Author has nothing to disclose with regard to commercial support.

RIGHT INTERNAL THORACIC ARTERY OR SAPHENOUS VEIN FOR GRAFTING THE RIGHT CORONARY ARTERY?

To the Editor:

We read with great interest the article by Benedetto and colleagues¹ and would like to take part in this ongoing debate regarding the choice of grafts for coronary artery bypass grafting. The authors report that right internal thoracic artery (RITA) to right coronary artery (RCA) grafting is associated with improved late survival compared with saphenous vein grafting, and this beneficial influence on survival appears around 9 years.

In principle we agree with the authors¹ that arterial grafts should be considered for the anterolateral wall as the first choice, as shown in their cohort (RITA-left anterior descending artery [n = 273] and RITA-circumflex [n = 414]) and grafted to the inferior wall only when the right coronary branches are critically stenosed (ie, >75%).

We find that the patency of each conduit is invariably connected to the runoff and the ventricular mass supplied by the anastomosed coronary artery. This is why grafts to the left anterior descending artery exhibit the best patency rates. Shah and colleagues² reported on the factors affecting the late patency of the internal thoracic arteries (ITAs). They showed that grafts to the RCA and posterior descending artery (PDA) had worse patency and higher failure rates than left-sided grafts. Schmidt and colleagues³ concluded that using an arterial conduit to treat right coronary artery disease is not beneficial. These authors demonstrate a significant improvement in survival of patients who received ITA grafts to left-sided arteries compared with patients who had an ITA grafted on the right side.

We also need to focus on the article's subgroup analysis, which showed evidence toward better results with in situ configuration rather than the free RITA. This comes as no surprise.

It is widely recognized that an in situ RITA may not always reach the PDA, even when harvested in a skeletonized fashion, and it is difficult to use even as a free graft due to technical considerations arising from the proximal anastomosis to the aorta. Moreover, we think the average RCA is not clinically equivalent to the left-sided branches. The RCA is often a small, calcified, and hence suboptimal target.

The choice of location for the second arterial graft should be individualized according to the dominance of the circulation; the size of the branches arising from the RCA; and, most importantly, the runoff and myocardial mass supplied by each target vessel. The importance of this last criterion is highlighted by the fact that even saphenous veins exhibit better patency rates when grafted to the left anterior descending artery compared with the RCA.⁴ In general, the lateral wall constitutes a better potential second target due to the fact that the PDA usually supplies only one-third of the interventricular septum. This was advocated by Gaudino and colleagues in a recent article.⁵ Ultimately, location of the second arterial graft should be guided by the extent of viable myocardium at risk in each territory.

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References

1. Benedetto U, Caputo M, Gaudino M, Mariscalco G, Bryan A, Angelini GD. Is the right internal thoracic artery superior to saphenous vein for grafting the right coronary artery? A propensity score based analysis. *J Thorac Cardiovasc Surg.* 2017; 154:1269-75.e5.
2. Shah PJ, Durairaj M, Gordon I, Fuller J, Rosalion A, Seevanayagam S, et al. Factors affecting patency of internal thoracic artery graft: clinical and angiographic study in 1434 symptomatic patients operated between 1982 and 2002. *Eur J Cardiothorac Surg.* 2004;26:118-24.
3. Schmidt SE, Jones JW, Thornby JJ, Miller CC III, Beall AC Jr. Improved survival with multiple left-sided bilateral internal thoracic artery grafts. *Ann Thorac Surg.* 1997;64:9-14; discussion 15.
4. Goldman S, Zadina K, Moritz T, Ovitt T, Sethi G, Copeland JG, et al. Long-term patency of saphenous vein left internal mammary artery grafts after coronary artery bypass surgery: results from a Department of Veterans Affairs Cooperative Study. *J Am Coll Cardiol.* 2004;44:2149-56.
5. 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.

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TO SKELETONIZE THE INTERNAL THORACIC ARTERY OR NOT TO SKELETONIZE? TO BE OR NOT TO BE!

