Circulation

ORIGINAL RESEARCH ARTICLE

Long-Term Results of the RAPCO Trials

Editorial, see p 1339

BACKGROUND: An internal thoracic artery graft to the left anterior descending artery is standard in coronary bypass surgery, but controversy exists on the best second conduit. The RAPCO trials (Radial Artery Patency and Clinical Outcomes) were designed to compare the long-term patency of the radial artery (RA) with that of the right internal thoracic artery (RITA) and the saphenous vein (SV).

METHODS: In RAPCO-RITA (the RITA versus RA arm of the RAPCO trial), 394 patients <70 years of age (or <60 years of age if they had diabetes mellitus) were randomized to receive RA or free RITA graft on the second most important coronary target. In RAPCO-SV (the SV versus RA arm of the RAPCO trial), 225 patients ≥70 years of age (or ≥60 years of age if they had diabetes mellitus) were randomized to receive RA or SV graft. The primary outcome was 10-year graft failure. Long-term mortality was a nonpowered coprimary end point. The main analysis was by intention to treat.

RESULTS: In the RA versus RITA comparison, the estimated 10-year patency was 89% for RA versus 80% for free RITA (hazard ratio for graft failure, 0.45 [95% CI, 0.23–0.88]). Ten-year patient survival estimate was 90.9% in the RA arm versus 83.7% in the RITA arm (hazard ratio for mortality, 0.53 [95% CI, 0.30–0.95]). In the RA versus SV comparison, the estimated 10-year patency was 85% for the RA versus 71% for the SV (hazard ratio for graft failure, 0.40 [95% CI, 0.15–1.00]), and 10-year patient survival estimate was 72.6% for the RA group versus 65.2% for the SV group (hazard ratio for mortality, 0.76 [95% CI, 0.47–1.22]).

CONCLUSIONS: The 10-year patency rate of the RA is significantly higher than that of the free RITA and better than that of the SV.

REGISTRATION: URL: https://www.clinicaltrials.gov; Unique identifier: NCT00475488.

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Clinical Perspective

What Is New?

- The RAPCO trial (Radial Artery Patency and Clinical Outcomes) was designed to compare the long-term patency of the radial artery with the most frequently used complementary grafts: the right internal thoracic artery and the saphenous vein.
- The 10-year patency rate of the radial artery was found to be significantly higher than that of the free right internal thoracic artery and better than that of the saphenous vein.

What Are the Clinical Implications?

- The use of more than 1 arterial conduit for coronary bypass surgery is infrequent, accounting for <10% of cases in North America.
- Our findings support the use of the radial artery as the free conduit of choice to complement the left internal thoracic artery in coronary surgery.

Coronary artery bypass grafting is the treatment of choice for severe multivessel coronary artery disease.[1,2] The internal thoracic artery to the left anterior descending artery (ITA-LAD) graft is considered the gold standard, but there is controversy around the best graft for the second most important coronary target. Observational series have suggested a survival advantage when a second arterial conduit is used to complement the ITA-LAD graft, but they are susceptible to allocation bias and hidden confounders.[3]

The Arterial Revascularization Trial recently reported no difference in 10-year survival for patients receiving bilateral versus single ITA.[4] A pooled analysis of 6 randomized trials comparing the radial artery (RA) and the saphenous vein (SV) as the second graft has reported significantly better patency rate and clinical outcomes at 5 years for the RA.[5]

The Stand-in-Y trial compared the clinical outcomes of the RA, the right ITA (RITA), and the SV in different configurations for the second left-sided target among 815 patients.[6] The authors reported no difference in survival but better event-free survival for patients who received an arterial graft at 2 years follow-up. This trial lacked long-term clinical data and did not include angiographic follow-up.

Another small trial undertook a 3-way angiographic comparison among the RA, RITA, and SV in patients with in-stent restenosis. The authors reported significantly better patency rate for the arterial grafts, but clinical follow-up and sample size were limited and the patient population did not represent the majority of patients receiving coronary artery bypass grafting.[7]

The RAPCO trial (Radial Artery Patency and Clinical Outcomes) was designed to compare the long-term patency of the RA with that of the free RITA and the SV. In RAPCO RITA (the RITA versus RA arm of the RAPCO trial), patients <70 years of age (<60 years of age if they had diabetes mellitus) were randomized to receive RA or free RITA on the second most important coronary target; in RAPCO-SV (the SV versus RA arm of the RAPCO trial), patients ≥70 years of age (≥60 years of age if they had diabetes mellitus) were randomized to receive RA or SV grafting. The primary outcome was 10-year graft patency and all conduits were used as aortocoronary bypass to minimize heterogeneity.

