I’ve always felt that the mission of helping somebody with health care when they’re in trouble is as wonderful and as powerful, as important a mission as anything you can do in life. And I think we’re fortunate to have a great staff who feel the same way and carry it out every single day.

Located in New York City, New York Presbyterian is ranked among the top ten hospitals in America by “US News” and “World Report.” New York Presbyterian is affiliated with two Ivy League medical schools, Columbia University College of Physicians and Surgeons, and Weill Cornell Medical College, and receives about $450 million in annual NIH research funding. It’s faculty of about 5,000 physicians provides comprehensive care to patients in all specialties of medicine.

At the end of the day we all can walk away and say, “This is our team and it’s a great team.”

Good evening and welcome to New York Hospital Presbyterian System. We are doing a live webcast on the innovations in both endovascular and conventional therapy for the treatment of thoracic aortic disease. I’m joined tonight by my esteemed colleagues, Dr. Len Girardi, who is the Wayne Isim Professor of Cardiothoracic surgery and Director of the Aortic Surgery Program here at Weill Cornell, and by Dr. Allan Stewart who is the Director of the Aortic Program at New York Presbyterian Columbia.

Tonight we’ll be discussing multiple aspects of the treatment of aortic pathology. Dr. Stewart, can you start and give us an overview of the aortic thoracic disease?

Aortic disease can start from the aortic root, which is comprised of the aortic valve where valves may become stenotic or begin to leak; also, aneurysms of the ascending aorta, the aortic arch, the descending thoracic aorta, and into the abdomen. It’s important to understand a few terms as we go along with our talk tonight. A normal aorta is comprised of three layers. When those layers dilate or expand, it’s considered an aneurysm. However, if one area dilates through, not all three layers are expanded; that’s considered a false aneurysm or a contained rupture. Subsequent to that is an aortic dissection, which is a cleaving off of the meteor or middle layer of the aorta to create essentially a double barrel or a true lumen and a false lumen.

When we talk about aneurysms and dissections, we talk about different classifications. For dissections, as can be seen here, we generally call dissection a “Type-A dissection” and a “Type-B.” They’re divided into two areas or two terms to talk about the treatment of an aneurysm – treatment of a dissection. A Type-A dissection is a surgical emergency requiring an immediate trip to the operating room, where a Type-B is a treatment in evolution involving hybrid approaches to remodeling the aorta, as well as optimal medical management.

The incidence of aortic dissection is appearing to increase with about 10- to 20-million people per year worldwide. The apparent increase may be a result of the increasing age of the population as a whole, the increased prevalence of hypertension and poor diet, and probably better recognition with increased imaging.
There are certain risk factors that are involved in both aneurismal disease and an aortic dissection. The peak incidence in age is between 50 and 70 years old. It generally involves males greater than females, usually involves a history of hypertension, may have connective tissue disorders such as Marfan’s Disease, and also is associated with folks who have bicuspid valve disease. The clinical presentation is most often sudden onset of severe chest pain. It’s usually described as a ripping or tearing pain. It may begin in the anterior chest and it may migrate. Oftentimes when dissections begin, the pain is in the neck or jaw, which can masquerade as an acute MI. The migration of pain is highly specific, but it may be a painless presentation, with symptoms of arm weakness or neurologic dysfunction.

About 40% of the folks who present with an aortic dissection die immediately. Some more famous examples include Lucille Ball and John Ritter. About 30% of the folks who present at the hospital are misdiagnosed, most commonly given a diagnosis of a heart attack. The most common symptom, as I said, is severe unrelenting chest pain, and the patients often look quite ill.

This is an example of what an aortic dissection looks like, both before and after. You'll see the bluish discoloration of the ascending aorta shown there is really the false lumen, and that's blood tracking through a very thin, almost tissue paper-like, wall of the aorta. And then subsequent to that on the right side you’ll see that patient has had an ascending aortic repair.

Often we're asked, “What is the appropriate diagnostic study for a patient who presents with a dissection?” The most reliable imaging modality is the CT angiogram. It’s quite sensitive and quite specific. We like to confirm that in the operating room with a transesophageal echo, or if the echo is available as the initial study, it can often make the diagnosis with quite good sensitivity and specificity as well.

There are a number of reasons why people die of dissection -- pericardial tamponade, aortic insufficiency, stroke, and malperfusion syndrome. What I mean by malperfusion syndrome is that blood can’t get to the organ it needs to get to because that false lumen is squishing the flow through the ostium of the artery. The most frequent area that is involved in dissection is a cleaving off or a malperfusion of the renal artery. Second to that are malperfusion to the extremities, either the left or the right leg. The in-hospital mortality associated with malperfusion syndrome is in excess of 60%.

We treat malperfusion syndrome through a variety of ways, including direct stenting of the renal artery if need be, catheter-based fenestration, or open fenestration in the operating room if an endovascular approach is not indicated.

Some of the operative indications for aortic dissection include the presence of aortic involvement, meaning aortic insufficiency; coronary dissection to prevent the consequences often associated with this surgical emergency. And Type-B dissection, why, that's a treatment modality in evolution. Often, we intervene with an endograft in these folks when they have a failure of medical management to control their hypertension, if they have aortic rupture, in patients who have had a chronic dissection with aneurismal formation, and in patients who have connective tissue disorders, we’re are quite frequently aggressive in managing these operatively.

