ENDOVASCULAR AORTIC ANEURYSM REPAIR
THOMAS JEFFERSON UNIVERSITY HOSPITAL
PHILADELPHIA, PENNSYLVANIA
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ANNOUNCER: Welcome to Thomas Jefferson University Hospital in Philadelphia, Pennsylvania. Over the next hour, surgeons will perform an endovascular aortic aneurysm repair. You will also learn about the latest advances in vascular surgery and research at Jefferson. Viewers are invited to email questions to the surgeons at any time during the webcast. Medical professionals may take a post-assessment survey at the end of the program for CME credit. Now, let's join the doctors.
00:00:44
ROBERT LARSON, MD: Good afternoon and welcome to the Endovascular Operating Room here at Thomas Jefferson University Hospital. My name is Dr. Robert Larson. I'm one of the vascular surgeons here and today we will be performing an endovascular repair of an abdominal aortic aneurysm. I'd like to tell you a little bit about our patient first. She is a 73-year old female who was found to have an aneurysm on a CT scan that was obtained for other reasons. The aneurysm itself was asymptomatic. This is the normal course of things. During her pre-operative assessment, she was shown to be fairly healthy and had no cardiac issues. Before I introduce Dr. Lombardi, who will be performing the procedure, I'd like to remind everyone that you can contact us and submit questions at any time by clicking the MDirect Access button on your screen. So, now I'd like to introduce Dr. Joseph Lombardi, Associate Professor of Surgery, who will be performing the procedure and he'll bring you up to date on where he is currently, as he's already obtained access. Dr. Lombardi?
00:01:54
JOSEPH LOMBARDI, MD: Thanks, Dr. Larson. I appreciate it. I'd like to welcome everybody here to the endovascular suite at Thomas Jefferson University Hospital. We have a lovely patient here today with an abdominal aortic aneurysm, who has anatomy that is very favorable for a minimally invasive repair. So, what we're going to do today, we're going to show you a little bit around the suite here and let you see how technology has evolved in repairing these aneurysms. Also, I first want to introduce our staff. First, immediately to my right is our scrub tech, [Chris Gaffigan], she's going to be responsible for helping us out with handing instruments and what not and she's really in charge of the operating room table. Behind her is [Cindy Mendelsson]. She's our circulating nurse and she's going to be retrieving products and what-not that are necessary for aneurysm repair. We also have our technician, who operates the imaging. That's [Maureen Grivnotix] and she is going to make sure that all our imaging is up to speed and we can adequately fix the aneurysm. Also, we have [Ellen Staller], who's in charge of the operating room here on the fifth floor of [unclear] of Thomas Jefferson University Hospital and she's really

responsible for helping us make this happen. To the head of the table, very important, is our anesthesiologist, [Hasim Gupta], who is maintaining the patient's vitals and maintaining the patient under general anesthesia.

So, let me just get you up to speed in terms of what we've done thus far. If we can take an aerial view here of the operating room table, you can see here this is the incisional, my side of the table. And what you see is a little blue object, and this blue object is going right into the femoral artery. So we expose this artery and the size of this incision, you can appreciate, there is the tip of my finger and you can see how small the incision is in gaining access to the femoral arteries. She actually has wonderful femoral arteries. That should make access very – I don't want to say easy, but not difficult. So, here we have vessel loops that literally tie up the artery in the event that that sheath comes out. So this is our access point and we have a similar incision on the other side. Now we're going to go to a live image here of the fluoroscopy machine, which is just a fancy word for "x-rays." This x-ray is of, you can see the spinal column along the back and what I'll show you here is a live image shows that we have these wires that run up the abdominal aorta and go all the way up to the level of the thoracic aorta. Here you can see the patient's heart. This is the cardiac silhouette. Here you can see our wires are parked well up into the thoracic aorta and they help direct our endograft placement.

So, right now, without further ado, we're going to proceed with placing up the catheter that is going to help us locate some vital structures that is going to direct our therapy. Before I continue, two more introductions, very important. Across from me at the table is Dr. Paul DiMuzio, and he is the chief of our vascular division here at Jefferson. You may have recognized his face behind that mask from on the front cover of *Philadelphia* magazine this year. We're all very proud. To his right is Dr. Nick Tarola. He is our chief surgical resident and all of us will be performing this procedure here today. So let's get our pigtail catheter up. During this case, we'll have several times or several areas where we'll break to Dr. Larson, who will give you a little more specifics about the procedure and what you anticipate to do or what you may anticipate us doing. Now going to our live image, we are advancing this catheter, as you can see, up into the aorta. It's currently tracking up and we're going to park it right beneath that last rib. That's perfect. Let's take out the wire and hook up our power injector. Now might be a great time to show the animation in terms of what we're going to do, so we'll give you back to Dr. Larson while we prepare our device.

