Abdominal - Aortic Dissection and Aneurysms

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I've always felt that the mission of helping somebody with health care when they're in trouble is as wonderful and as powerful and as important a mission as anything you could 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 “U.S. News” and “World Reports.” 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 from New York Presbyterian Medical Center. We’re joined here tonight to discuss the innovations in conventional and minimally-invasive treatments for aortic aneurysm disease. I’m joined by my esteemed colleague, Dr. William Gray, who is director of Endovascular Services here at Presbyterian Hospital Columbia, and Dr. James McKinsey, who is chief of vascular surgery at New York Presbyterian.

Dr. Gray could you perhaps introduce us to an overview of abdominal aortic aneurysms.

Sure. Well the incident of abdominal aortic aneurysm is actually quite large, but the diagnosed cases are really represent about 10% of the total population that has aneurysm disease, and of the diagnosed patients, about half of them undergo treatment for indications we’ll talk about shortly. And of those people who undergo treatment, about half of those have a surgical treatment primarily counterbalanced by an endovascular treatment, which we’re going to talk about today.

If you look at the risk factors for abdominal aortic aneurysm, or triple A, they are primarily around the notion of male sex; five-to-one predilection; age, the older population is more prone to aneurysm formation, peaking around the age of 70; the family history of a first year relative who also has an aneurysm is present in about 15 to 20% of the population undergoing aneurysm repair; and a strong predictor is the use of tobacco, either former use of tobacco or current use of tobacco.

The presentation for triple A is actually interesting in that most patients who have abdominal aortic aneurysm are asymptomatic; therefore, we depend on serendipitous or happenstance discovery of these aneurysms, either on physical examination if the aneurysm can be palpated through the belly, although obese patients that can be quite difficult; or other testing like either CAT scan or MRI for lumbar disease, back pain, or ultrasound other issues, and potentially either cardiac catheterization where the wires may get caught up in the aneurysm itself.
Interestingly, although the aneurysms tend to thrombose they don’t embolize that thrombus very often, so that’s a rare presentation, and unfortunately occasionally patients will rupture their aneurysms, and that’s heralded by the sudden onset of abdominal or back discomfort or both, and once the onset of rupture has taken place, the mortality from surgical repair is upwards of 50 to 70%, although there are data to suggest that endovascular treatment of these ruptured aneurysms can actually be better in terms of morality outcomes.  Harry.

Thank you.  We feel that early diagnosis is very important and, indeed, in high-risk populations, screening can be performed with duplex ultrasound, which is a noninvasive technique.  It involves no exposure to radiation.  There’s no contrast media that may injure the kidney function.  It’s relatively inexpensive, and, indeed, we can see an image of that, which would show a clearly how well we can measure the size of the aneurysm so that not only we have seen its size but we now know it’s present.  Dr. Gray, are there other modalities we can use.

Well there are two other modalities we can use.  One is MRI or magnetic resonance imaging. Contrast-enhanced MRI can actually be quite accurate and precise in extent of the abdominal aortic aneurysm, as well as the access vessels.  The only issue or drawback from that is that calcification is not well seen with MRI, and that can be very important for planning purposes, especially for the access vessels, which can be quite torturous.

Here you see a rotational angiogram, which is part of the Dyna-CT acquisition.  The Dyna-CT is actually a very interesting technology, which we have now at New York Presbyterian Labs, which allows us to acquire a CT-grade image during the case, which you can see here the reconstruction of which, and this reconstruction actually allows us to view not just the angulation intraoperatively but also do measurements, which are quite accurate off this type of technology and really represents a step forward in the intraoperative imaging of these patients.

After their graft is placed in endovascular repair, the graft can be checked for endoleaks and this can actually obviate the 30-day usual CT scan that we put patients through.  Jim.

I think also is the imaging we have when we’re doing the grafting, and here you see the state-of-the-art robotic arms for imaging that we’re now having available at New York Presbyterian that really allows really that 360-access to the patients.  We can do a 3D spin, and as you showed in the last slide, get a CT equivalent of this patient’s anatomy.  So if someone comes in with an acute aneurysms, ruptured, leaking, we can bring them right to the OR suite, the Cath Lab, wherever we’re working, and actually intervene with high-quality imaging in an emergent basis.

One thing when we have the luxury of time, we’re also now using a 3D reconstructive package based on CT not on angiography.  And here’s a case we’ll discuss a little bit later in the presentation.  But we’re very -- it gives us significant detail as we’re looking at this complex anatomy of interaction between the aorta, the iliac vein, and a patient that as a connection or a fistula between those two, and then really helped us make the diagnosis and form late the best treatment plan for this particular patient.

Harry, what about the open repair, is that still something we do?

We do that, and it’s certainly a tried and true surgical procedure.  It involves exposing the aneurysm directly through either the abdomen or through the left flank, visualizing the normal arteries above and below to control them, actually opening the sac, and then manually sewing in a graft to replace the aneurysmal segment, and this has proved to be a very durable procedure and very effective.

The real questions then become when is surgery the appropriate treat.  Certainly the patient’s choice plays a role.  Younger patients, we feel, potentially should be considered for open surgery.  People who have visceral aortic aneurysms potentially can best be treated with open surgery,
and in some patients who have very large aortic necks proximal to the aneurysm, and particularly when there’s clot forming inside that large neck, can best be treated with opened procedures.

In addition to that, there are other issues, which can potentially lead to consideration of open surgery, and we’ll discuss some of these as to how we can treat them other ways, but people who have short angulated necks above the aneurysm, people who have renal artery branches that come off the wall of the aneurysm directly, people who have disease in the iliac arteries down below the aneurysm, which can either be very tortuous or small in size or densely calcified or actually have aneurysms in those arteries themselves.

Dr. Gray, what do you think about the role for endovascular procedures in the aneurysm patient?

