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ADAM KIBEL: Hi. I'm Adam Kibel, the Chief of Urology at Brigham and Women's Hospital in Boston, Massachusetts. Today, we're going to talk about robotic assisted laparoscopic partial nephrectomy. So the patient we're discussing today is a 34-year-old female who presented initially with recurrent urinary tract infections. Of importance in how we managed this case vis-a-vis the imaging, the patient had spinal rods in place for scoliosis. These were placed in Eastern Europe. And we were unsure whether they were metallic that would be safe put in an MRI. The patient really had no other significant medical problems. The patient initially presented to me after already undergoing an outside ultrasound which demonstrated a cyst. This was followed by an outside CT which confirmed the renal cyst. But the patient was sufficiently concerned about this that she came to the Brigham and Women's Hospital for a second opinion, in large part it was because these were not simple cysts. But these were cysts that had some complexity to it. And again, because of the spinal rods, the concern was that the imaging had been suboptimal. This is an example of the patient's CT scan. What you'll notice first of all is the spinal rods are creating a lot of artifact, which obscure-- partially obscures the imaging of the kidney. I've circled the renal mass which, unlike a simple cyst, is not a sphere or an ellipse, but is complex and also some complexity on the inside, indicating there may be a solid component. Because of the concern about the complexity of this cyst, that it was not simple, that it was complex, we felt additional imaging was warranted. We could not get an MRI because unfortunately, as I stated earlier, these were placed in Eastern Europe and was concerned that these were not MRI-compatible. The decision therefore was to obtain a second ultrasound at the Brigham and Women's Hospital. While we usually don't like to repeat tests, ultrasounds are very operator-dependent that we could possibly get the information that we needed by using one of the ultrasonographers here at our institution. This is an example of the ultrasound. The kidney can be seen to the left of your screen. And the mass has been circled. Again, the ultrasonographer placed some dots around in order to highlight the exact size of the mass, which is approximately 2.5 by 3.3 centimeters in size. Notice there are some clear areas which are cystic, but there are also some solid areas which are white on this gray scale ultrasound. This is clearly concerning for renal carcinoma. So complexity was clearly concerning for a kidney cancer. She had normal renal function with a creatinine of 0.79 milligrams per deciliters. We discussed the different treatment options with the patient including observation, an open radical and partial nephrectomy, as well as minimally invasive radical and partial nephrectomy. Observation is an option that we use quite frequently in patients that are older that have a shorter life expectancy. Small renal masses like this can be safely observed for several years. A radical nephrectomy, removing the entire kidney either vis-a-vis a minimally invasive or an open approach, seemed slightly excessive in a lesion that possibly could be benign. The cure rate for removing part of the kidney versus removing the entire kidney is identical for renal lesions of this size. So therefore, after a long discussion with the patient, we decided to proceed with a robotic assisted laparoscopic partial refractory. This is an example of a robotic assisted laparoscopic partial nephrectomy, as performed at Brigham and Women's Hospital. So the first thing we need to do in performing this procedure is mobilize the colon and the duodenum off of the retroperitoneum, off of the kidney in order to expose the kidney. So during this portion of the procedure, what we're doing is trying to get into the plane between Gerota's fascia, the colon, and then following the colon, the duodenum. So the kidney is lateral, is up on your screen. The liver is just to the right and inferior, being reflected, is the colon and the duodenum. And in my right hand is a pair of scissors which I can use both sharp, dissection, and that also have cautery, which allows me to cauterize vessels as well as the ability to use them as a cutting instrument. At this point, the colon has been further reflected. And we're trying to identify the vena cava. This is necessary in order to march up towards the liver, where we're going to find the renal hilum, where the real vein and the artery are located. As you can see, the planes in this patient are quite nice, which allows for an easy dissection. Where this patient's [? solder ?] is, which is being used for retraction, is actually where the vena cava is eventually going to be located. Again, this is a careful portion of the procedure which is important in terms of setting us up to the rest of the operation. Again, just below the grasper that's lifting up and approximately where the patient's sucker is, you can see a slightly blue tinged