00:06:25

ROBERT LARSON, MD: All right. Thank you, Dr. Lombardi. This animation is basically the procedure in a nutshell. What you see here is the wire being passed through the aorta. This is the device itself, which you'll see very shortly, being positioned below the renal arteries and deployed by an unsheathing type of maneuver, exposes the contralateral limb, which is then cannulated with another wire, and another piece, an extension limb, is advanced and put into position, and on the patient's right side, a second extension limb will be placed. That's the design of this type of aortic endograft. It is a three-piece endograft. There are other ones out there and they all have different strengths and weaknesses and we certainly have the opportunity and ability to use the graft device that is the most applicable to the patient at hand. So you'll see all these steps live as they

happen, but this gives you an orienting view, puts things into context, because looking at them on the fluoroscope, for the uninitiated, can be a little confusing. So I think I'll hand you back to Dr. Lombardi.
00:07:46
JOSEPH LOMBARDI, MD: Thanks, Bob. We have our pigtail catheter in place. What we're going to do is position our x-ray in an area where we can get a full vantage view here of the aorta. Let's mag up a little bit, get a closer look. There you can see our aorta and our imaging is ready to go. Let's take a picture here. [Maureen] is going to charge up the system here. We're going to take an angiogram, which is a fancy word for taking a look at the flow within the aorta. We inject contrast within the artery and that basically lights up all of the blood vessels so you can see actually what's going on and where the aortic aneurysm is relative to some vital arteries. So we're going to do a 20 for 20, Mo. Could we hold respirations, please? We have to frequently hold respirations so the patient doesn't breathe during the injection. All right, let's hit it. Go ahead. Okay. All right, let's stop there. Let's breathe, please.

Now you can see – No, let's go to a nice representative picture here. Let me have our little pointer. What we'll do is, I'll select this for a roadmap, and we're going to superimpose this image onto a live feed and basically you're going to be able to see the blood vessels and here's the aorta. What just disappeared on us are renal arteries, but we'll go back to them, and our renal vessels were right about in this area. Those are the arteries that go to the kidneys and we want to stay below those, obviously, and not cover them up. Here is the neck of the aneurysm and down here you can see where the aneurysm increases in size. This is the aneurysm. It's actually much bigger than what the flow would suggest here because the wall of the aneurysm is lined with cloth. So here are the iliac arteries and we're going to now get our main body device and we're going to put it in a position where we need to deploy beneath the renal vessels.

Let's get another picture, [Maureen], of those renal arteries. Let's get the main body. Can we show a picture of the main body here? So, that – [Chris] is holding up the main body of the device. This is a sheath. It's got what's called a hydrophilic coating, so when you wet this it's super slick and it allows very good delivery. This sheath also flexes in all different directions, to accommodate the patient's anatomy. So, what we're going to do now is remove our current sheath and then we're going to place this up into the patient's body, through the femoral access site we have exposed. For now, I want to take a quick peak here. This is a main, or live feed of the device on top of the patient's belly. Let's go to the live feed here. You can see that it's made up of many stents and I like to get a good orientation of how this device is going to be placed, prior to placing it into the femoral artery. So, I'm going to come out with our sheath here.

All right, [Maureen], feel free to go back to that picture with the renal arteries. Right there. That would be perfect. So what we'll do, Mo, is we'll get our device up. I want to mag up and put it into a little bit of a different angulation. Here's our live feed right now. We are going up into the abdominal aorta as you can see with our delivery system. It's gone fairly smooth and it's going up in the direction and orientation I had hoped it would. So right now everything is going pretty smoothly and what we're going to do right now is

we're going to magnify. We're going to take a good look in the area where our renal arteries are and I'm going to adjust our system a little bit to allow us to see the renal vessels a little more clearly. The system kind of likes that. Let's come back with this. Okay, Mo, we're going to do another 20 for 20 mag like this. One second, let me center the screen a little bit. We're ready. Can we hold respirations, please? Go ahead, Mo. Great. Let's get an early phase of that image. Right there's great. Back up a little. Get those [unclear] out of the way. Fantastic.

