NARRATOR

Each year, several thousand Americans under the age of 50 are found to have a narrowed or leaky aortic valve. This condition is usually congenital and inevitably progresses until the aortic valve needs replacement. During this live webcast, surgeons from Beth Israel Medical Center in New York City will perform a unique aortic valve replacement known as the Ross procedure.

PAUL STELZER, M.D.

The Ross procedure is a very specialized version of aortic valve replacement. The aortic valve is one of the four important valves of the heart. It’s the outflow valve from the left ventricle, so when the heart squeezes, it goes through the aortic valve to deliver blood to the entire body.

NARRATOR

A standard aortic valve replacement uses a mechanical or animal valve to replace the diseased area. The Ross procedure, however, uses the patient’s own living tissue to replace the aortic valve, thus eliminating the need for blood thinners, a major benefit with this procedure. At any time throughout this program, you may email questions to the physicians by clicking the MDirectAccess button on the screen.

ROBERT TRANBAUGH, M.D.

Good morning. I’m Dr. Robert F. Tranbaugh, Chief of Cardiac Surgery at the Beth Israel Medical Center. I am delighted to welcome you to our operating room suites and I’m delighted that you are able to join us this morning. I’m sitting here in Room 11. Next door is my colleague, Dr. Paul Stelzer, who is a national expert in the Ross procedure. I’d like Paul to introduce the team that’s operating presently in Room 10.

PAUL STELZER, M.D.

Good morning, Bob. Welcome. We’ve got quite a team here, our usual 6-7 folks, all ready to go. We’re just drawing up some strings here. Hang on a second, so we can get to a stopping point and talk to you. Why don’t we go around the room and introduce people. Across from me is Dr. Charles Gellert*, my trusty right hand man. We’ve got Rachel
Parker, PA Extraordinaire. Roselio* Antonio*, scrub nurse. We’ve got, where’s Carlene? Is she still circulating around here somewhere. We’re always asking where’s the circulating nurse. Behind me, driving the pump, is Katie. Just in case she passes out, we’ve got Gary over there, who can run the music too. Up top is Ed Machernis* of anesthesia, although right now he’s not needed much because we’re on a heart-lung machine. It takes a number of people to make all this stuff come together in this sort of operation. We’re glad to have you with us. Bob, I’ll let you tell them a little bit about what we’ve done so far.

ROBERT TRANBAUGH, M.D.

Thanks very much, Paul. Obviously Dr. Stelzer and his team have been working for several hours now. What I’d like to do is show you a condensed version of what they’ve done. This is footage from a young man actually from Oklahoma, that came here a couple of weeks ago, that Dr. Stelzer fixed up. Obviously this is the heart. It’s stopped and now you can see being exposed what is probably one of the most severely diseased aortic valves that we’ve seen in a good while. This is a bicuspid valve. This is really a terribly diseased valve. There is a metallic suction device inside the ventricle and you can see how friable that degenerative calcium is. What’s being sucked up there is potentially very dangerous material. Actually, some patients even present with embolic strokes or temporary vision trouble from these kind of little pieces of calcium that can break off. Dr. Stelzer is now excising the valve and trimming it back. You can see the terrible debris and calcium and what a rock pile. This is very end stage severe aortic stenosis in a bicuspid valve. This is a young man who is in his 40s, who was actually born with an abnormal valve. That’s why we call it a bicuspid valve. It should normally be a tricuspid valve or three leaflets. This is a bicuspid valve and it’s taken it about 40 years to reach this severity of illness. You can see how just rigid and absolutely terrible this valve is and how much strain you can possibly anticipate it would put on the left ventricle. The heart has to squeeze against this obstruction and it’s very difficult for it to get the blood out through that tiny little hole, so the aim of aortic valve surgery is really to eliminate that degree of stenosis, so this is one common problem we see and what the Ross procedure is often done for, is aortic stenosis. You can have a leaky valve in addition and that’s called aortic regurgitation, but this man obviously has aortic stenosis, very critical.

Now, the valve has been excised. The annulus has been debrided and now Dr. Stelzer has just passed a sizer in there to carefully evaluate how big the annulus or the circumference is where the valve used to sit. This is, again, a sizer going in and he’s very carefully determining what the appropriate size is, and we’ll compare that to the pulmonary autograft which he is about to start preparing here. This is the valve now that’s going to go into this area, where the aortic valve was just excised. Again, excising it, you get a good view of inside the heart there. You don’t see that too often. That’s actually another valve that’s at the bottom of the sizer there, where the pickups are. That white tissue in there is called the mitral valve, which sometimes can be diseased also. In this case, it’s not.
Now, this is the pulmonary artery. It’s immediately, as we’re looking at this, to the left of the patient’s aorta and you can see the yellow catheter inside the pulmonary artery. That’s actually called a pulmonary artery catheter or Swanganz catheter. That’s used to monitor pressures inside the pulmonary artery and the lung. He’ll displace that in a second and get it out of the way. Now he’s creating the autograft or the valve that will be used to replace the aortic valve. This is an important part of the Ross procedure, preparing the autograft. This is actually now going to move over and take the place of the aortic valve that is obviously now excised and in the bucket somewhere.