METHODS

Study Design

RAPCO is a research initiative performed in a tertiary referral university hospital in Melbourne, Australia. It comprises 2 parallel randomized trials designed to compare graft patency and clinical outcomes at 10 years of the RA with the RITA and the SV.[8]

The RAPCO trial (URL: https://www.clinicaltrials.gov; Unique identifier: NCT00475488) protocol (see the Data Supplement) was approved by the Austin Hospital Human Research Ethics Committee in August 1995 (H95/086). Amendments were approved in 2002 and 2006 (H2006/02690). All patients received written information about the study and gave written informed consent.

The data, analytic methods, and study materials will be made available to other researchers for purposes of reproducing the results or replicating the procedure on reasonable request and approval by the trial steering committee. Data will be provided by the senior author.

Patients

Patients undergoing elective isolated coronary artery bypass grafting requiring more than 1 bypass conduit were eligible for the trial. An ejection fraction >35% and at least 1 non-LAD vessel with a proximal stenosis of at least 70% and diameter of at least 1.5 mm were required. Patients with body mass index >35 kg/m^2, renal impairment with serum creatinine level >300 μmol/L, lung disease with a forced expiratory volume in 1 second (FEV_1) <1 L, and major illnesses (eg, malignancy) with expected survival <10 years were excluded.

Patients younger than 70 years of age (or 60 years of age if they had diabetes mellitus) were randomized to receive RA or free RITA on the second most important target coronary vessel. Patients ≥70 years of age (or ≥60 years of age if they had diabetes mellitus) were randomized to receive RA or a SV on the second most important target coronary vessel. Patients were excluded if they could not receive both possible conduits.

The RA was deemed unusable in the presence of an abnormal Allen test (>10 seconds) or abnormal digital/brachial index (≤0.8). The free RITA was not deemed safely usable after previous thoracic trauma or chest radiotherapy or in the presence of severe airways disease (FEV_1 <50% of expected value or <1 L). The SV was deemed unusable in the presence of varicose veins or previous leg trauma.

Randomization

Patients were enrolled and randomized before surgery by a clinical trials nurse. Randomization was performed by the University of Melbourne Statistical Consulting Center using a random number generator and Minitab software (Minitab Inc, State College, PA). Simultaneous randomization for conduit allocation and for timing of graft angiography was performed. Random assignments were kept concealed in sealed envelopes until eligibility was confirmed by the surgeon.

Procedures

Surgery was performed by the same group of surgeons using a standardized technique. At operation, all patients received a left ITA graft to the LAD. The randomized conduit (RA, RITA, or SV) was used to graft the most important non-LAD target. Choice of the target was at the operating surgeon's discretion and dependent on vessel size, territory of runoff, and area of myocardium at risk. This was determined preoperatively from the angiogram and confirmed at operation. All conduits were used as aortocoronary grafts, with composite or Y-graft configurations not allowed to minimize confounding variables. The smaller and subsequent targets, named third or fourth order, received conduits that depended on surgeon preference. These were normally with SV.

Both RA and RITA conduits were prepared with minimal manipulation, with the RA being harvested by open technique (detailed description available in the Data Supplement). A buffered solution of blood, Ringer's lactate, and papaverine was used for storage and dilatation. Surgery was performed using cardiopulmonary bypass, mild hypothermia, and myocardial protection by antegrade/retrograde tepid blood cardioplegia. Low-dose intravenous milrinone was infused after cardiopulmonary bypass and up to 18 hours postoperatively in all patients.

All patients were discharged on the dihydropyridine calcium channel blocker amlodipine, which was continued for 6 months. As in the protocol, from 2003, patients with poor left ventricular function could instead receive an angiotensin-converting enzyme inhibitor as the vasodilator. All patients were discharged on aspirin 100 mg per day. All other medications were dependent on the treating cardiologist. All patients were given secondary prevention education and offered cardiac rehabilitation.