So, Maureen has highlighted for me a perfect representation of the renal arteries. These are the arteries that go to the kidney. Again, we're going to want to deploy our graft, at least the covered portion of the graft, below this area. What I'm going to do is mask this area so that we have some guidance in our deployment. We're going to go to a live image now and you can see our renal vessels light up nicely and while they're holding my wire, I am advancing this system upward right to that area there. I think everyone here is in agreement that we are well below the renal arteries and deploying in this area is very satisfactory for excluding this aneurysm. I think we're going to do this. Excellent. Where is our top stent? Okay. So now we're going to begin deployment. We're well under the renal arteries. The graft is actually going to flower open. Back off just a little bit here. The graft is going to flower open. Then we're going to bring this down to the point where the contralateral limb popped out.

So at this point, what I'm going to do is deliver what's called the top cap of the device. The top cap constrains, basically the anchoring portion of the graft. These go above the kidney arteries and they lock into relatively potion of the aorta, such that the device won't move. So it really anchors with some barb wire. I'm going to back off just a little bit on that. [spring noise] You can see it just springs into place. We are well below the renal arteries as defined by our arteriogram and the first portion of the case is complete. So we're going to come off our mask. We're going to now come down low and what we need to do at this point is get back into a good position here. Let's get an angled glide wire. We have to basically get a wire inside the left leg of the graft. So, the wire is going to come up here by Dr. DiMuzio. He's going to fish that up. Okay. At this point, while we get access to this gate, we'll allow Dr. Larson to continue his presentation and we'll be back with you in a moment.

00:16:52

ROBERT LARSON, MD: Well, I think, first thing, we have a couple of questions that have come in online from viewers and we can try to handle a couple of these while Dr. Lombardi does a fairly tedious and unexciting portion of the procedure. The first question is, “What is the possibility of starting the procedure and then finally, basically having to perform the open procedure?” I can't read the handwriting there. This is always a possibility and it's something that these days is actually quite rare. With the high-resolution CT scanning that we now obtain and the 3-D imaging, 3-D reconstructions that we're able to use for device management and for planning, it's very uncommon to be surprised by something during the procedure. Things theoretically can happen, and so the incidence in reality is less than 10 percent and even less than that, I think, in our practical experience here. I can't recall an event in the past several years where we've had to do that. But, the patient is always prepared, just in case. So it's a very uncommon situation.

What sometimes can happen is that an adjunct procedure would have to be done. Sometimes it is difficult or challenging to pass the device through the femoral arteries into the aorta. It's all a matter of size. The catheters that are placed are approximately 20-22 French, which is 7-8 millimeters in diameter and someone, especially a small woman with small iliac arteries, may pose a challenge and sometimes a conduit procedure or some other type of intervention to facilitate that is required, but that is in no way as big of a deal as converting to an open procedure. So that's actually a very uncommon situation. You still fighting with that, Joe?
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JOSEPH LOMBARDI, MD: Well, I just got started here.
00:18:55
ROBERT LARSON, MD: Okay. Well then we have time for another questions. Another viewer asked, "My friend has a bad heart and a triple-A. They tell us that the aneurysm was inoperable because of the condition. Could this procedure make him operable?" Well, it's possible and it really depends on the reason that the patient is inoperable and these days I think most surgeons will at least consider the endovascular option, but not everybody is a candidate for the procedure. With the devices we have available, we can treat about 80 percent of patients with this technique. There are some still, however, who are not candidates. This is based primarily on the anatomy of the aorta. As you saw in the deployment of this graft so far, we need to be able to place the device below the renal arteries to allow for the blood flow to the kidneys to be uninterrupted. Some patients do not have an adequate landing zone below the renal arteries for this. There are other patients who have aneurysms which extend further into the iliac arteries, which also makes it challenging, so there still are some people who cannot be treated with this technique.

The second factor is the patient's overall health condition. There are some patients who certainly may have cardiac disease or pulmonary disease that is significant enough to make an open aneurysm repair prohibitive from an overall risk standpoint, who might be able to undergo and endovascular repair. It is a smaller operation. It is a less stressful operation. But it is still an operation and because of that, the risks are present. That has to be taken into consideration. The risk of the aneurysm rupturing versus the risk of the procedure. There's no way to say one way or the other whether in this case the patient would be made operable, but it's certainly something that should be considered and we have been able to treat a large number of patients in this fashion who otherwise would not be candidates for the open repair. So it's something that certainly should be considered. So, back to Dr. -- nope, you're still working?
00:21:11
JOSEPH LOMBARDI, MD: Still working, Bob. We're trying a different catheter.
00:21:14
ROBERT LARSON, MD: That's okay. This part can be challenging. It's kind of like shooting fish in a barrel. What Dr. Lombardi's trying to do is to take a wire and place it within a 12-millimeter hole while only looking at the picture in two dimensions. It is a little bit challenging and takes a bit of skill but no doubt he'll be successful shortly.

