



BEATING HEART BYPASS PROCEDURE
MERITCARE MEDICAL CENTER, FARGO, NORTH DAKOTA
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NARRATOR

Now, live from MeritCare Medical Center in Fargo, North Dakota, MeritCare surgeons will perform a beating heart bypass procedure.

AJIT DAMIE, M.D.

Normally when you do bypass operations, you have to use a heart-lung machine because to do a bypass operation you have to stop the heart. When you stop the heart, something else has to take over the work of the heart and that's where the heart-lung machine comes in. We have found ways where you can let the heart beat and it continues to function as a heart pump and still can do a graft to bypass the heart. That's what beating heart surgery is about.

NARRATOR

Nationwide, 25% of bypass procedures are performed off pump, but at MeritCare, the majority of cases are performed off pump because overall the physicians believe it may result in improved outcomes for patients.

ROXANNE NEWMAN, M.D.

Benefits to the patient for beating heart surgery is less manipulation of the aorta, where frequently the plaque occurs or the atherosclerotic disease that we see, especially in our older population, that can be dislodged with manipulation of the aorta that's required with conventional bypass surgery. With this, we never touch the aorta. The heart is never interrupted. By that, there's less risk to the patient for stroke or other complications.

NARRATOR

MeritCare heart surgeon, Dr. Roxanne Newman, will perform the procedure and Dr. Jim Burdine will answer your email questions. Jeff Hoss, executive partner of surgical services at MeritCare, will be your host.

JIM BURDINE, M.D.

Our primary goal in any of this is to do a good job. As we do this more and more, we gain experience and we become more comfortable with doing surgery that a year or two ago we might not have felt comfortable with. Now we're very comfortable with it and use it almost exclusively.

NARRATOR

Please send in your email questions by clicking the button on the player window. And now your host, Jeff Hoss.

JEFF HOSS

Welcome to MeritCare. I'm Jeff Hoss and I'm serving as your moderator today. On my right is Dr. Jim Burdine, cardiovascular and thoracic surgeon at MeritCare here. Dr. Burdine will help field questions coming in from our viewers. We also have Dr. Roxanne Newman, attending physician for our surgical presentation today. Dr. Newman, would you be able to take a minute to introduce your crew for us?

ROXANNE NEWMAN, M.D.

Thank you. Our crew today is going to include Lee Dietrich, our nurse anesthetist. His attending is Dr. Brunswald for anesthesiologist. Across the table from me is my first assistant, Greg Langley. My scrub nurse is Lois Copang. My circulating nurse is Clarice Bobolean and on standby for perfusions is Karen Selgivo.

JEFF HOSS

Thank you very much. I'd like to remind everyone that our viewers today include both a professional audience as well as a public audience. If you have any questions, we would invite you to send them via email to feedback@meritcare.com. Dr. Burdine, would you be willing to go over the objectives for today?

JIM BURDINE, M.D.

Sure. Today we want to discuss the procedure of coronary artery bypass grafting. We want to review the benefits and complications of doing this in a traditional fashion, that is on pump or with use of the heart-lung machine, and compare that with doing the surgery off pump or without using the heart-lung machine. Off bypass surgery was first started in about 1996. Nationally about 25% of the 400,000 bypass surgeries were performed without use of the heart-lung machine in 2003. At MeritCare, 83% or 402 of the 483 procedures that we performed in 2003 were performed off pump. Off pump bypass surgery is relatively new. We don't have long-term 10-15 year follow-up, but short-term and medium-term follow-up is very promising.

JEFF HOSS

Excellent. Maybe we can take just a minute and talk a little bit about what is a beating heart or off pump bypass procedure, exactly?

JIM BURDINE, M.D.

Well, the procedure coronary artery bypass graft, we work at 1-2 mm tolerances on 1-2 mm coronary arteries. To do that, in the past we had to stop the whole heart so that we could do it accurately. In 1996, some people developed techniques where we could stop just a portion of the heart and continue to let the rest of the heart beat and to pump blood throughout the body. In doing that, we did not have to put the patient's human blood through plastic tubing, through the heart-lung machine. We did not have to place large tubes into the large blood vessels of the body. We think we've realized significant advantages to the patient in being able to perfect this technique.

JEFF HOSS

Dr. Burdine, I have a follow-up question to that. I've heard that there are some disadvantages to a patient when you have to use a heart and lung machine. Can you talk about that for just a little bit?

JIM BURDINE, M.D.

Well, putting that blood through the plastic incites an inflammatory response. It's not natural so the body gets turned on. There's increased bleeding and when we manipulate these arteries of the patient, the aorta, the big blood vessel that comes out of the heart, it too is involved in the process of hardening of the arteries and we can dislodge some material and cause stroke or kidney or liver damage, or damage to the other parts of the body. There's another syndrome we call pump head and that is a subtle decrease in the cognitive function or thinking power of the person who needs to be on heart bypass. By alleviating that or preventing that, we think we're seeing that the patient's mental status is improved after having surgery without the use of the heart-lung machine.

JEFF HOSS

Excellent. In just a minute we're going to go into the operating room, but first, if you've just joined us, we're here at MeritCare Health System in Fargo, North Dakota, where we're broadcasting at this point a beating heart bypass or an off pump bypass. Dr. Newman, could you give us a brief overview of where you are in the procedure?