Contraindications for management of dissection, well the age of population have high risk, not to say that we don’t do it, but folks above 80 have a very high risk of having major morbidity and mortality. Generally, in patients who present comatose or obtunded, there’s a very high incidence of fatal stroke in those folks.

Our surgical goals in both aneurism surgery and in dissection surgery are about five; and in order. We protect the brain, we protect the heart, we convert a Type-A dissection to a chronic Type-B which can be managed medically or with an endograft later, we like to remove the tear, and most advantageously, obliterate flow into the false lumen.
These patients, once they have either an aneurysm repair or repair of a dissection, are lifelong patients of ours. We need to observe them frequently and annually after that. The false lumen is obliterated after a Type-A dissection in less than 10% of patients. What that means is that these folks are prone to a dilatation of their descending aorta over time. Their best chance for survival is aggressive blood pressure control and remodeling of that false lumen. We do a CAT scan six months after our initial repair, and then yearly afterwards.

Thank you, Allen. You know, I think that’s one critical area we have to deal with with a thoracic aorta, but another, and can be associated with dissection, is the thoracoabdominal aneurysm. Thoracoabdominal aneurysms, unlike dissections, contain all three layers of the arterial wall, and really represent a ballooning out of the aortic wall, similar to a weakening area in a tire. Unfortunately, like any weakened area, if it gets large enough, there is a potential of rupture. The comorbidities associated with those patients are generally those people with cigarette smoking, hypertension, and also coronary artery disease, so it’s a very morbid procedure if they go on to rupture and can have a mortality that can be in the 50-70% range.

To further clarify the potential extent of the disease and the risk of complication, we look at the position of the aneurysms relative to the takeoff of the left subclavian, going down through the visceral vessels of the celiac, SMA, and both renal arteries. And the more of that section of the aorta is involved, the greater the risk of complication. And, hence, we have the standard Crawford classification of Type I involving from the left subclavian down to the takeoff of the visceral vessels. Type II, actually extending from the takeoff of the subclavian all the down to the bifurcation of the iliac vessels. And then type III being slightly lower in the chest. And probably the one with least associated morbidity is the type IV thoracoabdominal, which starts about the level of the diaphragmatic hiatus.

Some of the causes for a thoracoabdominal aneurysm and aneurysm of the descending thoracic aorta, the majority of them are atherosclerosis, hardening of the arteries, or idiopathic. The second is chronic dissections. As Allen pointed out, you can get these tears that persist and then over time become enlarged, and that occurs about 28% of the time. Acute dissections that extend down and become symptomatic are extremely challenging to deal with because of the very friable nature of the tissue. And then, finally, infective or mycotic aneurysm result in a small percentage of less than 2% of thoracoabdominal and descending thoracic aneurysms.

Here is a classic thoracoabdominal aneurysm. You see it in the mid-chest with a significant enlargement of the descending thoracic aorta. And then as we extend down, you see a dissection flap, so this is an aneurysm secondary to an aortic dissection. And then you see what it looks like an area of contained rupture as it goes down into the abdominal area, or at least significant enlargement.

This is an intraoperative portrayal of this image. Where you see the aneurysm coming down, its very circuitous and tortuous because of the enlargement in the size of the aneurysm. And the patient’s head is to the right side of the screen, and to the left side of the screen is the abdominal components. In many cases we’ve found that if there’s extensive involvement as in the Type-II and Type-III thoracoabdominal aneurysms, there is a – it does require some time to re-implant the visceral vessels, as well as the ever-important spinal artery of (INAUDIBLE). And so, in some cases, we’ll actually profuse the renal arteries and small branch vessels while we’re performing the proximal anastomosis, and even extending down to try and protect the spinal cord by re-implanting the lumbars in the area of the thoracic and the proximal lumbar region.

Here’s an example of a graft that’s been implanted, the proximal anastomosis performed at the far right, re-implantation of the visceral is at the left, with a separate graft coming up to the left renal artery, and then the lumbers are in the area of the spinal (INAUDIBLE) are re-implanted as a separate patch.
This was performed by Dr. Girardi. And, unfortunately, Dr. Girardi has been called away for a surgical emergency, and we have Dr. Arash Salemi that’s with us now that will be commenting on some of these cases.

If you look at the indication for surgery, you know, you can generally say, “What is the size when it’s too big and needs to be repaired?” That’s generally, for the thoracoabdominal, greater than six centimeters in a good risk patient should be considered for some form of operative repair, whether it be endovascular or a standard open repair. If you see a rapid growth in the aneurysm, that’s something that always raises our concern. So if it grows over a centimeter in one year or the patient starts developing pain, persistent pain, these are all indications for repair. And if there’s signs of leak, rupture, or embolization, meaning part of the clot that can form in these aneurysm sacs that can embolize distally, that’s another indication for intervention and repair.