This is a very critical part of the operation. What Dr. Stelzer is doing is carefully looking at the leaflets of the pulmonary valve and he’s determining their mobility, their thickness to make sure there are 3 leaflets and to make sure they are very fine and delicate and are going to be able to do the job for him, for the patient. So this is a very critical assessment part because we can still turn back at this point, just close up the pulmonary artery and put a different type of valve in the aortic position. Once the decision is made and the valve is excised, you’ve pretty much determined that this is the procedure that’s going to be done, so a lot of judgment. You’ll see, I think, one of the themes this morning will be that there’s a lot of judgment involved in making these kind of multiple decisions and performing a Ross procedure. I might add that Dr. Stelzer is a nationally recognized expert in this procedure and the one he’s doing today is #375 of his experience, spanning over 20 years of doing this procedure.

He now has his finger right actually inside the right ventricle. The pulmonary valve, as you may know or may recall from high school biology or science, is the valve that connects the right ventricle to the pulmonary artery. We’re inside the pulmonary artery now, determining where to open up the right ventricle. We want to get below that valve and have a sewing ring to sew to. We can’t just sew to the leaflet itself. Pretty soon here, you’ll see a knife coming in. There it is. He’s going to incise the right ventricular outflow tract. That’s muscle. You also see the right ventricle is actually quite thin because the pressures are quite low in the right side of the heart. He is now opening up the right ventricle. The left ventricle, as you may surmise, is very thick because the pressures are much, much higher in the left ventricle. Here he’s opening the right ventricular outflow tract, being careful, as we’ll see in a second here, not to injure the valve, but he also has to have enough tissue to sew to so that he can get a nice, firm implantation.

This is a great view. See the valve. The whitish structure is the valve, that he’s pointing to with the scissors. Now he’s developing the muscle below it and incising and at the same time developing the plane here. This is a very critical part of the operation, where he’s now looking for the coronary arteries that live in this neighborhood. The one is called the LAD or left anterior descending and a particular branch of it is called the septal perforator. That hides right in this area, where the muscle is being opened, where he’ll get back to. He’s now just trying to position a suction device so he can see better. Now he’s coming back to developing the autograft and using a Bovey, which coagulates the tissues and creates a little smoke there in the screen. So now here’s the autograft. It’s excised and this is going to be the new aortic valve. We call it an autograft. It contains the pulmonary valve. There’s the muscle from the right ventricular outflow tract. That’s a beautiful
demonstration of what he’ll sew to ultimately, that we’ll see her shortly. You can see him trimming it a little bit, giving it a little haircut, to get the excess tissue off, looking at it from all angles to make sure it’s an excellent valve and there’s just the right amount of tissue on there to sew to and make sure it stays where it’s supposed to. A very nice view.

Now, as you saw with the aortic valve, he is now sizing with the pulmonary valve and making sure there’s not too big of a size discrepancy. If this is a lot smaller than the aortic annulus that he previously measured, then what Dr. Stelzer will do is reduce the size of the aortic annulus to accommodate this valve. I think in this particular patient, it’s a pretty good size match and no added reduction procedures need to be done. Here he is, looking at the pulmonary end of it, which is going to be the new aortic end. Here’s the critical test of the autograft. Does it hold water? You can see now, he has injected into the autograft and this is a gorgeous view of the three pulmonary valve leaflets holding together, nicely coapting and nicely holding water, so we know this valve is going to work.

So now, the next thing is to sew it in where the aortic valve was, so we’re back at the heart now. We’re looking down and you can see the aortic valve is gone and the pulmonary valve is gone. This is a view that, unless you’ve done a lot of these, it can be a quite sobering view, looking down there and seeing no heart valves.

The next thing is, as you know, the coronary arteries come off the aorta just above the valve. Where that blood is coming out is the left main coronary artery. This is the most important and one of the biggest challenges of this procedure, to make sure you get a nice pod of tissue around here and don’t at all injure this artery and have it freely mobilized without any tension or any distortion. In older patients and those with disease, if you have calcific disease in the region, right where that sucker is, that’s the left main, where he just aspirated the blood. If you get a blockage of that, that’s nicknamed the widowmaker in our adult coronary artery population. That’s a very, very critical area of the heart. Again, he’s freeing up the pod of tissue here from surrounding adhesions, just tidying it up here a little bit more. You can see the coag. It’s important to get as much hemostasis as possible, especially in the back there, where it’s almost impossible to get back to once these things are sewn back into the heart. So there it is. It’s a beautiful pod of left main and surrounding aorta. That will go back into the autograft. That has to be reimplanted back into the autograft. There’s a mirror image here, which we’ll start working on also. That’s the right coronary artery pod. This is very demanding and technical root surgery that a surgeon like Dr. Stelzer has tremendous experience in. I think that’s a very important fact of having a Ross procedure, is the skill and expertise of a gifted valve surgeon, like Dr. Stelzer. This is a great view of the right coronary artery. Now, you can just, sort of peeking out from underneath there, you’ll see it a little better here as Dr. Stelzer mobilizes the aorta. He’s going to start coming underneath the right coronary. You can see that little orifice peeking out there with blood draining from it. Again, very, very delicate, very important area not to go too deep or too far or too far off in one direction. So this is very delicate, a very crucial part of the surgery, to make absolutely sure these coronary arteries are going to go back in and behave themselves. There it’s being nicely demonstrated, the pod of tissue, and he’ll free this area up again with this
coagulation device, what we call the Bovey coagulator. You can see the little branches of tissue.

