Commentary: If RITA did not exist, it would be necessary to invent it so if you can't beat them join them

Chaim Locker, MD

From the Department of Cardiovascular Surgery, Mayo Clinic, Rochester, Minn.

Disclosures: Author has nothing to disclose with regard to commercial support.

Received for publication Oct 1, 2018; accepted for publication Oct 1, 2018; available ahead of print Nov 17, 2018.

Address for reprints: Chaim Locker, MD, Department of Cardiovascular Surgery, Mayo Clinic, 200 First St SW, Rochester, MN 55905 (E-mail: lekerlocker.chaim@mayo.edu).

J Thorac Cardiovasc Surg 2019;157:1826-8

0022-5223/\$36.00

Copyright © 2018 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2018.10.030>

Video clip is available online.

“Men make history and not the other way around. In periods where there is no leadership, society stands still. Progress occurs when courageous, skillful leaders seize the opportunity to change things for the better.”

—Harry S. Truman

In this issue of *The Journal of Thoracic and Cardiovascular Surgery*, Gaudino and colleagues¹ present their tremendous work on a large and comprehensive meta-analysis conducted to compare the effect on clinical outcomes of using the radial artery (RA) versus saphenous vein graft (SVG) as the second conduit for coronary artery bypass grafting (CABG) after the regular use of the left internal mammary artery to the left anterior descending coronary artery.¹ A total of 14 studies were included, 7 observational and 7 randomized, including 20,931 patients to represent the “best” evidence available. The authors report that there were no differences found in the rates of perioperative myocardial infarction (MI), stroke, and mortality. With a mean follow-up of 6.6 years, no differences were found in the rates of MI and repeat revascularization, but mortality was lower by 26% with the use of the RA.

The search for the “ideal” second conduit after the left internal mammary artery was ground for numerous observational and randomized studies, but the authors should be commended for their persistency to further explore and analyze the existing data on this debated subject. Importantly, in a very recent previous patient-level combined analysis of 6 randomized controlled trials, comparing RA grafts versus SVGs,² Gaudino and colleagues found somewhat conflicting results with the current ones. In that report of the Radial Artery Database International Alliance project, mortality rates were not different between the RA and

Chaim Locker, MD

Central Message

Skeletonized BITA grafting is superior to any other technique. Total arterial grafting with the addition of radial artery improves survival. Training programs for multiarterial grafting are mandatory.

See Article page 1819.

SVG groups at 5 years, but the rates of MI and repeat revascularization were significantly lower (hazard ratio, 0.72 and 0.50, respectively) in the RA group. In addition, a higher patency rate for the RA grafts was discovered by angiography studies performed on many of the patients included in those trials.

The question raised after the current study is how we could explain lower mortality rates in the RA group at 6.6 years, in the absence of significant differences in the rates of repeat revascularization and MIs. This might definitely stem from unidentified biases in treatment and/or patient selection, and in addition, although repeat revascularization and late MI rates were important goals for the current study, the analyses on those outcomes might have been statistically underpowered. Furthermore, and as the authors stated, these differences might have resulted from the different inclusion criteria; mainly, the inclusion in the current meta-analysis of the important randomized trial conducted by Goldman and colleagues among 757 patients who underwent CABG at 11 Veterans Affairs centers, which did not show any differences in angiographic graft patency between the SVG and RA at 1 year.³ It would be imperative to follow-up on the longer-term angiographic studies of this trial.

Having said this, there are some additional important considerations in the debate for the “second best” arterial conduit. First, there is a big elephant in the room, namely,

VIDEO 1. BITA grafting 32 years ago, still patent LITA to LAD+Diagonal and in-situ RITA through the transverse sinus to obtuse Marginal. Video available at: [https://www.jtcvs.org/article/S0022-5223\(18\)32781-8/fulltext](https://www.jtcvs.org/article/S0022-5223(18)32781-8/fulltext).

the right internal thoracic artery (RITA). It is acceptable for many surgeons, that the RA has superior patency and long-term survival rates compared with the SVG.⁴ However, it has also been shown that the RITA is superior to the RA in clinical outcomes.⁵⁻⁷ It is also agreeable that the left internal thoracic artery (LITA) and RITA are identical arteries, with the same biological qualities. Raja and colleagues reported that using the RITA instead of LITA to bypass the left anterior descending artery has not increased the long-term risk for late death or repeat revascularization.⁸ Hence, if one argues that the RA is superior or at least equal with the RITA, and should be used as the “second best conduit,” why is it only the second best, and not “the best”? No surgeon would suggest using the RA to the left anterior descending artery as the first option. Tatoulis and colleagues showed that the RA is inferior to the LITA and the RITA as a bypass conduit for any coronary target.⁹

