STS/EACTS Latin America Cardiovascular Surgery Conference
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Hilton Cartagena | Cartagena, Colombia

Radial Artery as the Second Arterial Graft: A New Appraisal

DR. Marco Antonio Praça Oliveira, MD, PhD
Cardiovascular Surgery
Hospital Israelita Albert Einstein
Hospital Beneficência Portuguesa de São Paulo

NO DISCLOSURE

Introduction

- Late survival after CABG is improved when the left internal mammary artery is graft to the left anterior descending artery.

Loop FD et. Al N Engl. J. Med. 1986;314:1-6

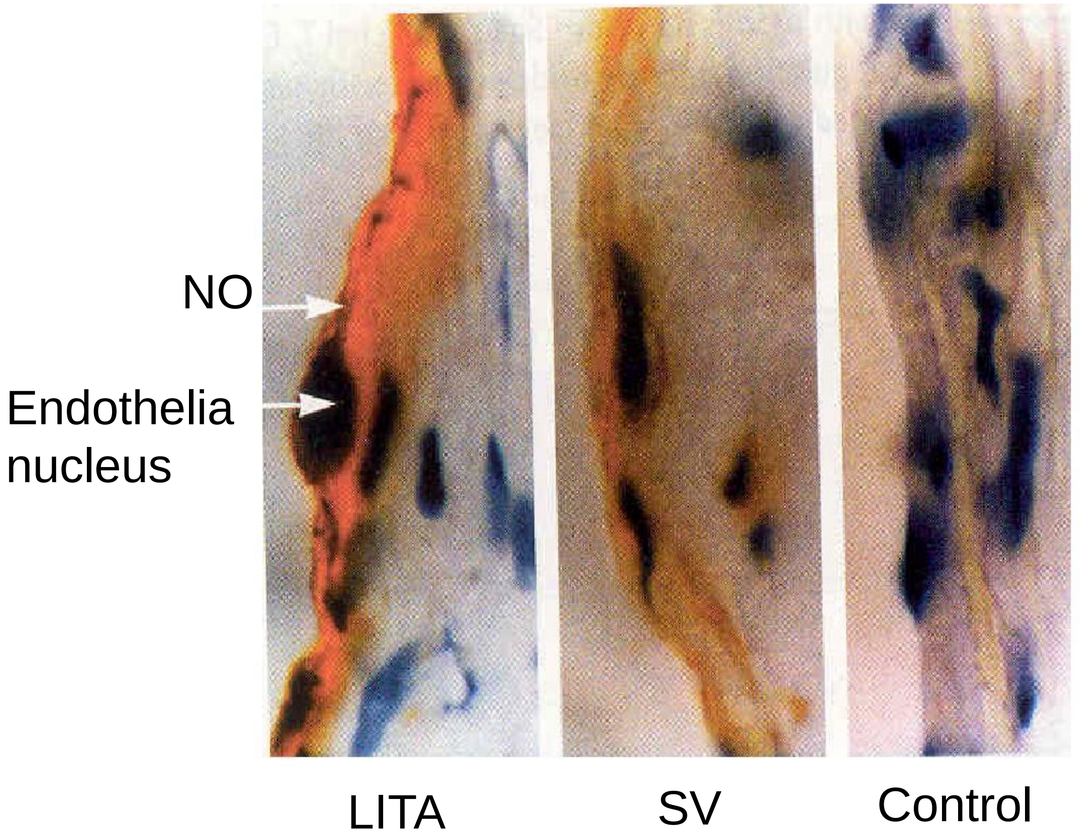
Taggard D et. Al Rambam Maimonides Med J 2013;4 (3):e0018

Introduction

- High proportion of elastic rather than muscle or adventicia compositon
- Nitric oxide
- Decrease release of vasconstrictors
- Potent anti-atherosclerotic effects

Taggart D Med J 2013;4(3):e0018

ENDOTHELIUM
Nitric Oxide Synthesis (NO)
Immunohistochemical staining



Buxton B, Fraizer OH, Westaby S.
Ischemic heart disease surgical management. Ed. Mosby International Ltd, 1999, p.132.

TWO INTERNAL THORACIC ARTERY GRAFTS ARE BETTER THAN ONE

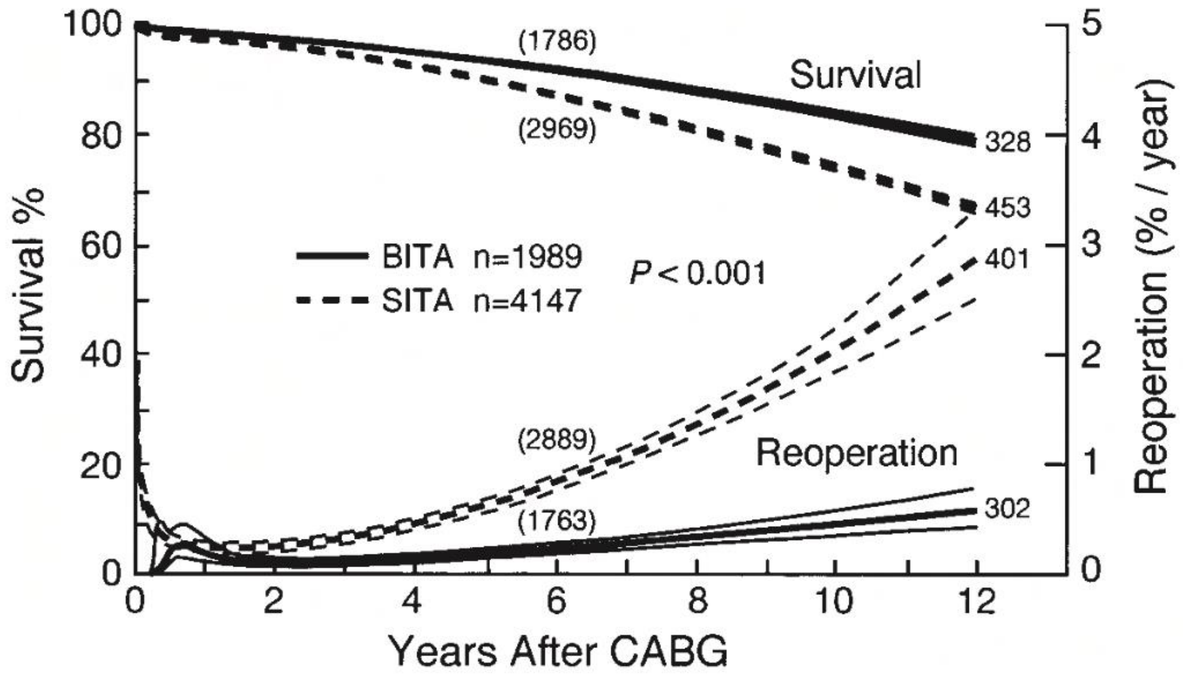


Fig 2. Comparison of survival and reoperation hazard function curves in the propensity-matched patients (both $P < .0001$) (bilateral *[BITA]*, n = 1989; single *[SITA]*, n = 4147). *CABG*, Coronary artery bypass grafting.