structure which is the vena cava. This is going to become increasingly obvious as we complete the dissection. One of the really nice features of a robotic or laparoscopic procedure is the pneumoperitoneum, which provides a certain amount of pressure in the patient's abdomen. This limits the amount of bleeding substantially. I think the blue of the vena cava can be appreciated much better now. And this is allowing us to move towards the patient's head, towards the patient's liver, in an effort to identify the real vein, and with the renal vein, the renal artery, which will be posterior to it. I think one can appreciate the ability of the instruments to both grasp as well as to be used as dissection instruments. At this portion of the procedure, we've identified the renal veins. This patient actually has two renal veins. The first one is approximately where the sucker is right now. It can be seen coursing from the bottom of your screen toward the top left. The second renal vein is just approximately where the sucker is, to the right of the sucker right now. The renal artery is going to be located between these two renal veins. Most patients have only a single renal vein. And the fact that this patient has two was identified on the preoperative imaging, and one of the reasons why a surgery like this is much easier and possible as it was in the past, because we can actually identify the structures preoperatively and don't have to depend on any surprises in the operating room. Right now, we're trying to identify the renal artery. That is the structure that can be seen pulsating in the middle of your screen. We need to isolate this in order to clamp it to cut off the blood supply to the patient's kidney during the operation. That's a critical element in doing a partial nephrectomy, either open or robotic, because obviously a large amount of blood flow goes through the kidney. Approximately 20% goes to both kidneys, so 10% to each kidney. And as a result, a large amount of blood can be lost if one does not identify and clamp the renal artery. At this point in the procedure, we've identified the renal artery. And so what we need to do now is identify the mass. Again, we know where it is from preoperative imaging. And you can actually see a bulge at the very top of your screen. That is the renal mass. So what we're doing is taking off Gerota's fascia, which is the fat that surrounds the kidney and protects it, so we can properly identify the mass. This portion of the procedure can take quite awhile, even though there are no significant blood vessels in this area. Older patients, which this obviously isn't, can often have fat that is very densely adherent to the kidney. You can see the normal kidney just to the right of the screen where the scissors are. It's actually pointing at it. We're continuing the dissection in order to identify the renal parenchyma all the way around the renal mass. At this point, you can actually identify the renal mass to the right of your screen. The scissors are retracting it. The normal kidney is to the left. My instruments are on both sides of it right now. And the fat is left overlying the renal mass. At this point, we use ultrasound during the operation to identify it. This is an intraoperative ultrasound probe that is dropped in. You can see the ultrasound images at the bottom of your screen. And actually, the mass can be seen, partially cystic, partially solid. We're putting it over the mass, one to confirm this is indeed the renal tumor. Shortly, what we're going to do is try and identify normal renal parenchyma superiorly, inferiorly behind, and below so we can actually map out where we're going to have our negative margin as we do the operation. Drop in probes like this have significantly improved our ability in order to achieve a negative margin. The lesion has been identified in the left lower quadrant ultrasound and has been frozen. Now it's free again. You can see normal renal parenchyma here. And what I'm going to do is pull the ultrasound probe back until I start to see the mass, which you can see again in the ultrasound images below. And this allows me to identify where normal parenchyma is and where tumor is. Once we've done this, now we circumscribe the mass in the area that we've identified as normal kidney. This is going to be done all the way around the renal mass. It is done with electrocautery. This allows us to mark out exactly where we want to do our excision. At the same time we're doing this, we're giving the patient mannitol. The reason why we give mannitol is that it scavenges free radicals in the kidney when we clamp the kidney. It also flushes out a lot of the tubules. Both of these things are designed in order to decrease the likelihood the patient has any residual ATN following the procedure. As you can see, we're circumscribing the mass [INAUDIBLE]. This is more of a marking exercise than actually an excision exercise. What we want to do is be sure when we're trying to rapidly excise the tumor while the canc-- while the kidney is clamped, while the kidney is not receiving any blood flow. And by