As we’ve mentioned, these are fairly complicated repairs, and we try and do as many modalities as to try and improve the outcome for these patients with thoracoabdominal aneurysms. Monitoring the evoked potentials and somatosensory evoked potential give us the idea that spinal cord function. We decompress the spinal cord with CSF drainage, if it’s an extensive case, doing cold perfusion and protection of the renal arteries, epidural cooling. There are many different things we can do to try and help decrease the risk of either paraplegia, renal failure, mesenteric ischemia, or death. In those very complicated proximal repair, even circulatory arrest can be invoked to allow for the proximal anastomosis. Allen, when do you use circulatory arrest?

Well almost never now. We generally prefer axillary artery cannulation with selective antegrade cerebral perfusion. I believe that this limits the need for profound hypothermia and can allow us to do most complicated arch aneurysm repair with continuous blood flow to the brain.

Arash, what is your cocktail when you try and protect the patient, both their spinal cord ischemia, visceral and renal ischemia, when you’re doing these complex thoracoabdominal aneurysms?

Well our strategy here is to use continuous perfusions to the viscerals. We use, as you saw on the previous slide, balloon occlusion 9-French cannulas into the visceral vessels where we inject a cocktail of saline, Mannitol, and steroids into the visceral vessels, along with – at a rate of approximately 200ccs per minute. We find that that keeps the visceral organs well profused and protected during the time of our operation.

Very good. I think that these type of maneuvers are what are important. And we looked at the overall New York Presbyterian Hospital system outcomes, and specifically that of Dr. Girardi’s, and over 465 patients being treated, and the risk of overall mortality was around 5%, which is well below the national average for these types of repairs. And the risk of other complications including paraplegia, renal failure, heart attack, wound infection were all exceptionally low. Dr. Salemi, would you like to comment on that further?

Well I think that at the New York Presbyterian Hospital, what we try to do is protect the patient as much as possible and perform the right operation for the individual patient. We will see a case of a patient who clearly was very high risk for an operation, but we felt that we would be able to get an operation done expeditiously, and we were able to accomplish that. We have found that our paraplegia rate is on the order of approximately 1½%, our neurologic incidence rate is also around the order of 1.7%, and our overall mortality in 465 cases is on the order of 1.7%. And it’s a combination of factors, including spinal cord drainage, perfusion, and certainly speed plays into it as well because, as we know, if you get beyond 30 to 45 minutes there is a diminishing return on your outcomes.

And what impact do you think there is on volume? Is there a steep learning curve for doing thoracoabdominals, or is it something that you can do a few cases and feel confident in doing it?
Well we are very proud of the multidisciplinary team that we have put together here. And from the anesthesiologist to the perfusionist, the nursing staff, everyone is able to work very well in cohort, and that's really what it takes to perform really a quality thoracoabdominal operation. That is an extension of having enough volume to know how the pieces fit together well. And so I do think that it is important to have a center that performs enough of these and all the moving pieces work well together.

So that’s, again, something important that we see here at New York Hospital Presbyterian System. We have a dedicated team who’s doing these types of repair. It’s interesting, there’s actually a publication in the “Journal of Vascular Surgery,” that showed there’s a direct correlation with volume and surgery outcome and mortality, and the higher volume centers had a better, both patient survival rate, as well as a lower complication rate for these types of very complicated thoracoabdominal aneurysm repair.

Right now we’d like to go to a taped case demonstrating the techniques of repairing a thoracoabdominal aneurysm. This is a case from Dr. Girardi in which it was an 83-year-old gentleman that really was not a good candidate for an endovascular repair because of inadequate landing zones for the proximal and distal aspect of the stent graft. So, Dr. Stewart, do you want to comment first on the exposure here?

The exposure here, you’ll see a rib was just notched to provide exposure into the chest, and you’ll see the costal margin being incised here. This gives us adequate exposure to retract that lung, which you can see in the top right-hand corner of the screen, a way to expose the aneurismal segment in the chest. It does involve a large incision. You’ll see now, looking down at the lung in the field, we’re now exposing the chest. We’ll retract that lung anteriorly, and you’ll be able to start seeing the large thoracic aneurysm to the right of the screen.

Arash, as you’re doing these cases, especially those that get up close to the aorta or are involved in the takeoff of the left subclavian, what are some of the tricks you use to get that proximal control?

Well, you know, it’s a very important point because in this particular case, he is an elderly gentleman. He has a history of a prior coronary bypass grafting operation with an intact internal mammary artery. And we debated performing a carotid-subclavian bypass to be able to provide an adequate landing zone for an endograft, but we thought that distally it extended too far and it would require another bypass procedure distally to the visceral vessels. So we chose to go ahead and do an open operation.

In getting around proximally, we felt we had to go all the way up to the subclavian artery. And exposure is critical. If you need to shingle the higher rib, in this case the fourth rib, you have to do that to gain adequate exposure to the space; that’s first. Additionally, you really want to hug the aorta in that space so as to avoid injuring the recurrent laryngeal nerve. Ultimately, our feeling is that if you can avoid circulatory arrest and you can get a clamp across that area and perform an expeditious procedure, you’re going to be in the best shape.

Yeah. Let’s pause the video just for a second here, if you don’t mind, and really look at what’s going on in that aneurysm sack. Let’s go back to the picture just for a second. You see a lot of that kind of yellowish kind of fatty material. What is that? Is that clotted blood? Is that fat? What are they taking out from the center of the intraluminal component?