J Thorac Cardiovasc Surg 1999; 117: 855-72

REAL WORLD

- Multiple arterial grafts <13%
- 5% USA
- 11% Europa

JUSTIFICATION

- Technical Issue
- Long surgical time
- Confort Zone
- Simple surgery - complex

J Thorac Cardiovasc Surg 2014; 148:1149-51

JUSTIFICATION

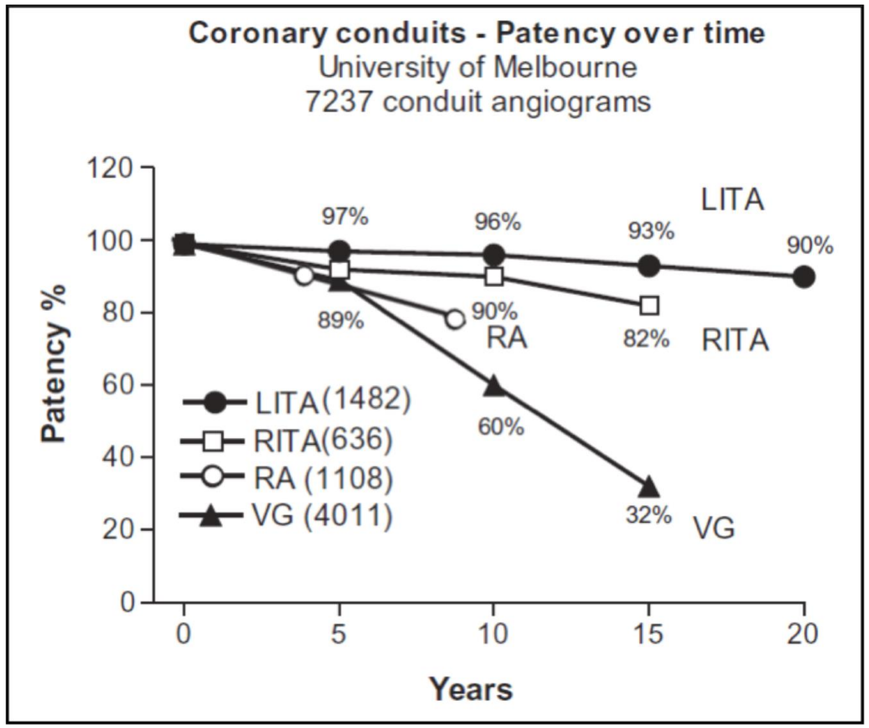
- Readmissions
- Open data for the population
- Based in short term
- DSWI – Quality STS

J Thorac Cardiovasc Surg 2014; 148:1149-51

AATS 2011

Giant Leaps in Surgical Myocardial Revascularisation

James Tatoulis, M.D.
University of Melbourne



Tatoulis J. Heart Lung Circ 2011;20:149-56.

The NEW ENGLAND JOURNAL of MEDICINE

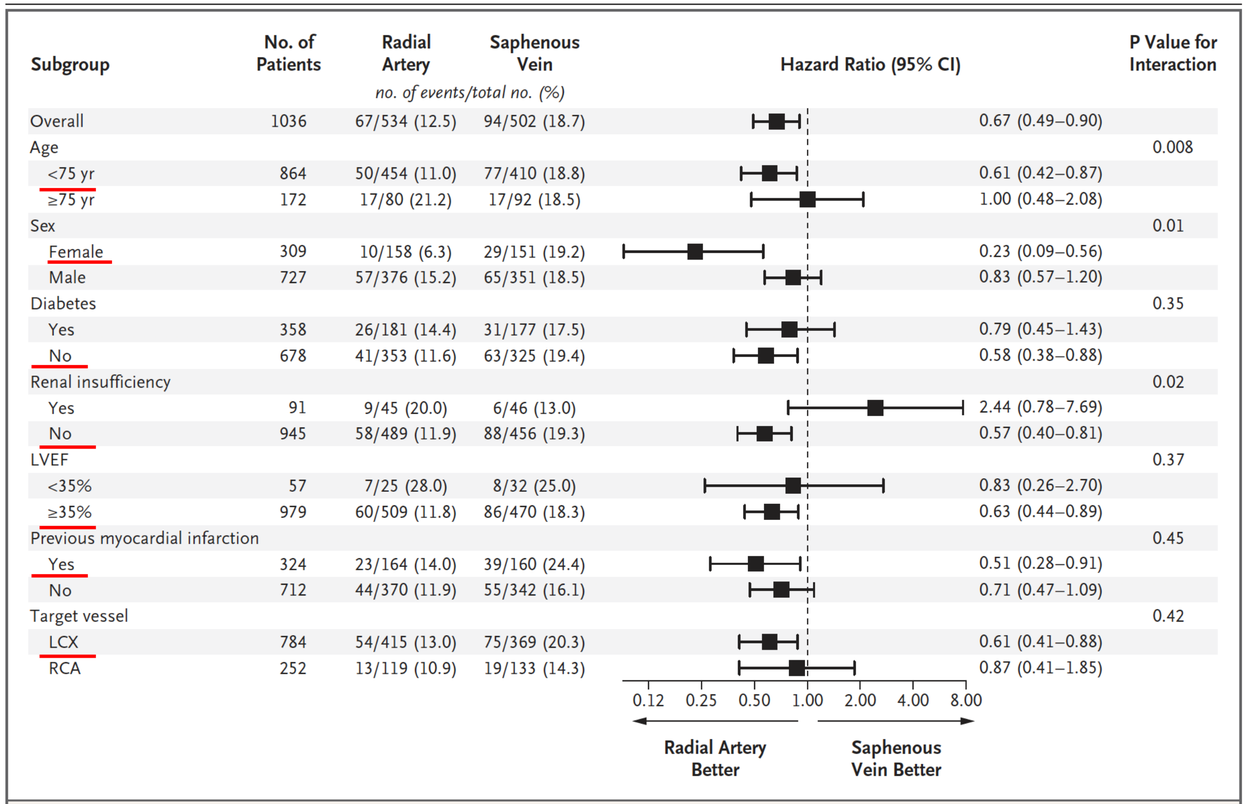
ESTABLISHED IN 1812 MAY 31, 2018 VOL. 378 NO. 22

Radial-Artery or Saphenous-Vein Grafts in Coronary-Artery Bypass Surgery

Mario Gaudino, M.D., Umberto Benedetto, M.D., Stephen Fremes, M.D., Giuseppe Biondi-Zoccai, M.D., M.Stat., Art Sedrakyan, M.D., Ph.D., John D. Puskas, M.D., Gianni D. Angelini, M.D., Brian Buxton, M.D., Giacomo Frati, M.D., David L. Hare, M.D., Philip Hayward, M.D., Giuseppe Nasso, M.D., Neil Moat, M.D., Miodrag Peric, M.D., Kyung J. Yoo, M.D., Giuseppe Speziale, M.D., Leonard N. Girardi, M.D., and David P. Taggart, M.D., for the RADIAL Investigators*

N Engl J Med 2018;378:2069-77

Radial-Artery or Saphenous-Vein Grafts



Subgroup	No. of Patients	Radial Artery	Saphenous Vein	Hazard Ratio (95% CI)	P Value for Interaction
		no. of events/total no. (%)			
Overall	1036	67/534 (12.5)	94/502 (18.7)	0.67 (0.49–0.90)	
Age					0.008
<75 yr	864	50/454 (11.0)	77/410 (18.8)	0.61 (0.42–0.87)	
≥75 yr	172	17/80 (21.2)	17/92 (18.5)	1.00 (0.48–2.08)	
Sex					0.01
Female	309	10/158 (6.3)	29/151 (19.2)	0.23 (0.09–0.56)	
Male	727	57/376 (15.2)	65/351 (18.5)	0.83 (0.57–1.20)	
Diabetes					0.35
Yes	358	26/181 (14.4)	31/177 (17.5)	0.79 (0.45–1.43)	
No	678	41/353 (11.6)	63/325 (19.4)	0.58 (0.38–0.88)	
Renal insufficiency					0.02
Yes	91	9/45 (20.0)	6/46 (13.0)	2.44 (0.78–7.69)	
No	945	58/489 (11.9)	88/456 (19.3)	0.57 (0.40–0.81)	
LVEF					0.37
<35%	57	7/25 (28.0)	8/32 (25.0)	0.83 (0.26–2.70)	
≥35%	979	60/509 (11.8)	86/470 (18.3)	0.63 (0.44–0.89)	
Previous myocardial infarction					0.45
Yes	324	23/164 (14.0)	39/160 (24.4)	0.51 (0.28–0.91)	
No	712	44/370 (11.9)	55/342 (16.1)	0.71 (0.47–1.09)	
Target vessel					0.42
LCX	784	54/415 (13.0)	75/369 (20.3)	0.61 (0.41–0.88)	
RCA	252	13/119 (10.9)	19/133 (14.3)	0.87 (0.41–1.85)	

Figure 2. Subgroup Analyses and Interaction Terms for the Primary Composite Outcome of Death, Myocardial Infarction, or Repeat Revascularization.