Well in the patient who is a reasonable candidate for endovascular procedure, it can actually reduce morbidity and mortality that would be compared to an open procedure. But as you have mentioned, there are difficult segments of the aorta which may not lend themselves to this. Only about 50 or 60% of patients currently being entertained for aortic endovascular repair actually are able to have that.

You know, the real issue revolves about the infrarenal neck. Today the neck really has between 1 and 1.5 centimeters in length. It shouldn’t be too angulated. The neck size really can’t be a whole lot more than 32 millimeters, and the access vessels have to be adequate. Luckily for most patients who have aneurysm disease, access vessels don’t tend to be much of an issue.

There are actually now five options for therapy in term of the devices, which were approved by the FDA. Each of them have their own qualities. I have listed them here. There is an active fixation on two of the devices that actually have barbs or hooks that grab the aorta and fix it into there so it doesn’t slide or move over time. There’s a couple of devices that have active -- sorry, suprarenal fixation, which are varus stents not covered by graft material that allow a longer columnar extension of the graft.

Aortic bifurcation fixation in one of the grafts that, actually, the graft sits on the aortic bifurcation and uses that as a fixation point. Most of the grafts are modular; that is, they’re built inside the body through piece work that’s done through the access vessels. There is one unibody vessel, one unibody graft. Most of them have exoskeletons; that is, the stents are contained on the outside of the graft, and one has an endoskeleton, and lastly, most are made of -- well two out of three -- two out of five are made out of Gore-tex or ePTFE, and two are made out of Dacron or woven polyester.

The method we’re going to go through in a little while here, but the typical method for access is using a bilateral common femoral artery cut down to expose the femoral arteries, because these devices do range between 18 and 21 French in general, and that therapy is accepted and appropriate.

We have been using more for the last four years or so at New York Presbyterian of remote suturing access technology where we’re able to place sutures at the site of the insertion of the graft in the common femorals before we do the procedure, so the sutures are in place, the site is expanded through the dilators, and then the grafts are placed, and at the end of the procedure we can tie those sutures remotely. And using that, in selective cases, we can really get about 90% success without the need for anesthesia, general anesthesia and just conscious sedation. And it avoids the potential consequences of open access, which are not dramatic but do occasionally result in seroma infection or collateral interruption, which can be important, especially if you’re going to compromise hypogastric vessels.

So as I mentioned before, if we look at the EVAR outcomes, they are quite good, and they typically have less 30-day mortality, especially in the older patients where there seems to be a greater differential compared to the open operation; less blood use; shorter length of stay in the
ICU. Most of our patients actually go back to a routine floor, and have groin care as there primary issue. And then the total length of stay has also been shown to be reduced. And last, there is a very important thing, which is that they return to function very quickly. You will see patients in the Cath Lab or OR, and then in the next week we’re seeing them in the office for their routine follow up rather than discharging them from the hospital.

You see here outcomes from endovascular versus open repair, the Medicare dataset, which Jim helped me put together on the slide. And basically it looks at the early advantage to morality of endovascular repair, but you can see over the ensuing, you know, four or five years, that there is an all cause mortality basis a catch up phenomenon, so for some reason we see these lines converge, and this has been shown not just in Medicare datasets but also in randomized trials. So while there is a certain advantage and less morbidity, we don’t see it play out in the long term.

Thank you, Bill. I think one thing we have to also look at though, is you mentioned only about 50% of the patients and maybe 60% may be candidates for the conventional endovascular therapy. But we have another whole subset that don’t fit the IFU. They may be juxtarenal, going up to the renal artery themselves. It may extend above the renal arteries and have it as part of it, or even going to the diagram as Type-4 thoracoabdominal, and these type of aneurysms are very complicated and do require a dedicated team and a lot of planning on how to manage it.

Sometimes we’ll come in and do a standard open repair with collaboration with cardiology to make sure that they can tolerate that type of stress, as well as having a pulmonary evaluation. In those patients that can’t tolerate a major open operation, which is a significant number, because these patients are prone to have multiple comorbidities that led to their atherosclerosis and their aneurysm. We have to talk about what are their options, and this includes debranching where we we’ll actually come in and bypass around the aneurysm to the visceral vessels. It’s still an operation but it’s not as big as an operation where you actually have to clamp the aorta. We have newer technology such as fenestrated grafts that can deal with those aneurysms that have very, very short neck, and then now we’re looking at technology that allows us to do branch vessel, which will actually allow us to work within the aneurysm sac and actually take small grafts out to the visceral vessels maintaining profusion to those vessels, but preventing leak into the aneurysm sac.

And here is a case that we’ve filmed in one of our recent cases in New York Presbyterian. It’s a 64-year-old gentleman that presented with an intercranial aneurysm times two and then later presented with a significant plank in abdominal pain. He was originally worked up by his primary medical doctor thinking he had lumbar sacral spine disease, and as Bill pointed out earlier, many aneurysms are found as incidental findings during other workup, and that’s exactly what happened in this case.

He had a 5.5 centimeter abdominal aortic aneurysm that looked like it originally had a decent long neck below the renal arteries. But then as we started doing our imaging studies, what we actually found was a very large accessory renal artery going off to the right kidney that probably had at least 50% of the flow to that kidney coming from that accessory renal. So Harry, what are your options when you deal with these patients that have, you know, large branch vessels or accessory renals going to it and you want to try to do an endograft?

Well really you are in a situation there where you do want to maintain profusion and you do need to revascularize that kidney. You could do a limited extra anatomical bypass to the renal artery prior to that and then allow you to extend your stent graft up to an appropriate level, or you could use what is now available, the fenestrated graft device, to allow you to seal around the orifice of that renal artery and maintain profusion to it.

Bill, what are your thoughts on the fenestrated graft versus coverage versus open repair.
Right. Well, you know, the surgical repair, Harry went through it nicely. I think that the real issue is, you know, how important is that accessory? You know, if the patient has normal renal function, and even if it accessorizes half of the kidney, they may actually be able to tolerate that occlusively. But you don’t like to give up too much to any visceral vessel.

