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Discussion

Dr Nishant Saran (Rochester, Minn.) Last year, the 5-year results of ART were published, which showed essentially no difference in survival benefit at 5 years between the BITA and the single ITA groups. This brings back into focus the debate between BITA and LITA. For the last 1.5 decades, the evidence has shown that use of BITA is superior to the use of LITA alone, and despite this evidence, there has been a low worldwide use rate of BITA, with 4% in the United States and 12% in Europe and Australia. So why has there been an inherent resistance, despite the evidence, among the surgeons to embrace BITA more liberally? This has been because of the perception of poor results of BITA in patients with perceived high-risk factors, such as advancing age, low EF, obesity, diabetes, and CLD. Of course, in the current era the surgeon is

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pressed to look into improved short-term outcomes and operating room turnover times; an extra half an hour for BITA tends to push the surgeon the other way. We looked into identifying the trends in BITA use in our practice to ascertain if there is a survival benefit and find if this survival benefit persisted in the high-risk groups. We retrospectively reviewed 9084 patients from January 2000 to 2015 who received CABG at our institution. We included patients who had 2 or more grafts and had BITA or LITA use alone. We excluded patients with single grafts, use of RITA alone, or concomitant cardiac surgery. We found 6468 patients with isolated multivessel CABG. Of these, 1037 patients were in the BITA group and 5431 patients were in the LITA group. To achieve a comparable matched group, we did the propensity score matching and found a matched pair set of 1011 patients. We did a survival analysis between these 2 groups and found the differential effect of BITA on the survival in the high-risk groups, where the high-risk groups were defined as EF less than 30%, BMI more than 30, age more than 70 years, and patients with CLD or stroke. What we found in our study was since 2012, there was a doubling in the rate of use of BITA from 12% in 2012 to 27% in 2015. This was the result of our own analysis published in 2012, wherein we found that multiarterial grafts had a better survival benefit compared with LITA-vein. Excuse me for this busy slide, but I have used this to convey the message of the exhaustive list of variables we included to match the patient subsets.

When we look into the unmatched subset, we find that the BITA patients are younger and have lesser diabetes and lower BMI, and are less often female. Patients with LITA alone have 4 times the chance of being in congestive heart failure. Stroke and CLD were twice as common in the LITA alone group, whereas patients with BITA had better heart function. This unmatched set shows the clear treatment selection bias we have. BITA goes to the healthier patient set, and to remove this treatment selection bias, we wanted to achieve a propensity matching that would give us a standardized difference of 0.0 for all these variables. We found 1011 pairs of patients with this matching. To convey the effectiveness of the matching, here is the slide where we see the distribution of the propensity score between the matched sets. When we evaluated our results, of course the SVGs were more common in the LITA alone group, but the radial grafts were also more common in the LITA alone group. Perfusion time was lower in the BITA group, although the crossclamp time was higher in the BITA group. Of course, incision time was approximately 40 minutes more than in the LITA alone group. When we looked into the postoperative outcomes, the ICU length of stay was lower in the BITA group, but the sternal infection, both superficial and deep, was twice as common in the BITA group. The deep sternal infection, although the numbers were slightly higher in the BITA group, was not statistically significant. In terms of survival, with a $P$ value of .03, we found that the BITA cases tend to do better than the LITA-alone cases. The Kaplan–Meier curves clearly show the difference at 5 years too, with 93.8% of the BITA cases surviving. The curves really tend to diverge after the first 7 to 8 years with 10-year results of 19% risk reduction in death in BITA cases.

Having established a survival benefit, we looked into the high-risk factors, and you see from this slide, in patients aged more than 70 years, the HRs were still protective in the BITA group. The HR for patients aged more than 70 years was 0.75, not much different from the HR with age less than 70 years. For women, the HR is not much different. For BMI more than 30, the HR was pretty much unchanged, the interaction being just 0.87. Lower EF, the HR with BITA cases was actually better at 0.54, but there was no significant interaction. For diabetes, the HRs were better. For stroke, the HRs were unchanged. For CLD, the HRs were better with BITA cases. In patients with nonelective surgery, the HRs were pretty much unchanged, thereby suggesting that the survival benefit of BITA persisted in all these high-risk groups that we looked into. Having established this, we then looked into the higher risk of sternal-site infections, and whether the higher risk persisted if we adjust for the risk factors, which included gender, diabetes, BMI more than 30, CLD, and the year of surgery. In the earlier years, pedicled thoracic harvesting technique was more common than skeletonized, whereas the use of aspirin and statins was common in the latter era. We found that the risk of sternal site infections was 2 times higher with BITA, but we found no significant difference in deep sternal infections. This higher risk persisted with an OR of 2.39 despite adjusting for the high-risk factors.