Well that’s a combination of, as you said, it’s resolving clot. Also the number one cause of this process is atherosclerosis, so you’re going to see a lot of plaque as well in there, but you also will see, and we didn’t get a look at the CAT scan on this patient, you will see resorbing hematoma, possible resolving dissection in that tissue plane there.
So, Dr. Stewart, is there any concerns you have when you’re dealing with a very significant burden to mural thrombus and clot like you see in this case, especially that kind of old chronic clot?

Well sure. The atherosclerosis is laid down in the plane of blood flow, and really, it’s a laminar deposition. But when we resect this area to clean it up for an open graft, it becomes grumous or loose material, and one of the risks of that is showering debris distally into the smaller branch vessels of, say, the renal arteries, the blood flow to the gut, and also into the legs, which could cause ischemia of any of those end organs.

Yeah. I can't agree with you more. I think that’s one of the important things when you’re doing these types of aneurysm repair, you get your proximal clamp in place, you open the sack, and you very carefully remove that. You don’t just try and kind of quickly shell it out because this is important material that is friable and can be emboligenic.

So we’ll go ahead and continue on and we’ll see, as they actually remove this coagulation and mural thrombus, they’re bringing the aortic walls, using it as tethers to kind of expose this area nicely. Again, as we talked about earlier, this is a key component of these types of procedures, is making sure you have very good exposure of your anastomotic sites. Arash, would you like to comment more on kind of how they’re tacking this down?

Yeah. What we’re doing right now is we’re exposing the aneurysm. As you said, we’re excising the debris that’s within the aorta so that we can expose some of the intercostals and vessels that arise from the aorta there. I think it is also worth mentioning, relative to the prior point, that this type of patient would not fair well from a fem-fem bypass or something like that because you’re set up for embolization to the head, and that’s the material that goes and embolizes, as you said, both distally and proximally. Right now we’re getting all that layer of grumous out of the aorta. We are clamped proximally. And now we’re suctioning to assess the intercostals.

And which intercostals do you decide are the important ones to re-implant and which ones will you just ligate?

Well, you know, I’ll be interested to hear what Allan also has to say about that. But we look at the intercostals in two ways: one, if intercostals aren’t draining at all, we assume that they are collaterals to them and we don’t worry about them. If they drain briskly, we assume that they’re collaterals to them and we don’t worry about them. It’s the in-between ones that we worry about the most. So if they are sort of trickling back flow into your intercostals, those are the ones that we pay the most attention to.

Allan, are there certain locations you also fixate on close to the subclavian? Any other locations?

Well, sure. As Arash was saying, the most important area are the in-between and it’s really a matter of doing a lot of these operations to figure out what the appearance of that is. Certainly, the so-called Artery of Adamkiewicz is the one that we’re most interested in implanting, but we often don’t see that. Because if you look, a lot of these intercostals are obliterated by atherosclerosis.

The most important thing in multimodality therapy to avoid paralysis is the avoidance of hypotension. We know that the spine has a robust blood supply that’s collateralized by the subclavian artery, by the hypogastric, and a contribution of these intercostals. We try and preserve the ones that do have sort of moderate flow in between brisk and non-existent, but most importantly, to avoid low blood pressure during these operations.

I think that’s critical and that’s one area we’re seeing now with endovascular procedures. There’s a much lower rate of paraplegia in most areas, and comparable, I think, to what we’re seeing at centers of excellence as you see here at New York Presbyterian. But, I think, when you’re doing
the proximal anastomosis as you see here, you have to be very careful, make sure that you’ve had it well secured, anchored to very viable tissue, and, if necessary, use supports such as a felt or a pledget, especially in those cases of dissection.

So you see now where they’ve done the proximal anastomosis. It looks quite good. It’s appropriately sized and matched. You don’t try and undersize or oversize the graft to the aorta. You want it to be a reasonable match to the size, and then securing it with some reinforcing sutures here. You’ll then test the proximal anastomosis, and I think this is something that, again, is your best time to see that the area and make sure there’s no small little leaks and everything. And one thing we’ll try and do is, if you can see a lumbar that’s very close, we’ll actually bevel a little bit onto that area and try to incorporate those intercostals, especially very close to the left subclavian to try and preserve those collaterals you were mentioning for the spinal cord.

Here’s it’s, again, important, since we had all that great grumous material in there, that you flush the grafts as Dr. Girardi is doing here, and then you’ve simply put a clamp on graft itself, and then set you up for the next phase of the operation. Arash, what are you going to think about doing next now that you’ve got your proximal anastomosis?

Well, now we are going to look at, as I said, the draining vessels are the branches off the aortic here, the intercostals, get another sense for which ones we need to ligate and which ones we need to re-implant. We’re going to start looking distally at our distal landing zone. I believe this patient was aneurismal down to about the celiac, and so we usually don’t have to get into the abdomen for this. We can bevel behind the celiac artery, and do our distal anastomosis. And that looks to be what we’re doing right here.

So you’re coming in and you’ve hooded over the origin, you’ve very carefully seen the origin of the celiac axis, and kind of beveled your graft there. Any thoughts of, you know, how far is far enough to go down? Will you accept a slightly ectatic area? Or do you go down to do you get to good normal thoracic or abdominal aorta?

