Aortic surgery symposium 2010 discussions—Session III: Ascending aorta and session IV: Arch

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Discussion

Dr F. Meadors (*Little Rock, Ark*). I have a question for you, Dr Miller, and the panel. If you have a patient who is going to require graft replacement in the ascending aorta, how big does the true transverse aortic arch have to be before the panelists would convert from a hemiarch replacement to either a conventional open arch, total replacement, or a hybrid?

Dr Miller. Is it a bicuspid aortic valve or a trileaflet aortic valve? I think that makes a very important difference.

Dr Meadors. I think it is certainly pertinent to pose the scenario of the patient with bicuspid valve because that denominator is going up with the baby boomers coming into middle age. Therefore I would take the easy way out and ask for answers to both scenarios.

Dr Miller. Therefore the question is how big does the arch have to be to make you go beyond a simple open distal or hemiarch to a total arch in both trileaflet and bicuspid aortic valve disease. My response would be to parrot back what I learned at this meeting over 20 years ago from E. Stanley Crawford and that is to use the patient's own meter stick or yardstick when the aneurysm or what you are thinking about replacing exceeds the normal contiguous aorta by a ratio of 2. E. Stanley used this rule of thumb for patients with Marfan syndrome way back when, and I have found it to work pretty well. But he admitted, and I will admit also, that we do not have one shred of scientific evidence to back that up. However, this barometer of $2\times$ works pretty well, remembering that the denominator for a patient with a bicuspid aortic valve cannot be the distal ascending aorta because it way too often tends to be dilated. It has to be the distal arch for the denominator on a patient with a bi-

cuspid valve, whereas the distal ascending or proximal arch might be okay in a patient with a trileaflet valve. Therefore it does not take much in my book, especially for young elective cases because it does not add to the risk. For the patients with trileaflet valves, probably I would be a little less aggressive, but patients with bicuspid valves tend to be younger, and I think we have to do a better job up front to confer the most durable repair we can.

Dr Stewart. I would agree with you. With patients with bicuspid valves, we tend to be a bit more aggressive and move to a total arch when you exceed 2 to 1. You have to make the patient's operation individual as well, though, and in some of the older patients, you can generally almost perform a total arch by using a method I think you described, a peninsula operation in which you can just leave the greater curve and take the whole arch essentially off and reconstruct it with a very aggressive hemiarch. We do that more often than not for patients with trileaflet valves.

Dr Bavaria. I think there is some science to the bicuspid. I think a total arch operation with a bicuspid valve is almost never necessary. It is backed up by the fact that if you look at data from embryology and arch development from lots of basic scientists, the whole bicuspid valve gene penetration is about at the proximal and middle arch. It does not go much more distal than that. Therefore I almost never do a full-blown aortic arch procedure.

Dr Miller. Wait a minute. Neural crest development starts at the ligamentum and goes retrograde. You said proximal arch?

Dr Bavaria. No. There are data that suggest that bicuspid aortic valve pathology ends at the mid arch, and the only exception to that is when you start having coarctation issues. Therefore I do not do very many full arch procedures in patients with bicuspid valves because I do not think they really need that. To answer your question about tricuspid atherosclerotic disease, if you start having 5- or 5½-cm aortas, you should probably go down and do kind of a first-stage elephant trunk type of procedure to get rid of the full arch in cases like that.

Dr Di Bartolomeo. Sometimes, in patients with bicuspid aortic valves, the aortic arch is small or hypoplastic. In these cases I am very aggressive and replace the ascending and the full arch. In cases of tricuspid aortic valve, the extension of the arch replacement depends on the size of the aneurysm, the age, the etiology, and so on.

Dr Miller. Do I interpret your remarks correctly by saying you are more aggressive in the younger patients with bicuspid valves than you are in the older patients with trileaflet valves?

Dr Di Bartolomeo. Yes.