In the meantime, what I can do is give you a little background, something useful for the lay audience, but also for the primary care community on aortic aneurysms. We can go to our slide that I have up here. There we go. As in this patient, most aneurysms are found incidentally. That's actually a good thing because by the time they're symptomatic they're usually very dangerous and often deadly. As in this patient, a CT scan obtained for a different reason located the aneurysm and fortunately she was a candidate for the endovascular repair and we're able to fix her aneurysm today. Other times aneurysms are found based on physical examination. An astute primary care physician can do an abdominal examination, feel a [unintelligible] mass, and that certainly can start a work-up looking for the aneurysm. Now there are ultrasound screening programs where patients, especially elderly patients with a history of smoking, can get an ultrasound examination to diagnose an aneurysm. It's a great way to see if a problem is present.

Once an aneurysm has been diagnosed, a CAT scan is the best way to completely define what the aneurysm looks like, its shape, its dimensions, and its extent, and to do determine whether or not the patient is a candidate for an endovascular repair. Once symptoms develop, that's usually in the setting of an aneurysm rupture and that's a very deadly situation where the mortality can exceed 50 percent. The decision on when to fix an aneurysm is a balance between the patient's overall health status and the size of the aneurysm. It's basically the risk of the operation versus the risk of rupture. For most patients the risk-benefit ratio balances out at about 5 centimeters. So aneurysms that are smaller than this, aside from a few stragglers, are observed on a biannual basis generally with ultrasound examinations and because the risk of rupture in a small aneurysm is quite low. As they get bigger, the risk of rupture increases.

The decision for an endovascular versus open repair, these days, is mostly based on the anatomy. If a patient has applicable anatomy, then most of the time we're recommending endovascular repair because of the decreased stress of the surgery and also the decreased recovery time that it entails. Most of the patients these days are endovascular candidates. In the pre-operative evaluation, because there is a risk of cardiac disease in any patient who has an aneurysm, a full cardiac evaluation is obtained, stress test is obviously an important part of that, sometimes an echocardiogram, and this is all done in consultation with the patient's cardiologist. Blood pressure control, cholesterol control, smoking cessation, and these are all important factors for atherosclerotic risk factor control, which will help prevent further progression of the patient's atherosclerosis. Ruptured aneurysms are a deadly event, and I think that we've seen fewer of these in recent years. And I'm hopeful that it's because aneurysms are being treated more frequently and earlier because of the endovascular option nowadays, but when the patient presents with an aneurysm rupture, the mortality rate is on the order of 50 to 70 percent. So the key is to prevent that, is to get to the aneurysm and fix it before it ruptures, because once that happens it's usually a very bad situation. It is a frequent cause of death in the Western world. The endovascular repair as we've seen here is currently used for treatment of the infrarenal repair. You guys are ready? We'll get back to this in a little bit. We'll go back to Dr. Lombardi. It looks like he's successfully cannulated the contralateral limb and we'll get the left side up.
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JOSEPH LOMBARDI, MD: Thank you, Dr. Larson. Ooh. Let's go back to that image there, Maureen. We're going to go to a live image here. You can see the wire on the left side here. This wire. We'll show you in two seconds. We're going to show you the little contrast run that we did to define the iliac arteries, the arteries that go down to the left leg. We're going to show you. They're going to light up. Let's hold it right there. Let's go back one. Very good.

So basically what we have to do here is get our left leg of the graft, the graft that's going to supply blood to the left leg of this patient, and I'll show you right here. Here is the artery. it gets a little bit on the beefy side. We would call that an ectatic, or large iliac artery. Here is the hypogastric artery coming right down here. That is the artery that supplies the pelvis and the left colon. So we're going to try to preserve that and land our device right in this area right here. So we're going to get our device, which is an 1888 and you're going to see Chris put that on the sheath. Little pinch. Little pinch. You don't have to pull up on that loop. There you go. And our device is now going into the femoral artery and we're going to go to a live feed here and based on our road map, we are going to get this delivered up into our graft. We're going to come off road map here for a moment. We're going to go to 1-1/2 stent. That's about right. Based on our CT scan and pre-operative measurements, this looks like a good place to deploy this limb and we're going to bring now flower. Actually we're going to start deploying. We'll take a quick look. Come off our [unintelligible] here. Okay, very happy with that. We continue on at this point, come of that image. Accordion this just a little bit. You're going to see this land kind of where we want it. Excellent.