A perfectly good kidney.

A perfectly good kidney. So I think preservation of the access vessel, assuming the options are available, is optimal. Without it, I think you’re committed to an open operation, recovering and infracting part of that kidney.

Well I think that was our thoughts exactly. And courtesy of Cook will show our IDE for fenestrated aortic stent grafting, and this is a technology that will allow us, from a remote access in the groin, to deploy a graft that will actually cover the renal vessels but have -- and even the visceral vessels, but have specific holes or fenestrations cut within the graft such that we can come up from the contralateral leg and actually go through those holes and go into the visceral vessels.

This obviously requires computer generation modulation of figuring out exactly where to put those fenestrations, but with that you can see we’re able to implant a graft, come in, and then anchor those penetrations over the renals or the SMA and secure them in place such that you have a much better more normal landing zone for the aortic stent graft and prevent the chances of leak around the short necks that you may have in other situations.

Here you see the stent being implanted, flared, which we’ll cover in a little bit more detail, and then the same thing is done on the other renal artery, and if necessary, for the SMA with a scallop or a fenestration.

As we move forward with this case, let’s walk through it, in which the patient was brought to the operating room. He’s an 83-year-old. He was brought to the operating room for repair, and it was done under a local anesthesia with just a little IV sedation, and we did a bilateral groin cut down, as Bill had indicated. Now we can actually do them with per cutaneous access. But in this case we did it with bilateral groin cut downs and we’re able to get our access up and put a specially-designed fenestrated graft in the area of the renal artery. So if we could run that tape please.

Here we are in the operating room. It’s an angio OR suite, similar to what’s available in our Cardiac Cath Labs also, and we’re able to come in, we did bilateral groin cut downs. Here we are putting a catheter up to allow us to measure the exact length of the aneurysm, the origin of the accessory renals, as well as the true renals, and also the flow into the iliac vessels. And there, very nicely you see that accessory renal coming off on the right and the intrarenal abdominal aortic aneurysm.

Here is our fenestrated aortic graft. Again, it will be in the 22-French range, so it’s not a huge system but yet still requires adequate iliac access. We’ll orient to the graft here to make sure the marker is indicating where the fenestration or multiple fenestrations are and assure we have appropriate graft position. We’ll then go over a stiff wire, again, feed it through a percutaneous or a small cut down, and this is all under local anesthesia. And we’ll position it with it that calibrated that catheter, knowing exactly where those fenestrations, or in this case single fenestration are, and then shoot an angiogram so we can line things up with the fenestration and that accessory renal artery.

There are restraining wires so that you can partially deploy this stent graft, so you have room to move it without it forms its seal. So here you see we’re coming in doing a flair, then we’re going to coordinate and line up that area of the fenestration with its markers and then slowly rotate that to allow us to line up that fenestration with it, that accessory renal artery.
Again, using our image modalities we’re able to very specifically localize and image the area that we’re looking to catheterize, and here we put a catheter through that fenestration straight out into the renal artery, that accessory renal artery. Once we’re able to have the wire, we’ll exchange it for a stiffer wire and put another catheter out there that will give us a little bit more stability as we’re anchoring it in.

Here you see we are bringing a six French sheathe over that wire to help secure that position going into that accessory renal artery, and it’s brought up, and then we bring another diagnostic catheter into position, and here you see the sheathe traveling over one of our catheters. You can do it over a balloon, or if you have enough purchase, you actually can just use the dilator of the system, and then we come in, put a stent that we use to anchor it in position.

Here you’re seeing we released that lower aspect of the restraining wire, so now the graft is able to fully expand and become opposed to the arterial wall. Once we have that in place, we have to remove the restraining wire that controls the top cap release, so now we’re able to release that suprarenal fixation, Bill, that you alluded to earlier, to really help seal that graft and that more normal aorta on the supraceliac aorta.

Once the stent has been deployed, as you see here, it is a balloon-expandable stent, we’ll come in and then flair that with a balloon to act, as I mentioned before, as a rivet to kind of seal that connection between the aortic stent graft and the visceral branch going out here. And here you see the balloon being inflated and pushed up just a little bit to kind of create that downward flair. Again, that maintains our position there with the wire out into the renal artery.

Once we’ve completed that we’ll take angiogram to assure we have good position of our stent graft. If they have other visceral vessels that have fenestrations, we’ll sequentially go through and do the renal and the SMA as we need to. And then we come up, we recapture the top cap, having implanted our main body of the graft. This is an open-ended non-bifurcated system at this point, so now we need to bring up the second portion or the distal main body, which has the bifurcation similar to some of the other grafts where we have it with a long limb on the side of the graft coming in and a short gate on the contralateral side. We assure appropriate orientation with that graft and then we go up over the stiff wire here with the delivery system of that lower aspect of the main body.

That, again, goes through the original groin puncture, and here you see the graft coming up and crossing into that main body. You have to be careful as you go through the area where you’re stents are for your fenestration to make sure that you don’t disrupt that. You see the checkmark right there that allows us to orient to the contralateral side, and then we come in and we deploy the second phase of the main body here, again coming down until we release that contralateral gate, which you should see pop open in just a second, and that will allow us access to now profuse not only the right left but the left leg through this endograft and exclude flow to the aneurysm sac itself.

We then take a wire and catheter and selectively catheterize that left gate, and we will take and we will actually do a spin with the catheter within the lumen of the graft to make sure that we’re in good position there and assure that we have, in fact, cannulated the gate and not gone in front of or behind it. And this is where we’re going up through that catheter now with a wire to engage the gate.

Bill, one thing -- can we pause that just if for a second. With all these procedures, how are you finding little tricks for cannulating the contralateral gate?