Reply to the Editor:

Karangelis¹ has contributed insightful comments to the debate of choice of grafts in coronary surgery. He states that arterial grafts should be considered for

Author has nothing to disclose with regard to commercial support.

the anterolateral wall first and grafted to the inferior wall only when the right coronary artery (RCA) or branches are critically stenosed. In addition, he points out that patency is invariably connected to the runoff and the ventricular mass supplied by the coronary artery. Up to that point his statements are reasonably agreeable. However, he continues by bringing up a 2004 study reported by Shah and colleagues² stating right internal thoracic artery (RITA) grafts to the RCA and posterior descending artery (PDA) had worse patency rates compared with left-sided grafts. True, but we have to note 2 important points. First, this applies to all conduits, including saphenous vein grafts and radial arteries, as clearly shown by the same group 7 years later, where Tatoulis and colleagues³ concluded that “RITA patency was always better than the radial artery and saphenous vein grafts ($P < .001$)” no matter to which coronaries they were grafted. Second, a more important fact not mentioned by Karangelis¹ is that in the first study, none of the internal thoracic arteries (ITAs) harvested as in situ grafts were skeletonized, whereas in the later study, all ITAs were harvested in skeletonized fashion. This apparently made a major technical difference in reaching the RCA and its branches.

Karangelis¹ quotes another study, concluding that using arterial conduit to the RCA is not beneficial.⁴ That series, from 20 years ago, exclusively used pedicled ITAs and the authors acknowledged particularly the technical limitations of in situ pedicled RITA and the available options to better use it as described by Tector and colleagues.⁵ More recent reports have shown similar benefit from using the RITA to the left or to the right coronary system, as long as it was skeletonized.^{6,7}

In our report,⁸ indeed, more arterial grafts were directed to the left coronary system, but overall, 30% of RITA grafts were anastomosed to the RCA territory, and 20% of cases in our multiarterial grafting cohort were grafted with 1 artery to the left anterior descending and a second artery to the RCA territory with no additional arterial grafting to the left coronary system. In our experience, meticulous skeletonization of the in situ RITA graft almost always achieves enough length to easily reach the PDA (Figure 1). There are additional technical pitfalls to be avoided and measures to be taken to ensure that outcome, but those are beyond the scope of this letter. In the rare event when an in situ RITA would not reach safely to the PDA, there are 2 options. First, if the stenosis is prominent ($>70\%$), the RITA could be detached from its origin at the right subclavian artery and anastomosed as a free graft to the side of the skeletonized

FIGURE 1. In situ skeletonized right internal thoracic artery (A) reaches to posterolateral and posterior descending artery (B). Note the diaphragm.

left ITA. This way it could be used as a composite-T graft to bypass lateral wall coronaries sequentially, if needed (and there is no risk for competitive flow),⁹ and with its end it will reach to the PDA 100% of the time. The second option, and in our experience the less common, is to use the RITA as a free graft to the PDA and perform a proximal anastomosis to the aorta; a previous report showed equivalent excellent results with this technique.³

The RCA is in some cases an important dominant vessel and should not be neglected due to lack of surgical experience. Many surgeons are not familiar with the appropriate use of the RITA, and hence they are reluctant to perform composite-T grafting, sequential coronary grafting, and other required arterial conduit configurations.¹⁰ In the best-case scenario they may be using RITA as an in situ graft if it reaches the target. This also explains the persistent low rate (4%) of bilateral ITA (BITA) use in the United States, and further enhances the importance of implementation of the skeletonized ITA harvest technique.

Skeletonized BITA allows a higher rate of arterial grafting due to increased length and flow, and improved outcome and survival compared with pedicled BITA.¹¹ It is a more difficult operation to perform and requires more time, patience, and surgical skill. It is no longer the

bread-and-butter coronary artery bypass graft operation to be performed by a first-day, first-year resident physician. Residency programs should focus on learning to harvest ITAs in skeletonized fashion, and how to use them. Considering that skeletonized BITA also substantially lowers sternal infection rate¹² compared with pedicled BITA, it should become the exclusive technique used with patients undergoing coronary revascularization.