Now, this is where the autograft is being sewn into the aortic annulus. Here you can see a good, healthy bite of annular tissue. Again, this annulus is where the valve used to sit. There it is. It’s one of the commissures, one of the points where the valve comes up onto the aorta. Now, this little white piece of felt that’s going to be coming in here shortly is a very, very important part of this procedure. This is a heavy cloth-like material we call felt. This has been carefully measured, based on the sizing of the pulmonary autograft previously. This is going to support the annulus so it doesn’t dilate at all over time, so every bite he goes through here, he’s going through the aortic annulus, up through the felt, and there’s a nice bite of the felt. You can see it going through and then up into the autograft that’s being sort of moved down into position. There is it now, in position and ready to be sewn. This is what’s called a running suture. It’s a non-absorbable suture. It will be there forever.

Now, this is a nice demonstration of, what he’s doing is getting just the right amount of tissue underneath that muscle. It’s the right ventricular outflow tract. You can’t get the valve. That would damage the valve and cause it to leak. So this is a very important aspect of the procedure. You can see him nicely protecting those leaflets and getting just the right depth and right amount of tissue coaptation, so this is, again, more tissue, more valve bites, the felt carefully pre-measured. This felt is important to prevent any dilatation of the autograft, of the Ross itself. In patients that have not been supported, there’s been concern with dilatation of this autograft. I must say, it’s been Dr. Stelzer’s experience that as long as we have the felt in there, it stabilizes the autograft. Reoperation is extremely unusual in patients with the Ross. There were earlier reports of more reoperations in a more difficult technique, but Dr. Stelzer has pioneered this technique, which is called a total root replacement, and this eliminates, basically, leakage of the autograft and then that piece of felt eliminates any potential dilatation of the autograft and leakage at that point. So we’re continuing to sew the autograft in. We’re now coming around the front. We’ve done the back row and now this is what’s called the front row. Again, very careful bites, good healthy bites of the fibrous and strong tissue, and then up through the autograft, right ventricular outflow tract muscle, underneath the valve, and into the felt.

Now, the suture line has been completed, but this is a nice technique that Dr. Stelzer likes to do and I think it’s a very important aspect of this procedure, to make sure there’s no loose sutures here, so he’s pulling up each successive suture, keeping pressure on the left one. This is a bit tedious but very important. It’s almost crucial not to have any bleeding at that suture line way down at the aortic root. It’s very hard to get back in there. So now he’s tightening this up and then about to tie this. I think, in Dr. Stelzer’s hands, this is obviously a critical part and it’s something that we really don’t want to have any bleeding at all. Somebody with his skills and judgment, doing these over 20 years, has learned how important that kind of hemostasis is.
Now, the autograft is in place. We now want to test it and we’re going to examine it carefully. Now we’re looking back down the autograft, inside the hole down at the bottom there is the left ventricle. That’s the left ventricular outflow tract. Does it hold water in vivo? We’ve implanted it and now we can see the saline’s in there. It’s holding water nicely. The leaflets are coapting well. It’s a beautiful view of it. You can see there are three nice pulmonary leaflets that are now the new aortic valve and aortic root. So, a very nice demonstration of a successful first portion of the autograft implantation.

So now what Dr. Stelzer is doing is determining where to place the coronary arteries. You can see a knife coming in here and this is a little incision in the autograft, or the neoaorta now, and we need to reattach these pods of coronary arteries. Hopefully we’ll join Dr. Stelzer live here shortly and he’ll give us an idea of where he is exactly in this procedure and what coronary artery he is working. Here you can see the left coronary pod now being attached to the aorta and it’s a slow process but we’re making good progress.

PAUL STELZER, M.D.

We’re actually done with the left coronary artery on this fellow. We’ll show it to you in a minute. We’re working on the right coronary.

ROBERT TRANBAUGH, M.D.

Great, Paul. We’ll switch over to you then, if you’re all set. We’ve just seen a condensed version of probably about 2 hours of work. Now we’re going to go live to Room 10 with Dr. Stelzer and he’ll be working on the other coronary artery pod, the right coronary artery. Paul?

PAUL STELZER, M.D.

Thank you, Bob. That’s a great description of what we did here a few weeks ago. This is Dr. Geller’s* favorite part of the operation because it’s a better angle for him to sew this than it is for me, so he gets to sew these few bites. This is the right coronary button, as you were showing just a little bit ago, the development of those buttons and how important it is that we mobilize this up and figure out where we want to put this in the wall of the autograft. It’s actually just a little higher and toward me than it came out because the right ventricle tends to fill up and there’s a little swelling, and that can taint this thing if you don’t allow for that. There was some calcification in the wall of this coronary, so we made this button a little bit bigger so we could work around those little blobs. I’m actually going to make this hole a little bigger for this. You can always make it bigger, but it’s hard to make it smaller. These little punches make that hole a little bit larger.