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Dr Safi. Dianna Milewicz, with her work on the bicuspid aortic valve gene, thinks they have a transforming growth factor $\beta 2$ mutation. You operate on them, even at 4 cm, because they are prone to dissection and rupture. With regard to the elephant trunk procedure, if the descending thoracic aorta is big or it is going to dilate because of dissection, I would use the standard elephant trunk procedure. Otherwise, I will resect most of the lesser curvature and the lateral wall of the aorta, and it seems this is very stable.

Dr Spielvogel. I tend to agree with Dr Safi. If the descending aorta is really normal and you just have sort of a dilatation at the proximal aorta into the arch, I think you can resect most of the underside of the aortic arch with an extended hemiarch and remove the pathology without resorting to a full arch. My only question is this: What was the descending aorta like? Was there aneurysmal disease there where you did not expect to be coming back? In that case, I think you would like to put in an elephant trunk and do a full arch replacement.

Dr Ogino. I think total arch replacement is not necessary in most patients with bicuspid aortic valves because the dilated part is limited to the proximal arch. Therefore I think hemiarch replacement is a good operation for patients with bicuspid aortic valves.

Dr Bekkers. I think it is nice to make an anastomosis on a rather normal-sized aorta, and therefore I try to resect or remove as much as needed until the aorta returns to normal. Whether that is some kind of an extended hemiarch or needs to be a full arch with an anastomosis either distal to the subclavian artery or at the level of the subclavian artery can be decided during the operation.

Dr Di Luozzo. Basically if a patient has a bicuspid aortic valve and a normal-sized descending thoracic aorta, data from our institution indicate that just a hemiarch replacement is good enough. The need for a distal aortic reoperation is very, very low. I think in our series it might be 1 of more than 200 patients who required a distal aortic reoperation. Therefore based on our data, I think just a hemiarch is all that is needed.

Dr Stulak. Having presented a congenital topic, and this admittedly not being an area of expertise for me, what I have seen at Mayo Clinic with Dr Sundt is basically the same as what Gabe has said. If there is a normal distal aorta, then he can do most of his resections with a hemiarch.

Dr Wheatley. I agree, a hemiarch would be our approach as well.

Dr N. Kouchoukos (*St Louis, Mo*). I have a question for Dr Bavaria. Some of the 3-dimensional reconstructions you showed of these distal arch aneurysms suggest that they could be easily dealt with from a left thoracotomy, resecting only the very distal part of the aortic arch. You might have to reimplant the subclavian artery, but you would not have to do anything to the left carotid or innominate arteries. Why not use that procedure? You indicated that there was a 20% stroke rate associated with open operation, and I would take strong issue with that. Some of Dr Stanley Crawford's data from the 1990s, when he was putting clamps on the aorta, indicated a 20% stroke rate. With circulatory arrest, however, you do not need to place any clamps on the aortic arch, and the prevalence of stroke is quite low. I would suggest that hybrid procedures are unnecessary for these cases in which the aneurysm is in the very distal arch.

Dr Bavaria. I think if you can get into a zone 2 landing with a regular thoracic endovascular aortic repair (TEVAR), then you would do that. Therefore we would never operate on any of those cases if we can get into zone 2 with a stent. To do a thoracotomy

on a patient who has a proximal descending aortic aneurysm with an adequate zone 2 landing is something I would avoid: I would stent in every case. Therefore the question is this: What about something that precludes landing in zone 2, which then means you have to come in and maybe do a left chest case? These patients all have big atherosclerotic aneurysms, and most of those patients have very high atherosclerotic burdens and are really bad smokers. We believe that a fourth interspace, high reverse, hemiarch distal arch procedure from the left chest or from an anterior clamshell is just not appropriate in these cases. We have learned from the volume reduction data in thoracic surgery that a sternotomy compared with a thoracotomy in patients with chronic obstructive pulmonary disease is so much better tolerated. Therefore a proximal median sternotomy-based solution, in our opinion, is a better option here.