The P values given are the P values for the interaction-term analyses. Renal insufficiency was defined as a preoperative serum creatinine level of more than 1.5 mg per deciliter.[3] LCX denotes left circumflex coronary artery, LVEF left ventricular ejection fraction, and RCA right coronary artery.

N Engl J Med 2018;378:2069-77

Radial-Artery or Saphenous-Vein Grafts

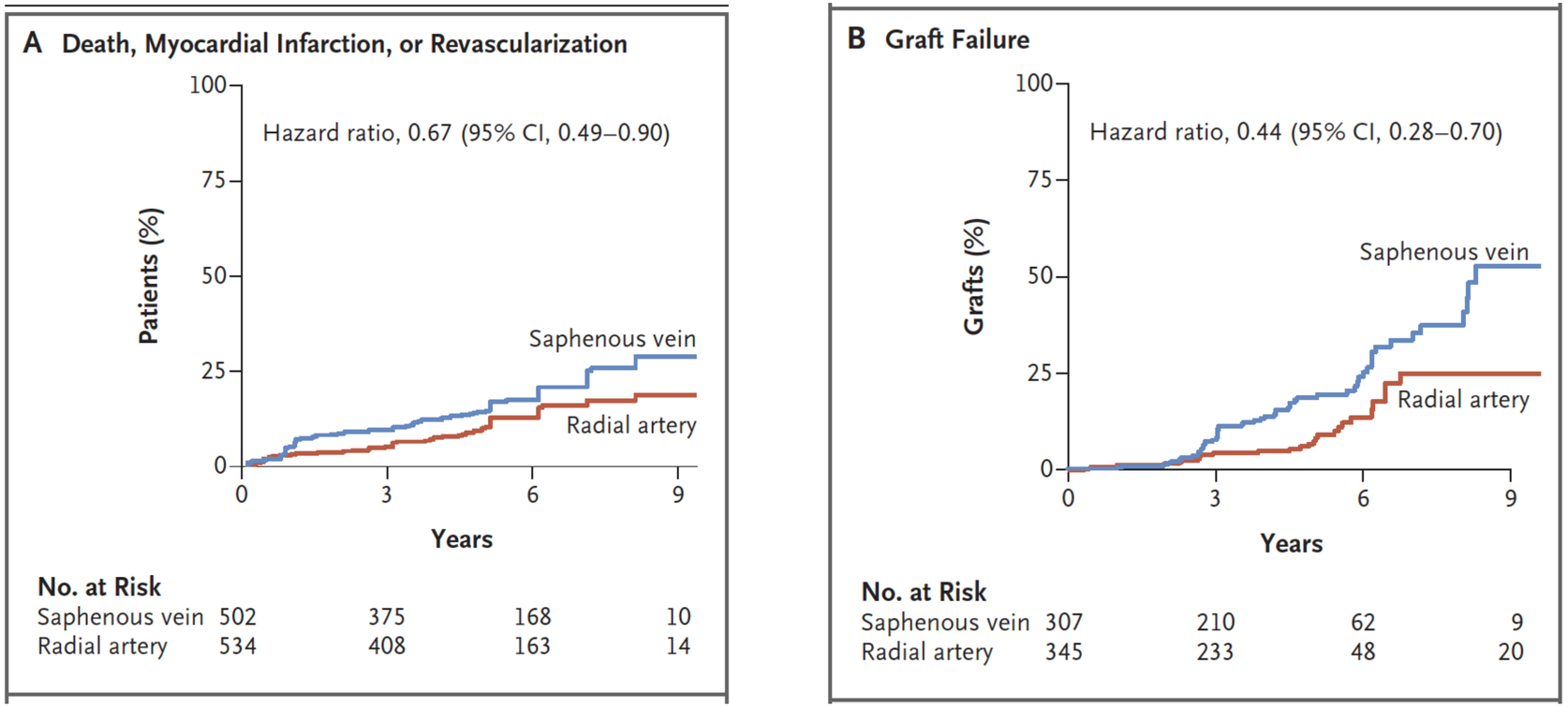


Figure 1. Cumulative Incidence of the Primary Composite Outcome of Death, Myocardial Infarction, or Repeat Revascularization and of Graft Failure in the Intention-to-Treat Analysis.

N Engl J Med 2018;378:2069-77

Radial-Artery or Saphenous-Vein Grafts

Table 3. Main Outcomes.*

Outcome	Radial-Artery Group (N = 534)		Saphenous-Vein Group (N = 502)		Treatment Effect†	
	No. of Events (%)	Events per 1000 Patient-Yr‡	No. of Events (%)	Events per 1000 Patient-Yr‡	Hazard Ratio (95% CI)	P Value
Death, myocardial infarction, or repeat revascularization	67 (12.5)	25	94 (18.7)	39	0.67 (0.49–0.90)	0.01
Death	40 (7.5)	15	42 (8.4)	17	0.90 (0.59–1.41)	0.68
Myocardial infarction	16 (3.0)	6	21 (4.2)	9	0.72 (0.53–0.99)	0.04
Repeat revascularization	23 (4.3)	9	43 (8.6)	17	0.50 (0.40–0.63)	<0.001
Graft occlusion§	28/345 (8.1)	19	61/307 (19.9)	46	0.44 (0.28–0.70)	<0.001

* The analyses of clinical outcomes included all patients enrolled in the RAPCO, RSVP, Stand-in-Y, Yoo and colleagues, and Petrovic et al. trials.
† Results are from a mixed-effect Cox regression model with individual trials included as a random effect (saphenous-vein group is the reference group).
‡ The total numbers of patient-years were 2675 in the radial-artery group and 2510 in the saphenous-vein group.
§ The main analysis of graft occlusion included all the patients with follow-up angiography with data available from the RAPCO, RSVP, Stand-in-Y, and Yoo and colleagues trials. Data were available for 345 of 434 radial-artery grafts (1454 patient-years) and 307 of 402 saphenous-vein grafts (1311 patient-years).

N Engl J Med 2018;378:2069-77

Radial-Artery or Saphenous-Vein Grafts

CONCLUSIONS

As compared with the use of saphenous-vein grafts, the use of radial-artery grafts for CABG resulted in a lower rate of adverse cardiac events and a higher rate of patency at 5 years of follow-up. (Funded by Weill Cornell Medicine and others.)

N Engl J Med 2018;378:2069-77

REVIEW TOPIC OF THE WEEK

The Radial Artery for Percutaneous Coronary Procedures or Surgery?

Mario Gaudino, MD,[a] Francesco Burzotta, MD, PhD,[b] Faisal Bakaeen, MD,[c] Olivier Bertrand, MD,[d] Filippo Crea, MD,[b] Antonino Di Franco, MD,[a] Stephen Fremes, MD,[e] Ferdinand Kiemeneij, MD, PhD,[f] Yves Louvard, MD,[g] Sunil V. Rao, MD,[h] Thomas A. Schwann, MD,[i] James Tatoulis, MD,[j] Robert F. Tranbaugh, MD,[a] Carlo Trani, MD, PhD,[b] Marco Valgimigli, MD, PhD,[k] Pascal Vranckx, MD, PhD,[l] David P. Taggart, MD, PhD,[m] for the Arterial Grafting International Consortium Alliance

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Guadino M et al. J Am Coll Cardiol 2018;71:1167–75

RADIAL ARTERY versus Saphenous Vein

TABLE 2 Randomized Trials With Sample Size >100 Grafts Comparing the Patency Rate of the Radial Artery With That of the Saphenous Vein

Trial/Year	Number of Grafts Restudied	Mean Follow-Up	Main Finding
RSVP/2008	134	5 yrs	Better patency rate for the RA (p = 0.004)
VA/2011	266	1 yr	No difference in patency (p = 0.98)
RAPS/2012	269	7.7 yrs	Better patency rate for the RA (p = 0.002)

RA = radial artery; RAPS = Radial Artery Patency Study; RSVP = Radial Artery Versus Saphenous Vein Patency trial; VA = Veterans Affairs trial.