Graft patency was assessed using angiography or computed tomography angiography. Patients underwent randomization with respect to the timing of imaging to provide a comprehensive description of the natural history of graft status. The randomization was weighted toward the end of the follow-up to provide long-term data. Specifically, 10% of the patients were assigned to have the examination at 1 year, 10% at 2 years, 20% at 5 years, 30% at 7.5 years, and 30% at 10 years follow-up. For practicality, the graft study was permitted to occur within 18 months of the randomized study time. To enrich the number of patency endpoints, a protocol amendment allowed patients to be offered an additional imaging study at the 5- and 10-year follow-up. Clinically directed coronary studies were also reviewed and recorded. A secondary analysis including only per protocol angiographies was also performed. When patients had more than 1 examination, the first detected failure or last demonstrated patency of the study graft was used for the analysis.

Images were reviewed by 3 observers independently and the patency of all grafts and major coronary branches was recorded. In the situation where 2 of the 3 observers were unclear as to definite agreement (ie, not in agreement or disagreement), the adjudicating opinion of a fourth reviewer was obtained.

The main analysis was based on a combination of protocol-driven and symptoms-driven imaging studies. Protocol-driven examination data were used when available and symptoms-driven examination data were used when protocol-driven examinations were not performed.

Telephone review by a clinical trials nurse was performed annually for clinical outcomes. Myocardial infarction and repeat surgical or percutaneous revascularization were recorded as events after adjudication by a clinical event review panel. Mortality was confirmed when necessary using the Australian National Death Registry.

Outcomes

Primary endpoints were as follows:

1. Angiographic graft failure at 10 years. Graft occlusion was defined as total occlusion, stenosis >80%, or string sign (indicating the absence of functional flow in an arterial graft despite anatomic patency). These modes of failure were pooled for analysis because at the clinical level, they are equivalent in terms of inadequate perfusion of the target artery territory.
2. All-cause mortality, documented by clinical record, trial nurse contact, or National Death Registry.

Power calculation could be performed only for the angiographic outcome because of the absence of survival data for RA grafting at the time of trial design. Results for the mortality outcome were underpowered and must be considered hypothesis generating.

The secondary end point was the incidence of major adverse cardiac events, defined as the composite of death, myocardial infarction, or repeat coronary revascularization.

Statistical Analysis

For sample size calculation, it was assumed that the 10-year patency rate of the RA would be 93%. In the RITA versus RA arm, to detect an absolute difference in patency rate of 10% (from 83% to 93%), 180 patients in each group were required. In the SV versus RA arm, to detect an absolute difference in patency rate of 15% (from 78% to 93%), 95 patients in each group were required.

For each group, a 10% dropout rate was assumed. Therefore, for detecting a significant difference with 80% power at a 2-sided α of 5%, 400 patients were required for the RA versus RITA comparison and 211 patients for the RA versus SV comparison.

Imaging and clinical data were recorded in a trial database using Visual FoxPro software (Microsoft Corporation, Redmond, WA) under the control of a dedicated data manager. Clinical event dates were recorded and graft failure was inferred as the date of imaging examination. Data were exported to SPSS Inc version 25 (IBM, Armonk, NY) and R version 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria) for statistical analysis.

Continuous variables were reported as mean and SD or median and 1st through 3rd quartile values; categorical

variables were reported as counts and percentages. The RITA and SV arms were the references in their respective analyses.

Kaplan-Meier (K-M) estimates of survival and major adverse cardiac events–free survival were constructed and compared by log-rank analysis. Cox regression was used to calculate hazard ratios (HRs), with 95% CIs for all estimates. Diabetes mellitus and sex were tested as potential effect modifiers on the primary end point using interaction term analysis. The effect of time of enrollment on the primary outcome was explored using interaction term analysis. Sensitivity analyses on the effect of the imaging modality used for follow-up and on the reason for imaging (protocol versus clinical) on the primary outcome were performed.

A competing risk framework was used to compute pseudo HRs for nonfatal events (graft patency, myocardial infarction, and repeat revascularization).[9] The cumulative incidences were obtained from competing risk data using a proportional subdistribution hazards regression model described by Fine and Gray[9] and the *ggplot2* and *survminer* R packages.

A descriptive analysis of patency including both the study grafts and all the complementary grafts was also performed.

The primary analysis was by intention to treat. An analysis according to the graft received (as-treated) was performed as sensitivity analysis. All *P* values were 2-sided. *P* values <0.05 were deemed statistically significant.

