

Is the right internal thoracic artery superior to saphenous vein for grafting the right coronary artery? A propensity score–based analysis



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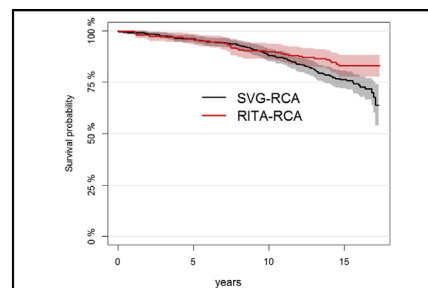
ABSTRACT

Objectives: Although the use of the right internal thoracic artery (RITA) as second arterial conduit to graft the left coronary system consistently has been shown to provide a survival benefit compared with the saphenous vein graft (SVG), the choice of conduit for the right coronary artery (RCA) system remains controversial. We compared long-term (>15 years) survival in patients who underwent RITA-RCA versus SVG-RCA grafting at a single institution.

Methods: The study population consisted of 7223 patients undergoing coronary artery bypass graft surgery. Of them 245 (3.4%) and 6978 (96.6%) received RITA-RCA and SVG-RCA graft, respectively. Propensity score matching and time-segmented Cox regression were used to compare the 2 groups.

Results: Survival probability at 5, 10, and 15 years were 95.9% (95% confidence interval [CI], 93.4–98.4) versus 96.0% (95% CI, 94.3–97.8), 89.8% (95% CI, 85.9–93.7) versus 88.0% (95% CI, 85.0–91.0) and 82.9% (95% CI, 77.6–88.2) in the RITA-RCA and SVG-RCA group, respectively. Time-segmented Cox regression showed that during the first 9 years, the 2 strategies were associated with comparable risk of death (hazard ratio, 1.13; 95% confidence interval, 0.67–1.90; $P = .65$) but beyond 9 years, the RITA-RCA was associated with a significantly lower risk of death (hazard ratio, 0.43; 95% confidence interval, 0.22–0.84; $P = .01$).

Conclusions: Revascularization of the RCA system with the RITA was associated with superior late survival compared with SVG. This supports the view that, the use of RITA to graft the RCA should be encouraged, especially in patients with long life expectancy. (*J Thorac Cardiovasc Surg* 2017;154:1269–75)



Survival in the propensity score matched sample according to use of the RITA and SVG for revascularization of the RCA.

Central Message

In a low-risk population, revascularization of the right coronary artery system with the right internal thoracic artery was associated with superior late survival compared with saphenous vein grafting.

Perspective

The choice of conduit for the right coronary artery (RCA) system remains a controversial issue. The present long-term propensity score–based analysis showed that revascularization of the RCA system with the right internal thoracic artery (RITA) is associated with superior late survival when compared with saphenous vein grafting in a low-risk population. However, the beneficial impact on survival from the use of the RITA was delayed by as much as 9 to 10 years. This supports the view that the use of RITA to graft the RCA should be encouraged, especially in patients with long life expectancy.

See Editorial Commentary page 1276.

The choice of conduit for coronary artery bypass graft (CABG) is debated widely by cardiac surgeons.¹ Although the use of the right internal thoracic artery (RITA) in

addition to the left internal thoracic artery (LITA) to graft the left coronary system consistently has been shown to provide a survival benefit compared with saphenous vein graft

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Abbreviations and Acronyms

CABG	= coronary artery bypass graft
CI	= confidence interval
HR	= hazard ratio
LAD	= left anterior descending
LITA	= left internal thoracic artery
PS	= propensity score
RCA	= right coronary artery
RITA	= right internal thoracic artery
SVG	= saphenous vein



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(SVG),² the choice of conduit for the right coronary artery (RCA) system remains a controversial issue. To date, the only randomized controlled trial designed to compare long-term survival after CABG with bilateral versus single internal thoracic artery grafting (ART trial) included only patients receiving the arterial conduit on the left coronary system.³ Observational studies that compared RITA-RCA versus SVG-RCA have shown conflicting results. Some reports have suggested that the RITA grafting improves long-term survival over LITA plus SVGs and propose that the RITA should be used to bypass the circumflex artery rather than the RCA.⁴ Others documented equivalent long-term results with the use of the RITA, whether applied to the left or RCA system.^{5,6}

Current comparisons between RITA versus SVG for grafting the RCA are limited by relatively short follow-up (~5 years).⁷ In the present study, we aimed to get further insights into the role of RITA graft for revascularization of the RCA by comparing long-term (>15 years) survival in patients who underwent RITA-RCA versus SVG-RCA strategy at a single institution. We also aimed to investigate whether different RITA-RCA configurations (free vs in situ grafts) were associated with similar survival rates.