TABLE 3 Meta-Analyses of Randomized Trials Comparing the Patency Rate of the Radial Artery With That of the Saphenous Vein

First Author (Online Ref. #), Year	Number of Patients/Grafts	Follow-Up, yrs	Main Finding
Benedetto (1), 2010	936	mean 1.8	No difference in patency
Hu (2), 2011	3,889	1–6	Better patency rate for the RA (RR: 0.51; 95% CI: 0.41–0.63)
Athanasiou (3), 2011	1,157	>5	Lower patency rate for the SV (OR: 2.28; 95% CI: 1.32–3.94)
Cao (4), 2013	1,708	>4	Better patency rate for the RA (OR: 0.31; 95% CI: 0.14–0.68)
Zhang et al. (5), 2014	1,860	1.7–7	Better patency rate for the RA (OR: 0.52; 95% CI: 0.37–0.73)
Benedetto et al. (6), 2015	2,780	1.7–7	Lower patency rate for the SV (OR: 2.36; 95% CI: 1.37–4.06)

CI = confidence interval; OR = odds ratio; RA = radial artery; RR = relative risk; SV = saphenous vein.

Guadino M et al. J Am Coll Cardiol 2018;71:1167–75

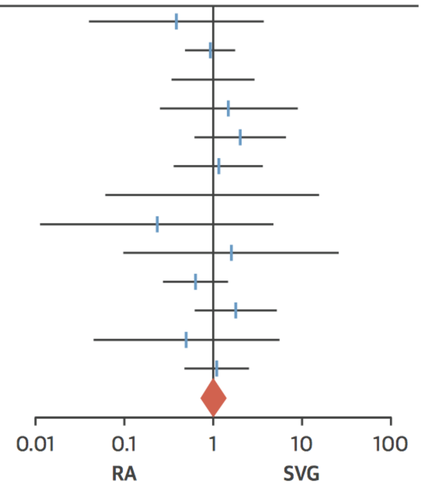
RADIAL ARTERY versus Saphenous Vein

FIGURE 2 Operative and Long-Term Mortality in Patients Receiving the Radial Artery or Saphenous Vein as the Second Conduit

A Peri-operative mortality: radial artery vs. saphenous vein

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Anyanwu 2001	0.391	0.040	3.799	-0.809	0.418
Benedetto 2013	0.943	0.483	1.844	-0.171	0.864
Cohen 2001	1.000	0.340	2.942	0.000	1.000
Goldman 2011	1.508	0.251	9.080	0.449	0.654
Lin 2013	2.032	0.604	6.832	1.146	0.252
Locker 2013	1.161	0.362	3.724	0.251	0.802
Petrovic 2015	1.000	0.062	16.212	0.000	1.000
Santarpino 2010	0.237	0.011	4.979	-0.926	0.354
Shapira 1997	1.657	0.103	26.706	0.356	0.722
Shi 2016	0.636	0.273	1.484	-1.046	0.295
Taggart 2017	1.812	0.604	5.436	1.060	0.289
Tranbaugh 2010	0.499	0.045	5.518	-0.566	0.571
Zacharias 2004	1.101	0.465	2.606	0.219	0.826
	1.021	0.733	1.422	0.123	0.902

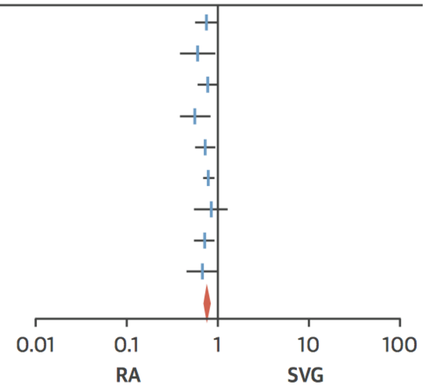
Odds ratio and 95% CI



B Long-term mortality: radial artery vs. saphenous vein grafting

Study name	Point (raw)	Lower limit	Upper limit	Z-Value	p-Value
Benedetto 2013	0.750	0.572	0.983	-2.081	0.037
Cohen 2001	0.600	0.378	0.951	-2.173	0.030
Lin 2013	0.760	0.598	0.966	-2.240	0.025
Locker 2013	0.560	0.378	0.830	-2.892	0.004
Petrovic 2015	0.720	0.562	0.923	-2.594	0.009
Shi 2016	0.790	0.706	0.884	-4.089	0.000
Taggart 2017	0.830	0.541	1.273	-0.854	0.393
Tranbaugh 2010	0.710	0.553	0.911	-2.687	0.007
Zacharias 2004	0.670	0.459	0.978	-2.076	0.038
	0.748	0.692	0.809	-7.311	0.000

Point (raw) and 95% CI



For details of the meta-analysis, see the Online Appendix. CI = confidence interval; RA = radial artery; SVG = saphenous vein graft.

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Guadino M et al. J Am Coll Cardiol 2018;71:1167–75

Effectiveness of radial artery–based multiarterial coronary artery bypass grafting: Role of body habitus

Thomas A. Schwann, MD,[a,c] Paul S. Ramia, MD,[b] Joseph R. Habib, BS,[b] Milo C. Engoren, MD,[d] Mark R. Bonnell, MD,[a] and Robert H. Habib, PhD[e]

J Thorac Cardiovasc Surg 2018;156:43-51

OBESE versus NON-OBESE

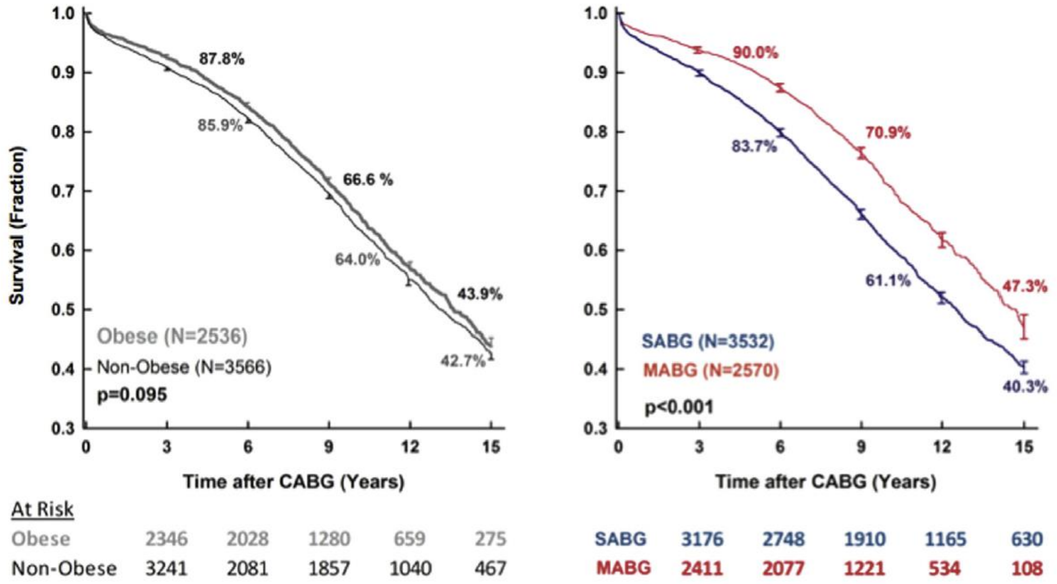

FIGURE 1. Unadjusted 15-year cumulative survival after primary CABG surgery: (*left*) all obese (*grey line*; mean age: 61.9 ± 9.9 years) versus all non-obese (*black line*; 65.8 ± 10.5 years) cohorts; and (*right*) MABG (*red line*; 61.7 ± 10.2 years) versus SABG (*blue line*; 66.0 ± 10.2 years) surgery cohorts. Error bars = ±1 standard error estimates. Percentages shown correspond to survival (%) for each comparison group at 5, 10, and 15 years. Survival comparisons were based on log-rank test. *CABG*, Coronary artery bypass grafting; *MABG*, multiarterial bypass grafting; *SABG*, single arterial bypass grafting.