This study has the limitations of being a retrospective single-center study and our inability to control for all the possible variables despite the best possible efforts to use an exhaustive list of measurable variables, but then there will always be variables that you cannot measure (eg, patient fitness).

There is an increasing use rate of BITA at our institution, and the favorable outcomes of BITA persist in perceived high-risk patients; therefore, there should be a more extensive use of BITA in patients with multivessel CAD.
less than 4% of CABG cases in the United States are afforded the benefits of BITA grafts. Across the 17 cardiac surgery programs reporting outcomes to the Cardiac Outcomes Assessment Program in the state of Washington, BITA use ranges from just 0% in most programs to 54% and only 1 program uses BITAs more than 10% of the time. It is important to consider that in the SYNTAX Trial, 28% of the patients in the randomized trial and 16% of patients in the registry received BITA grafts. Whether every patient benefits from BITA grafting remains undetermined. Despite the favorable observational trials, David Taggart, as you mentioned, published the 5-year data from the ART that failed to demonstrate a survival advantage for BITA at 5 years. I congratulate you and your co-authors for your persistence and successfully increasing BITA use in coronary vascularization at the Mayo Clinic. In your current study, you have shown improved survival for BITA grafting at 1, 5, and 10 years over patients receiving only a LITA graft with no difference in operative mortality. The cost of this 20% to 22% survival advantage in several high-risk patient subsets was a small increase in the incidence of sternal site infections but not deep sternal wound infections. I have several questions for you regarding your study. One, coronary disease complexity could influence surgeons against using BITA grafts and influences CABG outcomes, thereby introducing the possibility for bias. Did you consider including any assessment of the complexity of coronary disease, for example, the SYNTAX score and your propensity score?

Dr Saran. We did include patients with left main stenosis more than 50% as 1 of the variables. This study included patients with multivessel CAD as in 2-vessel and 3-vessel disease to account for the coronary anatomy that we were talking about. We did not include the SYNTAX scores. This is an STS database study.

Dr Lehr. It would be difficult to calculate the SYNTAX scores, but just looking at left main and simple 2- or 3-vessel diseases may not capture all of that bias. A number of different grafting strategies were used for the RITA. Could you detect if one approach provided a greater benefit to patients, and likewise, did any strategies fail to benefit patients?

Dr Saran. We did not specifically look into the grafting strategies. We did find that approximately 30% of our RITA grafts went to the right coronary, and despite the use of multiple grafting strategies and concern for use of RITA for right coronary grafting, we still found a survival benefit in favor of BITA.

Dr Lehr. Finally, should BITA grafting be considered a quality metric in coronary vascularization, despite the small increase in sternal site infections, even though sternal wound infections have been declared a never event and are tied to reimbursement.

Dr Saran. I agree with you, I think BITA should be the gold standard, and it should be the first thing that a surgeon, a coronary surgeon, should always think of when he/she meets a patient for CABG, and then look into things or concerns of why he/she cannot or may not be able to do it. But I guess the current trend of practice is different.

Dr Richard Shemin. Please identify yourself and where you’re from.

Participant: _____. Did you examine the effects of multiple risk factors on outcomes with BITA use, such as patients who have obesity, diabetes, and CLD? How does the use of BITA affect that patient group?

Dr Saran. We did. So that’s what the differential effect of all these high-risk groups looks into, and we found that essentially the survival benefit persisted in these high-risk groups. We also did a multivariate analysis that established the same thing.

Participant. But I’m asking in combination, if you have patients who have 3 risk factors versus no risk factors, 4 risk factors versus no risk factors?

Dr Saran. Right. So, in patients such as diabetic women with obesity, we did look into it specifically and found that survival benefit persisted, and there was no adverse differential effect on the survival benefit.

Dr Tony Furnary. I’m having trouble reconciling your main figure and your conclusion that there are significant improvements in survival with 2 survival curves that have 95% composite intervals that overlap the entire way out. I’m wondering if you used the correct test to determine the difference in survival, because when I look at that or my statistical colleague Gary Grunkemeier looks at that, there’s no difference in those curves. So, I’m not sure that the main premise is correct. Could you explain that?