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References

1. Karangelis D. Right internal thoracic artery or saphenous vein for grafting the right coronary artery? *J Thorac Cardiovasc Surg.* 2018;155:229.
2. Shah PJ, Durairaj M, Gordon I, Fuller J, Rosalion A, Seevanayagam S, et al. Factors affecting patency of internal thoracic artery graft: clinical and angiographic study in 1434 symptomatic patients operated between 1982 and 2002. *Eur J Cardiothorac Surg.* 2004;26:118-24.
3. Tatoulis J, Buxton BF, Fuller JA. The right internal thoracic artery: the forgotten conduit – 5766 patients and 991 angiograms. *Ann Thorac Surg.* 2011;92:9-17.
4. Schmidt SE, Jones JW, Thornby JJ, Miller CC III, Beall AC Jr. Improved survival with multiple left-sided bilateral internal thoracic artery grafts. *Ann Thorac Surg.* 1997;64:9-15.
5. Tector AJ, Dress DC, Downey FX, Schmahl TM. Complete revascularization with internal thoracic artery grafts. *Semin Thorac Cardiovasc Surg.* 1996;8:29-41.
6. Sabik JF III, Stockins A, Nowicki ER, Blackstone EH, Houghtaling PL, Lytle BW, et al. Does location of the second internal thoracic artery graft influence outcome of coronary artery bypass grafting? *Circulation.* 2008;118:S210-5.
7. Kurlansky PA, Traad EA, Dorman MJ, Galbut DL, Zucker M, Ebra G. Thirty year follow up defines survival benefit for second internal mammary artery in propensity matched groups. *Ann Thorac Surg.* 2010;90:101-8.
8. Locker C, Schaff HV, Dearani JA, Joyce LD, Park SJ, Burkhart HM, et al. Multiple arterial grafts improve late survival of patients undergoing coronary artery bypass graft surgery. Analysis of 8622 patients with multivessel disease. *Circulation.* 2012;126:1023-30.
9. Glineur D, Boodhwani M, Hanet C, de Kerchove L, Navarra E, Astarci P, et al. Bilateral internal thoracic artery configuration for coronary artery bypass surgery a prospective randomized trial. *Circ Cardiovasc Interv.* 2016;9:e003518.
10. 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.
11. Di Mauro M, Iaco AL, Acitelli A, D'Ambrosio G, Filippini L, Salustri E, et al. Bilateral internal mammary artery for multi-territory myocardial revascularization: long term follow up of pedicled versus skeletonized conduits. *Eur J Cardiothorac Surg.* 2015;47:698-702.
12. Kieser TM, Rose MS, Aluthman U, Montgomery M, Louie T, Belenkie I. Toward zero: deep sternal wound infection after 1001 consecutive coronary artery bypass procedures using arterial grafts: implications for diabetic patients. *J Thorac Cardiovasc Surg.* 2014;148:1257-64.

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LEFT-RIGHT CHOICE IN CORONARY ARTERY BYPASS GRAFTING SURGERY

Reply to the Editor:

We thank Dr Karangelis for his comments on our recent article.¹ We agree that the left coronary system represents the first target for bilateral internal thoracic artery (BITA) grafts,

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and that the role of BITA grafting for right coronary artery revascularization is less relevant.² The BITA graft should be used for the right coronary artery when no targets suitable for the BITA graft are present on the left coronary artery system. As suggested by other reports,² BITA grafts to the right coronary artery should be used only in the presence of severe proximal stenosis and viable myocardium in its distribution (good runoff). In the case of BITA grafting to the left coronary system, the radial artery remains a valid alternative for right coronary artery revascularization, particularly in young patients with long life expectancy.³

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References

1. Benedetto U, Caputo M, Gaudino M, Mariscalco G, Bryan A, Angelini GD. Is the right internal thoracic artery superior to saphenous vein for grafting the right coronary artery? A propensity score-based analysis. *J Thorac Cardiovasc Surg.* 2017;154:1269-75.e5.
2. Sabik JF III, Stockins A, Nowicki ER, Blackstone EH, Houghtaling PL, Lytle BW, et al. Does location of the second internal thoracic artery graft influence outcome of coronary artery bypass grafting? *Circulation.* 2008;118(14 Suppl):S210-5.
3. Shi WY, Tatoulis J, Newcomb AE, Rosalion A, Fuller JA, Buxton BF. Is a third arterial conduit necessary? Comparison of the radial artery and saphenous vein in patients receiving bilateral internal thoracic arteries for triple vessel coronary disease. *Eur J Cardiothorac Surg.* 2016;50:53-60.

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TOPOGRAPHIC MAPPING OF REGIONAL CONTRACTILE INJURY IN ISCHEMIC MITRAL REGURGITATION: ARE REGIONAL SHAPE DEFORMATION INDICES ANSWER ENOUGH?

To the Editor:

We read with great interest the article by Lancaster and colleagues¹ regarding regional left ventricular contractile injury in ischemic mitral regurgitation (MR). Magnetic resonance imaging-based multiparametric strain analysis demonstrated severe normalized contractile injury in the papillary muscle-related left ventricular subregions in