19. Parker MW, Iskandar A, Limone B, Perugini A, Kim H, Jones C, et al. Diagnostic accuracy of cardiac positron emission tomography versus single photon emission computed tomography for coronary artery disease: a bivariate meta-analysis. *Circ Cardiovasc Imaging*. 2012;5:700-7.
20. McArdle BA, Dowsley TF, deKemp RA, Wells GA, Beanlands RS. Does rubidium-82 PET have superior accuracy to SPECT perfusion imaging for the diagnosis of obstructive coronary disease? A systematic review and meta-analysis. *J Am Coll Cardiol*. 2012;60:1828-37.
21. Sand NPR, Veien KT, Nielsen SS, Nørgaard BL, Larsen P, Johansen A, et al. Prospective comparison of FFR derived from coronary CT angiography with SPECT perfusion imaging in stable coronary artery disease: the ReASSESS study. *JACC Cardiovasc Imaging*. 2018;11:1640-50.
22. Ben Bouallègue F, Roubille F, Lattuca B, Cung TT, Macia JC, Gervasoni R, et al. SPECT myocardial perfusion reserve in patients with multivessel coronary disease: correlation with angiographic findings and invasive fractional flow reserve measurements. *J Nucl Med*. 2015;56:1712-7.
23. Kim K-B, Hwang HY, Hahn S, Kim JS, Oh SJ. A randomized comparison of the Saphenous Vein versus Right Internal Thoracic Artery as a Y-Composite Graft (SAVE RITA) trial: one-year angiographic results and mid-term clinical outcomes. *J Thorac Cardiovasc Surg*. 2014;148:901-7.
24. Lima RS, Watson DD, Goode AR, Siadaty MS, Ragosta M, Beller GA, et al. Incremental value of combined perfusion and function over perfusion alone by gated SPECT myocardial perfusion imaging for detection of severe three-vessel coronary artery disease. *J Am Coll Cardiol*. 2003;42:64-70.

Key Words: coronary artery bypass grafting, myocardial ischemia, outcomes

Discussion

Presenter: Dr Ho Young Hwang

Dr David P. Taggart *(Oxford, United Kingdom)*. I would like to thank the American Association for Thoracic Surgery for the opportunity to discuss this excellent work. I would first like to congratulate Dr Hwang and his colleagues on what are outstanding results and also to thank you for your clear presentation. And I'd also like to acknowledge the consistent outstanding work from Dr Ki-Bong Kim and colleagues at Seoul National University in contributing to our understanding of coronary artery bypass grafting (CABG) over the past 2 decades.

To understand the background, there are 3 important things that we need to bear in mind. The first is that we know very well from the cardiology data that using the eye to assess visually an angiographic stenosis is pretty unreliable, unless it's above 90%. The second issue is that the cardiologists again have shown us the importance of using fractional flow reserve (FFR) to define functional severity of stenosis. That has been a very useful technique to improve the outcomes of percutaneous coronary intervention with stents.

The third consideration is that there have been a number of small studies trying to assess the value of FFR in CABG. There's not time to discuss those today, but in summary, what this shows is that we don't really know enough about the role of FFR in CABG. These studies were small, had a limited duration of follow-up, and had a loss of almost one-third of patients to follow-up.

So if we summarize the results as I understand them today, there were just under 300 patients from an initial cohort of 900. And these patients had in total more than 1000 anastomoses and these were then analyzed according to 2 factors: was it an intermediate stenosis as defined by angiography (that occurred in about one-third of patients), or functional stenosis assessed by single-photon-emission computed tomography (SPECT). And in about one-quarter of patients, the stenoses were deemed nonfunctional.

So what did your results show us at 1 and 5 years? The results are remarkably consistent. If a patient has a functionally significant stenosis, then the angiographic severity of stenosis seems to be largely irrelevant. On the other hand, if a patient did not have a functionally significant stenosis by SPECT, then there was a drop by about 5% in the patency rates at 1 year in those patients with severe angiographic stenosis, and a drop by about 10% for those patients with intermediate angiographic stenosis. And those results at 1 year were very largely maintained through to 5 years.

So what can we conclude from these data? Well, I think we can see that using functional assessment with SPECT, similar to FFR, is indeed the best way to predict patency of grafts, not only at 1 year, but at 5 years. So I would like to congratulate Dr Hwang and colleagues on their excellent results and I have 3 questions that I will ask in order.

How reliable is the authors' ability to separate visually an angiographic stenosis as above 90% or between 70% and 90%? We know from cardiology data that if a stenosis is below 90% on an angiogram, it is very difficult to know how functionally significant it is.

Dr Ho Young Hwang *(Seoul, Republic of Korea)*. Thank you for your question. Actually, if we measure the stenosis degree exactly, we should use the quantitative coronary angiogram, but we did not perform quantitative coronary angiogram for the stenosis degree in this study. We evaluated stenosis with visual estimation by 2 specialists for intervention. And, if there is any discrepancy >5%, we looked at the data again, then discussed the degree of stenosis and got the conclusion.

Dr Taggart. Thank you. My second question is that you used a composite Y technique based on the left internal thoracic artery (ITA) and then either using a vein graft or a right ITA as a second graft. I would like you to please try and explain your strategy for using either of these grafts.

Additionally, in your odds ratio, the use of the right ITA resulted in better patency than the saphenous vein graft. How would you explain that when we believe that ITA grafts are susceptible to competitive flow?

Dr Hwang. During the early study period, we used the right ITA as a preferred graft for second conduit. But after we got the reliable study results that the no-touch saphenous vein graft was comparable with the right ITA in terms of 5-year and 10-year graft patency rates. Now we use the saphenous vein composite graft as the preferred conduit for the second graft.

The results show that the difference between right ITA and saphenous vein grafts was not statistically significant. The odd ratios were not between the right ITA and saphenous vein. They were between the right ITA and left ITA, and saphenous vein to left ITA. So I think it is comparable data between the right ITA and saphenous vein.

Dr Taggart. Thank you. My next question is: With your anaortic technique, could you tell us what was the risk (or the incidence) of stroke in these patients when you did not manipulate the aorta?

Dr Hwang. Thank you. In this study, we did not evaluate the clinical outcomes. But when I looked at the overall clinical data, the stroke rate was almost 0%. Maybe 0.2% or 0.3%.

Dr Taggart. Thank you. I'd like to congratulate you and your colleagues again on your outstanding results, and I would also like to congratulate South Korea in seeming to have gotten a handle on coronavirus disease 2019. Very well done. Thank you.

Dr Hwang. Thank you very much.

Dr John D. Puskas *(New York, NY).* Dr Hwang, you elegantly presented the data showing that functional significance of stenosis had a relatively modest influence on intermediate and long-term graft patency. Was the loss of a bypass graft (the patient group without significant stenosis) associated with myocardial infarction or an adverse clinical event, or were these in fact silent events?

Dr Hwang. We did not see those types of events. For intermediate-grade stenosis, the native flow is quite sufficient for the coronary territory. So the influence of occlusion of a graft was not significant.

Dr Puskas. And I think this is a critically important factor. We are hearing much about the use of FFR to guide percutaneous coronary intervention, and interventionalists are trying to use FFR to downgrade the severity of multivessel coronary disease. But we have to understand that a nonsignificant stenosis treated with a stent is very different from a nonsignificant stenosis treated with a graft. If the stent closes, the patient has a myocardial infarction every time. If the graft closes, the large majority of those events will be silent—not associated with a myocardial infarction and not associated with an adverse clinical outcome. This is among the fundamental advantages of CABG over percutaneous coronary intervention.

Dr Hwang. Yes, I totally agree with you.