The baseline characteristics of patients lost to imaging follow-up were compared with those of patients who had imaging in both arms to assess that they were representative of the parent cohort.

RESULTS

RA Versus RITA (RAPCO-RITA)

During the period from June 18, 1996, to February 4, 2005, 980 patients were screened. From these, 394 were enrolled in the trial (Figure I in the Data Supplement).

The demographic details of enrolled patients revealed no differences between randomized cohorts and are summarized in Table 1. Three surgeons performed the majority of the procedures (98, 84, and 79 cases, respectively), with the remaining 45 split among 5 other surgeons. There was no difference in the number of grafts performed in the 2 groups, with a mean of 3.2 grafts per patient.

There was no operative mortality. One patient had a nonfatal myocardial infarction in the first 30 days. Deep sternal wound infection occurred in 2 of 394 patients (both randomized to RITA; *P*=0.24). Ventilation was required for over 24 hours in 8 of 394 patients, evenly split between RA and RITA. There was no significant difference in the incidence of early complications between groups.

One patient was lost to 10-year follow-up. Assessment of the study graft was achieved according to protocol timing in 317 of 394 patients (80.5%). Examinations were performed at less than 1 year in 26 patients, at 1 to 4 years in 43, at 4 to 6 years in 75, at 6 to 9 years in 91, and at 9 to 11 years in 77 (Figure II in the Data Supplement). A total of 110 supplementary examinations were obtained at 5 years, and 75 at 10 years. Nine clinically indicated angiograms were also included in the analysis. Median angiographic follow-up time was 7.1 years (range, 5.0 to 9.4 years).

Failure of RA versus RITA grafts occurred in 15 versus 23 patients. Ten-year K-M patency estimates were 89% and 80% for the RA and RITA, respectively, and the HR for graft failure was 0.45 (95% CI, 0.23–0.88; Figure 1).

There were 50 deaths during follow-up, with 18 and 32 deaths in the RA and RITA groups, respectively.

Table 1. Patient Demographics for the Radial Artery Versus Right Internal Thoracic Artery Comparison

Variable	Radial Artery Group	Right Internal Thoracic Artery Group	*P* Value
Total, n	198	196	
Age, y, mean (range)	59.2 (36.9–71.0)	59.5 (36.2–70.9)	0.72
Sex, male	175 (88)	178 (91)	0.51
Diabetes mellitus	22 (11)	21 (11)	1.0
Hypertension	113 (57)	99 (51)	0.23
Elective presentation	160 (81)	161 (82)	0.80
Grafts, mean±SD	3.2±1.0	3.2±1.0	0.49
Smoking history	148 (75)	143 (73)	0.73
Preoperative myocardial infarction	75 (38)	68 (35)	0.53
Preoperative percutaneous coronary intervention	20 (10)	27 (14)	0.28
Target vessel			
Circumflex artery	122 (62)	131 (67)	0.28
Right coronary artery	69 (35)	52 (26)	0.07
Ramus or diagonal artery	7 (3)	13 (7)	0.16

Data are displayed as n (%) unless otherwise indicated.

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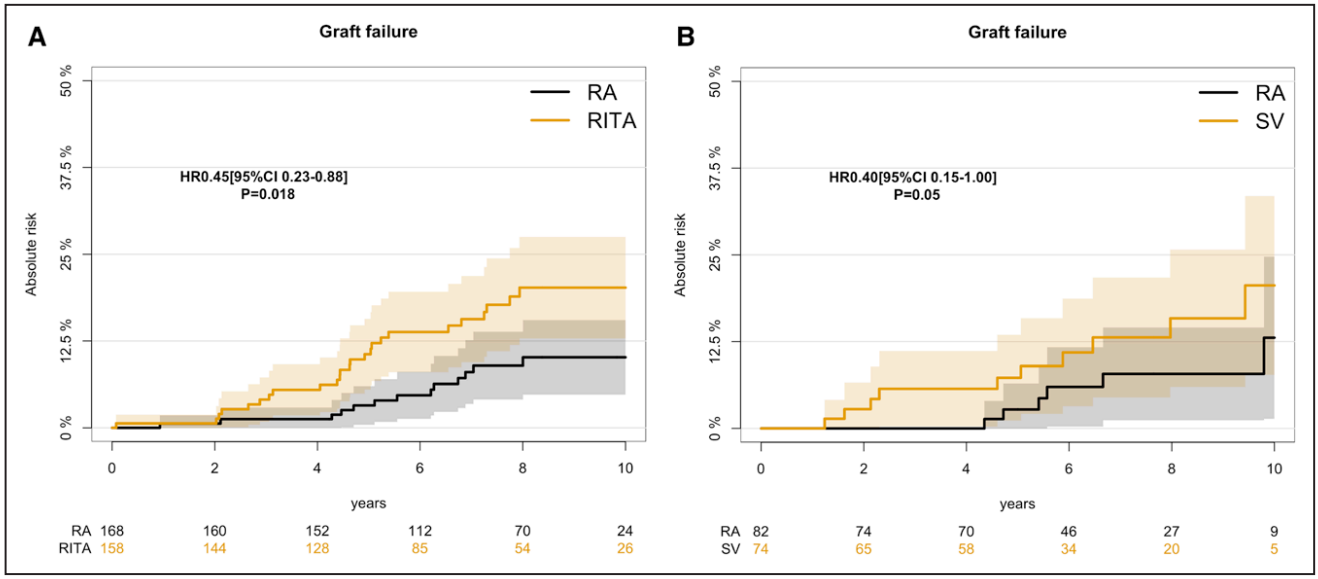