ROXANNE NEWMAN, M.D.

Sure. The patient's sternotomy has already been performed. We've already harvested the artery from underneath the chest wall, which is the internal mammary artery here, and also an artery from his arm, called the radial artery, which we have taken endoscopically. We're already in position and ready to start our bypasses.

JEFF HOSS

Excellent. One additional question. How long do you expect this procedure to take today, Dr. Newman?

ROXANNE NEWMAN, M.D.

Generally speaking, if you include from start to finish, we usually quote about 3-4 hours, but it depends on the patient's anatomy and the number of grafts we're performing that day.

JEFF HOSS

Perfect. Again, should you have any questions that you'd like to send us, please do so by emailing to feedback@meritcare.com. I think now we have a video that we'd like to show you that details radial artery harvest.

VIDEO VOICEOVER

Using the latest endoscopic equipment, the radial artery can be harvested from the entire length of forearm, from the elbow to the wrist, using a small incision that is approximately the width of a watch band. Using a small camera and small retractor, the artery is exposed and the various branches can be removed using thermal ligating shears. The endoscopic camera gives us an excellent view of the artery so that no injuries occur to the artery or the other structures in the arm. The entire length of the artery can be accessed, from the wrist up to the elbow, very easily and with little discomfort to the patient postoperatively. As the side branches are removed, a special suture can be placed into the tunnel and the artery can be tied off by the elbow without any further incisions. This is the entire length with the retractor under the skin just over the artery. Small vascular clips are applied, which will stay under the skin. The artery is cut and Heparinized saline is injected. The loops are inserted and the artery is tied off under direct vision and removed. This technique allows for little, if any, blood loss and certainly is less traumatic than a full incision. This is cosmetically appealing to the patient, as well as the incision is usually not visible underneath watch bands, as most people wear their watch on their left hand. Once the radial artery is removed, the left internal thoracic artery, which is harvested from inside the chest wall, is prepared and the radial artery is sewn to the side of that in preparation for the bypasses. This technique allows the surgeon to bypass the vessels on the heart without manipulating the aorta, thus decreasing the potential possibility of neurologic complications from debris in the aorta. Once this step is completed, blood flow will be checked into the radial artery and the internal thoracic artery to ensure good flow and the retractors for the off pump stabilizer and heart retractor will be inserted.

JEFF HOSS

Dr. Newman, we've got a follow-up question. We just saw the video on radial artery harvesting. The question came in, what's the advantage of using arteries versus veins?

ROXANNE NEWMAN, M.D.

Well, some of the initial data have proven that arteries do have a longer patency than veins and there's certainly the patient comfort factor. Patients have told us that they would much rather have the artery taken from their arm than have the veins harvested from their leg, where they have experienced long-term pain and also swelling.

JEFF HOSS

Very good. Are you in a position where you'd like us to come into the OR?

ROXANNE NEWMAN, M.D.

Yes, please. At this point right now we've made the arteriotomy or small incision into the diagonal artery. I have inserted a small shunt. It's about the shape of a dumbbell and we're beginning an anastomosis of the internal mammary artery to the diagonal. As you can see, we have already positioned our retractors. The octopus is positioned right here. Small suction cups on the side are able to keep the area that we're actually working on relatively stable while the rest of the heart is able to continue beating. You can tell with the shunt we have a relatively bloodless field. It's not completely bloodless, but when you actually look at the amount that's here, under magnification, it's really just a few cc that we're losing. As soon as we complete this anastomosis, the spool dog that's on the artery up here will be released and that will immediately supply blood flow to the anterior wall of the heart.

We can certainly take questions during this time. We're doing fine here.

JEFF HOSS

Excellent. We have one question that came in. This has to do again with the use of the radial artery. When you've taken that out, what takes its place?

ROXANNE NEWMAN, M.D.

Technically, nothing takes its place, but the arteries in the arm, there's a dual system. Both the radial and the ulnar are present. With using ultrasound beforehand, we confirm that the ulnar artery is large enough to take over the circulation of the radial, so once it's harvested, there should be no impairment to blood flow to the hand.

JEFF HOSS

I've got another question. Is there any restriction on the kind of activity one can have after having the radial artery harvested?

ROXANNE NEWMAN, M.D.

No, there really should be no restrictions. The only restrictions we place our patients on are actually because of the sternotomy because that's going through a bony structure, which will need time to heal, but as far as the arterial structures, they're ready to work right away.

JEFF HOSS

I understand that many times in the past, surgeons have used leg veins. Is that still a common practice?

ROXANNE NEWMAN, M.D.

It's still common. It's still standard of practice. Again, there's the potential longevity of using an artery graft instead of a vein and also the patient comfort factor, not having the incisions on the leg.

JEFF HOSS

Are there any other arteries that you would choose to use for this procedure, other than the radial?

ROXANNE NEWMAN, M.D.

Routinely we use the internal mammary arteries. You can use both sides. Today we've only used the left side. There have been some early studies on using the gastroepiploics and other arteries, but our preferences have been the internal mammary artery and the radial artery.

JIM BURDINE, M.D.

Looks like you're just about to take the shunt out here?

ROXANNE NEWMAN, M.D.

We've got about $\frac{3}{4}$ of this anastomosis completed. In 3-4 more bites, we'll be ready to do that.

JIM BURDINE, M.D.