marking it out, this allows us to do it as expeditiously as possible. So here we've identified the renal artery. We already had done this. You can see it pulsating in the middle of the screen. We're going to put a bulldog clamp in. This is a laparoscopic instrument that is passed by the assistant. It goes around the artery and then clamps the artery and prevents blood flow to the kidney. People often ask why we don't clamp the renal vein. We do in certain situations with very deep tumors. One of the advantages of not clamping it is there is some back flow from the vasculature. This allows us to identify bleeders much more easily. So the kidney is now ischemic, because the renal artery has been clamped. We're going to use both sharp dissection with the scissors and electrocautery. Remember, the scissors have both electrocautery and obviously function as scissors. Both allow us to accurately excise the tumor. At the current time, what we're trying to do is develop the initial plane. This will allow us to excise the tumor with

a negative margin. We're going to gradually increase the depth of the incision as we perform the procedure. The assistant's role in providing suction here is critical, because we need to be able to see our field in order to adequately excise and ensure a negative margin. In addition, they can provide traction in order to pull the normal parenchyma down, as you see the assistant is going to be doing this shortly, and allow us to better see the depth of our excision margin. So you'll see here that I'm using a little bit of cautery. On of the most important things is to achieve a negative margin. We have a new tool at our disposal called Firefly. This is a drug that is given intravascularly and allows the kidney to light up under a special light. A normal kidney will look bright, bright green. And cancer will look dull. And the reason we use is in order to achieve a negative margin. If we see some dull areas when we're doing our excision, that indicates that we've exposed a little bit of tumor. And we need to go a little deeper in order to make sure that we have a negative margin. At this point in the procedure, now that we feel comfortable that we're achieving a negative margin and getting around the tumor, we're deepening our incision. As you can see, we do encounter blood vessels, even though the artery is clamped. This is from back bleeding from the renal vein. What it allows us to do is identify where the vasculature is and provide a cautery, or possibly even throw a suture in that area in order to ensure that we have a negative-- that we control hemostasis when we unclamp the artery. Right here, I've entered the collecting system. That frequently happens. The collecting system is approximately where the sucker is. My scissors are in it right now. With this is a natural extension of a deep tumor, where we have to get deep enough in order to get a negative margin. And once identified, it's easy enough to close using a suture, which you will see later. The tumor and the normal parenchyma is being elevated superiorly. The normal kidney is inferiorly, approximately where the sucker is. And right now what we're doing is completing our excision towards the back side of the kidney. Again, we're using a combination of both sharp dissection and cautery, depending on whether or not we're seeing blood vessels or whether we're interested in ensuring that we have a negative margin and want a better visualization of the tumor and normal kidney. At this point, the kidney is only-- tumor is only being held posteriorly by actually a very small amount of tissue approximately 1 and a 1/2 centimeters and maybe a quarter of a centimeter deep. But the magnification is really an incredible advantage of the robotic system, the da Vinci robotic system, in addition to the three-dimensional aspects of the visualization that you actually see when you're looking through the console. So clearly the magnification can be appreciated on this video. The three-dimensional aspects can really only be appreciated by looking at it under a console. So in a moment, you'll see that the tumor has been excised. You can see that's normal kidney we're looking at with the tumor on the other side of that normal kidney that we're excising. What I'm doing right now it's just checking the base to make sure that I feel comfortable that there's no tumor at the inferior aspect of my resection. And at this point, I'm ready to complete the excision of the tumor by cutting its last remnants. Notice the real lack of bleeding that we see. That is a large part due to clamping the renal artery. If the renal artery was unclamped, essentially there'd be an incredible amount of blood loss at this point in time. What I'm doing now is just inspecting the tumor base. And I'm going to start closing the collecting system, as well as sewing up any areas that I'm concerned about blood vessels. So remember earlier identified an area in the collecting system that I was entered, you can see now that I'm closing this with a 2-0 Vicryl. I am able to do this in a very precise manner, again because