Figure 1. Incidence of graft failure during follow-up.
A, Incidence of graft failure in the radial artery (RA) versus right internal thoracic artery (RITA) comparison (RAPCO-RITA [the RITA versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). **B**, Incidence of graft failure in the RA versus saphenous vein (SV) comparison (RAPCO-SV [the SV versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). HR indicates hazard ratio.

K-M estimates of survival at 10 years were 90.9% and 83.7% in the RA and RITA groups, respectively (log-rank *P*=0.03). The HR for death was 0.53 (95% CI, 0.30–0.95; Figure 2).

In patients with diabetes mellitus, the incidence of death at 10 years was 9% for the RA group and 19% for the RITA group. In patients without diabetes mellitus, the incidence of death at 10 years was 9% for the RA group and 16% for the RITA group.

There were 11 versus 13 myocardial infarctions and 22 versus 26 repeat revascularizations in the RA versus RITA groups, respectively. The HR for major adverse cardiac events was 0.65 (95% CI, 0.44–0.96; Figure 3).

Also, 27 patients (6.8%) did not receive the randomized conduit: 11 patients allocated to receive the RA received another conduit (2 RITA, 8 SV, and 1 left ITA) and 16 patients allocated to receive the RITA received another conduit (13 RA, 2 SV, and 1 left ITA). The results of the as-treated analysis were consistent with those of the main analysis (see the Appendix in the Data Supplement).

RA Versus SV (RAPCO-SV)

From June 25, 1996, to March 6, 2005, 902 patients were screened and 225 enrolled (Figure III in the Data Supplement). The demographic details of the patients are summarized in Table 2. Four surgeons performed the majority of the interventions, with 67, 40, 38, and 29 cases, respectively, with the remaining 51 split among 5 other surgeons. There was no difference in the mean number of grafts performed in each group (3.3 versus 3.2 grafts per patient).

Operative mortality occurred in 1 patient in the SV group. One patient had nonfatal myocardial infarction in the first 30 days. Deep sternal wound infection occurred in 3 of 225 patients (RA=1, SV=2; *P*=0.62). Ventilation was required for over 24 hours in 7 of 225 patients (RA=4, SV=3; *P*=1.00). There was no significant difference in the incidence of early complications.

Assessment of the study graft was achieved according to the protocol in 146 of 225 patients (64.9%). The examination was performed at less than 1 year in 13 patients, at 1 to 4 years in 19, at 4 to 6 years in 47, at 6 to 9 years in 38, and at 9 to 11 years in 22 (Figure IV in the Data Supplement). We obtained 31 supplementary examinations at 5 years and 5 at 10 years. Ten clinically indicated angiograms were also included in the analysis. Median angiographic follow-up time was 6.1 years (range, 4.6 to 8.8 years).

Graft failure occurred in 6 RAs and 12 SVs. The 10-year K-M estimates of patency on intention-to-treat analysis were 85% for the RA and 71% for the SV. The HR for graft failure was 0.40 (95% CI, 0.15–1.00; Figure 1).