Well I think that your goal is definitely to get to normal thoracic aorta. You want to make sure that you have good tissue to sew to distally, and you also want to make sure that you optimize the operation for the patient. Having said that, in this particular patient, we were able to really just dissect free the crus of the left diaphragm in order to expose the distal extent of the aneurysm. And so we felt that we were able to get a complete operation without having to go too far into the belly.

Well I think that’s important because when you don’t get down to what you consider good aorta, in especially some of the younger patients we see, you know they’re going to be back with a more complicated problem and now with a re-op situation. How are you seeing – you’ve had significant exposure and experience with endovascular, how is that changing your though process in dealing with these types of thoracoabdominal aneurysms?

Well, you know, Allen sort of alluded to this, that patients, certainly over the age of 80, whether it’s a dissection or a thoracoabdominal aneurysm, are certainly very high risk, and the number of patients out there with this type of problem are increasing rapidly as the population ages, and a modality that avoids this incision, that is very useful to having in your armamentarium is endovascular approach. Now obviously there are limitations to that at present, you have to have good proximal and distal landing zones for your stent grafts. And in this particular patient, we thought we would need a very long stent graft and we didn’t have ideal proximal and distal landing zones, but for patients who are otherwise too old to undergo an operation, it’s a great alternative.

Now in this particular case did you re-implant any of the lumbar vessels or?

I don’t believe that we did.
Okay. And, again, would you use the same—many times, especially with these aneurysms that have a lot of mural thrombus, it seems like those intercostals will actually thrombose, and it may not be as many as present as you were with a dissection. Dr. Stewart, when you’re dealing with these complex symptomatic dissections, is there anything you do specifically when you see a lot of lumbars going down through the diaphragmatic hiatus and the, you know, T10 to L1 region.

Yeah, we’d like, rather than to spend time doing individual anastomosis, we’d like to find an area where, again, we can see intermediate flow coming out of those ostium, not brisk flow, not an absent flow, but an intermediate flow in a host, and then can re-implant them as an island to try and get a half dozen or so, if we can, use it as one, big, beveled portion in the distal thoracic and early lumbar vessels to try and maximize perfusion to the spine.

And I think that’s key is when you see those not vigorously back leading vessels, try and preserve them, even doing an onlay patch with a patch, kind of a u-shaped graft has been helpful. Here we’ve obviously completing an operation, they’ve closed the aortic sac around the graft, it’s very dry, putting chest tubes in for drainage, and now we’re re-approximating the ribs to close this fairly large incision. Dr. Stewart, any comments on your closure technique and what you’re thinking about at this point in time?

Well the goal is to re-approximate the ribs here, as you’re seeing. The major complication of a large thoracic incision here is a lung hernia, which can be a rather morbid complication, so we take great care to bring the ribs together and obliterate that space. Having said that, it is a large incision, and we often will infuse some topical anesthetic, either as a bulb infusion over time or a temporary nerve block to facilitate early extubation after this rather large procedure.

Okay. I think that’s a great overview of a big operation with a very good outcome. I think these are all things we have to look at. And many times this is the right thing to do for patients. If they have good risk or they have poor anatomy, you need to be able to have the ability to come in and do the right operation and have the right team to do it. I think Arash was right on when he said that you need to have a dedicated team, not just the surgeon, but the anesthesiologist, the surgical team, and in the post-op critical care team, that really helps give the very outcomes that we’re seeing here at New York Hospital.

Another option though, as we’re looking moving forward, is the endovascular approach, and I think this is something that’s fairly dramatically changed how we look at management of patients with thoracic aortic pathology. And the thoracic stent graft, as Arash was alluding to, is a very good option when you have adequate sealing zones, both at the beginning of the graft and the end of the graft, and many times we’re talking of two, sometimes three centimeters in length of normal aorta for these grafts to fix. So that is a limitation right now with the current aortic stent graft technology.

People have come in and they’ve covered the left subclavian artery. We’ve found that less likely to be—to do that now just because the risk of vertebrobasilar insufficiency, or covering the celiac axis, but if they have a complication from celiac coverage, it can be devastating. That has brought forward to look forward to even more sophisticated grafts where special holes or fenestrations are cut in the graft to allow perfusion to these critical vessels, such as the left subclavian, celiac, or the renal arteries and SMA for more abdominal work.

And then, finally, what we’re looking to move forward to is what we call branch vessel grafts where thoracic and thoracoabdominal aneurysms, as well as abdominal aortic aneurysms, where you actually have, within the graft itself or the endograft, a branch that you can then place covered stent and perfuse from the lumen, the endograft, to the lumen, the visceral vessel, without actually having blood flow exit into the aneurysm sac, and therefore, prevent the risk of rupture by decompressing the aneurysm.
Here is a caricature of some of the technologies that we're now using. On the far left, you see a straight forward nice long neck for an infrarenal abdominal aortic aneurysm. If you've got more than a centimeter to a centimeter-and-a-half, most of the conventional endografts are approved for treatment there, and so a fairly straightforward procedure. Many patients, however, that we see here at New York Hospital come in and have the aneurysm come up very close to the takeoff of the renal arteries or come down, as we saw in the case with Dr. Girardi, to the origin of the celiac. And now we're looking at using fenestrations in those grafts to allow perfusion to those vital vessels, but yet prevent blood flow going into the aneurysm sac itself. And then on the far right you actually see the branch vessel technology where covered stents are used to bridge into through the aneurysm sac, almost as a bypass, going from the lumen of the endograft to the visceral vessels.