When we finish this, we’ll show you where the main button is. It’s over there behind it and we can show you how that looks from the inside. You can see the difference in thickness of these tissues. This is what the aortic wall looked like, where we cut this out, and the thin, thin pulmonary wall. It’s a little thicker up here, but in the sinus portion,
where the coronaries live, the pulmonary artery is extremely thin, so we use very delicate suture material here and the same kind of needle holders that we use to do coronary bypass surgery. Rachel’s taking a look at the homograft for me to make sure that’s okay. We’re going to be needing that in a little bit. We keep the supply of homografts in a liquid nitrogen freezer. These are human donor valves. We took this human valve out of the right ventricular outflow tract, but we need to replace it with something. The best thing we’ve come up with is a human donor valve. These are beating heart donors that can’t be used for a heart transplant or so-called non-beating heart donors that are able to donate valves, even though their hearts are no longer bleeding, which happens shortly after death. There is always a greater need for organ donation to make this kind of surgery possible.

We’re getting up into this calcified area, this button. It’s easier to do this inside out. That’s why Charlie is on the driver’s side here. A couple more bites and we should have this thing secured. If the button’s just a little bigger than the button hole, it makes it harder to get your shirt on in the morning. This particular patient is 43 years old, a very active fellow. He likes to play hockey and he wants to get back to that activity. It’s hard to get clubbed in the head with a hockey stick if you’re on Coumadin, so he really wants to avoid that. He wants to maintain his active type of life, so that’s why he sought out this particular type of operation. He had a severe aortic stenosis and also had some degree of aortic regurgitation. He actually had one of the complications of valve disease, which is endocarditis, an infection of the heart valve, last summer, and that added the regurgitation part. That made our lives a little bit more complicated because he had a little healed abscess cavity right underneath the left main coronary and we had to dig out the scar tissue there and put a little pericardial patch on that to rebuild that. He also had this calcium on his aortic valve, extending way down onto the anterior mitral leaflet. The mitral leaflet lives right smack underneath the aorta and we spent a long time digging that calcium off. 2/3 of the anterior mitral leaflet didn’t appear to move at all because of the calcium, so hopefully we’re going to improve that valve’s function as well. We had a little hole in this atrium septum, we call a PFO or patent foramen ovale, sort of like an atrial septal defect. Our astute anesthesiologist, Dr. Machernis*, picked that up during a transthoracic echo.

What you see is black blood coming out of the coronary artery, which is the left vein, having been reimplanted back here, and the black blood coming out of it is blood that’s going in over here, through the veins of the heart. That’s called retrograde cardioplegia. We give the heart a drink of oxygenated blood every 20 minutes or so and you’ll see that this blood turns from black to pink very quickly, as the oxygen debt is paid. The inside of the right coronary that we just did, you get a view here and you can see the blood coming back out of that one too. Rachel’s just trying to keep the spillover from coming out of here.

You can see here, this vein on the front of his heart is all distended with red blood because we’re giving blood backward through the vein. This white structure here is the left anterior descending coronary and some of its branches. It’s just right here, next to where we took the right ventricular outflow tract apart to get this pulmonary out of here,
so we’re just a few mm away from where that one lives. We’re just giving the heart a
drink here and while we’re doing that, we’ve got to anticipate now how we’re going to
put this back together to this, which is the aorta proper, the distal aorta.

Let’s use that other strip. We can show you the reinforcement strip that we use to keep
this from dilating, that Dr. Tranbaugh was referring to earlier. These are strips of Teflon
felt, a little fuzzy. We have it divided into thirds so we kind of know where we are. A
strip like this is actually incorporated around the bottom of the autograft and that’s
measured around a cylindrical sizer that’s just one size bigger than what fit on the inside
of that autograph. On this end, we’re probably not going to use it all because it’s about
10% smaller on this end. Now you see the blood that’s coming out of here is a lot pinker.
Way down at the bottom, you can see the leaflets. I don’t know if we can distend this one
like we did the other day.

Here’s a little extra pulmonary artery. We’ll let the pathologist take that for active tissue
stains. We’re trying to keep this pinned down fairly close to where the commissures of
the valve live, in order to give the valve support on this end. His distal aorta was not
dilated at all. Sometimes the aorta is much too big and we have to cut a little dart out of
that and do a little extra trimming. We’re not going to have to do that today. Let’s try
holding all three commissures and see if we can see the leaflets down underneath there.
Now you can see the leaflets at the bottom, through the water. There they are. Those are
the new leaflets of the aortic valve, the coronary and the other coronary.

Okay, now we’re going to put it back together again. I’m going to start over here at the
commissure area.

ROBERT TRANBAUGH, M.D.

Paul, while you’re working, we have some interesting email questions that have come in.
One I’d like to address to you, it’s an interesting question, when you talked about the
discrepancy of how thick the aorta is and how thin the pulmonary autograft is, one
question was, are there any complications with that long-term? Perhaps you could
address that and give us your thoughts on that.

PAUL STELZER, M.D.

