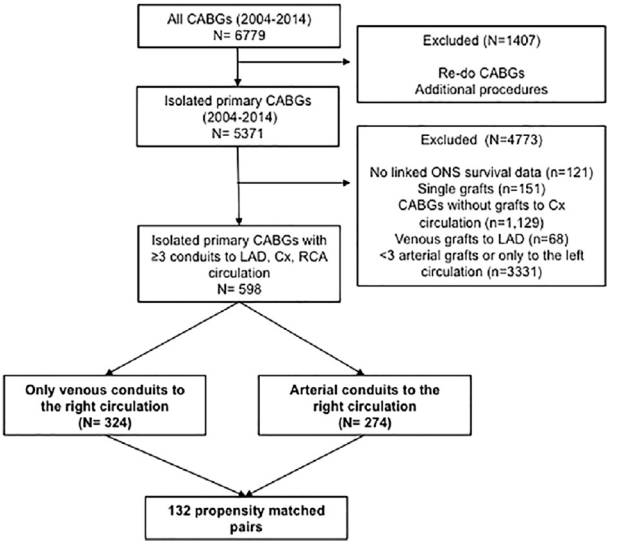

FIGURE 1. Data flowchart for patients included in the study. *CABG*, Coronary artery bypass grafting; *ONS*, Office for National Statistics; *Cx*, circumflex; *LAD*, left anterior descending artery; *RCA*, right coronary artery.

sequential modeling, extracardiac arteriopathy and LVEF <30% remained unbalanced so these variables were incorporated in the multivariable analysis as described in the next section.

Hazard Functions and Survival Analysis

Kaplan-Meier survival curves were plotted for the matched and unmatched data and the equality of survivor functions was tested using a log-rank test. To analyze the association between risk factors and survival among the propensity-matched cohorts, each covariate was tested for prediction using a Cox proportional hazards model or a log-rank test, respectively. All covariates with a $P \leq .2$ as well as those unbalanced were included in the multivariate model, and the proportional hazard assumption was tested using Schoenfeld residuals. Hazard ratios (HRs) were calculated for each variable. Overall survival was compared using a log-rank test; this test was stratified by the pair identification in the propensity-matched cohort.

RESULTS

A total of 598 patients with triple-vessel disease were included in the study (274 venous; 324 arterial). All patients had an ITA to the LAD and at least 1 arterial graft (RA or ITA) to the circumflex circulation. Median follow-up was 85 (interquartile range, 68-105) months versus 51 (interquartile range, 35.5-87) months ($P = .024$) for venous and arterial grafts, respectively. The baseline demographics and operative characteristics are shown in Table 1.

A total of 167 pairs were propensity matched to the venous or arterial (third conduit) to right coronary circulation. Most of the arterial grafts to the right circulation were RAs (Tables E1 and E2). Of those patients who had bilateral internal mammary arteries to the left circulation, 60 had single radial conduits to the right circulation. Cox proportional hazards regression analysis in the propensity-matched cohorts identified extracardiac arteriopathy, logistic euroSCORE,