That’s a great question. You know, I have gone through a series of different catheters and wires and techniques, and our favorite actually is to use a slightly angulated angled guide wire -- a glide catheter and an angled guide wire, and select the gate using that. Sometimes we use a more aggressively-formed catheter like Omni Flush catheter and park it down by the bifurcation where
it opens up, and we can actually swing anteriorly and posteriorly. I think the bigger question about cannulating the gate, which can be a real problem for a lot of people, for everybody actually, is that, you know, orienting the gate correctly on its implantation.

If you’ve got a swooping aorta that does like this and you put the gate up against this wall, it may be tough for you to find, especially if you’re coming in from the right side. So many times we’ll cross the limbs of the graft so that we can actually get the gate in the position that will be most easily cannulated. And that, I think, has led to an easier -- you can use almost any tool at that point.

Harry, do you have any thoughts?

Well I think, as you say, the other aspect is trying to orient the geometry of the aneurysm, which you can see on your reconstructed CAT scans and then where that contralateral limb is going to end up within that structure, because sometimes I lined that, particularly if it is a little far away, you end up with more of an angle like Cobra glide wire catheter, which give you a little bit more steerability in terms of the angle.

And I think the newer modalities for imaging that are coming on board will make some of this even easier, because then you can see online where you are in relation to it. It will be much less of a blind approach but actually a very directed approach and should speed that up dramatically.

When all else fails you can always go up the same side you put it in and hook over the flow divider and then snare the wire coming through. That is very useful.

It’s useful but work.

Yeah. And then you will lose access to the graft also.

Right.

I think, you know, Harry, as we talk about some of these new imaging modalities we’re having, both with the new ecosystem that has it where you can actually import your CT image into your image intensifier, your radiation source, such that you can really build a virtual graft within it and you can almost preplan how you’re going graft, how you’re going to position, and then how you’re going to try and do some of these more difficult catheterizations.

Let’s go back to our video though, and complete this one case. So here we’re coming up now, and we have con angulated the contralateral gate, and we’re bringing up the next limb that will go down to the contralateral limb and the land just above the takeoff of the hypogastric artery on the left. This is a little come complicated because they actually had a focal dissection over the distal common iliac on the left, which will be a little bit of a factor towards the end of the case.

Again, you need a dedicated team. We have a crew that really has worked with us for -- like with you, Bill, for four years and kind of anticipate our every move as we’re doing it, and that let’s us be very efficient with these more complicated cases.

And so here we’re coming in, you prep it. There’s a hydrophilic coating on this sheathe to help it slip up through the iliac vessels a little more easily. We’re coming in now and making sure that the packing it is good on it, and then we’re going to take it and pass it up over our stiff contralateral wire.

Jim, in these more complex cases, you know, ordinarily in a case straight forward aneurysm will take 45 minute or an hour for implantation part, with or without the closure. How much longer do these cases take? How much more work is this?
Let’s pause this, because I think this is an important question. I think it’s directly related to the number of fenestrations you’re doing. In the next case we’re going to show will be a good representation of that. Here, this added another 15 minutes really, just because we had fenestration, one accessory renal. Everything kind of had to line up. The measurement was not as critical when you’re trying to line two or three points up in space. Here we just had to line up one. So it was purely a matter of getting it rotated, then out through it, and with the imaging we have, it really didn’t add that much longer. You are putting one more component in, so it’s that additional exchange.

In the next case we’ll show, it had a high angle short neck that really it was almost a vertical landing zone as you came in because it had really tilted on its own. And that made it very challenging, because even with the 3D reconstruction we had, it was not precise in anchoring. Once the graft was deployed --

It changed this anatomy.

It kind changed this anatomy, exactly.

So let’s go ahead and finish this case real quick. So we get the contralateral limb up and that seated very nicely, and then we complete the deployment on the ipsilateral side, and this is different than the standard Zenith case in that the ipsilateral side with the main body it goes down the hypogastric. But in the late film we see something here. And, Harry, I’d like your thoughts. What are you seeing here? Can we hold that, please.

We’re seeing an endoleak.

Is there different types of endoleaks that you’re concerned with?

Well we’re usually concerned about all of them, but the most important ones are what we call “type-I,” where blood will either come down from the aortic junctions or retrograde back from the iliac junctions. The other major type that we worry about is a type III where the components actually separate and flow can then go directly into the sac from the main flow column. The very common one we see, which is not always significant, is a type II where a normal side branch that comes off the aortic wall has flow going retrograde into the aortic sac. These can have high pressure, and that can be an issue. Most of them, fortunately, have low pressure and turn out not to be clinically relevant.

And in actuality, we are very concerned this was a type-IB or a distal attachment site leak, and that’s where I think that dissection issue came in.

Bill, how do you manage when you get, you know, these distal leaks and everything else?

Yeah. Well the type I leaks are typically managed by re-ballooning the attachment zones and re-ballooning the overlap segments for the type III, so you’re make sure all that is taken care of optimally. They tend to be more common in the calcified thrombotic, you know, vessels. If you’re got a distal one, you may have a problem on your hand if you’ve already taken the graft all the way to the hypogastric. Hopefully your hypogastrics are maintained here, they’re both open, so you probably can cover one if you needed to and get away with it pretty well and probably not sacrifice too much in terms of patient comfort or outcome. So that would be the typical approach.

The type IIs, we look for where they’re coming from, but mostly we put that as a tickler in our head so when we get the CAT scan in the future we know what to expect. But we’ll sit on those. You know, most people will look at those for a year, as long as the aneurysm is not expanding. And most of them will close up on their own. But they are a major source of secondary procedures.
I agree, and we, like you, will not intervene on a type II unless we really see sac expansion. Let’s go ahead and finish.

So we did exactly what you recommended. We came back in, we re-ballooned it with a 12-millimeter balloon in that left limb. And so here is the balloon going up, and then we came back and did a final angiogram, which, fortunately, as we’ll see in just a second, now shows we’ve got complete seal. We’ve got to maintain both hypogastric flow, as well as the flow to that accessory renal. This patient did very well, actually went home the next day, and has continued to do well with good renal function after this type of procedure.