Let me just comment. It looks like you've got a clamp on the proximal side of the artery that you're bypassing through, that shiny metal clamp.

ROXANNE NEWMAN, M.D.

Yes, this right here is actually a cerebral aneurysm clip that we've employed in our practice as well. We probably...sometimes we leave the clip on and sometimes we don't. This particular artery is totally occluded on the patient's native circulation, so it's really not impeding any significant flow, being there, and it's making the field a little cleaner for us right now but we'll be removing that shortly as well.

JEFF HOSS

One quick question. As I said, we have both professional and a nonprofessional audience viewing today. A question came in, could you please explain what is an anastomosis?

ROXANNE NEWMAN, M.D.

An anastomosis is what you were just watching me do, hand-sewing of artery to artery.

JIM BURDINE, M.D.

So it's the connecting of two arteries.

ROXANNE NEWMAN, M.D.

Yes, whether it's vein to artery or artery to artery, but it's the connecting of the two structures.

JIM BURDINE, M.D.

The idea is that the blockage is on the upstream of the coronary or the heart artery and you're getting a new blood supply downstream from the blockage. You just took the shunt out and you can see a little blood squirting.

ROXANNE NEWMAN, M.D.

We purposely do a little blood backflow to make sure there's no debris or artery that might be entrapped in that, so that's intentional.

JIM BURDINE, M.D.

It also makes sure that your anastomosis doesn't purse-string or pull the suture too tight, to make sure that it's as big as it needs to be and not allowing any bleeding to occur. Now you're just finishing tying. You can see, I don't know if Greg can point out the internal thoracic artery toward the 9:00 side of the screen or now the 12:00 side. There's a finger pointing down.

ROXANNE NEWMAN, M.D.

We're just going to put some little stay sutures on the side to make sure the artery is secured. Should it get tugged or pulled, it's not going to disrupt our anastomosis at all.

JIM BURDINE, M.D.

Can we zoom down right on that anastomosis from one of the camera? I'm not sure if we can. Right where that index finger is is right where the anastomosis is. It looks like a good one.

JEFF HOSS

Dr. Newman, a question has come in about this. Does the heart beat at a normal rate during this procedure?

ROXANNE NEWMAN, M.D.

We rarely do any manipulation. There are some techniques to slow the heart rate down if it's too difficult to sew on, but as we become more experienced on this, we rarely do anything to really manipulate that. This is a normal beat right now.

JEFF HOSS

So when you're working on the heart, you don't see a response from the heart trying to speed up or anything because of any stress it might be going through?

ROXANNE NEWMAN, M.D.

No, we really shouldn't. Occasionally you'll see some premature beats when we manipulate it to change the position of the retractors, but that's about all the difference we should observe. In just a few minutes here, I'm going to reposition the heart. This might be a good time if Dr. Burdine can give a closer view of what the retractors look like.

JEFF HOSS

We can certainly do that. Thank you, Dr. Newman. Dr. Burdine, maybe you might want to help the viewers understand a little bit about the procedure that we're performing here on the model.

JIM BURDINE, M.D.

In order to perform the bypass surgery, we do have to have the area we're working still. How we do that is to start with what we call a starfish suction device or retractor. This is placed right on the tip or the apex of the heart. Suction is applied through this line. Jeff's going to be my retractor and hold that. This, then, is mobile. When we get the heart in a position we want, we can tighten that up and this becomes rigid, so now that holds the

heart however we want it. After we get the heart where we want it and where Dr. Newman's first anastomosis was today was through a diagonal artery, which is right here, so she got the heart where she could see the diagonal artery and then, using the starfish, then she used an octopus. You can see why it's called an octopus. It's got two arms with a number of suction catheters, suction pods, and then this sits right over the artery where you want to do your anastomosis. When you suction, it hooks onto the heart. The suction is applied and again it's got a mobile arm that we can tighten up and it's hooked onto a retractor, the chest retractor, which is very solid, so now just the area that we need to have still can be held still and that allows us to do the bypass surgery. Now I'm going to let go of this so I can free up a hand.

While you're here, we'll see Dr. Newman will open up the artery here and then put in the shunt, like a barbell. It's got a hole in the center and allows blood to flow down to the muscles so we don't have a heart attack while we're doing the surgery. It also keeps blood from coming out and into the field and preventing us from seeing what we need to see. So with that, we're ready to do the anastomosis.

If I can take just one more minute, I wanted to give sort of a schematic or cartoon type vision to the people watching to let you see what we're doing. The internal thoracic artery or internal mammary artery comes off an artery. It goes out the arm and supplies the chest wall. Dr. Newman took that artery down before we started the procedure, then she took a radial artery or that arm artery and attached it to the side of our mammary artery or internal thoracic artery. You just watched her perform an anastomosis between the internal thoracic artery and the diagonal artery. Now she's manipulating the heart. We've been seeing it like this. She's about to manipulate the heart to stand it up on its end. Then she'll peek over the top. We'll spin the heart around because we can. She's going to perform two more anastomoses, the arteries on the back of the heart, the posterolateral artery and then to the posterior descending artery, so she's going to do a three-vessel bypass. Now, using this artery from under the breast bone, she has not touched the aorta, which is the big artery as it comes out of the heart. This occasionally has hardening of the artery with plaques, so when we have to put tubes in here or put grafts on it, it can cause embolus or stroke. Things can break off and go down the bloodstream and can cause stroke or kidney damage, so that's why we've chosen this. It's a form of a T-graft. You can see why we call it that, so that's sort of a background of what she's doing in there. So far, she has taken this artery down and performed the first anastomosis. We saw that on the tape. She just now finished this anastomosis. Now she's positioning the heart so she can get around behind it. Roxanne, how are we doing with the positioning?

