STEFAN G.TULLIUS, MD, PHD: Hi. My name is Stefan Tullius. I'm the Chief of Transplant Surgery, Professor of Surgery at Harvard Medical School, and I'm also the Director of the Transplant Surgery Research Lab. What we will be doing today is a living related kidney transplant, a father donating to his daughter, his daughter in the 20s, who has endstage renal disease.

We will take the right kidney and transplant this right kidney into the left groin of the recipient. We know that the kidney has two arteries, which we will reconstruct after we take out the kidney. So we will proceed initially with a minimal invasive retroperitoneal hand-assisted donor nephrectomy of the right kidney.

It's important to know that we always try to keep, if there is a difference in the kidney size, a better kidney, with the donor. We take both right and left kidneys with the approach of our minimal invasive retroperitoneal donor nephrectomy, and we have a huge experience in reconstructing arteries in patients who have several renal arteries as well.

SPEAKER 2: So this is a 48-year-old young man, and he's donating his kidney to his daughter, who is on dialysis. We are going to be removing his right kidney today. We will see that he has two arteries and a single vein. The kidney, otherwise, is normal. Our approach is a retroperitoneal approach, totally retroperitoneal, and the incision that we are going to make to remove the kidney is going to be below the belt line. Actually, it's going to be a nice bikini-type incision.

He's a male, but in a female we want to put the incision as low as possible, and we will take you through the steps as we go along. So the patient is in the left lateral decubitus position. His right flank is up. This is his anterior superior iliac spine. Here is the 11th rib and the 12th rib, and the kidney is sitting somewhere here.

Imagine my fist being his kidney. It is in the retroperitoneal space. We are going to mark our incision in his right lower quadrant as low as possible, and then we will make two small incisions, 12 millimeters, for the camera port, one here, and the second incision will be above the umbilicus for the working port.

And during the course of the procedure, we will place a 5 millimeter port here to assist us with the surgery. And you can see here that the-- these are his Langer's lines and you can see how the Betadine has dried up. So these are his natural lines and the incision is coming along the natural line. So it is going to heal up very nicely.

So just to recap our anatomy, here's the skin, the external oblique fascia, internal oblique muscle, which has been split along with the transversalis, and here is our retroperitoneal space. And we will start mobilizing that now.

Here is the ureter and here's our external iliac artery, both sitting quite nicely. So we are going to end up freeing the ureter all the way up, putting an umbilical tape underneath it to tag it, and then we will mobilize the peritoneum.

The peritoneum is now being mobilized medially. We're developing the retroperitoneal space so that we can get our hand and port in. And then we'll establish pneumoretroperitoneum.

See, we have done our initial mobilization of the peritoneum. That is our retroperitoneal space. I'm going to push the camera in and it's developed all the way up to the liver.

STEFAN G.TULLIUS, MD, PHD: So this is the GelPort device that we use and we're going to put it in now, twist it down to skin level.

SPEAKER 2: So we mobilize the peritoneum from the inside so that we can get the first port, which is the camera port, and then we mobilize it all the way up so the peritoneum has been swept laterally to medially, it has been dropped down, and we mobilize it such that we can get the second working channel.

I had marked it here, but now looking at it from the inside, this is perhaps more medial, so we will eventually end up putting a port slightly more lateral in this region, and you can see when I put pressure on the Sponge-Stick, we are mobilized all the way up to there. Structures in the abdomen are well-protected. Pneumoretroperitoneum will now be established. We maintain it between 10 and 12 mmHg.

So this was a long 12 millimeter trocar so that we can move it freely. If this cannula is short, then the hub touches the GelPort and you can't move it freely. So we are in the retroperitoneal space. You can see the ureter that we have tagged, external iliac artery. This is the peritoneum that we had initially mobilized. The abdominal musculature. We will mobilize it some more and we'll just make space. I think we'll get a second port here.

STEFAN G.TULLIUS, MD, So as you can see, it's a little more lateral than where we had initially planned it on the body, but that's OK.

PHD:

SPEAKER 2: So the properitoneal fat has been removed. The kidney is underneath. Here is our Gerota's fascia, peritoneal edge. As I said, in some people it can be more generous, but what that does is gives us more room in the retroperitoneal space. We can freely move our hand and that completely exposes the Gerota's fascia, underneath which is the kidney. Here is the lower pole. The upper pole is up there. So we'll start by incising the Gerota's fascia.

STEFAN G.TULLIUS, MD, PHD: Just mobilized superiorly. I'm getting close to the diaphragm there.