J Thorac Cardiovasc Surg 2018;156:43-51

LITA versus LITA + RA

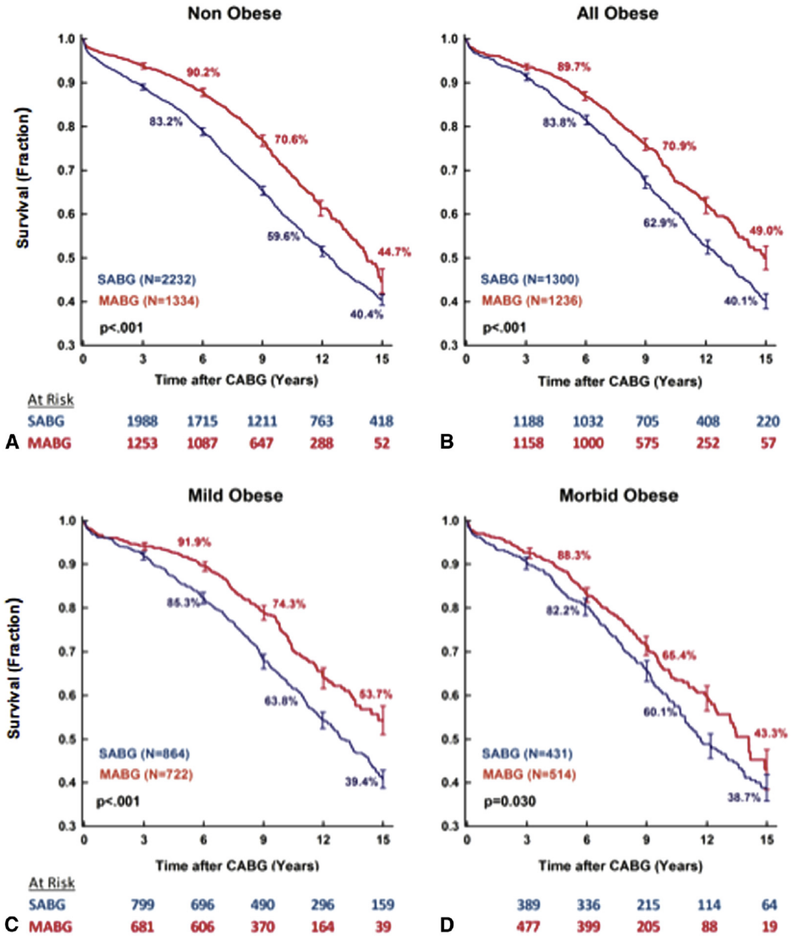

FIGURE 2. Comparison of unadjusted 15-year cumulative survival for MABG (*red*) versus SABG (*blue*) surgery cases after stratification to BMI groups: (A) nonobese, (B) all-obese, (C) mild obese, and (D) morbid obese. Error bars = ±1 standard error estimates. Percentages shown correspond to survival (%) for each comparison group at 5, 10, and 15 years. All pairwise comparisons were significant (log rank). *CABG*, Coronary artery bypass grafting; *MABG*, multiarterial bypass grafting; *SABG*, single arterial bypass grafting.

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J Thorac Cardiovasc Surg 2018;156:43-51

LITA versus LITA + RA

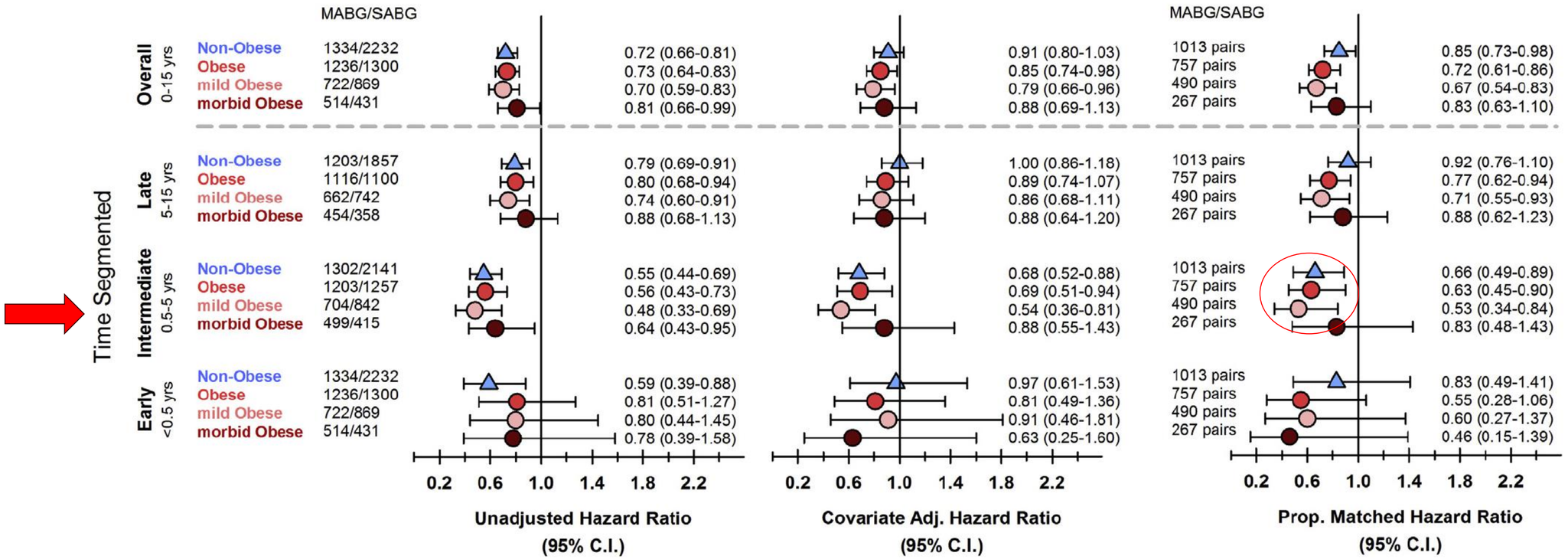

FIGURE 3. Top: Forest plot showing the time-segmented MABG versus SABG HRs (95% CI) for all body habitus subcohorts: unadjusted (*left*), covariate-adjusted (*middle*), and propensity-matched (*right*) patients. *Bottom*: Overall and time-segmented MABG versus SABG HRs across all body habitus groups: unadjusted, covariate-adjusted, and propensity-matched results. SABG/MABG = LITA-SABG/RA-MABG; early (0-0.5 years); intermediate (0.5-5 years); late (5-15 years). *Reported HRs also adjusted. *CI*, Confidence interval; *MABG*, multiarterial bypass grafting; *SABG*, single arterial bypass grafting.

J Thorac Cardiovasc Surg 2018;156:43-51

Effectiveness of radial artery–based multiarterial coronary artery bypass grafting: Role of body habitus

Thomas A. Schwann, MD,[a,c] Paul S. Ramia, MD,[b] Joseph R. Habib, BS,[b] Milo C. Engoren, MD,[d] Mark R. Bonnell, MD,[a] and Robert H. Habib, PhD[e]

CONCLUSIONS

Our analysis supports the aggressive use of the RA as a second arterial conduit in LITA-based CABG in the obese. Compared with the traditional LITA-SABG, this grafting strategy is associated with an improved long-term survival that is principally realized within 0.5 to 5 years postoperatively. Our results suggest that RA-MAB should be seriously considered by the Heart Team as the superior grafting strategy in the obese.