ROXANNE NEWMAN, M.D.

We're almost set here. We're just measuring out the length of our grafts and we'll be set here in just a couple of minutes.

JEFF HOSS

We can probably take time for a couple of questions, then. We've got a viewer that's asking, after the arteries are anastomosed or connected, what prevents the blood from leaking between the sutures once regular blood flow has returned?

JIM BURDINE, M.D.

That's a good question. The sutures themselves try to get the tissue close enough to where that doesn't happen, but the big advantage in the human body versus any mechanical process, like plumbing or a pipe or a car, the body heals itself and initially lays down some things that form a blood seal and ultimately that will heal tissue to tissue and be a new connection.

One thing that we have not mentioned, to do this bypass surgery, we do have the patient anticoagulated. We give them medication so the patient cannot form a blood clot because it's very important while we manipulate these arteries, turn them on and turn them off, we don't want the body to do what it normally would do and that is to clot the blood to prevent bleeding, so the patient right now is on a blood thinner and we will need to reverse that at the end of the surgery.

ROXANNE NEWMAN, M.D.

Dr. Burdine, we have the heart in position and we're starting that second graft now.

JIM BURDINE, M.D.

Here we have a good look. We're looking over the very top of the heart. The tip of it is in the lower left hand corner of the screen and you're probably standing on tiptoe to peek over. You can see the opening in the posterolateral artery. We're going to do a side to side anastomosis, so you're anastomosing an opening in the side of the radial artery, which is the tube that stretches across the TV screen. You're anastomosing it and putting a needle into the radial artery. Now you can see the blue shunt there. Now you're putting the needle into the posterolateral artery of the heart. It's just barely within the screen. There it is, back into the radial. That black suture that you see running toward the left of the screen is attached to the shunt, the little blue device that allows the blood to pass through the artery without stopping the blood flow to the downstream part of the heart.

JEFF HOSS

We have a question that just came in. Again, I would ask that if you do have questions, please feel free to email those to feedback@meritcare.com. Dr. Burdine, a question came in from a viewer wondering how many bypasses can be done using a beating heart procedure? Double, triple, quad?

JIM BURDINE, M.D.

I always tell people, when they ask me that, we always do enough, no matter how much it takes. How many heart bypasses you need depends on how you were put together when you were born, but is there a limit to the number we can do? The answer is no. We can do 5, 8, however many are done. I think that five years ago we only did 1-2, but the techniques have evolved. We feel pretty comfortable going anywhere on the heart for however many bypasses we need to do. Roxanne, do you have any comments about that?

ROXANNE NEWMAN, M.D.

I would agree. Basically, anything that we would do on pump we basically can do off pump now. The only stipulation is, of course, valvular surgery is done on the inside of the heart, so people need to not be confused about the differences between bypasses and valves.

JEFF HOSS

Dr. Newman, a question just came in. During a procedure like this, how much blood is really lost?

ROXANNE NEWMAN, M.D.

We actually use a cell saver, which will salvage any of the blood that is lost and wash it and transfuse it right back to the patient, their own blood, before they ever leave the room, but even at that, we're generally transfusing maybe less than 100 cc at the end of the case.

JEFF HOSS

So in layman's terms, 100 cc would equal...

ROXANNE NEWMAN, M.D.

30 cc to an ounce.

JIM BURDINE, M.D.

Can you just review, before we did this, we transfused or had to give blood to about 1/3 to 1/2 of the patients. Now we're down to 20% to 1/4 of the number of patients. Remember, again, to do this surgery, we do manipulate the patient's blood clotting ability and that's not an exact science and that can be part of the need for a blood transfusion, the things that allow the patient to clot. Just a quick question, Roxanne. How's the patient doing?

ROXANNE NEWMAN, M.D.

He's been very stable. We've had no troubles. His rhythm's nice and stable. He's really doing quite fine.

JIM BURDINE, M.D.

You're making this look routine, Roxanne.

ROXANNE NEWMAN, M.D.

That's the idea.

JIM BURDINE, M.D.

Good. I'm glad he's doing well.

JEFF HOSS

Following a surgery like this, Dr. Newman, a viewer writes in who has had a procedure, actually a past patient of yours, and is kind of wondering, once you've had surgery like this and you've had blood flow restored, can people resume normal activity following that, even if that activity is rigorous and includes exercise?

ROXANNE NEWMAN, M.D.

Yes, an activity really, the only restrictions we have are due to the sternotomy or if a patient has had previous heart attacks and has an impaired heart function, then their physician may recommend lighter duty work, but our expectation is a full return to activities.

JEFF HOSS

What about an individual who wants to partake in some climbing activities, rigorous climbing activities? Is that something that would be contraindicated?

ROXANNE NEWMAN, M.D.

No. Again, as long as their heart function and their overall health otherwise doesn't contraindicate, bypasses shouldn't interfere with that at all.

JIM BURDINE, M.D.