So at that point – you can dock it. The patient does have very twisted, or tortuous, vessels, so it makes passing this straight systems a little bit challenging, but not too much. We're going to take the stiff part of the delivery system out, but we're going to keep the main sheath in place. Okay. Fantastic. Let's keep coming out with that. We have it right to that point. Fantastic. So now we're going to direct our attention to another portion, or the other limb. We're going to come off the road map, go to a live image. We're going to straighten out our view here. There's a piece of this graft that we have to go and retrieve that's called the top cap. If we come off our magnification level you can see that cap is at the very top of the screen. This cap contained, this cap right up here, contained the suprarenal portion, or this part, the uncovered portion of the graft that was the anchor, as I mentioned earlier. Now we have to literally go retrieve that because pulling it back would literally plow into the graft and that would not be a good thing.

So we'll complete deployment of the remainder of the graft, just like that. We're going to take our fixation off. Now Dr. DiMuzio is helping me with this part while I advance the pusher, the main part of the delivery system that helps deploy the graft. Now I've retrieved the top cap or docked it. Now we're going to come out completely with our dilator or pusher device. Let's turn the cap. Good. So, we have the top cap deployed and out. We also have our sheath in place and let's have some dye please. We're going to get a little bit of a view here to help identify that iliac vessel, the hypogastric vessel. Do you have some heparinized saline please?

What you also missed at the beginning of the case is we gave the patient and anticoagulant or something that thins the blood while we do all these things. You have these large delivery systems inside the artery and we want to make sure that a clot doesn't form while we're doing this case because clot can spit off and then go down to the feet and cause problems post-operatively and we prevent that by giving the patient heparin. So we're going to take another little picture. That delineates the hypogastric artery very well. We're going to go to a – we're going to have a 2071, I believe. Let's get that open. Hmm? Yeah. That's good, Mo. While we're waiting for the device to get prepared, we'll get you back to Dr. Larson.
00:33:04
ROBERT LARSON, MD: All right, thank you, Joe. We've got a few more questions in and they really run into what I was about to talk about a few moments ago, so let's go back to our slide here for the end of the little spiel, about the endovascular repair itself. 95 percent of aneurysms are located below the kidneys, which is a good thing because those are the ones that are routinely able to be treated with an endovascular repair. The advantages of the endovascular repair are that it is minimally invasive. Two small incisions on the order of three to four inches each, one on each side, in the right and left groin area, are all that are required to place the graft. The incision that was required for the open repair is a large abdominal incision and certainly that is much more debilitating post-operatively. Because the incisions are smaller and the patient's hemodynamics and overall status is disrupted less by this procedure, the length of stay is decreased. The number of complications, pulmonary and cardiac, are decreased, and the patients get to go home earlier because they recover quicker. Most patients will go home the next day. Some patients, if they're older and a little more debilitated to begin with, they go home in two to three days but it certainly is a step up from the five to seven days that is seen with open aneurysm repairs.

So while Dr. Lombardi's putting this one up we can answer one question from a viewer. “How much pain is there after surgery?” Well, there is some pain. There are two small groin incisions and I liken it to my patients to something like a hernia repair. So patients are up and walking around the next day. It does take a little while for everything to wear off but pain control is generally not a major issue. There is generally no abdominal pain. It's only incisional discomfort that is noticed. All right, I guess we're back to Dr. Lombardi here, getting up to the right limb.
00:35:15
JOSEPH LOMBARDI, MD: Okay, we have our right limb graft in place. We're actually going to put it through the sheath of the main body, which is a nice design. We don't have to lose access. Push this up and while they're holding wire, we're just going to advance this up just a tad. See here. Turn our lights out. Okay, that's right where we want to be. Let's take that off. About a stent and a half there. We're just measuring the number of stents we have in place.

We're going to start our deployment. You can see the graft opening as we're pulling it back. One, two, and then a larger one at the very end. So that lines very nicely where we had planned to deploy this and just like the other side, we're going to back that out and get our dilator all the way back to the hub pusher and then the whole system is going to

come out over the wire very smoothly, very nice. Actually, I'll take this dilator out too. Very good. Let's slide that all the way out. At this point, we're going to now basically give our graft a permanent press with a balloon. The balloon is going to come up my side first. Adjust our sheath.