Well, that’s something that has been discussed often. There’s some question as to
whether the patient who has a bicuspid valve, for instance, has an automatic genetic
marker for dilatation because of abnormalities in the makeup of the wall. That’s
something that’s hard to prove. We don’t have enough pathological information. That’s
why I send a little piece of pulmonary artery to the pathologist, to see what they think of
the elastic tissues of the pulmonary. Then we know what that is. There’s really no way of
just looking at it and knowing, unless there’s a frank aneurysm. If there’s a frank
aneurysm and the guy is 20 years old, what are you going to do? Are you going to just
throw up your hands in defeat or are you going to do this? If you’re going to do it, you
have to support the autograft completely and get rid of the aneurysm. You can’t leave a
5-6 cm aorta behind. I don’t think you should leave anything bigger than 3.5. The wall tension just gets so much greater when you get up over the 4-5 range.

I don’t know if you can see this tissue here. This is the native aortic wall in the noncoronary sinus. This is the other part of the native aortic wall, between the two buttons that we cut out. In many patients, if there’s enough room, if that’s long enough, I can incorporate that as well as this felt, so what I’ll do is incorporate that as external support. Now, if you have a patient like this, who (a) didn’t have a bicuspid valve and (b) had a pretty normal distal aorta, it’s probably not necessary. The ones that we’ve seen the problem in have been the patients that I didn’t do this, who had a dilated aorta and they started out with aortic regurgitation as their primary pathology. So the patient with aortic regurgitation, you always want to be sure to support. That’s just to keep these sinuses, these big portions of the autograft, from dilating. If you’ve got it supported with the felt at the commissures on one end and at the annulus on the other end, the valve mechanism is usually going to work just fine. The sinuses may dilate out and the echo will show a dilated aortic root because the upper limits of normal are somewhere between 37 and 39 mm and you often get to 41 or 42, but that’s not going to hurt you. When you get to 75, you get a little worried. I had one like that, which made me think about this, so we put a little jacket. In a patient with a frank aneurysm, this aortic wall isn’t any good, so I can actually take a piece of Dacron graft and fashion a little tube that goes outside and around this and just sits down around this. I’ve cut little notches over the corners so it can externally reinforce the autograft so it’s carefully encased in that. We have to be very careful not to make that too short or too small because it can constrict the leaflets, but with those kind of caveats, I think we’ve learned over the years who needs that kind of real extensive support and who can get away without any or who can get away with, like this one, where initially I cut the aorta open further distal than many people do, so I’ve got enough of this tissue to be able to lock in here and give him a little extra external support. Does that answer the question?

ROBERT TRANBAUGH, M.D.

Yes, very nicely, Paul. There’s another question that I would like to address. That is, is there a chance of dying during this surgery?

PAUL STELZER, M.D.

Me? Or the patient?

ROBERT TRANBAUGH, M.D.

I hope they were referring to the patient and we’ll keep you around for a while. The issue is, what are the chances of dying with this kind of operation. In Dr. Stelzer’s total series, it’s about 1.5% of all patients. What he just referred to, I think is very true, that his experience is very important in this kind of procedure. When you first start doing this, there is a higher risk of more complications and more potential problems. Since that sort of early learning phase, the risk of death is actually well under 1% with this procedure, in
the experienced and very, very mature, seasoned surgical hands of Dr. Stelzer. I think, if anything, this webcast will demonstrate how challenging a procedure it is and how important it is to have the skills and the judgment and the ability to do this kind of procedure and do it with the same mortality that a 40-year-old undergoing a regular aortic valve replacement would have. That is, somewhere under 1%. So there is a chance of dying, but it is extremely low. I think that’s a very important point for the audience to understand and to appreciate, but I want to emphasize too that this is in someone like Dr. Stelzer’s hands. He has the world’s third largest series of Ross procedures. This patient is #375. There are only two others that have done more, both of whom are retired, so we’re delighted with Dr. Stelzer’s experience.

In addition, other complications are very rare. About 80% of patients like this are done without any blood transfusions at all. There’s been one wound infection in 375 patients, one external wound infection, so the risk of complications is low. The need for blood transfusions and most patients are in the hospital 4-5 days and then are ready to travel to get back home or wherever they come from. We usually like to have them stay around 4-5 days after their discharge from the hospital, but then they’re able to hop back on a plane or car and head back to Oklahoma or wherever they happened to come from. So that is a good question and it’s something we’re concerned about and I think it’s something that’s obviously important when judging what is the most appropriate procedure for you or a family member.

PAUL STELZER, M.D.

I think it’s also, you mentioned the learning curve, so to speak, with experience from when I started doing this and I learned who not to do it on by losing a couple of patients with bad endocarditis, one of whom had a previous pig valve that was infected and one of whom had native valve endocarditis and their clotting factors were all blown apart and they just had bleeding, bleeding, bleeding that I couldn’t stop. We use a lot of extra tricks to make sure bleeding is not an issue. This is not an operation for a wet surgeon, that’s for sure. There’s a lot of little needle holes we’re making in thin tissue that’s going to be under high pressure. I put them close together too, probably far closer together than most people do. I think bleeding is easier prevented than treated. That learning curve meant that I lost 3 out of my first 30 patients. I lost 3 out of the next 200. I haven’t lost anybody since 1998, so somebody knock on wood and we’ll keep going, I hope.

ROBERT TRANBAUGH, M.D.