Dr Kouchoukos. But you really have not shown that the mortality rate or the stroke, renal failure, or paraplegia rates are any better.

Dr Bavaria. I do not even think you need to show that they are any better. Even if they are the same, it is still probably preferable for the patients to go in from the front compared with the back. We are still early in this business. I just showed you the meta-analysis. I think the world literature only shows about 180 cases. We will have to see how it goes, but noninferiority is really all you need here.

Dr Miller. Let me ask a few zingers here. Allen, in the first session you were telling us about your neat 3f valve in a De Paulis graft. You are too young probably to know that Christian Cabrol in Paris did all of his composite valve grafts for 30-plus years, even going back to the Starr-Edwards ball valve days, sewing the valve way up, leaving a cuff, and then sewing the cuff of the graft to the annulus. But that is what led him to have to create, out of misery, the Cabrol II mustache coronary revascularization when the coronaries would not reach because it was too high. Have you seen that with your new technique?

Dr Stewart. Interestingly, Dr Coselli just reminded me that Dr Cabrol did that. We have not had a problem. I mobilize the button from the bottom up and do not spend too much time mobilizing the sides. I just have not had that problem.

Dr Miller. Yet.

Dr Stewart. Well, we have done a good number now, and we have not had any difficulties. That skirt at the bottom is not very long. We usually go about 3 rings up with our sutures, and therefore really it is not a long skirt underneath the valve.

Dr Miller. Maybe the examples we saw in the movies were before you cut them down.

Roberto, you talk about paraplegia of 7.5% with the long frozen trunk with the E-vita, and I do not know whether that is chronic A, acute A, or B dissection, but you are covering a lot of intercostals, and I am worried that the paraplegia rate might be excessively high. I am also worried about the chronic dissections, A or B, in which you are stuffing an E-vita into a very tiny frozen true lumen. Tell us how you avoid trouble there.

Dr Di Bartolomeo. We had 1 episode of paraplegia in a 52-year-old patient with chronic type A dissection. Two weeks after the operation, we performed magnetic resonance imaging, and we found that the patient had an angioma at T5; we do not know whether the cause was this angioma. Another episode of paraplegia occurred in a patient undergoing intervention for a very bad atherosclerotic aorta with 3 large aneurysms involving the arch, the proximal descending aorta, and more distally the infrarenal aorta. The

endograft was deployed at T6. It is difficult to find a reason in these cases. Embolism? Insufficient spinal circulation?

Dr Miller. Therefore your advice to us would be to study the intercostals carefully and only go as far you need to distally? Would that be the safest course of action?

Dr Di Bartolomeo. Generally we use only the angio-computed tomographic scan and sometimes an aortogram, but it is difficult preoperatively to stabilize the patient.

Dr Miller. The open E-vita, which we do not have in this country, does it come in different lengths for the stent graft part? Do you have a choice of length for the stent?

Dr Di Bartolomeo. The length is 15 or 16 cm, but it is also possible to get a shorter stent graft of 10 cm.

Dr Miller. A custom-ordered shorter stent graft.

Dr R. Griep (*New York, NY*). I don't like to speak up, but with the degree of ignorance about spinal cord perfusion, I think I have to say something. I can guarantee you that I can take a patient and ligate T3, which is usually the first intercostal artery coming off the aorta, to T7 a hundred times and never get a spinal cord injury, and I challenge those of you who do descending thoracic aortic surgery to remember the last time you had a paraplegia if your distal anastomosis ended above T8 or T10. Nonetheless, this phenomenon of paraplegia in frozen elephant trunks has been reported by a lot of practitioners. I am not sure of the reason. One thing I am confident about is that it is not taking those intercostals out of the circulation. It might well be embolization down one: if you embolize an intercostal artery and obstruct an end artery into the cord, you will have a localized infarct and possibly paraplegia or paraparesis. But I do not think depriving the body of the upper few intercostal arteries in itself will cause a neurologic injury. I would be curious to hear whether anyone else has an explanation for why you can resect the aorta from the left subclavian artery to the mid and lower descending thoracic aorta almost every time without a neurologic injury, but when you do this with a frozen elephant trunk procedure or TEVAR, you see neurologic injury in a significant percentage.