Let's come off our road map and get a full view here. Get back into a good plane. We're going to now advance a balloon. Can you get a picture of this balloon as we put it up? Let's go to an overhead view. This is basically – if you watch it, you see that balloon inflating. You can't really see that. Let's go to our light overhead imaging. There we go. There's the balloon. Let's bring it back down. This is actually going to go inside and it's going to take the pleats of the fabric out and make sure our graft is opposing the wall. Now we go to a live feed. We're going to see, my balloon's going to come up and you're going to see it tracking up. It's going to go through the right limb and advance up and we're going to go right to the level of the renal arteries, where we were earlier, just below that stent. We're going to inflate gently. This is not an angioplasty, however, it's just a molding balloon just to make sure our graft is against the wall basically. We're going to walk that out just a little bit. We're also going to take care of the zones where the graft overlaps. Come down a little more. Very good, right there. We're going to open that up. You can see we're above where the pants split off. Come down a little more and hit that. Give it up just a little bit. We're going to come down a little more, right to the very end, but not peeking out of the stent. Perfect. That is going to make sure that we're okay on the right leg. So we're going to walk that out and continue, continue, continue. Very good. Lock this. Chris, if you could get ready to put that up the left side. We're going to do the same thing up the left side. Got a wire? Very nice.

Chris has excellent skill in getting those balloons and catheters onto the wire. She actually cancelled some very important plans to participate in today's webcast and we're all very appreciative. This is the quietest we've ever heard Chris in the operating room. Again, we're inflating. Let's go to a live feed again and you can see we're ballooning again. On that one side we're going to pull down just a little bit. I want to make sure we get that bifurcation opened up a little bit. Go ahead and keep going down. A lot of calcifications in that area. Let's push up just a wee bit. You can see how tortuous this vessel is. Oh yeah, I think we're sized relatively well. Let's push up just a little bit more. Right in that area. Fantastic. It looks like there's a little stenosis there and you can see a little kind of a dimple in the balloon. That's just going to open things up just a little bit. Nothing drastic. So we're going to come out with that just to the very end here. Let's get our pigtail catheter and – I think you can leave that in place, otherwise it's going to hose. Actually the hypogastrics are open, so we should anticipate a good angiogram here. Probably going to do another 20 for 20.

We're putting back our diagnostic catheter. This is the catheter that we used initially to perform our arteriogram and all the little check marks on it. We'll go to a live feed here. You're going to see it snaking up into the aorta and we're going to now position in place, hook up our power injector. Very good. Advance this up just a little bit. Good. Roll forward. And back. Excellent. Towel. Okay, let's shoot another picture, Maureen. We'll do 20 for 20. Let me know when you're ready. We'll hold respirations. Okay, so let's hold

respirations. Very good. Go ahead, Mo, on your call. Okay, so let's do another picture, Mo. I want to splay out this image a little bit and get a good look at our left leg of the graft. Okay, let's get a 60 cc syringe or a 20 cc syringe. Okay, let's shoot one more time, okay Maureen? Let me know when you're ready. Okay, let's hold respirations please. Go ahead. Fantastic. Excellent. Yeah, I can see all those little puffy fixtures. There's the patient's valve. I see no type 1 leak, which would be a leak very proximal to where the attachment site is or where the distal or leg attachment sites are. I see no type 2 leak. Let's go back to our very first run, Maureen. That's what it used to look like. Now, our completion, that's what it looks like now.

So basically in about 40 minutes we have her aneurysm completely fixed. Right now we're going to work toward getting all these instruments out. It's just going to take about another five minutes, and then close the femoral arteries, which – and wake the patient up and get her ready for discharge tomorrow. So that's basically the completion of the procedure and that's pretty much it. Thanks a lot for everybody who's in the operating room. Really, it's a multi-specialty team. A lot of people come together and all do a significant part in helping these patients on the road to recovery. So we're very appreciative here. We've got a fantastic team and we're very privileged to work with all these fine professionals. Thanks a lot for watching. I think I'm going to give you back to Dr. Larson, who's got some new and exciting things to discuss as well and again thank you very much for your attention.
00:45:58
ROBERT LARSON, MD: Okay, well, Dr. Lombardi, thank you very much. That certainly went very well and is a great example of how an endovascular aneurysm repair is supposed to proceed. We do have a little bit of time left and I'd like to take it answering some questions and then going over some other developments here at Jefferson. First off, why don't we put up this slide that I have up here? It's just a completion slide. On the left side, you can see the actual graft that is put in. The cartoons don't quite do it justice. That's what it looks like. You can see the bare metal stents that go above the renal arteries that do not cover them, allow blood to flow through them, but do supply some force in holding the graft into position. On the right side is a cartoon of the finished product. You can see the graft below the kidney arteries and basically relining the aorta, taking the aneurismal portion out of the circulation.