One patient in the SV group was lost to clinical follow-up. There were 31 deaths in the RA cohort (14 patients with diabetes mellitus, 17 patients without diabetes mellitus) and 39 deaths in the SV group (21 patients with diabetes mellitus, 18 patients without diabetes mellitus). At 10 years, K-M estimate of survival was 72.6% versus 65.2% in the RA versus SV groups, respectively (log-rank *P*=0.18). The HR for mortality was 0.76 (95% CI, 0.47–1.22; Figure 2).

There were 8 myocardial infarctions in the RA group and 10 in the SV group, and 7 repeat revascularizations in the RA group versus 9 in the SV group. The HR for major adverse cardiac events was 0.76 (95% CI, 0.51–1.15; Figure 3).

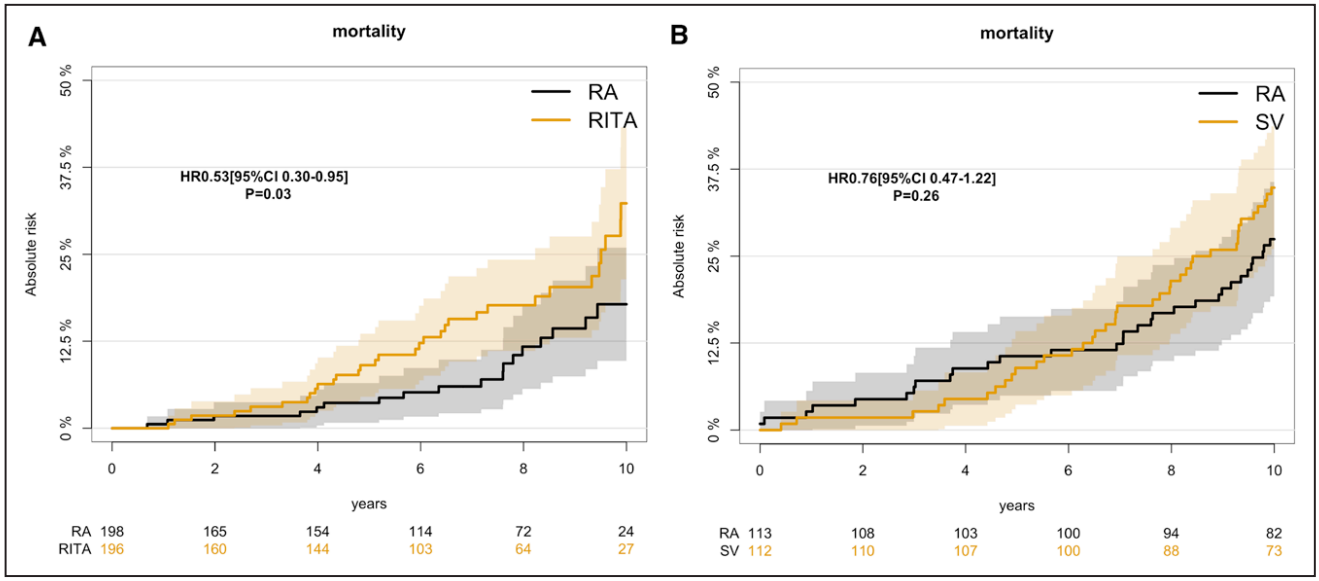

Figure 2. Mortality during follow-up.
A, Mortality in the radial artery (RA) versus right internal thoracic artery (RITA) comparison (RAPCO-RITA [the RITA versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). **B**, Mortality in the RA versus saphenous vein (SV) comparison (RAPCO-SV [the SV versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). HR indicates hazard ratio.

Eight patients (3.5%) did not receive the randomized conduit: 6 patients allocated to receive the RA received an SV and 2 patients allocated to receive the SV received another conduit (1 RITA and 1 RA). The results of the as-treated analysis were consistent with those of the main analysis (Figure V in the Data Supplement).

Results of the analysis for myocardial infarction and repeat revascularization individually and the competing risk analysis for both the RA versus RITA and the RA versus SV comparisons are given in Figures VI through X in the Data Supplement. The results of the analysis of graft patency based on the per-protocol angiographies are given in Figure XI in the Data Supplement. Diabetes mellitus and sex were not significant treatment effect modifiers in the comparisons (Figures XII and XIII in the Data Supplement). There was no significant change in the incidence of graft failure in the RA versus RITA comparisons over time; in the RA versus SV comparison, a significant time effect was found (Tables I and II and Figure XIV in the Data Supplement).