Dr Miller. The skeptics would say because your technique involves progressive ischemic preconditioning of the cord as you sequentially work down, and you do not have that advantage with sudden TEVAR coverage. Any other theories of why there is a difference from the panelists?

Dr Ogino. Regarding spinal cord injury after open stent grafting, I try to demonstrate the Adamkiewicz artery by means of computed tomographic scanning or magnetic resonance imaging preoperatively, particularly in operations on the descending and thoracoabdominal aorta. In most the Adamkiewicz artery originates between T8 and L1, but in a few patients it originates at the level of T6 or T7. Therefore I think we have to be more careful about the level of the Adamkiewicz artery in endovascular settings. Too long an elephant trunk or too long a stent graft can be very dangerous in terms of spinal cord injury.

Dr Bavaria. We have done a lot of stents with hybrids and standard endovascular deployment up to about T7. We have had no paraplegia except in one subcategory, which is with intramural hematoma cases, which might be because you are throwing a kind of junk into the spinal arteries.

Dr Miller. Does that include the traumatic tears?

Dr Bavaria. We have never had a spinal injury from a traumatic tear. We have had strokes but not spinal injury.

Dr Miller. The paper presented in Banff by your younger faculty colleague?

Dr Bavaria. We had a stroke, and we had some intramural hematoma cases.

Dr Miller. I recall it was a traumatic tear.

Dr T. Hanke (*Luebeck, Germany*). I have a question for Dr Bekkers from The Netherlands. You conclude that there is a high number of reoperations in the Ross patient population. Do you think, as does one of your Dutch colleagues in a comment in the *Annals*, that almost 100% will undergo reoperation? Do you agree with me that with special surgical maneuvers like the subcoronary technique or the reinforced full root, we can decrease this dramatic reoperation rate into more of a normal range?

Dr Bekkers. One thing for sure is that we are going to see more patients coming out having dilated aortas. Whether it will be all those patients remains to be seen, but there will be more. Of course, I am aware that a lot of colleagues advocate reinforcement either only at the site of the proximal anastomosis or as a full jacket around the whole aorta. The latter I can imagine will prevent the root from dilatation. If one reinforces only the proximal part of it, it is conceptually difficult for me to understand why that should prevent the whole aorta from dilating and not only the annulus.

Dr Miller. Dr Bekkers, were all of your Ross procedures done as a full root?

Dr Bekkers. No, they were not, but this report was only for the full roots. We had some dilatation, but not as much as seen with either a cylindrical inclusion or other techniques. This was a report only on 155 roots.

Dr Miller. I think that was Thorsten's point: if you do them the way the operation was designed to be done, as a subcoronary scalloped operation way back when, as Hans Sievers and you just reported (the article will be out next month), you would not see these dilatation problems.

Dr Bekkers. That might be. The other thing is that nowadays we reserve these operations especially for younger growing patients, and then it is hard to use any reinforcement with material that will not grow. We are hoping to see how the aorta and components can grow as the patient grows. Our experience is that whether it is a young patient or an old patient, they all receive these dilatations, and we think it will be hard to prevent that, especially in the younger group.

Dr Miller. Tell us about the Luebeck series, which is phenomenal. I think you were a coauthor?

Dr Hanke. Yes. With the subcoronary technique and the reinforced root, we were able to show that freedom from reoperation, at least after 10 years, was 94% and not 88% as with the nonsupported root. Therefore with the special surgical maneuvers, with a full root or the subcoronary technique, it seems, at least in the midterm, that there are better results. We do not know much about 15 years, and your data are great for all these 15-year survivors, so we will have to wait. However, we think with the original Donald Ross technique, we might be able to get better results.