So as we move forward, let’s look at another fenestrated case that we had. And this is a little bit more challenging. This, as I mentioned, is an 83-year-old gentleman that had a juxtarenal aneurysm, was on homo two, had a sizable aneurysm, and had a previous coronary bypass grafting procedure, and was on multiple medications, as you see here.

As we came in to evaluate, he certainly had multiple cysts in his kidney as you step down through it, you see his celiac SMA is okay, but he started getting large around the SMA, and then you see coming off to the left a large almost saccular component of what may be a penetrating or a false aneurysm coming off the side of that left aorta.

It’s compressing the kidney.

It’s compressing, and actually, you see it’s just right underneath that left renal artery, so you don’t have a lot of room there, and then as you follow this down, you actually note that not only do you have that large component coming off but then you’ve got a significant component of angulation as you’re dealing with it going below the renal arteries.

So we’ll step down. You see fortunately the access vessels were good and we came in, and here you see the angiogram, again shows that left renal artery coming off, and we literally had about four millimeters between that left renal artery and this takeoff of this aneurysm. As you may have noted from the CT scan, there’s a lot of clot in that aneurysm, so where the angiogram you’re just seeing the luminal diameter and not the true size of the aneurysm sac.

So we came in with this particular case and we made sure that we had orientation for not only the renal arteries but visualized the takeoff of the celiac and the SMA, and we planned for this case a three fenestration or actually two-fenestration scallop for both renal arteries and the origin of the mesenteric artery.

And here we’re going into position to the endograft, and you can get an idea of the angulation here. Even with a very stiff wire you were biased to the left superiorly and bias to the right with inflection point right just below the right renal artery. And, again, we were able to come in, and you can see we’re positioning there, able to position through the sac of the graft, the restraining wires are still holding the graft partially closed so it’s not being a friction fit onto the aortic wall and then able to pass the catheter and wire through one, anchoring it into position with a sheathe. You can see the markers there on the left that are holding that mark where the fenestration is, and then we pass through the other side to get the right renal artery and catheterize that.

We then did a lateral, assured that we were in good position for the SMA and then came in and deployed, first the restraining wires and then the top cap as you see here. We were able to then come in and stent those areas, and we actually used one of the covered stents in this particular case because of the proximity of that aneurysm to the origin of that left renal artery.

So here we had a high angled neck with a short neck, and by the use of the fenestrated graft we remain profusion to both renals and the SMA and got a good seal.

That’s a nice result.
And even -- proof's in the pudding. Here we have it as that, you know, as you follow through, the stent's in place, the aneurysm is completely excluded, and it's actually started shrinking already, and hopefully it can also help decompress that kidney from the pressure effect.

Excellent. Now there are also aneurysms that occur down below. The next set of arteries are the iliac arteries. Are there ways that we can deal with those?

Yeah. It's actually fairly common incidents of iliac artery association -- aneurysm association with triple A, and so while they occurred isolated, it's about two-thirds incidents of some aneurysm involvement of the iliac, and most of time that involves -- the management involves how far down it will go. If they go only as far as the hypogastric and there is a seal zone above the hypogastric vessel, then you can typically use the usual endovascular approaches and the typical devices.

Occasionally they will involve a hypogastric origin, one or both, in which case the hypogastric make need to be covered, and if that's the case, before that procedure what typically is done is a plug, a vascular plug or a coil embolization will take place as a separate procedure prior to covering the hypogastric. And the reason for that is because if we don't cover the hypogastric retrograde flow from the hypogastric will then fill the aneurysm again and will be the mother of all type II endoleaks.

So that's actually been the standard of care for the most part. Most people do very well with that actually. Rectal ischemia is exceptionally unusual. Most people will have, if anything, some buttock medication for a few weeks until they develop their collateral flow. You can even cover both -- there's a registry now actually in upstate looking at covering both hypogastric vessels, and the detail of that has yet be published, but actually the early indications are that that can be done as well.

For isolated iliac aneurysms that are greater than three centimeters, typically, repair is recommended, although the natural history of that is not understood as it is for triple A. And you can use either a covered stent, which is not necessarily an aortic dedicated device as long as the seal zones and tortuosity allow that. But you may need to use an EVAR device to get seal zone at the bifurcation. Many times I'll use a bifurcation seated device for that, and that usually works pretty well.

So, you know, the iliac aneurysms can present their own problems, and usually they are significant consideration in most of the endo vascular cases we'll end up doing.

Bill, you commonly uncover both hypogastrics.

Right.

What's your technique or what are people recommending for doing that?

Well, again, you know, we're typically going to try to preserve one whenever possible. But if we have to cover both -- we've only done actually once, but based on the discussion with the people who are running this current registry, it seems to be reasonably safe, surprisingly so, because many of these collaterals will come from other vessels. The femoral vessel will give off collaterals to the hypogastrics and others and lumbers and so on. So you can get collateral flow into there, but you'll typically, again, have to plug or coil them if they do involve an aneurysm. If you decide to preserve a hypogastric, then we need to have your assistance to bypass those vessels and try to maintain their flow.

And I think that's one thing we've seen is that the few cases we've done, we've always staged it. So you may do it a month apart.
Right.

Just trying to allow for some of that collateralization. And the other thing I think that’s important is trying to maintain that circumflex iliac artery so you get that collateralization coming back.

Exactly right.

Harry, what about the surgical bypass, when do you consider doing that if you just have to cover the hypogastric.

Well the technique is not too difficult in that you go in through a lower abdominal retroperitoneal incision and you make what, as it turns out, to be a very short bypass between the external iliac artery and the internal iliac artery, and you do it in a way to allow enough landing zone in the external for your device to actually seal that off. So it's not -- you don't want to be close to iliac bifurcation. And I think that’s a reasonable modality.

But there are other techniques that are evolving to try to deal with that in the more endovascular technique, and, indeed, with the right anatomy that sometimes works out nicely.