It reminds me of the old saying that good judgment comes from experience and experience comes from bad judgment. Maybe we could go to a couple of slides here. I’d like to review Slide 11, the indications for the Ross, who are the best candidates for the Ross, and go through these things as they come up on the camera. Dr. Stelzer referred a little bit to knowing who not to do this on. That’s probably just as important as knowing who to do it on. Obviously a big criteria is age. This is ideal for patients in their 20s and 30s. As both Dr. Stelzer and I have aged over time, we’ve now extended that to into the
50s and probably soon we’ll be up into the 60s, but age is clearly a major factor as to who is the ideal candidate for the Ross procedure.

There is an email question about a 12-year-old child. Again, in pediatric populations, the Ross procedure is an excellent option. It’s an option that’s widely used and widely applied. One must remember that most of the time these are patients with congenital aortic stenosis. They’ve been born with this bicuspid aortic valve, so at age 12, hopefully one could still delay surgery until they were older and then have surgery in their 20s-30s or 40s, as both the patient today and the video clip is from.

The other indications, I don’t know if Slide 11 is going to make it up or not, but if we have only aortic valve disease, in other words, there’s no other valves involved, and the heart is a good squeezing heart with normal function, no other coronary disease, and no other medical problems or issues, that in particular is the ideal candidate. Now, having said all that, we’ve extended the Ross procedure to patients with blocked coronary arteries or other valve disease and still have had excellent results. We’ve recently reviewed our experience in this subgroup of patients and have almost identical results to the standard patients that we take care of.

The next slide just gives some of the advantages of the Ross procedure. You can see that probably the best one is that there is no anticoagulation involved. For young patients, the most important valve is a mechanical valve that’s implanted and that requires the use of a blood thinner called Coumadin. The pulmonary valve also has been found to have excellent durability in the aortic position. It’s a nice size match. It really lasts a long, long time and certainly in our hands there have been very, very few operations in a pulmonary autograft. In addition, what we’ll see a little bit of, hopefully, is that Dr. Stelzer will put in, to take the place of the pulmonary that is being removed, there’s a valve that is being thawed now in Room 10, a cryopreserved homograft and that will be used in the pulmonary position. So we think, and there’s good data to support this, that the vast majority of patients probably won’t need any surgery. If they do, it’ll be a good 20-30 years later, if at all. The nice thing is, patients are very active. There’s no use of blood thinner. If you’re in your 20s and 30s, you can go play hockey. You can play football. You can ski and not have to worry about injury and use of anticoagulants, so those are nice things to keep in mind, as we’re plugging along here and Dr. Stelzer has pretty much got the distal end of the autograft into the aorta.

One of the questions is, are anti-rejection drugs used and when can the patient return to normal activity? The answer is, there are no anti-rejection drugs needed. There’s no rejection. There’s no antigenicity of the homograft. Normal activity is basically once the chest has healed, which takes somewhere between 6 and 8 weeks.

PAUL STELZER, M.D.

There may be an occasional patient, maybe 1 in 100, who doesn’t read those books about how they’re not supposed to react against these things and there’s some immune response that is hard for us to describe, but they can attack the homografts and make it stenotic.
That’s something that’s very, very low, but it happens rarely, so we don’t cross match people for blood type of the homograft or tissue typing like you do for transplant. It’s not impossible, in other words, but it’s very uncommon. With the homograft, there’s some living tissue in there, but it’s mainly the fibroblast cells, which are the worker bees of the body, I call them, to help build collagen, which is a protein that helps support the valve leaflets. Those are variably preserved and last for varying lengths of time.

I’m going to see whether this valve holds water. The way I’m going to do that is, I’m going to switch the cardioplegia to this antegrade cannula. I have to blow a little air out of there first, so we don’t blow his coronaries full of air. You’ll see some blood coming out of this hole that I’m holding open. See that? In order for that to happen, the valve has to close. Either that or the whole heart has to be pumped full. It’s always a good sign when that comes squirting out of there like that. We’re only giving it at 100 cc a minute. We can go up to 200 here in a minute and give it a little more of a stress test. Coronary circulation usually takes between 200 and 300 cc a minute of blood. When it’s cold, it doesn’t need that much.

Now what you’re seeing is very interesting physiology. You see the vein over here now that was red before? It’s blue now because the blood is going the right way, through the arteries which we’ve reimplanted, through the veins, and coming back into the right atrium, but since we have the cava taped, the blood is coming out here. The blue blood is coming out the right ventricle. Way down there is the end of the pulmonary artery that eventually we have to hook up. Come up to 200, Katie. If I hold this up, we can get a little bit of a look. Let’s take a peek here and make sure. We’re testing this suture line that we just did. There’s a little bit of oozing here. That’s not going to be a problem. You can feel pressure in the autograft. Again, the only way you can have pressure here is for the valve to be competent. Here we have the coronary artery. There’s enough calcium in there to hold itself open. I may have to open this up. We’ll open these tissues just slightly. That’s where the right coronary lives, coming out right there. That’s filling up nicely, going through here and around this way. The left coronary you can hardly see. He’s back here and all of that first suture line you don’t see at all. The heart’s not distending. Again, you know the valve’s not leaking. He’s got a real big, thick heart.