No significant differences were found between patients with and without imaging follow-up in the comparisons (Tables III and IV in the Data Supplement). The proportional hazard assumption was not violated for the

Table 2. Patient Demographics for the Radial Artery Versus Saphenous Vein Comparison

Variable	Radial Artery Group	Saphenous Vein Group	*P* Value
Total, n	113	112	
Age, y, mean (range)	72.6 (61.0–83.5)	73.1 (60.5–80.7)	0.43
Sex, male	91 (81)	91 (81)	1.0
Diabetes mellitus	50 (44)	52 (46)	0.79
Hypertension	68 (60)	78 (70)	0.16
Elective presentation	87 (77)	91 (81)	0.51
Grafts, mean±SD	3.2±0.9	3.3±0.7	0.26
Smoking history	75 (66)	76 (68)	0.89
Preoperative myocardial infarction	43 (38)	36 (32)	0.40
Preoperative percutaneous coronary intervention	11 (10)	12 (11)	0.83
Target vessel			
Circumflex artery	77 (68)	67 (60)	0.19
Right coronary artery	29 (26)	41 (37)	0.08
Ramus or diagonal artery	7 (6)	4 (4)	0.36

Data are displayed as n (%) unless otherwise indicated.

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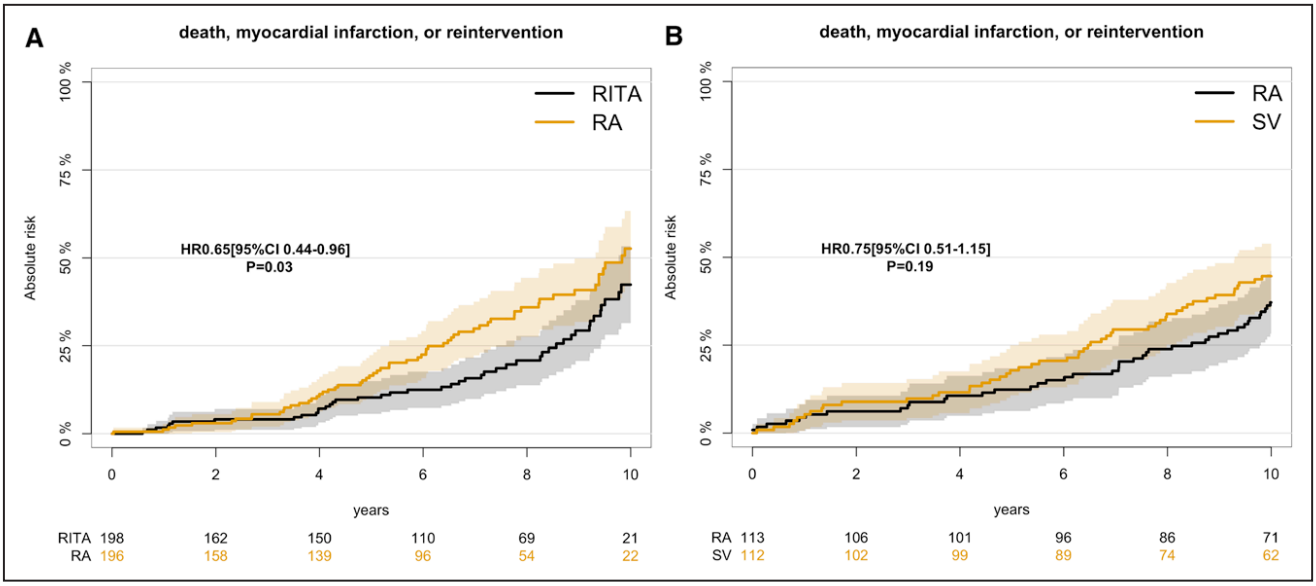

Figure 3. Incidence of the composite of death, myocardial infarction, or reintervention during follow-up.
A, Incidence in the radial artery (RA) versus right internal thoracic artery (RITA) comparison (RAPCO-RITA [the RITA versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). **B**, Incidence in the RA versus saphenous vein (SV) comparison (RAPCO-SV [the SV versus RA arm of the Radial Artery Patency and Clinical Outcomes trial]). HR indicates hazard ratio.

explored outcomes in any of the comparisons (Figures XV and XVI in the Data Supplement). The results of the analysis by imaging modality and by reason for imaging (protocol versus clinical) were consistent with the main analysis (Figures XVII and XVIII in the Data Supplement).