SPEAKER 2: So here we have the kidney that's popped up. The Gerota's fascia, which is right here has been opened up. Here Is the diaphragm. And that's the superior pole of the kidney. There's a little bit more here, which we'll take down. So now, the next step would be to mobilize the ureter all the way up to the renal hilum and mobilize the peritoneum further medially and higher up.

When we get to the renal hilum, we will kocherize the duodenum. So we're coming in a plane between all this perinephric fat. We want to preserve all of the fat with the ureter. [INAUDIBLE] here. Gonadal vein. Very nice anatomy. In the right plane the dissection comes very nicely.

He is finding the right plane here. And what we've done is, we've taken some of the fat along with the kidney, which we'll eventually remove. Just come a little higher here. Mobilize the upper pole. The adrenal gland coming up there.

So let's review our anatomy . And here's the peritoneum underneath the retractor. There is the duodenum that we just kocherized. Here's the inferior vena cava. Here is the gonadal vein.

Here's the main renal artery or one of the renal arteries, renal vein. Here's the midpole of the kidney, upper pole nice and pink. Here's the lower pole, and we have a generous amount of fat along with the ureter. OK. Great. A little stretch on the gonadals, so we'll simply take it here. . Small clips, please. Prevent it from avulsing.

So that's our set-up. We have a rolled lap that's retracting the duodenum and the peritoneum medially, and that is basically connected to the Omni retractor. So right there and then we have a 5 millimeter peanut holding it in place. Here is the kidney. Now we need to mobilize the

vessels.

I'm attaching the kidney posteriorly and inferiorly, preserving all the fat around the ureter. This is the posterior Gerota's fascia. that we are cutting through. All right. We are going to come between the adrenal gland and the upper pole of the kidney. Here's the adrenal gland.

OK. So we just freed up the upper pole laterally and medially we have a little bit more. Here's the adrenal gland and we came between the adrenal gland here and the upper pole of the kidney.

Here's some lymphatics, which we will take. The idea is to go as far back as we can and once we start coming to the posterior abdominal wall, there are a lot of attachments, lymphatics, blood vessels that we need to take down. There we go. Scissors, please. Can I have a right-angle, please.

OK. That looks good. Large clip, please. And the lymphatic. We should be able to get a stapler across there. Yeah. Scissors, please. We're going behind the cava. That's the edge of the vena cava. Posterior lateral edge.

The peritoneum, liver up there. We've got a rolled lap retracting the peritoneum and the duodenum medially. Here's the inferior vena cava, right renal vein. Here's the bifurcation that we saw on the CT. Accessory renal artery right down there. It's the main renal artery. There's quite a lot of distance between the two, and way behind the cava, as you can see, clips around the gonadal vein.

The kidney is completely freed up all the way, nice and pink. Here's the fat around the ureter. Here's the ureter all the way down to a tag. So we're ready to take the kidney out now. There you are. Peristalsing. There [INAUDIBLE]. OK. Large clip, please. Small clip, please. OK. These staple lines always bleed so we have to get a large clip underneath. Scissors, please. Thank you.

All right. So we've taken the kidney out, and we're just going to inspect the retroperitoneal space. So right here is the peritoneum medially, right there, and underneath that is the liver. This was a rolled lap to retract the peritoneum and duodenum medially near the inferior vena cava. It's the gonadal vein. That's the IVC. It looks secure.

We actually left this at atmospheric pressure for 10 minutes. Now we are having a look again, and there's virtually no bleeding. These are the clips on the main artery along with the

transfixing clips. The accessory renal artery was small, so we put two large clips and then a small titanium clip. It appears to be nice and secure.

This clip is going all the way across the larger clips, and there was some adventitial tissue superiorly, but this lower clip has gone right across the main renal artery, so it appears it may not be all the way through. But actually it is clipping the lumen of the artery.

So we have three clips on there, the transfixing clip and two additional titanium clips on the main renal artery. Here's the adrenal gland. No trauma noted there. Good. No bleeding. That's great. Here's the diaphragm right up here. That's the diaphragm. It looks good.

STEFAN G.TULLIUS, MD, PHD: So we start the surgery with a skin incision in the left lower abdomen. We try to keep the skin incision small, just to expose the area of iliac artery, iliac vein, and the bladder sufficiently for the renal transplant.

The skin incision, as you see here, is done in a hockey-shaped form. We continue then and divide the subcutaneous tissue and once we go through the aponeurosis, which connects the rectus abdominis with the oblique abdominal muscle, we enter the retroperitoneum.

What you see now is the exposure of the iliac artery. Here we see the iliac artery and, as you see, there are crossing lymphatics, which drain the lymphatics coming from the lower extremities and we divide those carefully and tie the lymphatics to avoid the occurrence of lymphocytes.