We do know that this distal suture line is not leaking too badly and that the coronaries are not leaking too badly. We have a little bit of the left main peeking up at us down here and we’ve got this jacket kind of put on it from the outside. Now we’re going to pull up the pulmonary homograft that Roselio* is going to rinse down there and we’re going to cut off a little excess on the end that we’re going to actually use. These come from the tissue banks with branches of the pulmonary artery. We can use some of this tissue to form a little support, like the felt that we used on the autograft. We’re going to use a little bit of this, which is useful tissue. This end is a little bit big and shaggy. They didn’t have to be as careful taking this one out of the donor, so we’re going to be trimming this one down a little bit because the body has to absorb all of this. We’ll try to create a little less of an absorption burden here, trimming this down to size. This is actually the coronary artery of the donor over here. We don’t need that, a lot of fat. Do we know how old this donor is, Roselio*? 47. That’s a pretty good age match. We try to match ages a little bit, if we can,
but mainly it’s a size consideration. This is the biggest one they had. He’s a big, tall fellow and we want to get him playing hockey again, so he needs a lot of blood flow through here. Alright, so here’s our homograft. It looks a lot like what we took out. It’s a good thing because that’s what we’re going to put it back in to do.

Okay, here we’ve got to watch out for those coronaries again. We’re probably going to end up showing only a part of this before you have to go watch Oprah or something, but we don’t get to watch her. Again, we’re just a few mm away from the left anterior descending, which is right over here. If I grab this fat and pull it down like that, that’s going to be a problem, so I have to quit doing that and I’ll put this stuff in there instead.

ROBERT TRANBAUGH, M.D.

While you’re working there, Paul, there’s another question here about the hospital stay and recovery time. Do you want to answer that?

PAUL STELZER, M.D.

These guys are young. Most of them are male. As folks who do these sorts of things know, bicuspud valves occur 5 times more frequently in males than females, so in our whole group, I think only 84 of them are women. They’re in a special club. A number of them had babies after these operations. I take full responsibility…well, I better not say that, but I take some responsibility for that. The stay in the hospital is, in general, four days after the operation. We had one recently who decided he wanted to go home at 3 and we couldn’t think of a reason why he shouldn’t, so we let him go. If they’re coming from way out of town, I usually have them stick around for a full week afterwards, as you referred to, just to make sure everything is calm and they’re confident getting on the airplane, but the time you spend getting back to full strength varies depending on what kind of work you do. This is hard to do this big an operation through a keyhole, so we do make a standard sternotomy incision, which we like to put together real solidly with lots of extra wires in these young, athletic guys, because they’re going to put it to the test. Sooner rather than later. Within 6-8 weeks, most people can be back doing whatever they need to do, unless they’re a bricklayer. Then they probably have to wait 3 months to get to that point.

I had a fellow from Michigan who was actually 54 years old when I did him, who ran his first marathon nine months after this operation and he did it in 3 hours and 25 minutes. That qualified him for the Boston Marathon, so he ran that the next year. He went on to do triathlons, which he loved doing, and he has done three Ironman triathlons with this architecture in place. I did him 10 years ago and he’s still running strong.

ROBERT TRANBAUGH, M.D.

What’s the youngest patient you’ve performed the Ross on, Paul?

PAUL STELZER, M.D.
The youngest one that I’ve done in official circumstances is 17, but that’s because we do only adults. In New York, we’re kind of regulated. We can’t do pediatric stuff. Even that required special permission to do. 18 is the official adult age here, so that would be our standard cutoff for us. The pediatric guys have a little easier time because they don’t have to operate on someone that’s 6’6” and 200+ pounds. It doesn’t take nearly as many bites to go around. As you see, we’re sewing and sewing and sewing and we’re not halfway around this thing yet, but this is a little bit more forgiving and we can move a lot faster than we could around the proximal end of the aorta. That’s the one that there’s just no getting back to. If that bleeds, you’re in big trouble.

Some people do the other end of this one first, then do this end. We’re all creatures of habit, so we tend to do things the way we’re used to doing them. When Donald Ross first started doing this operation in 1967, he put this on first, before he did the other parts, because he had them just in the refrigerator. He didn’t have them frozen. So all he had to do was tell them to go get one and they were readily available. I think he did them from the other end first too.

ROBERT TRANBAUGH, M.D.

The first Ross procedure was done in 1967?

PAUL STELZER, M.D.