of the magnification and the instrumentation that the robotic system provides. I usually do this in a running fashion. The blue clip that you see there is made out of Vicryl. It's called a Lapra-Ty. And what that does is provides essentially a knot, so you don't have to tie knots on the inside of the patient. While you'll see later it is relatively easy to tie knots, this does improve the speed, which I think is of critical importance when the kidney is under ischemic-- is ischemic because of the clamping of the renal artery. What you can see here is I am continuing to run this suture, both to control any small blood vessels, as well as to continue to reapproximate the renal parenchyma to ensure that we don't have a leak at the end of the procedure. Once we've completed running this suture we place another Lapra-Ty at the end, which you're going to see coming in a minute. What you're looking at now is we place in Floseal and Surgicel into the defect. You can see the normal kidney just on the inferior aspect of your screen. You can actually see the tumor up on the right at the upper part of your screen, waiting to be extracted later with the liver just below it. We use Floseal and Surgicel in order to assist with the hemostasis when we do this kind of procedure. What I'm doing now is reapproximating the cut edges of the kidney. This is done in a horizontal mattress manner. The system that we use places a clip on the suture which is very wide. And what this clip does is it provides traction and allows us to pull the cut edges of the kidney together. This is advantageous for two reasons. The first reason is it provides close approximation. But the second advantage is when the artery is unclamped, the kidney will swell. And this will actually [INAUDIBLE] normally, because now there's more blood in the kidney, not because of any pathologic process. And what this will do is provide more pressure across the defect and decrease the risk of having any sort of bleeding. So as you can see, those wide clips allow us to pull on the kidney fairly forcefully. And we approximate the cut edges of the kidney quite nicely. The Surgicel and Floseal will eventually dissolve inside the patient and will not will result in any residual defect. But at least in the short term when the patient's recovering from the surgery, it will provide an additional element of hemostatic control. I think once again, you notice how easy it is to place sutures using a robotic system. The wrist action really allows us to mimic what we'd be able to do in an open operation. Again, when the clip is placed on, we put pressure on this. And this allows us to reapproximate the cut edges of the kidney quite nicely, and provides pressure that when the kidney is unclamped will decrease the amount of bleeding. Again, I think one of things that can be appreciated here is the rapid rapidity in which we can close the edges of the kidney. I think what this allows us to do is decrease the ischemic time to a tremendous amount, and therefore decrease the risk of any sort of renal failure that could be associated with the clamping of the renal artery. Once again, the wide aspect of the clip allows lot of pressure to be placed on the kidney. So now the renal artery has to be unclamped. So again, your assistant, in this case, will flash the renal artery. We then look up at the kidney to make sure that it's not bleeding. If there was a significant amount of bleeding, I'd have my assistant reclamp the artery immediately so that we can investigate what was bleeding. Once we feel satisfied that there's not any bleeding, the assistant removes the clamp. At this point, the kidney is reperfused. And now we are reapproximating the fat over the kidney. This is done for two reasons. The first reason is that if we ever have to reoperate on this patient, it's nice to have a layer of tissue between the kidney and the surrounding structures. This will assist us in developing the proper planes. In addition, if there's any leak of bleeding or of urine following the procedure, this provides an extra barrier between the kidney and the rest of the patient. And for both these reasons, I think that it's important to at least attempt to reapproximate Gerota's fascia. Again, what you can see is the rapidity at which we can do this because of the ability to so rapidly-- because we can articulate our wrists. Again, the clips are quite useful in allowing us to rapidly proceed through the operation. We can see here is a kidney with the surrounding structures that appears essentially unchanged from prior to the operation. As you can see, this patient had an excellent result. It turned out to be a renal cell carcinoma on final pathologic review. It was a clear cell, T1aNOMO. Its size was approximately 2.2 centimeters and it was a grade 2 out of 4. At one month in followup, the patient was already back to work. She had no residual pain or discomfort. And she had normal renal function. Thank you very much for watching the video. I hope it was helpful. If you have any questions, please feel free to contact us at the number listed below.