First off, let's get back to a couple of questions. We've had a bunch of them running in here, so next question is, “My husband is a stroke survivor of ten years. Is he a good candidate?” Well, certainly having had a stroke is not an exclusion factor. All the other factors that go into patient selection would need to be addressed, but having had a stroke, especially if someone is in fairly good condition with a reasonable life expectancy, would most certainly be a candidate for an aneurysm repair, as long as everything else fell into line. Another question is, “My father died from an aortic aneurysm. Should my brother and I be concerned? We both have high blood pressure.” Well, family history is an important part of the development of aortic aneurismal disease and if there is a family history, and especially if someone has died from an aneurysm, then the risk of it happening in other relatives is fairly significant and I do believe that you should be checked, first by your primary care physician, and if felt appropriate, then screening

ultrasound tests can be obtained. That would be the best way to go about that. Certainly aneurysms don't cause symptoms until it's too late for the most part, so catching them when they're asymptomatic is the key to getting them fixed properly.

Another question, “What are the risks of recurrence of the aneurysm after repair?” Well, aneurysm will not necessarily recur at this spot but the aorta is a very long artery and it starts at the heart and goes all the way down to the aortic bifurcation that we saw treated today. Aneurysms will sometimes develop more proximal and patients who are at risk for that need to be followed. Patients who have an endovascular aortic aneurysm repair are followed regularly with CT scanning or ultrasound scanning post-operatively, and this goes on for the remainder of their lives. It's a part of a surveillance program which is important because this is an ongoing process. There are a small number of patients, who after an endovascular repair, need to have a tune-up, and this is not very common. Most of the time, the tune-up can be done, again using the endovascular techniques. But the graft itself is secured via the stent graft and by little hooks. It's not sewn into place and so it occasionally can shift and can cause small disturbances in the graft which may require a tune-up. These are generally not life-threatening issues. But again, surveillance is an important part of aneurysm care, both pre- and post-operatively.

“Can a ruptured aneurysm be fixed this way? What is your experience with this?” Yes it can, actually, and we've had a pretty good experience in fixing aneurysms in this fashion. Patients who present in a more hemodynamically stable condition to the emergency room, which is not terribly unfrequent. It is more common than not these days. We'll often times get a CAT scan as part of their evaluation in the emergency room. Based on that image, we can determine if the patient is an endovascular candidate and treat it in the same way as the patient was treated today. Again, this is a less invasive, less hemodynamically disruptive procedure than an open triple-A repair and so when it's technically feasible, the patients often do quite well. Again, given the context of the aneurysm rupture where the risk are always higher, but outcomes can be quite favorable.

Question: “What is the graft material made of?” Well, this graft is made of Dacron. It is the same material that is used for the grafts that are sewn in during an open repair. There are other grafts which we also use which are made of PTFE, or Gore-Tex, which is a different type of material and these are all vascular materials, however, and they're all used in vascular bypasses or repairs in some fashion or another. So it's the same stuff that's used for the open repair. It's just packaged differently. It's packaged with stents to hold it open and compressed onto the stent delivery system so the technological advance in some sense is one of miniaturization, putting everything onto the delivery system.

Okay, another question: “After placement of the graft in the aorta, how is flow maintained through the arteries branching off the aorta where the graft is placed, i.e. [unintelligible], inferior mesenteric, and lumbar arteries?” Well, the vessels generally thrombose on their own. Most aneurysms have a number of these vessels already thrombosed. The inferior mesenteric artery comes off of the aneurysm itself in most patients. It is sometimes thrombosed, sometimes it isn't, but is always sacrificed in this procedure. Despite that, the risk of colonic ischemia is much lower in endograft repair

than it is in open repair and this is probably due to the decreased hemodynamic changes that occur during the procedure. Because we always try to preserve flow through the hypogastric vessels as we were able to do today, pelvic blood flow is usually not disturbed significantly. Lumbar vessels are also patent during the procedure. Generally will thrombose on their own afterwards, but can be a source, from time to time, of what we call a type 2 endoleak, which is a small vessel which bleeds backwards into the aortic sac. This occasionally becomes and issue that has to be dealt with, but for the most part, the major blood vessels are kept intact and the ones that remain behind are relatively minor ones.