If I can clarify a little, just a couple of things. One is that we've used the term sternotomy. For the people that aren't technical, our breast bone is called our sternum and to do this surgery like it's being done today, we have to cut the sternum or cut the breast bone and that's like any broken bone. It takes about two months to heal, so there's a limitation. We ask patients not to do anything to jeopardize that bone until it heals, so we don't want people lifting for about two months. Then the other distinction to make here is coronary artery bypass grafting, the surgery is designed to get new blood to heart muscle

that doesn't have enough blood, so the success of the procedure depends to a certain extent on how good the muscle is before we ever got to it. Dr. Newman mentioned if ejection fraction is low or if there has been a lot of damage to your heart muscle and that damage is permanent, then getting new blood supply won't make that back the way it was. If that's the case, then there is going to be some limit to what you can do, but for the majority of people that we see, there hasn't been significant permanent damage and getting new blood supply to that muscle that's not getting enough returns that muscle to normal state and the sky's the limit as far as our mountain climber is concerned.

JEFF HOSS

I have another question that relates to the radial artery procedure. How many bypasses can be done normally with the radial artery?

ROXANNE NEWMAN, M.D.

Again, that depends on the position...

JIM BURDINE, M.D.

Hold on. You're about to take the shunt out. There it goes. You're going to put in the last stitch. You've got the sutures pulled up so there's no significant bleeding going on. Now they've completed the anastomosis between the radial artery, the first anastomosis between the radial artery and the posterolateral artery, which is an artery in the back of the heart.

ROXANNE NEWMAN, M.D.

Getting back to your question, the number of grafts that we can perform on the radial is really dependent on several things. #1, what is the size of the heart? What are the positions of the arteries that we're bypassing? And of course what is the length of the patient's arm? So it's variable, but you can get 3-4 grafts off the radial, plus the internal mammary artery offers 1-2 easily too.

JEFF HOSS

A question about technique and procedure. There's been a lot of discussion about the benefits to the patient. What about for the surgeon? Is this a more difficult procedure to do for the surgeon and the team?

ROXANNE NEWMAN, M.D.

It is more technically demanding, but like anything else that you do in practice, the more you do it, the greater the comfort level becomes.

JEFF HOSS

So there truly is an issue with volume leading to skill levels and those kind of things.

ROXANNE NEWMAN, M.D.

I believe so. I think anything that you do, you notice that it becomes easier the more that you do it.

JIM BURDINE, M.D.

I think initially when we started doing this, we would not have been comfortable doing the surgery as Dr. Newman is doing it now. We started with single vessel bypasses that were easy to get to and were on the front of the heart. As we became comfortable with those...

I'm going to stop talking for just a minute because you can see that little puckering. We call it a hickey. That little bruising from the suction cup is about the only "damage" to the heart. It doesn't end up causing any problems. It's just sort of a reminder that we've been there.

Now, this is the posterior descending artery and they've already scored it a little bit to identify where they want to do the bypass. She's using a round blade here just to clean off some of the tissue overlying it. You see that Q-tip to dab the blood so it's a good site so she can see where she wants to go. There, they're just cleaning off the posterolateral artery. The posterolateral and posterior descending arteries here are as far back on the heart as you can go and the patient will continue to do well. It always amazes me.

She's got a sharp knife and she's just going to make a small opening into the coronary artery. It's just at the bottom of our television screen. You can see the blood flowing out of it. This is called Potts scissors. It enables her to open that artery a little bit more. She did one way and now she's going to go the other. That's a perfect view right there. Now she's going to come at it a little bit, make it a little bit bigger, and then she's going to put a shunt in. Right there. Blue tip and clear in the middle. You can see the blood flowing through.

The other advantage of the shunt is that as you're putting your needle through the tissue, one of the concerns whenever you attach two tubes together is that your needle may catch the back wall, the wall on the other side, and without knowing it, you'll sew the thing shut. Well, the shunt is additional protection against that because if you have that problem, you would realize it because the suture would be on the shunt and not on the far side of the tissue, so I think it really makes a difference when you do the anastomosis.

Now they've put a metal clamp, it's a very soft clamp, on the radial artery just downstream from the anastomosis to the posterolateral artery. Now they're about to cut off the end of the radial artery, after they got it to the size they want. They'll cut it off and there are two veins that go right with it, so they're going to clip those veins so they don't

have any bleeding. Sometimes there can be very tiny communication. So you can see how the needle is going right through the end of the radial artery. This is going as an end to side, the end of the radial artery to the side of the coronary artery. She's putting the suture through the coronary.

Now, this suture has a needle on both ends, so it doesn't matter which one she's using. She can just lay one down and pick up the other and keep going. Her assistant's holding the radial and keeping the suture a little bit tight, just out of the way so Dr. Newman can easily get at that coronary artery.

The other thing I'd point out is all the bypasses she has done are already open and the heart is receiving blood through those. That is one of the advantages of doing it this way is that you have immediate revascularization.

JEFF HOSS

Here's a question that comes in that deals with this. If someone has had a previous bypass surgery using a traditional method and many years later they require it again, can this beating heart bypass method be used on that individual?

JIM BURDINE, M.D.

The short answer is yes. I think one of the last areas where we were able to do this off pump is in the redo operation. I think our experiences over the last two years have shown us that it is safe and can be done correctly, but again it's a technical question. Sometimes there are areas and situations on a redo that we would need to use the heart-lung machine, but certainly it's a possibility.