Towards the middle you see the peritoneum of the patient. The bladder, lymphatics crossing the external iliac artery. You see the psoas muscle, and now we see that we have surrounded the external iliac artery, which we expose with a vessel loop.

So once we have done this, we pay attention now to exposing the external iliac vein branches from the external iliac vein, divide it carefully to expose the sufficient length of the iliac vein, allowing us to connect the renal vein to the iliac vein later on during the renal transplant.

We divide those branches, allowing us a better exposure of the external iliac vein. And now we have surrounded the external iliac vein with a vessel loop. Here you see nicely the external iliac artery exposed, the external iliac vein, and the bladder, which we are going to free to connect the ureter.

Now you see the kidney coming out of the donor. There is still some fat surrounding the

kidney, and the kidney is now immediately flushed with either a physiological lactate solution or with a preservation solution, and we have two renal arteries here as we have expected that, based on the previous imaging, which we have done to delineate the donor anatomy.

See, now the kidney turning nicely yellow throughout and here you see the two renal arteries now prepared on the back table after the kidney has been cooled down and the kidney remains on ice.

What we do know is we try to connect both branches off the renal artery. There's one main renal artery and then there is an additional branch supporting the lower pole and the renal vein, which you see here and the ureter of the kidney.

So we cover all of this to make sure that the kidney stays nicely cold to limit the consequences of the ischemic injury of the kidney to a minimum. Now we do an arteriotomy, which is just going to allow us to connect this lower branch, which we do here with a very fine suture.

And you see that we have spatulated the lower pole renal artery to create a larger opening of the renal arteries. Both fit nicely together now and the connection is then competed with a running suture with 8-0 Prolene, which is a very fine suture, which helps us not to narrow the connection between both artery stumps. This whole process takes us about 30 minutes, so a very short period, which is tolerated by the kidney very well, while the kidney stays on ice.

So once we have recreated the connection between both renal arteries, we flush the real artery to assure the flow and to make sure that the connection is sealed and not showing any leakages. You see that the saline, the cold saline here is running nicely through both arteries without compromising patency and without showing leakages.

Now we place a vascular non-traumatizing clamp on the external iliac artery of the recipient and continue with an arteriotomy of the external iliac artery. We flush the artery with a heparin saline solution and then connect the main renal artery, in this case, to the external iliac artery, again, with a very fine, non-absorbable suture material.

The kidney's now coming down into the groin of the patient, and the renal artery is connected to the external iliac artery. You see both the opening of the external iliac artery as well as the renal artery and the connection of the renal artery to the external iliac artery is almost compete at this point. Next we will place a non-traumatizing clamp on the external iliac vein after we have completed the anterior anastomosis and connect the renal vein, providing the venous

outflow of kidney to the external iliac vein. Usually this procedure is taking us a total of 20 to 25 minutes. You see the renal vein connected to the external iliac vein.

You already see that we have done the back wall of the renal vein here and have anastomosed the back wall of the renal vein to the external iliac vein. Those are the last stitches to compete the connection of the bank wall and then we'll complete the anastomosis by running a suture on the anterior wall as well.

Now you see that the kidney is reperfused at this point, and you see the kidney turning nicely pink, and that is showing us that the blood is running well through the kidney. Here you see how nice and pink.

To confirm all of this, you do a Doppler ultrasound, which shows that there is a nice flow through the kidney. Now here you see the ureter, and you already see that urine is coming out of the kidney. And, in the case of a living donated renal transplant, we do see this in the vast majority of all of our transplants, that the kidney is producing urine immediately.

It is very rare that the kidney doesn't start to work immediately and that the patient still needs a few months of dialysis. You see the completion of the connection. The ureter connected to the bladder, renal vein connected to the external iliac vein, and here the renal artery, which is connected to the external iliac artery.

So now we close the surgical field. We place a drain in the area of the retroperitoneum. Just remember that fluid collecting in this area is not going to be absorbed, and in order not to get infected, it needs to be drained.

We usually can remove this drain after a few days, depending on the drainage and the amount which is being drained, and then we close the retroperitoneum. We usually close the skin with an intracutaneous suture, thus avoiding the removal of staples after the surgery.

This living donor nephrectomy was straightforward and the way we expected it. We reconstructed the arteries. The kidney looked beautiful and made urine immediately. It looked nice and pink.

You may have seen the urine production immediately after the kidney was reconnected, and we expect that the patient is going to do well. So everything went well. We are very happy about that, and if you have any questions, please feel free to contact me at any point in time.