Right.

You know, open surgery still comes back for some of these cases, and it's still, again, a very well developed technique for doing it. But when patients drive some of the decision-making, of course they’re intimidated by what is truly a major operation. And physicians are swayed by the recovery rate and the lack of early morbidity that can be associated with endovascular repair. But certainly the things that we worry about with open surgery are the fact that we do require general anesthesia. It is a significant hemodynamic and metabolic stress on the patient.

There’s obviously a significant incision, either in the abdomen or in the flank to expose the aneurysm. Recovery is undoubtedly a longer process, and for all of that is more durable procedure we feel long term in terms of the decrease in the number of interventions that are required at later times. But it still has a role, and many of the newer techniques that we’re using in endovascular devices have to be weighed against what is, in a sense, standard of care in terms of what we can do with open surgery and the right patient.

I think that’s the nice thing about having a working relationship. You may say, well this is right for this patient, and this may be the right answer for a difference patient, so, again, we can tailor the care to what the patient really needs.

Well, and so, again, the endovascular approach, there are some major challenges, some of which have been alluded to already and which are continuing the need to be worked out because people with a large aortic neck or have a very severely angulated aorta proximal to your aneurysm presents very specifically difficulties in applying endovascular care. Your access vessels through the iliacs need to be of a certain size to allow passage of these devices safely up to the aorta.

Certainly accessory renal arteries, as we have discussed, provide their own specific challenge, and certainly disease in the internal iliac artery, specifically if they are aneurismal, can provide, you know, issues that need to be dealt with, and so part of the issue is how we’re beginning to evolve techniques to deal with these specific issues to allow safe and effective and durable endovascular reconstruction, even in these situations.

The next -- you know, the short angulated neck can occur in several different ways. It can be a very short neck, as the aortogram on the left showed. On the right we see a very sharp angle. And the next slide shows even more, sort of a double angle for the proximal neck. And then, of course, there’s iliac disease distally that needs to be dealt with.
Certainly the options for the severely angulated neck involve particularly using the fenestrated graft in the appropriate patient. There’s a clinical trial graft out for severe angulation that’s available. There are certainly -- we can sometimes straighten out these tortuous areas, particularly if it’s a very focal angulation with a rigid stent such as a Palmaz stent, and certainly debranching procedures can allow us to provide profusion to the visceral vessels and then go up to where the aorta is healthier and not angulated to bring the stent graft up. And as we have said, there’s always open surgery for the properly-prepared patient for that.

One question also, and it becomes with some of the younger patients we’re seeing with these iliac aneurysms when you’re talking about open surgery, you know, there’s also the chances of sexual dysfunction, retrograde ejaculation. How do you bring that into your discussion with your patients?

Well I think with open surgery, particularly when it involves the iliacs, you need to deal with that directly. And to the extent from a technical point of view, I usually don’t open that common iliac aneurysm wall on the left side. I leave that intact so that that area is actually not surgically interrupted, so that specific problem is one that I think can be avoided from a technical point of view. But you never know exactly when you might have to open that wall ahead of time, and so it’s important that the patient understands that this is a possible side effect from open repair there.

We mentioned briefly the business about difficult access through the iliac arteries. Certainly these arteries, particularly in the elderly population as you know, can be very calcified and very stiff. They can be very angulated, and they can have high-grade stenotic lesions in them that minimize our ability to put our devices through in a safe fashion. And so to avoid that, sometimes we will put in what we call a conduit, which is a Dacron graft, which, again, sewn in down in the lower abdomen and the retroperitoneum, which is still an incision and an open exposure, but it’s very limited but allows us to have safe access if that’s necessary.

Here is a patient that presented that kind of summarized a lot of these issues. He presented with complaints of chronic left leg swelling, shortness of breath, and actually in right heart failure, which is not atypical for a lot of our patients that we see, except for he was 40 years old and he had been having these symptoms for the last six years.

He did show -- cardiac evaluation showed a diminished right heart if you think and significant tricuspid regurgitation. The classic medical school finding was he had a loud machinery murmur across his lower abdomen, and when asked further, he said, “Oh, yeah, I did have back surgery about six, seven years ago, where I had significant bleeding, I got taken back for bleeding, and sure enough, was found to have a hematoma back there. Since that time, he’s been progressively getting worse to the point that he was not able to function with his children. He lived at an altitude much higher than we here in the New York area, which made him even more susceptible to signs of his failure.

Here is just a quick view. You can see he has massive dilatation of his iliac veins coming in, his iliac arteries, the smaller vessels, you see here. And then on our 3D reconstruction that you see here, if we can rotate that, you actually see that there is a fistulous connection between the hypogastric artery on the left and the left iliac vein going back up, and significant enlargement of the vena cava from that fistula.

So now the real question is just very germane to the issues that we were just discussing, we discussed the potential of repair, going in and trying to ligate that, cover the hypogastric artery, all these things we’re fraught with. He didn’t want the risk of buttocks caudation. He didn’t want the potential for retrograde ejaculation. He was concerned about having more children. So these were all factors that brought him to actually fly in from a good distance away for us to consider his repair.
What we did -- Bill, did you have a comment first?

No. The case is interested because you don’t see too volume overload right heart failure in 40-year-olds, and so a search for the cause of the fistulous connection is, kind of like you said, a medical school question, and this is a very unique CT scan. You don’t see that every day, and I’ll be interested to see how you managed it. I’ve actually seen this before.

Okay. Well what we did, we came up and over. And the first thing whenever you did your angiographs, all the contrast just went up the cava, so you really couldn’t see much of anything. But by out imaging we had with the Terra Recon Station, we knew kind of where the offending agent was. So we came up and over, and we then selectively catheterized the hypogastric artery and got the catheter so that finally I could actually get an angiogram of the outflow vessels rather than just the fistula gram. So that let me know that I was beyond the area of the fistula.