JEFF HOSS

A question has come in about the stabilization devices. One of those is, is it ever a potential risk that either the starfish or the octopus can move or become dislodged?

JIM BURDINE, M.D.

You mean what happens when the suction comes off? That's something you like to not have happen. However, it can happen. Fortunately, it's fairly infrequent. When it does happen, we just need to make sure things are loose. There's no particular danger. We reposition things and get back on with the surgery.

JEFF HOSS

Dr. Burdine, you might just want to go through now, what are some of the benefits that you see, as a cardiovascular and thoracic surgeon, to beating a heart bypass for patients?

JIM BURDINE, M.D.

She's just about finished with this surgery. We might want to take a look at the anastomosis while I talk. The thing we've realized for sure, or the thing we've seen for sure is a definite decreased need for blood transfusions. We've talked about that. The other thing is there seems to be a faster recovery from surgery. Patients stay in the intensive care unit usually 12 hours or 16 hours. They wake up quickly. Within the first hour, most patients have the breathing tube out. There's also a shorter length of stay. We're down to 4-5 days for the patient to stay in the hospital. I will emphasize, this is not because we're putting people out on the corner with their suitcase. This is because they're tired of us and they want to go home. So I think the other advantage is the risk of bleeding and stroke risk is probably less. It's been hard to tell in a lot of the centers. Renal failure, injury to the kidneys, is less. I think most important is the idea of preserving the cognitive function or mental power of the patient. When we don't have to put somebody on a heart-lung machine, their thinking processes recover very quickly. There's something called pump head, where it takes as much as 3 to 6 to 9 months for people to get better mentally and it's subtle things, like remembering names of friends and things, so I think that's a real advantage.

JEFF HOSS

Another question about the bypass procedure. Those areas that you bypass that are blocked, that are left in the body, what happens to those arteries?

JIM BURDINE, M.D.

I always tell patients it's like if you were to replumb a house. You wouldn't take the old plumbing out. You wouldn't want to tear up all those walls. You don't need to. Instead, you're putting in new plumbing, new pipes, and the same thing happens here. You leave the old coronaries alone. You don't touch them other than to reroute blood until we get downstream. So we leave those arteries alone.

JEFF HOSS

A question from an individual that had open heart surgery in the past and is wondering, when he had surgery in 1991, they used a leg vein, in which they made an incision from the top of his knee to his ankle. Given the small size of the heart, he'd like to know why so much artery, or vein in this case, is needed.

JIM BURDINE, M.D.

Well, remember, even with the small size of the heart, a bypass may need to be 5-6" long, but if you have three bypasses, potentially they need, you know, 3 x 6, so they need a longer piece of vein. Also our veins are injured as we go through life and it may be a portion of the vein wasn't good in one spot so they had to not use that, so they need a length higher or lower. It's not unreasonable from the ankle to the knee, that's a pretty

common length, especially when you're doing not sequenced arteries, like we're doing here, but each artery has its own vein graft.

JEFF HOSS

Once you have the new arteries in place and the anastomoses are complete, is there any use of the coronary arteries that you are bypassing? If they have some minimal flow, will they continue to serve any portion or do the new veins actually take over for them?

JIM BURDINE, M.D.

Well, the new, in this case arteries, the new bypasses would carry the predominant amount of flow. However, it's a complex circulation and there will still be some blood flow through the old graft, some of it to subtle areas. The majority of the blood will typically go through the new bypass.

JEFF HOSS

I've got a question for you, Dr. Newman. Kind of futuristically looking, do you think bypass surgery is going to be able to be accomplished in the future without cutting the sternum?

ROXANNE NEWMAN, M.D.

Yes, we do believe that. Some of the early development of the retractors and the devices are ongoing right now. Just like when you realize that the first one of these was done in 1996, well, it took us about 5 years to get to a broad use of it and I think it'll probably be about the same time sequence for the port access or not going through the sternum to bypass as well.

JEFF HOSS

Another question in follow-up to that, Dr. Newman. This individual is interested in what is the percentage of relapse? After a procedure like this, are you at an increased risk for having another kind of surgery like this? How long will the bypass last?

ROXANNE NEWMAN, M.D.

Well, all we can give is a statistical analysis of that and of course each individual is different, but in general, internal mammary arteries, we know that at 10 years over 90% of those vessels are still open and working. Typically with vein grafts we can see a failure of up to 50% at 10 years, but that doesn't mean somebody can't have longer life out of their graft. That's where secondary risk prevention comes in, making sure blood pressure, cholesterol management, not smoking, all those other factors come into play.

JIM BURDINE, M.D.

One of the reasons everybody tuned into this webcast is so they can see some heart surgery. It's very dramatic to see it, but heart disease is a much bigger topic. It bears mentioning, as Dr. Newman did, that the most important thing you can do with your heart is to never have to have bypass surgery. If you have heart bypass surgery, you need to do everything you can not to have it a second time. Those are the secondary risk factor modifications, smoking, diet, exercise, talking with your doctor about cholesterol. So it is a multifactorial thing. Studies with just vein grafts from the 70s said the operation itself lasts 8-10 years. We think, with our more current treatments and secondary risk factor adjustments, that number's going to increase, but we know that heart disease or hardening of the arteries is a progressive problem. There is no cure for it, but there are things that will slow it down.