At this point, I would like to talk a little bit about the other technological advances that we have available to us here at Thomas Jefferson University. Even though abdominal aortic aneurysms comprise 95 percent of aortic aneurysms, a large number of patients still present with aneurysms of the thoracic aorta. This is an area where we can also treat the aneurysms through endovascular techniques and the morbidity and mortality of the procedure – from an open repair with thoracic aneurysms, is even greater than that of the abdominal repair, so the potential benefit of treating these endovascularly is certainly desirable. You can see here we have some 3-D reconstructions showing the aneurysm. That little yellow bubble at the top of the screen, within the descending thoracic aorta, and this typically would require a thoracotomy, now possibly a partial heart bypass with a heart-lung machine and a fairly high-stressful procedure for the patient, when treated endovascularly is tolerated much better. Some more images of the aneurysm in this case. Here on the left, you can see the aortic endograft. The difference here is that the descending thoracic aorta is just a straight vessel and so the branches are not required, as in for the aortic bifurcation. But the techniques are the same. You can see the marker catheter, the arteriogram looks very similar. After repair, after placing the devices that you can see on the left, the aneurysm is excluded and blood flows only through the lumen of the relined aorta. Another picture here of an aortic endograft in place in the thoracic aorta. So this is something that we can treat and it really revolutionized the therapy of thoracic aortic aneurysms as well.

Also here at Jefferson, we are honored actually to be the lead site for the new aortic dissection trial and have placed the first aortic dissection stent in the country and this is really also set to revolutionize the treatment of a fairly morbid condition. Aortic dissections are fairly common, generally in older patients and when they occur, they are quite deadly. The mortality rate during the first 48 hours is about one percent per hour. Operating on these is traditionally very, very challenging. The patients don't necessarily do terribly well and so less invasive ways of treating an aortic dissection have been devised and here you can see a picture of an aortic dissection. It's the dilated portion of the aorta, at the top of the screen, on the left, and this is a false lumen, a blood channel that is created within the wall of the artery. You can see the arteriogram on the left, how large this has become. Using the same techniques of endovascular repair, we're able to seal the tear within the artery and redirect flow through the true lumen, through the normal lumen of the vessel, taking the pressure off of the false lumen, off of the dilated portion and reducing the risk of rupture or extension of the dissection. The Zenith dissection stent, which you can see here is what we're evaluating here at Jefferson and it

is an additional way to help remodel the aorta after a dissection and is clearly a groundbreaking development. Do we have a little video here of the dissection?

Okay. Dr. Lombardi's just finishing up the very end of the procedure. Okay. While we're spooling up the video, let me see if I have another quick question here. Here we go. "What are the long-term benefits of open surgery, compared to endovascular surgery?" Well, there really isn't much. I think the long-term benefit for the open procedure is that you don't necessarily need the lifelong follow-up that you would get after the endovascular repair. Once an aneurysm is repaired, with an open repair, it's very uncommon to have a problem develop down the road. But that's a very steep price to pay in terms of the recovery time and the overall morbidity, so endovascular repair is certainly the best choice for most patients.

I think we have the video ready for the dissection deployment. Why don't we put that up? So here's a model of the dissection. I believe this is the dissection. There we go. Here's the dissection, which is basically the blood forming an abnormal channel within the wall of the artery, ripping its way within the tissues planes. With the placement of a stent proximally, the initial tear within the vessel can be covered, sealing it off, providing support for the true lumen, and depressurizing the false lumen. Okay, and this is the dissection stent which is able to support the true lumen without having to cover or close off any of the side branch vessels. So that is truly a remarkable achievement and we're very proud to be a part of that.

Well, this brings us to the end of the hour. I'd like to thank everybody for joining us today. If you missed any portion of the webcast, the video will be available later this evening on the website and you can see it by visiting jeffersonhospital.org. If you'd like to make an appointment or receive any further information regarding the procedure or anything you've seen today, please call us at 1-800-JEFF-NOW or click the "Make an Appointment" button on the screen. We would also like to remind the viewers who are watching for CME that there is a post-assessment survey at the end of the broadcast and the instructions will be posted on the computer screen. So, for Dr. Lombardi, Dr. DiMuzio, and the rest of the staff here, I'd like to thank everyone for joining us, and have a pleasant evening.
01:00:57
ANNOUNCER: This has been an endovascular aortic aneurysm repair, performed from Thomas Jefferson University Hospital in Philadelphia, Pennsylvania. To make an appointment with a Thomas Jefferson University Hospital physician, call 1-800-JEFF-NOW or click the "Make an Appointment" button. Medical professionals may now take a post-assessment survey for CME credit. Instructions are on the computer screen. This internet broadcast represents the hospital's ongoing efforts to bring the latest medical education to both patients and the healthcare community.
01:01:30
[end of webcast]