Dr J. Bachet (*Abu Dhabi, United Arab Emirates*) My comments are addressed to Dr Spielvogel. You have shown us a very elegant technique, and I will not be critical of this, although in many instances I think that the conventional arch replacement with an island reimplantation of the vessels is easier. However, I think that your outstanding results could be improved. I was very happy

to hear that Dr Kouchoukos already told you several times that you could perfuse the brain continuously without interrupting cerebral perfusion because you are cannulating the subclavian artery. Why do you not perfuse the brain continuously? Second, I think that you could improve your results by getting rid of deep hypothermia. Why do you not do the procedure with moderate hypothermia? Do the distal anastomosis. Then when you have anastomosed the main prosthesis to the distal aorta, reimplant your trifurcated prosthesis into this main prosthesis, reperfuse the patient, rewarm the patient, and during the rewarming, do the proximal repair. You will save time on bypass and degrees in temperature, and your results will most probably be a little better.

Dr Spielvogel. Thank you for your suggestions. In many patients, particularly patients with degenerative aneurysms and dissections, you can occlude the brachiocephalic vessels. However, in those patients with extensive atherosclerotic burden, there are times we have had to resect, particularly in the innominate artery, almost up to the bifurcation to clear it of atherosclerotic disease. In those patients you cannot occlude the innominate artery and begin selective cerebral perfusion. Therefore I think in the atherosclerotic subset you have to be particularly careful about doing any instrumentation or clamping of those vessels, and that is one of the reasons why we have stayed away from the approach you suggest. However, there are patients in whom you can certainly do it.

In terms of the issue with hypothermia, if you look at the history of those who presented today, several have created very complex methods for perfusing the head and the lower body in an attempt to avoid using hypothermia. What we have found is that to preserve end organs in the lower body, it is very simple: just cool to a sufficient degree, and then, with the protection of hypothermia, you can go about your repair in an unhurried fashion and not worry that you are going to have renal failure, paraplegia, or some kind of ischemic event to the liver. As you saw, our reoperation rate for bleeding was not particularly high for this kind of operation. Although you can do it as you describe, we have stayed away from elaborate perfusion schemes and kept it as simple as possible. I always believe that if someone is going to adopt your procedure, it will be because they can understand it and perform it on an occasional basis without the requirement that they be in a major center that does a lot of similar cases. I guess that is part of the reason why we have not added those additional maneuvers. But thank you for your comment.

Dr Bachet. If you allow me, Craig, I have another question for the panelists. Why do you use so much Teflon felt in chronic patients? I have seen videos in which you could make the patient a Stetson with the felt that was used.

Dr Miller. I have not used Teflon felt in 16 years, and that is why I have so many hats.

Dr Stewart. I do not use any felt.

Dr Bavaria. I use no felt.

Dr Miller. No felt.

Dr Di Bartolomeo. I use it.

Dr Safi. Well, I use Teflon felt and pledgeted sutures, and I call them the home team. I want to go home. And I do not use the French glue or the cryo glue.

Dr Bachet. But in chronic patients we do not use the glue either. We just use the patient's aorta.

Dr Safi. In the chronic patient, the chronic dissection or medial degenerative aneurysm, if you put in real stitches—2-0 or 3-0 poly-

propylene sutures—sometimes there is a tear in the intima. I promise you, I spend days and nights trying to stop bleeding from outside. If you put felt in prophylactically, you go home, and there is no problem with it, and there is no incidence of infection. The biggest patch is the graft: Why are we worried about the Teflon patch?

Dr Miller. Hazim, try some 4-0 or 5-0 sutures. David, we know what you are going to say: felt, lots of it.

Dr Ogino. For 70% or 80% of my cases, I use felt. We have more than 3,000 cases at the National Cardiovascular Center. The frequency of pseudoaneurysm formation is quite low. I think the Teflon felt contributes to the prevention of pseudoaneurysm formation.

Dr Bekkers. I like 4-0 Prolene sutures without felt.