J Thorac Cardiovasc Surg 2018;156:43-51

Total Arterial Revascularization: A Superior Strategy for Diabetic Patients Who Require Coronary Surgery

James Tatoulis, MD, FRACS, Rochelle Wynne, PhD, Peter D. Skillington, FRACS, and Brian F. Buxton, MS, FRACS

Department of Cardiothoracic Surgery, Royal Melbourne Hospital, Melbourne; and Department of Surgery, University of Melbourne, Melbourne, Australia

Table 1. Preoperative, Intraoperative, and Early Postoperative Outcomes in Unmatched Diabetic Patients (n = 11,642)

Variables	TAR		Non-TAR		*p* Value
ITA	3,734	98.4	7,398	94.3	<0.001
BITA	597	15.0	299	3.7	<0.001
RAC	3,207	84.5	2,854	32.6	<0.001

Ann Thorac Surg 2016;102:1948–55

Total Arterial Revascularization: A Superior Strategy for Diabetic Patients Who Require Coronary Surgery

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Department of Cardiothoracic Surgery, Royal Melbourne Hospital, Melbourne; and Department of Surgery, University of Melbourne, Melbourne, Australia

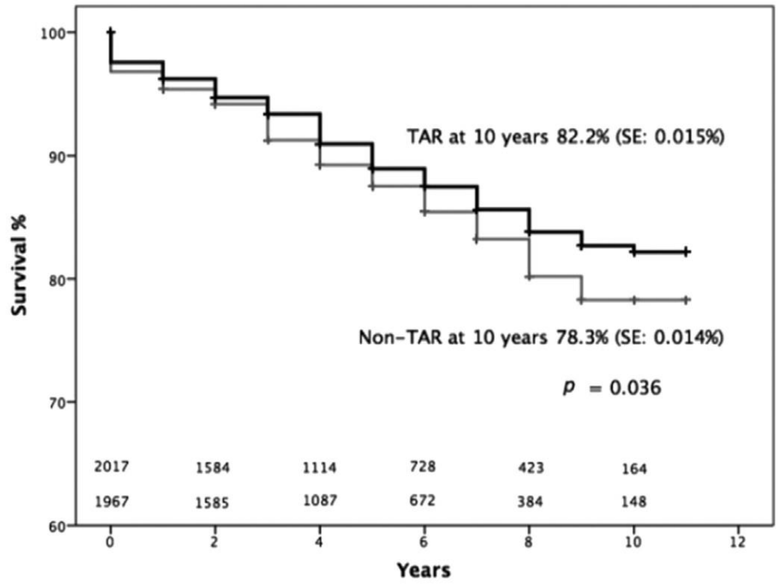


Fig 2. Comparison of Kaplan-Meier survival for matched diabetic total arterial revascularization (TAR) patients (black line) versus non-TAR patients (gray line [log rank, $p < 0.036$]).

Table 2. Preoperative, Intraoperative, and Early Postoperative Outcomes of Diabetic Propensity Matched Total Arterial Revascularization Patients ($n = 3,984$)

Preoperative Variables	TAR		Non-TAR		*p* Value
Early outcomes					
Deep sternal infection	17	0.8	23	1.2	0.301
Septicemia	23	1.1	22	1.1	0.948
Cardiogenic shock	42	1.2	13	0.7	<0.001
LOS >10 days	353	17.5	333	16.9	0.037
30-day mortality	24	1.2	28	1.4	0.506
Late mortality	205	10.2	240	12.2	0.041

Figures in the first and third columns represent number (n) for absolute numbers, and mean values for measurements. Figures in the second and fourth columns represent percentage (%) for absolute numbers, or SD of mean values.

Ann Thorac Surg 2016;102:1948–55

Arterial Grafts Protect the Native Coronary Vessels From Atherosclerotic Disease Progression

Kamellia R. Dimitrova, MD, Darryl M. Hoffman, MD, Charles M. Geller, MD, Gabriela Dincheva, Wilson Ko, MD, and Robert F. Tranbaugh, MD

Division of Cardiac Surgery, Beth Israel Medical Center, New York, New York

Background. We sought to examine the effect of different conduits on the progression of atherosclerosis in previously revascularized coronary territories.

Methods. Between 1995 and 2010, 4,960 patients were discharged alive after primary isolated coronary artery bypass grafting (CABG) with a left internal thoracic artery (LITA) conduit and additional conduits as needed: radial artery (RA) or saphenous vein graft (SVG), or both. Seven hundred seventy-two patients had coronary angiography for recurrent symptoms an average of 5.5 ± 3.5 years after CABG (range, 0.1–16 years). Cumulative graft patency and disease progression in the native vessels was estimated by the Kaplan-Meier survival method. The log-rank test was used to assess differences of disease progression per territory between different types of conduits.

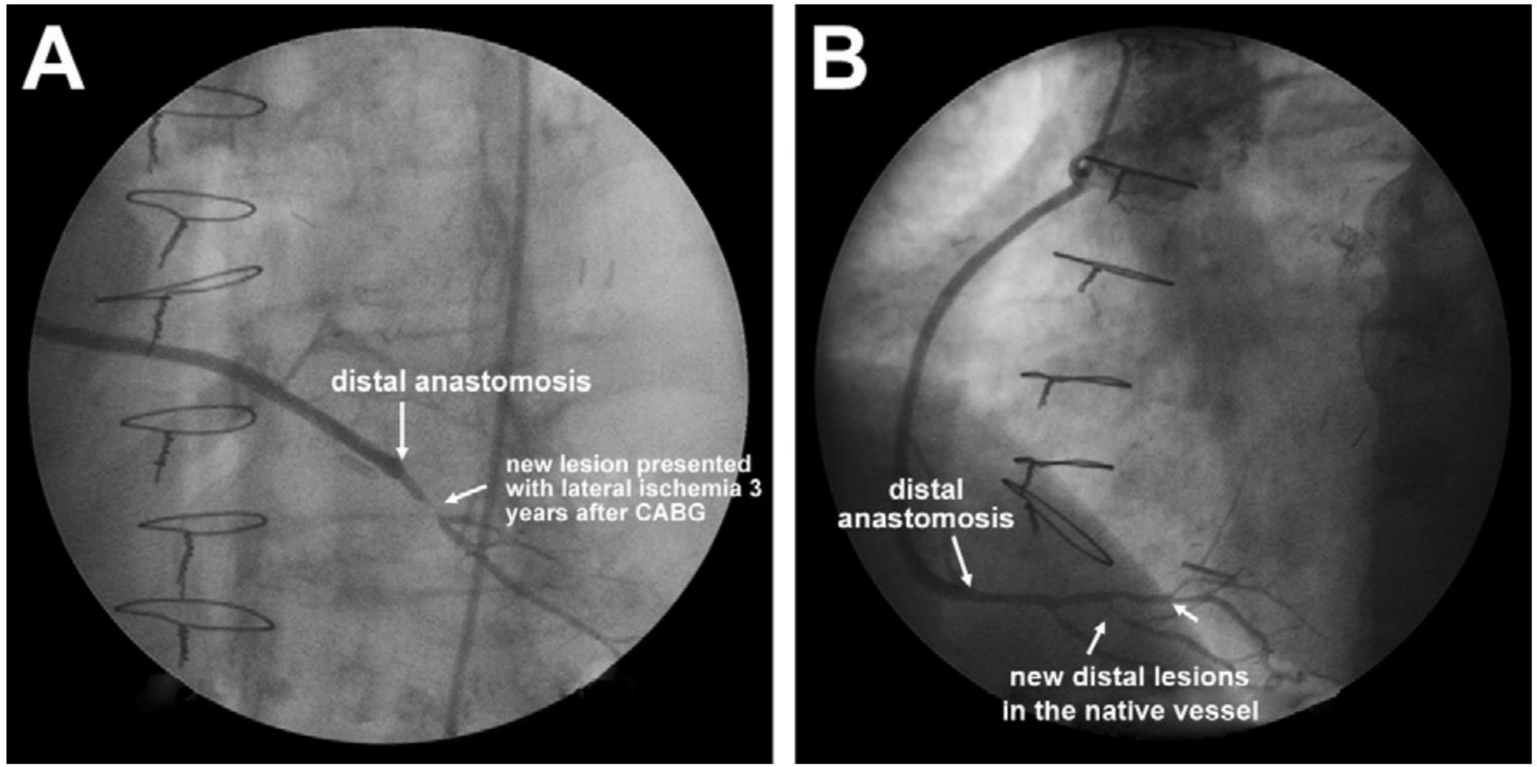
Results. Kaplan-Meier–estimated 1-, 5-, and 10-year overall disease progression in territories with patent LITAs was 0.01%, 4%, and 8%, respectively; with patent RA grafts, it was 0.01%, 6%, and 11%, respectively (log-rank test, $p = 0.157$); and with patent SVGs it was 3%, 19%, and 43%, respectively (log-rank test; $p < 0.0001$). Disease progression in grafted native coronary arteries in the anterior territory with patent LITA-to–left anterior descending (LAD) artery was 8%, and with patent RA grafts versus patent SVGs to the diagonal branches of LAD artery was 10% and 40%, respectively (log-rank test; $p < 0.0001$). Disease progression in grafted native coronary arteries to the lateral territory with a patent RA graft was 11% versus 50% with a patent SVG (log-rank test; $p < 0.0001$).