1967. That’s right. When you have your own autologous living tissue in the work horse side of the heart, that really can last a normal lifetime. The pulmonary valve is thinner, but it actually kind of redifferentiates itself in terms of the cellular architecture. There’s a very interesting article from Boston recently, a pathologist looking at a few valves that they’ve been able to find from people who have had them taken out, and they really are fascinatingly different than they are when you put them in, so the pulmonary learns to be an aortic valve over time. That makes this a kind of rate-limiting step. Any way you preserve it, whether you just keep it in the fridge in antibiotics, like Donald did originally, or whether you freeze it with the cryopreservatives that we use nowadays…they used to radiate them, you name it…but any way you do it, if you put a homograph, let’s say an aortic homograph, in the aortic position, it doesn’t last as long as if you put it over here in the pulmonary position. I think it’s simply a matter of pressure. That pressure in the aorta is just like what you have in your arm, 120/80 or even higher when you’re really hauling. This one has a pressure of 25/10 under normal circumstances and occasionally may get up to 40 or 50 if you’re in trouble, but if you have a normal heart on the other side, the pressures in the pulmonary artery are extremely low. The other thing, when Donald originally designed this, putting the pulmonary over, he thought he didn’t know what the homograft was going to do. If it threw a clot somewhere, it wouldn’t go to your brain. It would go to your lung. If it deteriorated, it would be easier to fix one than the other. That’s true. You don’t have the coronaries to worry about. His other thought was, if it became incompetent or leaking after some years, the right ventricle doesn’t seem to mind as much as the left does. Again, because the pressure is lower, pulmonary regurgitation is
extremely well tolerated. In children who have pulmonary stenosis, congenital abnormality, what we used to do is just operate on them and take the valve out, leave it out, no valve at all. Now they do it in the cath lab. They put a balloon up there and blow it away, but the right ventricle doesn’t seem to mind. There have been some studies of those kids and about 20 years later the right ventricles gets dilated and they get exercise-induced arrhythmias, so it’s probably better to have a valve over here, but you don’t need a very good one and it doesn’t need to last forever. You can get a lot more mileage out of it than you would in the left side. That’s why, in Donald’s experience, about 85% of patients were free from reoperation on a homograft in the right ventricular outflow tract. That compares to only 62% freedom from reoperation for severe AR in the aortic position with cryopreserved aortic homographs. That data comes from Australia, where Mark O’Brien really pioneered the whole concept of cryopreservation and he has patients out 20 years, so he can tell us that, so you’re trading a 62 at 20 for an 85 at 25. Then, if it leaks like a sieve, by that time, you can probably still get another 10-15 years out of it, which gives this operation a possibility of lasting maybe 40 years. If this guy is 43 now, that ought to get him to a ripe old 83 and there isn’t another operation you can think of that even has that as a possibility without anticoagulation, so it’s very exciting to be able to offer something with that kind of hope to a young person. You just have to work a little harder to do it. This is a lot more involved process than just opening the aorta and slamming in a valve and being done with it.

ROBERT TRANBAUGH, M.D.

Paul, you’re finishing up the anterior suture line now on the homograft?

PAUL STELZER, M.D.

Right. We put the Swanganz catheter back through there. That’s the monitoring catheter that Doug Machernis* put in in the beginning to monitor the pressures in the pulmonary artery. When we first started doing these, we didn’t use the Swan because we thought it would get in our way. We just take it out temporarily and put it back in.

ROBERT TRANBAUGH, M.D.

We’re coming up to a good time here in terms of where our time is going to run out and what you’re about to do.

PAUL STELZER, M.D.

What we have left to do is the other end of this. We’ll have to sew this onto the distal suture line and we may be able to show a glimpse of that at the very end, after we bid everybody farewell. My mission is to not take any of these stitches around that Swan. It’s harder to get out.

ROBERT TRANBAUGH, M.D.
I won’t ask any questions about that.

PAUL STELZER, M.D.

I’ve never done it, knock on wood. We think about it every time and that’s how you avoid doing it.

ROBERT TRANBAUGH, M.D.

It’s really a superb job here. You kept a nice tail wind…

PAUL STELZER, M.D.

Yes, we kept a nice tail wind down there. In just a few minutes, as we start the other end, what we’re going to do is run warm blood backward through the veins of the heart, so the heart will actually start wriggling around, as it’s going to start getting some warm blood instead of cold stuff. It’s just been sitting there limp all this time because we kept it paralyzed with high potassium solution and cold blood with some oxygen in it. I think we’re going to have to stop here. I want to thank everybody for watching and hopefully we’ll be able to finish this up real good and Bob will show you what it looks like when it’s actually completed. Thank you very much. Bye bye now.

ROBERT TRANBAUGH, M.D.

Thanks, Paul. That was a tremendous job. Congratulations on a superb technique and your success in doing the Ross procedure. We’re delighted that everyone was able to join us this morning. We really thank you very much for taking time. This is tape from the previous patient that was done a couple of weeks ago, just to show you what the completed repair would look like. These are temporary pacing wires being placed, but you can see that the heart is beating on its own now, that the suture lines are all intact and dry. There are still various cannulae in there because the patient is on bypass surgery, but this is what the final product would look like. In probably about an hour or so, the patient will be at this stage and then be ready to have the chest closed and be in the ICU shortly. Then, if everything is perfect, be sitting out of bed a little later tonight and out of the ICU first thing in the morning.

So that pretty much completes our portion of the Ross procedure at the Beth Israel Medical Center. We’re very, very pleased that you took the time to join us this morning. We thank Dr. Stelzer and the entire cardiac surgery room team from Room 10 for doing such superb work. I also wanted to point out that an archived version of this webcast will be available in several hours. You can access this on www.bethisraelny.org. Again, thank you very much. We’re very pleased with the procedure and we’re delighted that you were able to join us this morning. From Beth Israel, thank you.
This has been a live webcast of a Ross procedure from Beth Israel Medical Center in New York City. For more information, to make a referral or make an appointment, click the buttons below.