After the mounting data on the long-term survival benefits of bilateral internal thoracic artery (BITA) usage,¹⁰ it was only expected that the use of RITA would be skyrocketing. Unfortunately, this has not happened. According to the recent Society of Thoracic Surgeons database report, there was no change in the past decade in the rates of BITA usage.¹¹ Instead, cardiac surgeons are incentivized to care more about the short-term outcomes.¹² This might be the same background for promoting the use of the RA. The fact that the RA can be harvested at the same time with the LITA is appealing to many surgeons, even despite the fact that the transradial artery approach for coronary angiography and percutaneous coronary intervention has been shown to be associated with significantly reduced

all-cause mortality and reduced complications of major bleeding and vascular complications compared with the transfemoral approach, but also with significant intimal damage and reduced patency compared with noncatheterized RA grafts.¹³ If time is the concern with RITA harvest, it has been shown that CABG with BITA increases overall incision time by no more than 30 minutes.¹⁴ If sternal infection rates are the concern, the skeletonized technique has been shown to diminish those as well.¹⁵

The RA and the RITA are 2 very different arteries. Histological and functional studies by He have revealed that there are major differences between those grafts in terms of structure of smooth muscle, contractility, and endothelial function. He reported that the internal thoracic artery (ITA) releases significantly more nitric oxide and other important factors than the RA, and the expression and function of endothelial nitric oxide synthase messenger RNAs are much higher in the ITA than in the RA.¹⁶ Hence, the observation of many surgeons that ITA is almost always and exclusively free of atheromas whereas the RA is not, might be explained by those findings. Additionally, genomic analysis of both ITAs suggest that the pathways associated with atherosclerosis and inflammation are downregulated in these conduits and might also affect progression of disease in the conduit as well as in the bypassed coronary artery.¹⁷

There is a tendency to include those 2 different arterial conduits under the same umbrella of multiarterial grafting. Clear definition should be made between the two. It was also required in the current report,¹ to further extend on the main concerns with the use of the RA. The RA is prone to severe spasm (string sign) and to catastrophic consequences as a result. The caliber of the coronary vessel bypassed, the degree of stenosis in the coronary compared with the diameter of the vessel and the conduit, the competitive flow in the coronary artery, the number of targets bypassed with the RA, the use of it as free graft or as composite-T from the side of the LITA, the distance between sequential anastomoses, the lie of the conduit in between, and the size and configuration of the anastomosis (side to side vs diamond shaped)—all are crucial considerations to consider before and during the decision if and how to use the RA. The recent trend of promoting the RA as the “second best conduit” without carefully describing its limitations in detail is worrisome.¹⁸

There is still an important role for the RA. In many recent studies, it has been shown that total arterial revascularization is associated with a significant survival benefit compared with non-total arterial revascularization.¹⁹ Hence, if you can't beat them join them. Finally, because coronary surgery demands a higher level of surgical skills and expertise, and with the results of centers of excellence (Video 1) and experience in multiarterial grafting being superior than those without it,²⁰ the leadership of the cardiothoracic surgery societies ought to take explicit action,

and define the use of BITA grafting as a quality metric, and coronary surgery as a subspecialty in cardiac surgery, so specific training programs could be established soon.