Conclusions. RA and LITA grafting has a strong protective effect against progression of native coronary artery disease in previously grafted vessels. Multiple arterial grafting may improve long-term survival by preventing progression of atherosclerosis in the native coronary vessels.

(Ann Thorac Surg 2012;94:475–81)

Atherosclerotic Disease Progression

Fig 1. (A) Angiographic image of a patent saphenous vein graft (SVG) to OM_2 with disease progression distal to the anastomosis (10-degree right anterior 30-degree caudal view). (B) Angiographic image of a patent SVG to PDA with diffuse distal disease progression (30-degree right anterior oblique view). (CABG = coronary artery bypass grafting; OM_2 = second obtuse marginal branch of the left circumflex artery; PDA = posterior descending artery.)



Ann Thorac Surg 2012;94:475– 81

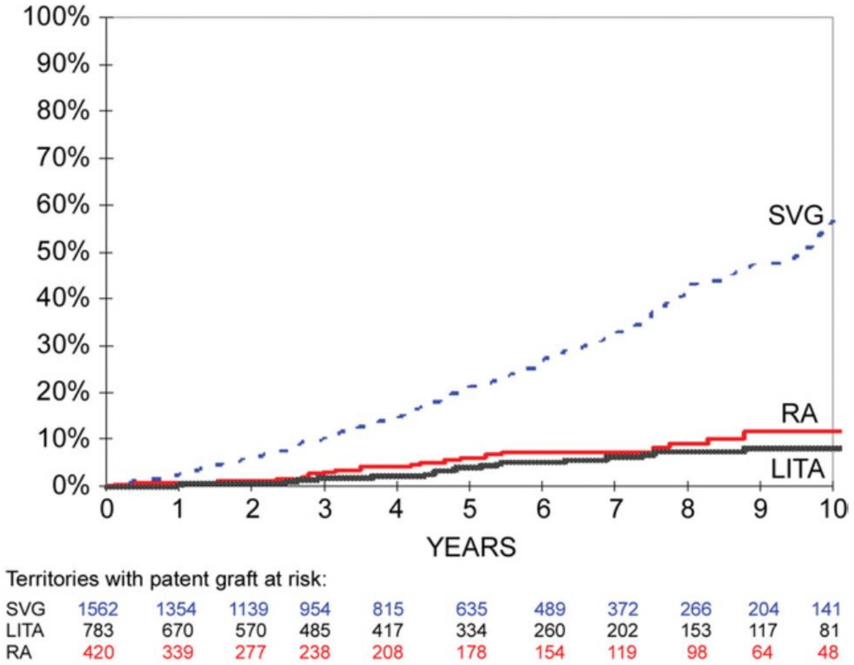


Fig 2. Kaplan-Meier–estimated disease progression rates in all territories with patent conduits. (LITA = left internal thoracic artery; RA = radial artery; SVG = saphenous vein graft.)

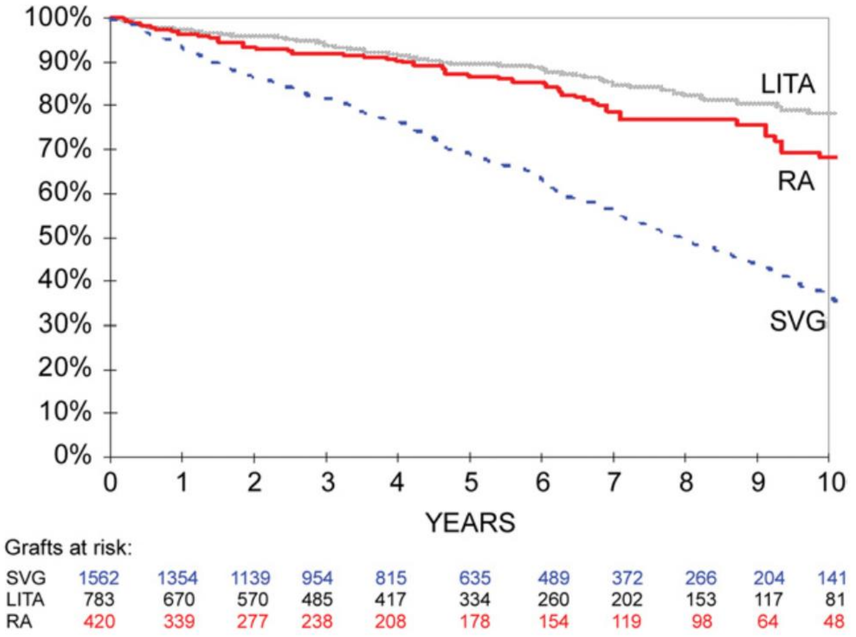


Fig 4. Kaplan-Meier–estimated conduit patency rates. (LITA = left internal thoracic artery; RA = radial artery; SVG = saphenous vein graft.)

Ann Thorac Surg 2012;94:475– 81

Conclusions. **RA and LITA grafting has a strong protective effect against progression of native coronary artery disease in previously grafted vessels. Multiple arterial grafting may improve long-term survival by preventing progression of atherosclerosis in the native coronary vessels.**

Ann Thorac Surg 2012;94:475– 81

AHA SCIENTIFIC STATEMENT

An Update on Radial Artery Access and Best Practices for Transradial Coronary Angiography and Intervention in Acute Coronary Syndrome

A Scientific Statement From the American Heart Association

ABSTRACT: Transradial artery access for percutaneous coronary intervention is associated with lower bleeding and vascular complications than transfemoral artery access, especially in patients with acute coronary syndromes. A growing body of evidence supports adoption of transradial artery access to improve acute coronary syndrome–related outcomes, to improve healthcare quality, and to reduce cost. The purpose of this scientific statement is to propose and support a "radial-first" strategy in the United States for patients with acute coronary syndromes. This document also provides an update to previously published statements on transradial artery access technique and best practices, particularly as they relate to the management of patients with acute coronary syndromes.

Circ Cardiovasc Interv. 2018;11:e000035

REVIEW TOPIC OF THE WEEK

The Radial Artery for Percutaneous Coronary Procedures or Surgery?