JEFF HOSS

Dr. Burdine, is there anything you can tell us about this particular patient, keeping in mind our need for confidentiality?

JIM BURDINE, M.D.

Roxanne, do you want to talk a minute about the indications of this particular patient? I think it's fairly typical of the patients that we see and probably worth reviewing that.

ROXANNE NEWMAN, M.D.

This gentleman actually did have what we call collaterals, where basically the body tried to make its own bypasses to this region. We gave him a trial of medical therapy first, but because of the vigorousness of his activity and his occupation, he was experiencing symptoms with minimal exertion. He would have angina with one flight of stairs. After a good trial of medical therapy, he really felt that his lifestyle was too impeded and he desired to go ahead with surgery.

JEFF HOSS

We're getting a lot of questions coming in right now about who are the best candidates, who should be looked at, what do they need to be looked at in terms of deciding who the candidate are, so Dr. Burdine or Dr. Newman, would you like to cover what is necessary for an ideal candidate?

JIM BURDINE, M.D.

I think five years ago we looked at patients and said is this someone who is a candidate that we possibly can do technically? Now we look at a patient and say, is there any reason I can't do it? So there's a big shift in our thinking, but there are cases, patients that have a heavily calcified aorta. The aorta is that big blood vessel that comes out of the heart, the main one that goes to the body. For an on-pump surgery, we have to manipulate that. We

have to put clamps on it. We have to cut it. So, for somebody that has a heavily diseased aorta, we really like to use this procedure. Patients that has a high risk for having neurologic problems, for example the elderly, we like to keep them off the heart-lung machine, if possible, and if we can do it safely. People who have had prior strokes, people who have had kidney disease or lung disease, all of these are people that we try very hard to use off-pump surgery. While you're taking this off, again you can see those little black or brown spots. They've actually faded from the other one, right up to it.

ROXANNE NEWMAN, M.D.

These over here have already disappeared and these will be gone by completion of the surgery.

JIM BURDINE, M.D.

So you can see she's putting a little blood clotting type cloth on it. Can you just show them the anastomoses here?

ROXANNE NEWMAN, M.D.

Sure. There's the one to the posterolateral and the posterior descending.

JIM BURDINE, M.D.

So those are two of the three bypasses and she's putting a little clotting cloth on there.

ROXANNE NEWMAN, M.D.

This just keeps the grafts from moving out of position and offers a little more hemostasis or keeping the blood clotted in that region. We're actually going to reverse our blood thinners now.

JIM BURDINE, M.D.

You can see the tip of that starfish just in the lower left corner there. There it is. That's our star, sort of like a lineman in a football game that nobody ever notices unless it quite working. This is the top of the heart, where your finger is.

ROXANNE NEWMAN, M.D.

This is the right ventricle, mostly. The left ventricle is already placed back in. This is the aorta we were talking about, where a lot of the plaque can develop, and this is a portion of the right atrium. This is the completed internal mammary artery that's directed to our diagonal.

JIM BURDINE, M.D.

Can you see the radial artery coming off there? I think you can.

ROXANNE NEWMAN, M.D.

Yes, right there.

JIM BURDINE, M.D.

That's where they put the two together to form that T-graft. Now just to orient people, the head is toward the left of the screen. The feet are toward the right. You can see that mammary artery. Now the head is toward the bottom of the screen and the feet are up toward the top. You can see that mammary artery with the radial artery coming off. One of the other things I like about this procedure is when we put the sternum back together, one of the issues that we have when we do the surgery is sometimes that artery will be right where we don't want it to be, right under our sternum, and this encourages that artery to be a little bit to the left, so I think it's a little safer if we ever have to do a second operation.

ROXANNE NEWMAN, M.D.

Dr. Burdine and Jeff, we're basically completed here. We're just going to start closing our incisions.

JEFF HOSS

Very good. We've got one question from a viewer, Dr. Newman, that you might be able to answer. This patient has done very well during the procedure and obviously we haven't encountered any complications. However, in someone where there would be something that would happen, is the operating room prepared to take a more traditional method if you would need to?

ROXANNE NEWMAN, M.D.

Absolutely. The heart-lung machine is actually right off to my right shoulder here. As I introduced in the beginning of our case, our perfusionist is on standby and in the room with us as well. The perfusionist is the professional that actually runs the heart-lung machine for us while we're using it.

JEFF HOSS

I've got a professional question for you, Dr. Newman. I'll read it word for word. Roxanne, we at Lenox Hill Hospital in New York applaud your efforts, which makes this look easy. To accomplish the multiple grafts that you are demonstrating, on average how long do you find your intercostal incision has to be?

ROXANNE NEWMAN, M.D.

My intercostal incision. Oh, I believe their question is with reference to doing this not through the sternotomy, if I'm correct. In reference to that question, basically the incision that would be performed between the ribs is done in approximately 2½-3". This we did through a standard sternotomy or through a chest incision, mostly for visibility. We do heavily screen our patients for the limited access because our retractors are still in developing. They're not quite prepared to take on all comers for that, but in general, I think that was the answer they were looking for there.

JIM BURDINE, M.D.

We should mention that Dr. Newman is a pioneer in doing this surgery with robots through a limited incision between the ribs, to do this same operation. Again, we're just getting started on that, so the techniques are being developed, so the patients who choose that operation are screened fairly heavily.