Dr Di Luozzo. I use felt.

Dr Stulak. Dr Sundt uses felt.

Dr Wheatley. No shortage of felt in Arizona.

Dr Griep. I would like to see publication on the rate of false aneurysm formation from those who do not use felt. We have published our incidence; it is in the literature. With felt, the rate is something like 1 false aneurysm per 357 patient-years looking back at all of our computed tomographic scans. Therefore if you do not use felt, fine, but give us some idea of how well it works.

Dr Miller. While we have Dr. Spielvogel here, let's talk about your elephant trunk procedure: 7% stroke rate for the first stage, and then up to a year, there was another 7% stroke rate, and you said most of those occurred during the second-stage operation. How can that be when it takes just a few seconds or a minute to reach in and grab the trunk and clamp it? Why are the patients exposed to such a high risk of stroke at the second stage?

Dr Spielvogel. That is a very good question. We had a number of patients who had strokes not so much as the result of the proximal reconstruction but in whom their habitus affected their cerebral perfusion. For example, we had a very obese patient, and the positioning in the right lateral decubitus position resulted in a very high central venous pressure during the thoracotomy with an inadequate arterial pressure, and therefore there was relative hypoperfusion of the brain, causing cerebral injury. We now recognize that we have to be very careful in maintaining adequate blood pressure in patients in that position. Also, once you clamp proximally, the central pressure can go very high, and patients who have undiagnosed cerebral aneurysms can have an intracerebral bleed.

Dr Miller. Is that why you are on the pump, to keep them decompressed?

Dr Spielvogel. That is the case, but we unfortunately had a few patients in whom that happened.

Dr J. Appoo (Calgary, Alberta, Canada). I have one point and a question for the panel. My point is about paraplegia with short stent grafts and why that might occur even though you are not sacrificing intercostals below T7 or T8. It could be due to spinal cord steal, which you do not see when you actually tie off the intercostals. However, maybe if you put in a stent graft, you actually have backward steal from the spinal cord.

I was interested in hearing that they use the E-vita graft for chronic dissections. I wanted to ask the panel how they handle the sort of patient we see a lot: the 70-year-old man who is 5 or 10 years out after a type A repair who has had a hemiarch done but still has a dissection flap in the arch. The aorta has grown over the last 5 to 10 years, and the distal arch is aneurysmal; the proximal middescending thoracic aorta is aneurysmal, perhaps

6½ or 7 cm; and there is a true and a false lumen and multiple fenestrations. How many people would re-enter, do a median sternotomy, and do some sort of hybrid approach with an E-vita type of graft or something else, as opposed to trying to manage this patient with circulatory arrest from the left chest to repair his distal arch and thoracic aneurysm?

Dr Miller. My answer is simple. It depends on how pathologically damaged the arch is. If there is going to be very little to sew up there, I would not want to be looking up through a left thoracotomy, hoping to do something quick. I would stage it with a total arch and a full surgical trunk, followed by whatever later.

Dr Stewart. I agree.

Dr Bavaria. I agree, for the most part, and that is the reason why when we do these type A dissections to begin with, we should be doing operations in which we do not leave a whole lot of arch and distal false lumen, so that we do not have this situation. There is one caveat: if you have a reasonable proximal landing zone of some sort, which might or might not be the case, and you have the celiac artery, superior mesenteric artery, and both renal arteries coming off the true channel, I would stent those cases. Those cases do really, really well.

Dr Di Bartolomeo. A chronic dissection?

Dr Miller. Chronic type A dissection with a previous ascending hemiarch.

Dr Di Bartolomeo. This is a perfect indication for the frozen elephant trunk procedure.

Dr Appoo. Do you find that there is still perfusion in the false lumen when you do that?

Dr Di Bartolomeo. I do not perfuse the false lumen.

Dr Miller. Do you see it later?