Mario Gaudino, MD,[a] Francesco Burzotta, MD, PhD,[b] Faisal Bakaeen, MD,[c] Olivier Bertrand, MD,[d] Filippo Crea, MD,[b] Antonino Di Franco, MD,[a] Stephen Fremes, MD,[e] Ferdinand Kiemeneij, MD, PhD,[f] Yves Louvard, MD,[g] Sunil V. Rao, MD,[h] Thomas A. Schwann, MD,[i] James Tatoulis, MD,[j] Robert F. Tranbaugh, MD,[a] Carlo Trani, MD, PhD,[b] Marco Valgimigli, MD, PhD,[k] Pascal Vranckx, MD, PhD,[l] David P. Taggart, MD, PhD,[m] for the Arterial Grafting International Consortium Alliance

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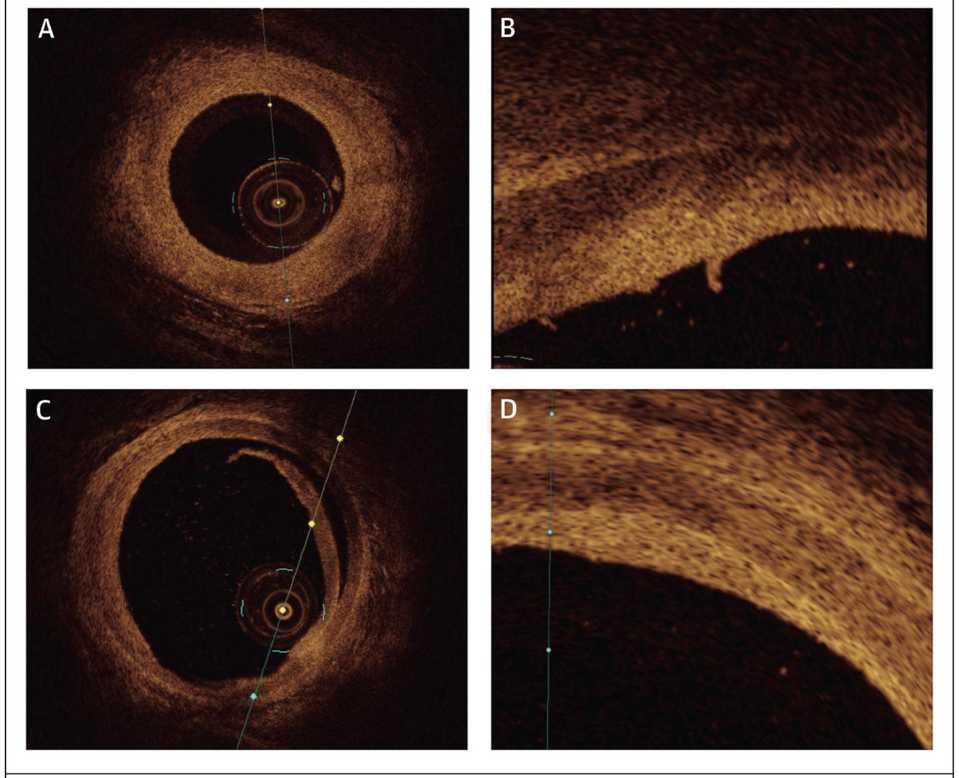
Guadino M et al. J Am Coll Cardiol 2018;71:1167–75

Effect of Transradial Access on Radial Artery

FIGURE 1 Optical Coherence Tomography Documentation of Different Radial Artery Damages Induced by Catheterization



(A) Radial artery spasm documented at procedure's end. **(B)** Radial artery intimal tear documented at procedure's end. **(C)** Radial artery media dissection documented at procedure's end. **(D)** Radial artery intima thickening documented 6 months after a first transradial procedure.

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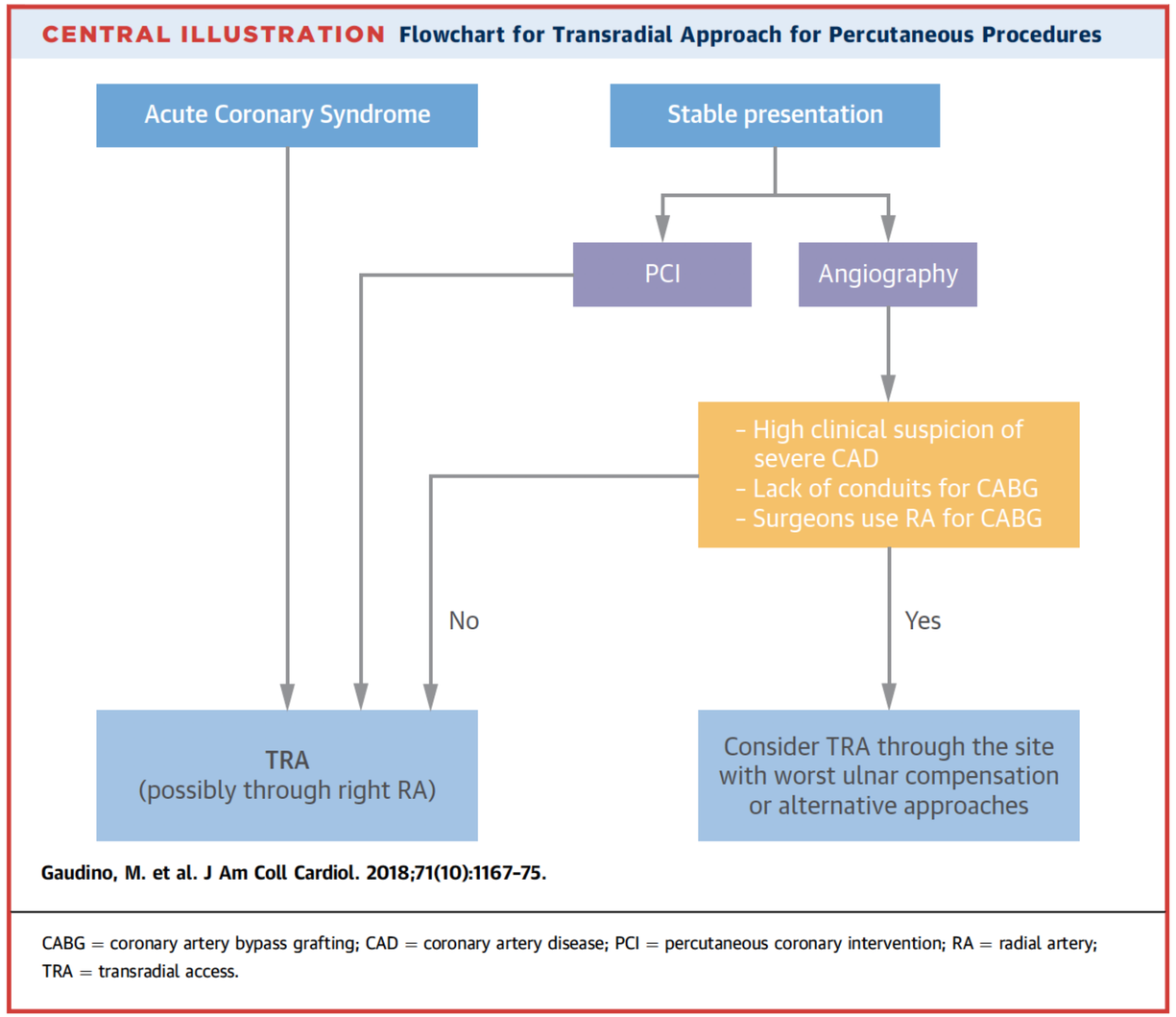

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Take Home Message

- Radial artery should be used in preference to the SV
- Multiarterial CABG
- Superior patency and potential for improved patient longevity
- Excellent for high risk patient for sternal wound complications
- Heart team effort for minimaze RA damage during TRA catheterizations

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THANK YOU

doutormarquito@gmail.com