PATIENTS AND METHODS

The study was conducted in accordance with the principles of the Declaration of Helsinki. The local audit committee approved the study, and the requirement for individual patient consent was waived. We retrospectively analyzed prospectively collected data from The National Institute for Cardiovascular Outcomes Research National Adult Cardiac Surgery Audit registry on June 1, 2015, for all isolated first-time CABG procedures performed at the Bristol Heart Institute (Bristol, United Kingdom) from 1996 to April 2015. Reproducible cleaning algorithms were applied to the database and regularly updated as required. To summarize, duplicate records and nonadult cardiac surgery entries were removed, transcriptional

discrepancies were harmonized, and clinical conflicts and extreme values were corrected or removed. The data were returned regularly to the local units for validation. Further details and definition of variables are available at <http://www.ucl.ac.uk/nicor/audits/adultcardiac/datasets>.

Among 15,119 isolated first-time CABG cases performed during the study period, we selected subjects who met the following criteria: multivessel coronary artery disease including left main and/or left anterior descending (LAD) coronary disease; requiring at least 2 grafts; CABG performed by using the following strategies: LITA used to graft the LAD territory and RITA graft the RCA with or without additional SVG (RITA-RCA group) or LITA to LAD graft with SVG to RCA with or without additional SVG for non-RCA target (SVG-RCA group). Exclusion criteria were (1) RITA graft to target other than RCA; (2) radial artery used; (3) LITA to target other than LAD; (4) RCA not grafted; right gastroepiploic artery used (Video 1). In the present series, the RITA and SVG were used to graft the RCA in case of target stenosis $\geq 75\%$.⁸ SVGs were used proximally connected to the ascending aorta in all cases. The internal thoracic artery was harvested as a pedicle in all cases. LITA was used as in situ graft that remained proximally connected to its respective subclavian artery and distally connected to the LAD. The RITA was used as both in situ graft or as a free graft proximally connected to ascending aorta.

Study Endpoints

All-cause mortality during follow-up was the primary endpoint. This is considered the most robust and unbiased index in cardiovascular research because no adjudication is required, thus avoiding inaccurate or biased documentation and clinical assessments.⁹ Information about postdischarge mortality tracking was available for all patients (100%) and was obtained by linking the institutional database with the National General Register Office. Other short-term outcomes analyzed were re-exploration for bleeding, need for sternal wound reconstruction, postoperative cerebrovascular accident (defined as any confirmed neurologic deficit of abrupt onset that did not resolve within 24 hours), postoperative renal-replacement therapy, need for postoperative intra-aortic balloon pump, and in-hospital mortality.

Pretreatment Variables

The effect of RITA-RCA versus SVG-RCA on outcomes of interest was adjusted for the following pretreatment variables: age, sex, body mass index; Canadian Cardiovascular Society functional class III-IV; New York Heart Association grade III or IV; previous myocardial infarction within 30 days; previous percutaneous coronary intervention; diabetes mellitus on oral treatment or on insulin; chronic obstructive pulmonary disease; current smoking; serum creatinine ≥ 200 mmol/L, previous cerebrovascular accident; peripheral vascular disease; preoperative atrial fibrillation; left ventricular ejection fraction between 30% and 49%; left ventricular ejection fraction less than 30%; nonelective admission, cardiogenic shock; preoperative intra-aortic balloon pump; left main disease; concomitant circumflex artery disease grafted; total number of grafts; and off-pump CABG and eras of surgery.

Statistical Analysis

For baseline characteristics, variables are summarized as means \pm standard deviation (SD) for continuous variables and frequencies and proportions for categorical variables. Multiple imputation was used to address missing data (<http://www.jstatsoft.org/v45/i07/>). To control for measured potential confounders in the data set, a propensity score (PS) was generated for each patient from a multivariable logistic regression model that was based on pretreatment covariates as independent variables with treatment type (RITA-RCA vs SVG-RCA) as a binary dependent variable (<https://cran.r-project.org/package=nonrandom>).¹⁰ The resulting PS represented the probability of a patient having RITA to RCA graft. PS model discrimination power and fit were tested with the c-statistic and the Hosmer-Lemeshow goodness-of-fit (<https://CRAN.R-project.org/package=ResourceSelection>). Pairs of patients undergoing RITA-RCA

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