Dr Appoo. Because of fenestrations. If the patient has a 7-cm aneurysm, part is true lumen and part is false lumen, and the graft sits in the true lumen. If you still perfuse the false lumen through fenestrations below, is that a concern for you?

Dr Di Bartolomeo. I do not understand.

Dr Miller. You still have persistent flow in the large distal false lumen below your elephant trunk.

Dr Di Bartolomeo. In most cases we have observed complete thrombosis of the false lumen. In case of retrograde perfusion at the false lumen, an additional stent can be placed 1 or 2 months afterward.

Dr Miller. This is a major difference in philosophy and maybe the laws of the country. In Italy it is legal to stent graft a chronic dissection. Be careful in North America: you will go to jail. I do not think it works, I do not think it is very effective, and it is futile because of that exact point. You are going to have far too many fenestrations, and even if the false lumen does thrombose, there is going to be endotension in the false lumen. You have not conferred protection from rupture.

Dr Safi. Well, I do exactly what you said: a classic elephant trunk procedure and wait for 6 weeks and do the thoracoabdominal procedure, and my associate, Dr Tony Estrera, is going to explain our recent results.

Dr Spielvogel. Again, I think I would follow your tack with a redo arch elephant trunk procedure, and then, depending on how the distal aorta looks, an open completion or endograft. However, one thing we have forgotten is that if it is accessible in the left chest, Dr Kouchoukos has operated on a number of patients like

this with a thoracosternotomy or a clamshell incision. Doing it all in one stage, you might be able to resect from your previous graft down to your distal extent, and Dr Kouchoukos has had excellent results. Therefore that is also an option if you think the patient can tolerate that type of procedure.

Dr Miller. I am glad you brought up Nick's thoracosternotomy, which was just updated and published recently.

Dr Ogino. I prefer a 2-stage approach with total arch replacement initially, with an elephant trunk procedure in the elderly. The second procedure actually depends on the patient's condition. If the patient can tolerate a thoracotomy, I prefer an open repair, but if that is not possible, I do a TEVAR, as Dr Bavaria said.

Dr Bekkers. I would preferably go through the left chest under deep hypothermic circulatory arrest and do some kind of a hemiarch from the other side.

Dr Stulak. Dr Sundt would do a total arch elephant trunk procedure, and then stage II would be through the left chest.

Dr Wheatley. I am going to side with our international colleagues: we would do a hybrid debranching and stenting, obviously under institutional review board approval as part of a research study.

Dr Di Luozzo. I would do a 2-stage approach. I did not understand Dr Appoo's first point about the steal phenomenon with the stent. Can you clarify that?

Dr Appoo. The question was this: Why were some of these patients with short stent grafts having paraplegia when Dr Griep said you could ligate all the intercostals down to T10 and not get spinal cord ischemia? Maybe when you put in a stent graft you are covering the intercostals but the orifices are still open, so there is actually retrograde flow. Instead of the vessels perfusing the spinal cord, the intercostals are actually stealing blood from the spinal cord. With time, those intercostals could thrombose, but in the acute setting they might actually be patent.

Dr Bavaria. What you are saying is that there are small type II endoleaks?

Dr Appoo. Yes, in theory.

Dr C. Young (London, United Kingdom). We heard 2 articles today looking at long, thin, small grafts going up to the cerebral vessels, and this worries me: I wonder what the rest of the panel thinks about it. With the ones that we have done before, using reverse transit grafts, we have had a lot of blockages, and we would aim to go with individual grafts, probably 12 mm, up to the underside of the subclavian. The other aspect that Dr Bavaria did not mention is that most of the patients we see for hybrid procedures have had previous TEVARs, and the problem is that they are left with endoleaks, type I endoleaks, into the arch. They are going back in this sort of redo setting. You did not mention that, and I wonder what your experience was.

Dr Miller. I think Joe has an extensive experience with that problem: going back in the arch for a proximal 1A endoleak after TEVAR.