References

1. Gaudino M, Rahouma M, Abourab A, Leonard J, Kamel M, Di Franco A, et al. Radial artery versus saphenous vein as the second conduit for coronary artery bypass surgery: a meta-analysis. *J Thorac Cardiovasc Surg.* 2019;157:1819-25.
2. Gaudino M, Benedetto U, Fremes S, Biondi-Zoccai G, Sedrakyan A, Puskas JD, et al. Radial-artery or saphenous-vein grafts in coronary-artery bypass surgery. *N Engl J Med.* 2018;378:2069-77.
3. Goldman S, Sethi GK, Holman W, Thai H, McFalls E, Ward H, et al. Radial artery grafts vs saphenous vein grafts in coronary artery bypass surgery. *JAMA.* 2011;305:167-74.
4. Gaudino M, Taggart D, Suma H, Puskas JD, Crea F, Massetti M. The choice of conduits in coronary artery bypass surgery. *J Am Coll Cardiol.* 2015;66:1729-37.
5. Ruttman E, Fischler N, Sakic A, Chevtchik O, Alber H, Schistek R, et al. Second internal thoracic artery versus radial artery in coronary artery bypass grafting: a long-term, propensity score-matched follow-up study. *Circulation.* 2011;124:1321-9.
6. Raja SG, Benedetto U, Jothisdan A, Jujjavarapu RK, Ukwu UF, De Robertis F, et al. Right internal mammary artery versus radial artery as second arterial conduit in coronary artery bypass grafting: a case-control study of 1526 patients. *Int J Surg.* 2015;16:183-9.
7. Benedetto U, Caputo M, Gaudino M, Marisco R, Rajakurana C, Bryan A, et al. Right internal thoracic artery or radial artery? A propensity-matched comparison on the second-best arterial conduit. *J Thorac Cardiovasc Surg.* 2017;153:79-88.
8. Raja SG, Benedetto U, Husain M, Soliman R, De Robertis F, Amrani M. Does grafting of the left anterior descending artery with the in situ right internal thoracic artery have an impact on late outcomes in the context of bilateral internal thoracic artery usage? *J Thorac Cardiovasc Surg.* 2014;148:1275-81.
9. Tatoulis J, Buxton BF, Fuller JA. The right internal thoracic artery: the forgotten conduit-5766 patients and 911 angiograms. *Ann Thorac Surg.* 2011;92:9-17.
10. Weiss AJ, Zhao S, Tian DH, Taggart DP, Yan TD. A meta-analysis comparing bilateral internal mammary artery with left internal mammary artery for coronary artery bypass grafting. *Ann Cardiothorac Surg.* 2013;2:390-400.
11. D'Agostino RS, Jacobs JP, Badhwar V, Fernandez FG, Paone G, Wormuth DW, et al. The Society of Thoracic Surgeons adult cardiac surgery database: 2018 update on outcomes and quality. *Ann Thorac Surg.* 2018;105:15-23.
12. Lytle BW. Bilateral internal thoracic artery grafting. *Ann Cardiothorac Surg.* 2013;2:485-92.
13. An KR, Tam DY, Gaudino MF, Fremes SE. Radial arteries for coronary angiography and coronary artery bypass surgery: are two arteries enough? *J Thorac Cardiovasc Surg.* June 23, 2018 [Epub ahead of print].
14. Calafiore AM, Iaco AL, Di Mauro M. Spending 30 minutes to add years to a patient's life: why is the last step so difficult? *J Thorac Cardiovasc Surg.* 2015;150:321-2.
15. Benedetto U, Altman DG, Gray AM, Gerry S, Gray A, Lees B, et al. Pedicled and skeletonized single and bilateral internal thoracic artery grafts and the incidence of sternal wound complications: insights from the Arterial Revascularization Trial. *J Thorac Cardiovasc Surg.* 2016;152:270-6.
16. He GW. Arterial grafts: clinical classification and pharmacological management. *Ann Cardiothorac Surg.* 2013;2:507-18.
17. Fortier JH, Ferrari G, Glineur D, Gaudino M, Shaw RE, Ruel M, et al. Implications of coronary artery bypass grafting and percutaneous coronary intervention on disease progression and the resulting changes to the physiology and pathology of the native coronary arteries. *Eur J Cardiothorac Surg.* 2018;54:809-16.
18. Royse AG, Brennan AP, Ou-Young J, Pawanis Z, Canty DJ, Royse CF. 21-Year survival of left internal mammary artery-radial artery-Y graft. *J Am Coll Cardiol.* 2018;72:1332-40.
19. Yanagawa B, Verma S, Mazina A, Tam DY, Juni P, Puskas JD, et al. Impact of total arterial revascularization on long-term survival: a systematic review and meta-analysis of 130,305 patients. *Int J Cardiol.* 2017;233:29-36.
20. Schwann TA, Habib RH, Wallace A, Shahian DM, O'Brien S, Jacobs JP, et al. Operative outcomes of multi-arterial versus single-arterial coronary bypass grafting. *Ann Thorac Surg.* 2018;105:1109-20.