DISCUSSION

This is the only randomized comparison of the long-term angiographic patency of the RA with each of the free RITA and SV.

We found that the 10-year patency rate of the RA was significantly better than that of the free RITA, and higher than that of the SV, although this latter difference was not statistically significant.

A previous network meta-analysis of randomized trials comparing the RA, the RITA, and the SV found the patency rates of both arterial conduits to be significantly higher than that of the SV after the 4th year of follow-up.[10] The analysis of RITA patency included only the midterm results of RAPCO and a small trial of 60 patients (20 RITAs).

Previous observational studies comparing the outcomes of the RA and RITA reported conflicting results,[11–13] and a meta-analysis of propensity-matched studies found longer postoperative survival in the RITA arm.[14] However, observational studies are open to treatment allocation bias and hidden confounders that may persist even after propensity matching.[3]

The Arterial Revascularization Trial found no difference in clinical outcomes when the RITA or the SV was used as the second graft.[4] In the Arterial Revascularization Trial, different RITA configurations were allowed (in situ, Y composite, or free graft), whereas in RAPCO, only the aortocoronary configuration was used to maximize comparability between conduits.

The RITA has a thinner wall than the RA and it is probably more fragile and technically more complex to use.[15] It has been shown that a volume-outcome effect is evident for the RITA, but not for the RA.[16] It is possible that technical factors such as the need for a proximal anastomosis to the aorta with the RITA have played a role in the reported results, rather than biological differences between grafts.

Harvesting of the RA does not increase the risk of sternal wound complications (as opposed to RITA harvesting[17]) and is better tolerated by patients than harvesting of the SV, as reported by us and others.[18,19]

All RAs in RAPCO were harvested by an open minimal-touch technique to avoid spasm or conduit damage. This has remained our preferred harvesting method. Endoscopic techniques were not used, although they are widely practiced in many centers and predominant in some. It is not known whether the use of endoscopic techniques would have affected the findings of the trial, although there is some evidence that open harvest may better preserve the RA endothelium.[20]

Use of more than 1 arterial conduit in North America has been infrequent, accounting for <10% of cases.[21] This may be attributable to perceptions of increased perioperative risk of graft failure or wound complications that might increase operative morbidity.[22]

Although not the focus of this trial, the minimal hospital or 30-day morbidity in this group highlights the safety of RA and RITA use by experienced operators.

The RAs used in this trial were not submitted to previous coronary angiography. The excellent patency and clinical outcome associated with the use of RA in RAPCO should not be assumed to be replicated by RAs previously used as access for angiography, which have been reported to have significantly diminished patency rate.[23]

Several limitations need to be acknowledged. RAPCO was a single-center study, the imaging core laboratory was not blinded, and the senior author was part of the angiographic assessment committee; all these factors may result in bias. The clinical outcomes were not formally powered and the results may be the consequences of type 1 or 2 errors. Use of the aortocoronary RITA was decided to maximize the comparability between conduits, but does not reflect the current practice of many surgeons. At the time when the protocol was originally written, it was considered important to standardize the use of the left ITA to the LAD as the primary graft. It was thought that this would limit the capability of the in situ pedicle RITA graft to always reach the randomized second most important graft target and that this in turn might result in larger numbers of patients who were randomized to RITA actually receiving a different graft. Thus, it was decided to standardize the use of the RITA as an aortocoronary graft. Also, only 80% of patients in the RITA versus RA and 65% in the SV versus RA comparisons had imaging follow-up, and this raises the important question of graft status in patients who were not imaged (especially in the SV versus RA group). However, analysis using a competing risk model (where death is counted with graft failure) was consistent with the main patency analysis. Patients and surgeons included in randomized trials are highly selected, and generalizability of the results to the clinical world may be low. Last, results were not adjusted for multiple comparisons.

In the only randomized comparison of all the conduits used to supplement the left ITA to LAD anastomosis, we found that the RA has significantly better 10-year patency rate than the RITA and higher (although not significant) 10-year patency rate than the SV. Our findings support the use of the RA as the free conduit of choice to complement the left ITA in coronary surgery.

ARTICLE INFORMATION

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Disclosures

None.

Supplemental Materials

Supplemental Protocols
Supplemental Appendix
Data Supplement Figures I–XVIII
Data Supplement Tables I–IV

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