How do we actually seal this? Here's an example of a fenestrated graft where we'll come in and actually place a covered stent into the fenestration and out into the visceral vessel, and then come in with a balloon and actually flare it like a rivet to help seal that graft into the fenestration and prevent blood flow from going outside the aneurysm – or outside the endograft into the aneurysm sac.

And as we move forward, you will see more branch vessel technology coming forward, where we can actually treat a thoracoabdominal involving both renal arteries, the celiac, the SMA, and use bridging stents or covered stents to work from within the aneurysm sac itself.

Interestingly, these procedures can actually be done under local anesthesia, and the length of stay can actually be in a matter of a day or two rather than matters of multiple days to weeks with the standard open repair.

This is an example from a case from Liverpool, where they actually created a fenestrated branch vessel graft with multiple branches going to the renals, the SMA, and the celiac and actually were able to treat a very complicated aneurysm with this branch vessel graft to the visceral vessels. This was courtesy of Cook Technology, Cook Medical who created this graft.

And here is a completion angiogram and CT scan that shows good profusion to all the visceral vessels and complete exclusion of the aneurysm sac using this endovascular technology. So I think as we move forward, this is something we're going to see at centers of excellence, such as you see here at New York Presbyterian Hospital, to treat these complicated aneurysms in those patients that may not be good risk for open repair.

Again, imaging is critical. Arash was commenting, and this is actually the CT 3D reconstruction of the aneurysm that Dr. Girardi repaired, and this allows us to actually sit down in a very relaxed environment and really size and measure and say, “Is this patient a better candidate for an open repair? Is he a candidate of combined procedure of open and endovascular, a debranching procedure; meaning to do bypasses to those visceral vessels, or can we actually do an endovascular repair?” So by having these types of imaging modalities, we're really able to sit down and specialize the care for each individual patient.

The other thing that's moving forward, and we're one of the first in the country to get the new robotic angiographic equipment, and this is going to allow us to have full access to our patients, do very complex endovascular procedures with the highest quality imaging that's available throughout the world. And this is something, again, where New York Presbyterian is really taking the lead in making sure that we have the best possible equipment to treat our patients in the most safe and efficacious manner.

So sometimes you can't make any one procedure fit, and this is an example of a patient that came into our clinics here, and she is a 75-year-old woman that had a known abdominal aortic aneurysm extending up into her left chest. She had been followed, and then she presented back with severe left upper quadrant pain radiating up into her chest. She had severe lung problems
with COPD, diabetes, hypertension, and on multiple medications. She had a palpable tender abdominal aortic mass in the left upper quadrant.

And on CT scan what we found was there was a distal thoracic component of her aneurysm, as you see here, and then as you move through, it got larger to about six centimeters in diameter. So not a huge aneurysm, but yet she’s tender. Arash, what would you think about in this case? Bad COPD, you know, has got significant comorbidities, and this tender aneurysm?

Well I certainly think that you’re worried about a leaking aneurysm there, and I think this is exactly the type of patient that we were talking about before that is very high risk for an open operation of the type that you saw before. And it is important to have every option available within your tool box, and I think that what I would like to do is get a full reconstruction, CT reconstruction of her aorta to see if this patient is a good candidate, first and foremost, for an endovascular repair.

Dr. Stewart, what do you think?

I would completely agree with Arash. I think that this is somebody who would not do well with an open repair. Part of an impending rupture is a tamponade is both a fatal complication of a leaking aneurysm and also a temporarily protective means of preventing a fatal free rupture. You could see in this case there is some layering in the pleura out in the bottom right-hand corner of that CT scan that makes you worry that in opening the chest and deflating that lung, starting to manipulate that aneurysm, if you might convert a contained rupture into a free rupture, which would have a much higher rate of morbidity and mortality. In this case you can see that there is both a very good proximal landing zone, and with some small debranching, you can create a good distal landing zone as well.

And that’s exactly, as we follow it down, similar to the case that Dr. Girardi was able to share with us, you see that going down into the chest is -- going from the chest to the abdomen, the aorta is still very large, and then finally you come down to take off the visceral vessels and start getting back to more normal size with the celiac and the SMA, and then finally coming down to the renals, which appear to be more normal in size. But, certainly, there is not a good landing zone for any type of endograft above the level of the renal artery.

So she was a little bit complicated. Unfortunately we did not have the branch vessel technology available to us at this time, and coming in with a symptomatic aneurysm, many times it takes eight weeks to get these grafts in. So we were kind of stuck on what type of procedure to do, and so we got an angiogram. We got a pulmonary function test on her, which did confirm she did have significant lung problems, and, really, I didn’t think could tolerate a left chest incision, as well as an abdominal incision. Her stress test is actually fairly unremarkable, which at least gave us a little freedom to try and treat her.