ROXANNE NEWMAN, M.D.

I'm pretty much completed here. We're looking good.

JEFF HOSS

We've got a number of questions too that deal with candidate selection again. Maybe Dr. Burdine, could you go through a little bit about a candidate's characteristics that would prevent them from having this type of surgery?

JIM BURDINE, M.D.

I think the people that we have had trouble with, and Roxanne can speak to this as well, the people we've had trouble with are people who have severely damaged hearts, where the left ventricular ejection fraction is down to 15%. To those who aren't in the medical field, that's the amount of blood that the ventricle pumps with each beat. Normal is about 60% of the blood in the left ventricle is pumped out each time the heart beats. Anything over 50% is fine. At 30%, people start getting into congestive heart failure or having heart failure, so 15% is a very reduced and very badly injured heart. I think another group of patients I've had trouble with is people who have some valvular disease. It's not necessarily so bad that we would want to do valve surgery. It's just bad enough that when the heart is tipped up on its end, the heart doesn't tolerate that position. So those are the main people that cause me to pause about doing this. Those are the people I want to make sure that the perfusionist is very close at hand. Roxanne, are there people you would not consider for this surgery or people that would cause you to think twice or to be ready to abandon it soon? Are there people that you wouldn't do this on?

ROXANNE NEWMAN, M.D.

I think the important premise you have to keep is that as long as a procedure is safe and you're gaining benefit from it, and that's why we offer it. It's not a matter of whether you can do it; it's a matter of whether you're still getting benefit from it. When you no longer experience the benefits, then the heart-lung machine is our tool that we use to keep the patient supported during the operation, so in general we plan on doing everybody on a beating heart, but if we experience a lot of adhesions or we think there's any instability of the patient, then certainly we're not going to continue with this technique.

JEFF HOSS

Dr. Burdine, a question has come in about what percentage of the total cases do you, as cardiovascular surgeons here at MeritCare, do beating heart on?

JIM BURDINE, M.D.

Last year we did 83% of our coronary artery bypass grafting without the use of the heart-lung machine.

JEFF HOSS

Once the surgery is complete, how long will it take for a patient to generally get back to normal activities?

JIM BURDINE, M.D.

Well, as we said earlier, it's about 4 days in the hospital. It is an injury. It is a broken bone at this point, so it's about 4 weeks of getting your strength back. We do try to limit people to not lifting anything for two months. We do want people at about 2 weeks to start on cardiac rehab and exercising. We would like them to get up to running 1-2 miles a day, even at 3-4 weeks.

JEFF HOSS

We've had a couple of questions come in that are asking about what kind of training have you and Dr. Newman both had that enabled you to perform this procedure?

JIM BURDINE, M.D.

I think we both started out at the very beginning of this process and I worked with the people at one of the companies that makes these devices, working with animal laboratories and then applying them to very heavily selected patients; that is, on people we thought would be technically easiest to do, and then over the years developing confidence. Going to meetings and talking with other people, heart surgeons who are doing this type of surgery, so it came with an interest and then just being part of the group that helped to develop it.

JEFF HOSS

Does the off pump heart surgery cost more than the on pump or are they fairly close?

JIM BURDINE, M.D.

Off pump surgery actually decreases the amount of cost per patient. The cost of a heart-lung machine, all the membrane oxygenators, the tubing and all the rest of it is actually quite expensive. These devices that we've shown you today are about 1/3 of the price of that material. We still need the personnel in the OR the same, but the material costs are about 1/3 of what a regular heart bypass would be.

JEFF HOSS

Dr. Burdine, as you know, MeritCare is establishing a heart center here. What do you see as being the most important factor with that?

JIM BURDINE, M.D.

I think our commitment at the MeritCare Health System. We have a strong cardiac health group, from cardiologists to cardiac rehab to our pathologists, radiologists, surgeons. We have developed a large enough group of patients that see us that we felt we needed to take the next step and that is to develop a physical plant, a heart center. That will allow us to encourage the team approach that we've developed, as each piece is needed. Now we can have a centerpiece, a center focus, where we can bring in resources, bring in talent, that would all be directed for patients that have heart disease, starting with prevention of heart disease, from treatment to surgery to whatever is necessary, but having a separate physical plant, physical building, to house a team of professionals, we thought that would provide the best possible outcomes for our patients.

JEFF HOSS

We're nearing the end of our procedure and webcast today. Dr. Newman, do you have any final parting words about the progress of our patient?

ROXANNE NEWMAN, M.D.

The patient has been very stable for us. We're just about completed. I would say we'll be out of the operating room in 15-20 minutes here.

JEFF HOSS

Very good. Dr. Burdine, any final comments?

JIM BURDINE, M.D.

I think that's it. I think Dr. Newman did a tremendous job with this surgery and she has made it look far easier than it really is. That's a testament to how good she is and how good our operating team is.

JEFF HOSS

On behalf of MeritCare Health System, the operating crew, our production crew, Dr. Newman, and Dr. Burdine, I'd like to thank everyone for joining us for this webcast. Good day and goodbye from MeritCare.

NARRATOR

Thank you for watching the live beating heart bypass procedure from MeritCare Medical Center in Fargo, North Dakota. For more information, to make a referral, or to make an appointment, please click on the buttons below.