But then I had another concern, and, Bill, you know, you wear two hats. You’re the director of peripheral intervention, but obviously you’re a cardiologist. What's the human dynamic sequelae of suddenly acutely occluding a significant right heart failure fistula like this?

Well that’s a good question. I mean you might expect hypotension obviously. You’ve got a lot of venodilation all right. It’s built in. It’s structural. So that’s going to be a consideration. I’ll be interested to see how it played out here. Did you do a test occlusion?

Yes we did, and so we came in, we put a balloon across the area of the fistula and inflated it just under low pressure to try and see what hemodynamic sequelae he would have. His pressure did go down. His heart dramatically went up. And so he tolerated it well, and we said, okay, so now we can go in and try and manage this area, and our options would be to try and cover it with a simple covered stent, except for the fistulous connection over the last six years had actually grown to the point that it was probably about 25 millimeters in diameter. So it really didn’t allow for, you know, a good seal in the small hypogastric artery without risk of actually losing the stent into the fistula and everything else.

So we thought of what else we could do, and we have used this technique also for patients that had hypogastric flow that you wanted to maintain. We actually came in with a bifurcated modular graft, except we used the modular connection to go into the hypogastric. And if use a 22, 24 millimeter graft, you can actually bell bottom from the superior aspect of it to do a modular/modular graft to treat abdominal and hypogastric artery aneurysms.

We used the catheter from the contralateral side to really mark where that hypogastric came off, because, again, we had poor visualization because of the fistula, and then oriented our graft so that the contralateral gate could be, you know, released and go right towards that fistulous connection in the hypogastric. And here we came in, if we could run this video, we actually came in and selectively catheterized it, and then we did a rotational angiography around that area, just making sure that the wire had, in fact, gone through the graft itself and into the hypogastric artery.

With that in place, we then put a bulk and sheathe up and through the main body of the graft into the contralateral limb, put a covered stent, covering the fistula, and then we’re able to come in and actually seal that area of the communication and basically obliterate his fistula and maintain profusion, both to his pelvis, as well as to his left leg. He’s gone back to altitude. He’s very active with his children, and his symptoms have completely resolved, and this is one of those rewarding times we as physicians get the call back from the patient that said, “You have dramatically changed my life, and my wife and I and my kids thank you very much.”

So this is something that we really found to be, you know, rewarding here by the technology we’re able to have to treat a lot of these patients with very complex problems.
That’s a nice result, and it’s a great demonstration of how clever you can be with existing technology. Clearly it’s an off-label use of an on-label device, but I think, you know, well done, and like you said, changes people’s lives for the better. Good case.

You know, Bill, I think that one thing that we’re discussing now is, you know, some of the new technologies come out. What do you see on the horizon for new grafts and new trials and what technology we’re going to have for available for patients coming to New York Presbyterian?

Well you’ve already talked about fenestrated grafts, and I think that still is in development and still in process in term of testing and, you know, you’re doing some good and research on that. There are also branch graft vessel technology, which not only in the abdominal aortic aneurysm, but also vascular aortic aneurysms may be very helpful. There are actually -- one of the things that’s also happening is that the graft calibers are coming down. There’s currently now a 16-French device on the horizon, and other technologies which are in development for even smaller devices, which will make it truly percutaneous, and I think some of the access issues that you talked about almost nonexistent.

Right.

In fact, already we know that patients -- that the early experience with the conduits was much more frequent than even know.

Yes.

In what we call the more modern era triple-A endografting. And lastly there’s a device that’s actually out there for angulated no necks, which is a sac which is filled with material that actually fills the aneurysm itself and takes the space of the aneurysm and depressurizes it is that way. So there’s all sorts of things going on, and I think we’re going to continue to see continued evolution of this. It’s a big problem in the United States. There’s still a lot of opportunity to repair the 40 or 50% remaining with the technology.

Correct.

And I think the one thing that you have highlighted nicely, Bill, in all these technologies we’re now going to have available through trials at New York Presbyterian. We have the no-neck device coming on board. We’ve been accepted as a site for that, the smaller caliber branch vessels. And we’re even looking now for thoracic aneurysms for subclavian and celiac fenestration. So I think this is something that gives us that opportunity to offer all aspects of care to our patients.

I guess, Harry, if you came back and you said, “You have a patient that is 65 years of age that has a six centimeter abdominal aortic aneurysm, a 15-millimeter neck, and straight iliacs,” I’ve heard they actually exist out there. I haven’t seen them recently.

Not recently.

What’s your treatment? How do you decide for 65, which is getting younger and younger, good anatomy for either technology, how do you decide which one you’re going to do?

Well, again, you have to go through the pros and cons of the two approaches with the patient so that they can, you know, participate in that decision. But from my perspective with good anatomy, with current technology, I would, in general, encourage use of the stent device because I think the endovascular repair is turning out to be durable, particularly with the modern devices that we’re using now. Most of the problems that developed from them are ones that we can deal with, again, with other endovascular techniques. And so, again, it all hinges on good anatomy, and I think it’s almost the treatment of choice. I don’t think that 65 is too young to consider that.
With reasonable anatomy, is there ever a patient that you would not do an endograft on, Bill?

You’re asking a cardiologist that? I don’t have a surgical option. Well I have surgical options.

There you go.

You know, I’ve counseled people less than 60 typically to consider open surgery. I think it is the gold standard. It is durable repair. But there are issues related to, you know, with impotence and other pelvic issues. So I’ve grafted people in their 50s, people who understood the issues, understood the durability and the other complicating issues on both sides and decided they wanted to have an endograft. And, you know, as long as they’re willing to commit to the long-term follow up that that requires with CT scanning on a regular basis and/or ultrasound once you get a stable device in place, then I think I’m less conflicted about that than I used to be.

We have more long-term data that the durability of this device is excellent, and that as Harry said, the secondary procedures tend to be relatively minor, and they can be managed without surgery.

Yeah. I think, you know, the concern we all have well if what happens if this endograft doesn’t work.