With that, we just, just as you recommended, Allen, we did a retroperitoneal approach and did a retrograde bypass to her mesenteric vessels that went very nicely. We have a maintained profusion to the celiac SMA, as well as the renals, and then came back in several days later, and here is her angiogram. You see the large aneurysm there to the left, and then she had had a previous abdominal aortic aneurysm repair, which you see the graft on the right, and we actually were able to come in -- you can see the bypass of this graft coming back to the visceral vessels and took a thoracic endograft and actually went from the mid-descending thoracic aorta all the way down, covering the celiac SMA and really abutting it down to the renal vessels to give good profusion -- or good protection and sealing of the aneurysm sack, but yet maintaining profusion to her visceral vessels and her renals.

So I think by this kind of combined debranching procedure, we were able to treat a woman that had very significant comorbidities with a life threatening problem and actually did it in such that she is out and was able to go home in a matter of days rather than weeks or months. Arash, what are your thoughts?
You know, the angiogram shows a very nice repair. I think that this is the type of patient who, with an open operation, you get her through the operation, but she’s in ICU in respiratory failure for weeks, and I think that this was a perfectly-selected case for this type of therapy, and the outcome really proves that.

You know, and I think that’s one thing that we’re trying to impress upon, is that, you know, many times if you come together with multiple specialists, you can figure out what’s exactly best for each individual patient, and that customization of care is really part of the continuum of care that we’re seeing here at the New York Hospital Presbyterian system. Sometimes you don’t have the leisure and time to say, let’s do A, then come back later and do B. Allen, what do you see in the future for that?

I think one of the most important improvements we’ve made are to say, for surgeons who can do both types of therapies, to work as a team with our colleagues in vascular surgery, interventional cardiology, and cardiac surgery to come together as a group and perform hybrid surgeries, which can minimize the incision, minimize recovery, and maximize the treatment options available in one surgical sitting. I think that hybrid surgical care will afford us the ability to completely treat an aorta without multiple steps and multiple returns to the operating room, each with its attended morbidity and mortality.

This is an example case of mine, which I think illustrates that point very well. This is a 66-year-old male who had, essentially, aortomegaly. He had important aortic insufficiency, large root aneurysm, an arch aneurysm, and a proximal descending thoracic aneurysm. And that’s something we can’t fix completely from a median sternotomy. It would involve typically a two-stage operation with an initial open heart bypass operation and a repeat thoracoabdominal incision.

In this case we’re able to accomplish it in one sitting -- or one hospital stay, and here is how. We started with preoperative imaging, which showed that the patient had a dominant left vertebral artery. That means that we can’t go ahead and cover the left subclavian artery with a graft with impunity. We’d worry about vertebral basilar syndrome.

What we did is we started with an open procedure, which comprised several operations -- a carotid subclavian bypass, a valve-sparing aortic root replacement, which I think is important, because in both campuses at New York Presbyterian, we have one of the largest experiences with valve-sparing root replacement in the country. We proceeded with a total arch replacement and complete debranching and accomplished this with no circulatory arrest, with modest hypothermia to only 28 degrees and a cross clamp time under an hour.

He did well from this procedure, and then we took him and did a stent graft of his proximal descending aneurysm on day five, and we were able to do that percutaneously on an awake patient. He went home from this entire aortic replacement on day seven.

This is an example of what the open procedure would typically look like. Not in this patient, but here is a guy who has a complete debranching of his ascending aorta, and you can see that trifurcated graft with new bypasses to the innominate left carotid and left subclavian from top to bottom. He also had a graft to his right coronary artery and an ascending replacement.

We’ll then go ahead, and in the patient I’m speaking of, this is his preoperative angiogram, which shows complete aortomegaly, you can see here with the proximal descending aorta being quite large as well. In the subsequent images, you will see on the first image before, as we position our stent graft, you will see our angiogram showing the bypasses to the top, and you will see that left carotid subclavian bypass in the top right-hand area of the screen, and now here’s how it looks at the end. You will see there is a complete obliteration of that aneurysm with a nice lumen directed flow with no endoleak.
So, you know, I think we’re going to have time for some questions, and I think this is something we’re seeing is that, you know, by being able to think out of the box and do different approaches, you and I performed an ascending cannulation for a thoracic aorta because he had a hostile abdomen, and we couldn’t get up to the iliacs to even do a conduit. So, again, by working together, this continuum of care, I think it really gives us the best possible care for our patients.

We have some questions from our viewers though, and the first question is one that goes back to just a technical questions, and it’s, “Why do we cover the graft with a discarded aorta at the end of the operation for the thoracic aorta? Allen, why do we do that?”

Well one of the issues with Hemashield is it tends to form adhesions. We see this more in the abdomen with enteric fistulas developing to sites of graft, particularly at the anastomosis. Here we cover it so that we can keep the lung away from our graft and prevent dense adhesions and the possibility of some sort of communication between our aorta in either the pulmonary vasculature on the lung parenchyma.

Very good. Arash, there’s a question regarding, “How long can you clamp the aorta?” When you’re doing these thoracic aortic aneurysms the clock is running, what’s your timeline that you work with?