Dr Bavaria. The second question is about the cases in which we performed the hybrid procedure. We do a lot of secondary procedures for type I endoleaks, which is pretty common. However, for this particular series, we only had 1 patient who underwent intervention elsewhere; it was a traumatic case. Therefore we only had 1 of the 27 cases that was a proximal endoleak disaster. The other 26 cases were actually classic hybrid procedures. And we have had no—zero—zone 0 endoleaks, which we think is

because, if you look at Czerny's paper from Vienna, you get type I endoleaks in zone 0 if you put stents in overly large aortas. We do not do that. I tried to point that out: when we do zone 0 landings, we do not do them in 4-cm aortas.

Dr Miller. You made that quite clear. You said 3.5 cm, and if it is bigger than that, you are going to replace it at zone 0.

Dr Bavaria. That is correct. We have had zero type I endoleaks in our hybrid procedures. Your first question, about small grafts into the cerebral vessels, I thought was very significant. I happen to agree with you completely. It is a little bit worse to have a single-branch 14-mm graft come off to the whole brain and arms. I am wondering whether the 7% stroke rate in the second stage of an elephant trunk procedure is related to some sort of issue regarding low flow, or maybe there is also some compression of the airway. Fear of low flow through small grafts is the reason why the vascular surgeons who do debranching operations come off with a single graft. I tend to not do that and come off with multiple grafts to the cerebral circulation.

Dr Miller. David, you gave us what long-term follow-up you had, admitting that it was neither complete nor very long term, but I think you were quite honest. We do not know, but you are not aware of any problems yet?

Dr Spielvogel. No. Actually, I recently got a call from a referring doctor who had a patient with a problem. The first hybrid procedure that I did was in 1999 in an elderly woman in whom I moved the left carotid and innominate arteries to the ascending aorta because of occlusive disease and then stented the arch retrograde with the old excluder. She is actually now more than 10 years out, and both of those grafts are widely patent. This doctor had to put another stent graft below the old one because she dilated her distal aorta and had a type I endoleak. We are following these patients very closely, and we have patients out over 10 years with grafts that are widely patent. Clearly this is a concern of ours. I think you should try and keep the limbs as short as possible. When you measure them, and we do, the average limb length is quite short. Again, we will continue to follow these patients, and we will see.

Dr Miller. Maybe that multibranch graft, when you turn these heavy people on their side for the second stage, might be where you are having an issue. I have to correct myself (which is common because I make a bunch of errors), but the Japanese study was not the first randomized controlled study of cerebral protection in arch surgery. Dr Griepp reminded me that Professor Bonser in Birmingham did a small one, and also Lars Svensson, when he was at the Lahey Clinic, did one looking at S100. Again, small numbers, but the Japanese, we commend you: that is what we need. That is real evidence, but the numbers are so small that even had you seen a difference, it might have been suspect. Is there hope that this JSTAR2 study can be continued? Is there funding to get bigger numbers?

Dr Ogino. That is a good question. Time is limited, and funding is also limited. Therefore we have discontinued the randomized controlled study. The power analysis regarding the JSTAR1 suggested that we should have 50 patients in each limb, but as you know, we had fewer than 50% of this number: this is a weakness.

Dr Miller. So your funding dried up and you cannot continue to randomize?

Dr Ogino. It is quite difficult to continue it. At the moment, our patient age has increased: the patients are 75 or 80 years old, and their aortic pathology is also quite complex. This study is just for isolated total arch replacement without any concomitant procedures for low-risk patients having simple aortic pathology. In 2004, when we planned this study, 50% of the patients had simple disease, but in 6 years, the aortic pathology has become more complex. Therefore it is quite difficult to continue the randomized controlled study for patients having simple disease.

Dr Miller. And the surgeons do moderate or more deeply hypothermic cerebral perfusion depending on how they feel about each patient? Some will go very cold and some will stay warm depending on the patients at the various hospitals? Have the results of the study changed their practice patterns? They probably do what they did anyway.