Dr Saran. Sure. So, we did the log-rank test to establish the difference in our survival curves and, the P value is definitely significant at 0.03. I understand what you’re saying that the curves look similar, but it’s after 7 to 8 years they diverge. Statistical analysis proves it.

Dr Furnary. I’m not sure that’s the correct test. I’m not sure you have shown a difference in survival in the long-term survival in these 2 groups. I think I would look at that closely. So, I don’t want to argue with you about it, we’ll let the statisticians determine that, but I don’t think you’ve proven the main premise to me yet.

Dr Saran. In the survival analysis figure, the appearance of overlapping CIs between the 2 treatments does not imply the group difference is not statistically significant. It has been shown that, in general, lack of overlap between two 95% CIs corresponds to an approximate P value of less than 0.005. Therefore, because our propensity analysis declared the survival curves different at P = 0.03, it is not too surprising to see those intervals overlap. Also in the Cox proportional hazard risk adjusting model, BITA was associated with 19% risk...
reduction with the HR being 0.80 and a 26% risk reduction after additional adjustment for all baseline covariates used in the propensity model with an HR of 0.74.

Dr Furnary. Yes, we’ll see what the reviewers say.

Dr Shemin. Yes?

Dr Howard Song (Portland, Ore). Congratulations, this was a great study, spreading the gospel of arterial grafting, which as you pointed out, our country is lagging behind in. You went through the list of variables that you controlled for in your propensity matching. Did you control for surgeon?

Dr Saran. No we did not.

Dr Song. Does the rate of BITA use vary by surgeon in your institution?

Dr Saran. To be honest it may, but we looked into our institutional practice as a whole, and at the Mayo Clinic, normally the practice is a standardized one, but of course the surgeon preferences change and so will according to the patients.

Dr Song. Do you think it’s possible that BITA use is a surrogate for a highly skilled subspecialist in coronary revascularization who you may expect to have improved outcomes over time?

Dr Saran. That may be one way of looking at it; however, even very skilled surgeons still have that inherent bias of not doing BITA. With the pressure of increased operating room turnover time and the short-sightedness of the short-term outcomes, I guess some of the surgeons do have that inherent reluctance in embracing BITA.

Dr Song. It is important as a message to the field that what these retrospective studies frequently show is that providers are skilled at picking the proper therapy based on both patient factors and their own skill level. I think a study like this doesn’t necessarily show that every surgeon should be performing BITA use liberally; it shows that surgeons in your practice who do that do have excellent outcomes.

Dr Saran. I agree.

Dr Shemin. Very quickly, we have time for 1 more question.

Dr David Joyce (Milwaukee, Wis). That’s an excellent point that was brought up, and I’d like to share with everyone kind of the nature of the practice at Mayo, and we have Chaim Locker here who is the second author on this article, and there’s no question that we treat BITA use like anybody can do it. If you can take a LITA, you can do a BITA. It is like anything else, there’s a 10,000-hour rule, and we are fortunate to have somebody who has exceptional skill in this operation, and I remember the first time I did a case with Dr Locker. He pulled the thoracic out of the right chest, wrapped it around the heart 3 times, and said, where do you want to put it. When you’re working with that kind of expertise, you’re going to be more likely to use a BITA. Just as he has a tremendous ability with this operation, he’s a huge, passionate advocate for it, and I think you need somebody like that in your practice as well. I started to worry that if I didn’t use a BITA, Chaim was going to send a bounty hunter after me or something if I didn’t have a high use rate. I think it takes a lot of aggressiveness within your program, and there’s no question that there’s a skill level here.

Participant. Currently in your practice, are you doing skeletonized thoracic arteries on all thoracic take-downs?

Dr Joyce. Yes, my personal style, which may be different than everyone else in the group, if it’s a LITA alone, I’ll use it as a pedicle, but for BITA, skeletonization, and we’re working on a follow-up study to show that we think we can bring that wound infection rate down by looking at the difference between skeletonized and pedicle, but we think there’s going to be a difference there as well.

Participant. In large groups like yours, do you think it’s worthwhile having a strategy to set a goal of how many bilateral thoracic arteries you should have in your practice given the literature and the fact that we appear to be laggards in achieving the goals that Europeans and other have been able to achieve?

Dr Joyce. Absolutely. That was really 1 of the goals of this study. We don’t really know what the max…I mean just like with off-pump or anything else, the correct percentage that we should have is probably not 100%, it’s somewhere between where we are now and something much higher than that. What I hope we’ve shown here is that maybe it’s certainly north of 15%, and so setting that goal makes a lot of sense to me and then we take it from there.