Well there are some gold standard studies, maybe about 20 or 30 years old now, that show that beyond 45 minutes, the peripheral organs and peripheral extremities begin to suffer pretty significantly, and that levels off at about 60 minutes. Now, typically, when we are considering our operation, whether or not to put the patient on partial bypass for the procedure, we look at the operation and say to ourselves, “Are we able to clamp this patient and finish the operation in about 30 minutes,” because we feel like we’re in a very safe zone. Once we get at about 45 minutes, and certainly onto 60 minutes, we are risking end-organ profusion and multi-organ failure.

So that 30 to 60-minute window is really the critical time period. Allen, you discussed dissections in the beginning of our webcast, and we have a question of saying, “If 30 to 40% of dissections become aneurysmal and then become more complicated to repair, why don’t we stent graft everybody as soon as they have a dissection, even a type B?”

Well it’s a fair comment. I think right now we’re limited by the devices, which are FDA approved. The devices approved are made for a straight tube graft with a good proximal and distal landing zone. The sections often arise just distal to the left subclavian artery. So to cover that will involve usually a fair angulation of the distal aortic arch in a somewhat unfriendly proximal landing zone, which can create a high rate of endoleak at the proximal site.

We get around this by covering the left subclavian artery to give us some more landing zone, but we don’t have the optimal device. Also, they’re not without risk. Often time, people with type-B dissections have a dissection that continuing down into the iliac vessels, with multiple fenestrations throughout the thoracic and abdominal aorta. Why that’s significant is by putting a wire through and a large instrument can cause a retrograde dissection, turning a type-B dissection into a type-A dissection and also can increase mal-profusio if the wrong lumen stented open.

I believe our technology is advancing but right now we haven’t shown a morality benefit in the early studies. There is one trial in Europe that’s called the “INSTEAD Trial,” which has failed to show a morality benefit at one year. The study is ongoing. There are other devices approved, which are more amenable to type-B endograft repair. But I think in the United States we’re limited so far to carefully controlled trials and the development of adequate technology.
Yeah, I agree with you, and think one thing we’re seeing, and there is a question about recurrence rate. And with the endovascular repair, we still haven’t gotten the perfect device. As we’re getting better and better devices, we then come back and say, “But now let’s push the envelope and treat going into the arch itself,” and I think looking into our crystal ball, it won’t be too far the future at least we see total arch replacement all from percutaneous endovascular approach.

I think one of the things we are seeing is that there still is a need for surveillance. We need to be following these patients with CT scans and potentially ultrasounds as we look at the abdominal component, and there is a need for occasional intervention. Many times it’s all done with endovascular repair.

The question also then is for open repair. Is this the gold standard? Is this something where once it’s fixed it never needs any other intervention for the thoracoabdominal interventions, or are there some recurrent issues with those also? Arash, what do you think?

Well I think it is the gold standard therapy. I think that we have looked at the results, and we discussed those briefly; that the results are really excellent, and that’s what we should shoot for within the vascular repair. Obviously there are reasons why you have to go back and re-operate. Certainly if you have graft infection, you know, fortunately the rates are very low and, you know, as Allen sort of stated, you know, you wrap that aorta around to hope that you don’t get a fistulization or you don’t get an infection in the area of that anastomosis.

Certainly if you do re-implant an island of intercostals you are always risking aneurysm development in those regions as well. And certainly in anastomotic sites you’re always worried about aneurysm formation. So there are things that can happen after this operation, but fortunately we try to avoid them as much as possible.

Yeah. I think we have all seen those where they come back, and unfortunately it’s a complication that can occur three, five, ten, fifteen year after the initial graft repair. Where the patient may have been in their 60s or 70s when they were first repaired, now in their 80s or even 90s, and they’re much less good candidates for open repair, and I think that’s where endovascular may even come in as a very valid solution if you come in and have a patch aneurysm of their re-implantation, celiac SMA, you can come in and put a covered stent in that way and then bridge that area of weakness from that diseased aortic segment.

One of our final questions -- and this is coming from one of our viewers that is not a physician -- asks, “What should I be looking for? What questions should I ask a physician when I’m considering endo versus open repair?” Kind of a very valuable question for the consumer, you know, what should I find out? Allen?

Well I think you’d like to be assured that the team involved in your care has a large experience with both; that an open repair can be accomplished as readily as an endovascular repair because that way there is no procedural bias; that the team is facile and will choose the right outcome from the individual patient. You’d want to make sure that each center is involved in the latest clinical trials, so that all tools are available, and that there is a multi -- a disciplinary team involved.

One discipline really can’t specialize in all areas of aorta anymore, and I think it’s valuable for someone like Arash, who is cross trained in both catheter skills and open repair to be able to offer a wide variety of tools and that there is a good working relationship between our vascular surgeons, our Cath Lab, and our cardiac surgical team.

Well I think our time is running out, and I certainly appreciate everyone, my panelists for joining us, Arash, for coming in to help, as Dr. Girardi is tied up with an emergency, and I think it’s important that we, again, stress that this is something where we’re looking at a team approach.
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At New York Presbyterian it is a continuity or continuum of care that really gives the patients the best possible outcome.

I, again, thank you for joining us. We will take a short two- to three-minute break, and then we'll come back with our second webcast, looking at the treatment of abdominal aortic pathology and new innovations for both open and endo vascular repair. Thank you and good night, and thank you to the panelists.

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