Right.

And in your experience -- and I’ll ask both of you this -- what percentage of your patients have a need to have re-intervention, and then also, how many of them have to have an intervention that’s not endovascular based, meaning being converted to surgery? Harry?

I’ve only had to explant one device in someone with where the proximal neck got to a size that we could not offer some extension and repair. That being said, this was five years ago and we didn’t have access to some of the devices that we now have that would probably have allowed us to repair that with another endovascular approach.

There have been a number of patients who have type II leaks where there’s a high enough pressure in the side branch, either through the inferior mesenteric artery or through one of the lumbar branches that are required intervention to seal off that feeding branch. Personally, I have not had any type IIIIs and hope not to see any.

Yeah, I mean, you know, think that our experience would reflect Harry’s comments. I think what we have been seeing is mostly an endografting failure only on the type II endoleaks primarily. We don’t see extension of aneurysm into the remaining vessels, that hasn’t been a problem for us. And for the endoleak people, we typically will follow them, as we said, for a year or so.

We’ve intended to use some remote pressure sensors, which have helped us get some comfort in the sense that we can follow these people and know that if their pressures in the aneurysm themselves are low, we have a lot more security that we think we’re doing the right thing by following them. But I would say probably on the order of 5 to 10% of the patients who end up getting grafted end up needing some endovascular procedure as a follow unto fix an endoleak, typically type II and typically embolization.

Occasionally if we can’t identify a graft endoleak easily, and the patient with renal insufficiency we don’t want to spend a lot of contrast doing that, so I’ve had a radiologist coming in with a CT-guided embolization to just take care of the either translumbar or transabdominal.

You know, it’s an interesting -- and I’ll close with this since we’re almost to the top of the hour again. It’s very rare I’ve actually had to take a patient and do a surgical conversion for an endovascular graft. Those few that I’ve done have been mainly from patients probably that
should have never had an endovascular graft. It was an error in judgment when the graft was originally presented.

What I have done more of though, and I think we all have, is the endovascular repair of the open graft. So if you have someone that develops a pseudoaneurysm or has other complications then we found that we've been able to do endovascular salvage of a failing open repair.

Bill, do you want to take us home and summarize everything for us.

Well, you know, I think it's been a great conversation and, you know, what I think what we have demonstrated here is that there has been a lot of progress in this field. We've got lots of options for both the standard devices, as well as the research fenestrated graft devices, all of which exist here at New York Presbyterian hospital. The multidisciplinary approach of these patients I think has been beneficial for patients, and as you demonstrated the clever uses of existent technology can really change people's lives.

So along with that, we have the state-of-the-art imaging, I think in the world, and we expect to use that to optimize all of our outcomes going forward. So, you know, it's been a great experience so far, and I think we look forward to an even broader application of this technology and a wider range of people, and having this type of technology consolidated at New York Presbyterian, I think, gives the patient all the options that are available.

I couldn't agree more. Harry, do we have some late-breaking questions here?

We have some zingers, which is a follow up to your presentation a minute ago. But there's a patient who has a father, 62, has coronary artery disease and diabetes and had an abdominal aortic aneurysm. The question is, should they pursue the possibility for endovascular repair considering that he's a very athletic person? Is there an issue unrelated to activity, potential for blunt trauma, anything like that that begins to concern you along the way?

You know, I think that the answer is, no. I mean if he's going to be a Motocross high speed -- I mean the only time I've every heard of some potential endovascular incident was after a high-speed motor vehicle accident, and the question is, which occurred first. But, you know, with the current technology we have, the active fixation, I think, you know, really it's something that, as we've just discussed, these patients do exceptionally well with endografts as long as the anatomy is appropriate for the implantation and the aneurysm is big enough.

You know, I think we all need to look and say, who needs to be repaired," and we have several trials saying the smaller aneurysms may actually be watched for the time being, and we're now also trying a medical management of Doxycycline trials. So I mean I think there's still some questions out there, but if you've got the appropriate size aneurysm with reasonable anatomy, endograft, and I don't think age becomes a factor anymore.

Another question in relation to the fenestrated grafts. Is that considered final therapy, or is there a perception that there will be an ongoing need for re-intervention because of the complicated device that's been used?

Well actually, yeah, I think it is final therapy. Because where we're having problem now with current endograft technology is that we're implanting the graft in the fixation site at points that are suboptimal, short necks, angled necks, and so now what we're doing with the fenestrated technology, we're moving up the aorta to a more normal section of the aorta, so you're now sealing in a centimeter-and-a-half, two centimeters of normal aorta, so you have much better fixation, and the cases we were just alluding to, the ones that had problems with endovascular, were ones that probably shouldn't have had the graft because they needed probably a fenestrated graft.
Right. I mean I would agree with that wholeheartedly. I mean I think that, you know, the more normal aorta you can get ahold of to seal and fixate the better off it’s going to be. The one kind of modification of that is that these patients tend to have aneurysms with these and all sites within the aorta, and that one graft isn’t going to fix all those things, so we don’t want to mislead the viewer. You know, these patients can have other aneurysms in other locations, so it’s important for people to recognize that.

And also the monitoring that’s so important in these grafts overtime, because the juxtarenal and the visceral aortic may change over time, as their own native aorta proceeds its natural history. So in that case it may not be the final therapy only because the aortic pathology has changed. But certainly with good aorta to work with you should be able to use a good endovascular technique.

I think we’re at the end of our time today. This has been, I think, from our point of view, an exciting session. We hope that you all will have questions in the future and will bring them to us. But we do feel that a multimodality is very important with all the different supports from the hospital to provide care for people who can be potentially very sick with multiple diseases, not just the aortic aneurysm.

We feel that we can provide in ourselves many different modalities of both conventional and less-invasive approaches to treating aortic disease, both in terms of established techniques as well as clinical trials to test new products for the future. But thank you much.

Thanks, Harry.

Good night.

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