

**DISCUSSION ABOUT ROBOT-ASSISTED CANCER SURGERY
NEW YORK-PRESBYTERIAN HOSPITAL
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HERBERT PARDES, M.D.: I've always felt that the mission of helping somebody with health care when they're in trouble is as wonderful and as powerful and important a mission as anything you can do in life. I think we're fortunate to have a great staff who feel the same way and carry it out every single day.

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ANNOUNCER: Located in New York City, New York-Presbyterian is ranked among the top ten hospitals in America by *US News and World Report*. New York-Presbyterian is affiliated with two Ivy League medical schools, Columbia University College of Physicians and Surgeons and Weill Cornell Medical College, and receives about 450 million dollars in annual NIH research funding. Its faculty of about 5,000 physicians provides comprehensive care to patients in all specialties in medicine.

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HERBERT PARDES, M.D.: At the end of the day, we all can walk away and say, "This is our team and it's a great team."

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ANNOUNCER: Welcome to this OR-Live webcast presentation, live from New York-Presbyterian Hospital in New York City. During the program, it's easy for you to make referrals, make appointments, or request more information. Just click on the buttons on your screen and open the door to informed medical care. OR-Live, the vision of improving health.

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KETAN K. BADANI, M.D.: Welcome to the New York-Presbyterian robotic surgery webcast. Thank you for joining us tonight. I'm Dr. Ketan Badani. I'm the Director of Robotic Surgery at the Columbia University Campus. I'm joined here by my colleague, Dr. Ashutosh Tewari, who's the Director of Robotic Surgery at the Weill Cornell Campus. I'll ask Dr. Tewari to lead our discussion. I'd like to remind the audience that if you click on the buttons on your screen, you can ask us a question any time or request more information as we go through the webcast. So without further ado, Dr. Tewari.

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ASHUTOSH K. TEWARI, M.D.: Thank you. I'm going to start the discussion about robotics and prostate cancer. Dr. Badani later will discuss not only prostate cancer, but will dwell upon robotic systectomies, partial nephrectomies, and other reconstructive procedures, but focusing on the prostate, there is where the robotic revolution started. I want to highlight one thing, that this is one surgery in which you get judged not by what you took out, rather you get judged by what is left behind. There is a very fine line on which a surgeon has to walk in order for him or her to get a negative margin, return of sexual function, and return of urinary control. Reason is that we have to find a fine balance between these three competing goals. This is that flimsy layer which surround the prostate all around. On one side are the cancer cells, which may be lurking so that they can have a positive margin, while on the other side, or sometimes through the layer, are the nerves, which are literally in here, which is right there and can easily be damaged. The margin for error is very, very minimal. I think using a robot in this scenario

helps us because I can see things in a little bit more detail. This is a picture in which prostate, its nerves, its urethral connection, and other structures, such as a tumor, is very easily identified. If I get a magnification, I can appreciate those structures. The magnification has also allowed us to rethink it through how the nerves around the prostate are organized. Normally we approach the nerves as a left and a right neurovascular bundle. The problem here is in 40, 50 percent of the times, the nerve responsible for the sexual function may not actually be traveling in this neurovascular bundle. There is a bundle. There is a vessel. There may be some nerves, but the real nerve might be traveling somewhere else. That is where the challenge comes.

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So we started thinking it through that this is a complex architecture. We thought, "How about looking at these nerves like a hammock?" There are multiple nerves there. They are there as if the prostate never existed, but prostate settles in that neurovascular plexus, and based on the size of the prostate, it displaces the nerve just like a hammock. Nerves, they travel all behind and besides at the posterior lateral aspect. They are very fine structures, so we started looking at this complex neurovascular tissue, using this robot in a tri-zonal concept. What is this tri-zonal concept? Basically, if you look at this picture, this will give you a bigger overview of how the prostate and its nerve supply interact. Look at the prostate here. The bladder is there, it's been lifted up, and this is the major vessel, known as abdominal aorta. At the junction of the bifurcation of the abdominal aorta, there is a plexus of nerve known as hypergastric plexus. Then a nerve comes out, known as hypergastric nerve. Other nerves are there which are parasympathetic and in fact more important for erection. They come out through the sacral foramina. They travel on the side of the prostate, and this entire area on the red actually is the zone which can be divided into three zones. The zone one is a proximal neurovascular plate. Nerves, which are on the proximal side, come very close to the seminal vesicles, then the main bundle, it's known as predominant neurovascular bundle, and then there are many, many nerves which are traveling on the side of the prostate and actually behind the prostate. So that's what completes the tri-zonal concept and this is the proximal plate. You can see that there are multiple nerves. They are very fine and you are seeing them in magnification. Then this bundle actually, the plate, comes very close to the tips of the seminal vesicles. In order for us to save these nerves, we have to be very careful and rethink it through how to avoid injury, traction, or a terminal injury to these neurovascular tissues. This is the main neurovascular bundle. By the time it's getting out of the male pelvis, this is at the apex and we are looking from the distal side to the apex of the prostate and those two fine structures, strand-like things, they are actually the nerves. It's so easy to damage these strands and that is actually [unclear] of the entire nerve-sparing procedure. So the margin of error really is very low. If you look at this sheet, these are the accessory nerves, which are enclosed in that sheet of tissue which has been reflected from the anterior lateral aspect of the prostate. But these nerves are not only present in the sheet, they are also present behind the prostate, in the superficial layers of a fascia between the prostate and the rectum. This picture actually highlights that there are multiple nerve fibers criss-crossing from left to right. In those layers of the [unclear] fascia. In order for us to really save the nerves, we don't just have to save the main neurovascular bundle, we have to try to save each one of these fibers.

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Let's look at how we approach doing a nerve sparing in our patients. I personally do about 600 of these procedures every year and that gives us experience, experience in terms of sometimes when not to select a patient for a nerve-sparing. That is how this algorithm has been built up. On the left side, we have very early cancer in which we can do a tri-zonal athermal grade one nerve sparing. Bottom line, we can do our best effort because the risk of cancer being left in the body is minimal. It's not zero, but it's minimal. Then comes the grade two, in which the patient has a moderate degree of cancer, and we can really do a good nerve sparing, may not be able to save every nerve fiber, but most, yes we can. Then grade three is an incremental and grade four is possibly not a best candidate for a nerve sparing. We have

developed this by a periprostatic dissection technique and this is a picture of that one millimeter of tissue around the prostate, which has been magnified here. My team has been able to dissect it out and we have to visualize this in a little bit more detail. Let's think about prostate on the right side of the screen and you are just looking at that flimsy sheet, which we showed in the beginning. Prostatic cells are on the right side of the screen. You can see some glandular structures in the purple color. Around that purple color is the prostatic capsule. Then in red, are the arteries around the prostate. In blue are the veins, and those greenish structures are actually the nerves fibers. Everything else is the packaging of fascia, fat, and other tissue, which makes lateral prostatic fascia. The grade one of sparing, as I have described, is actually developing a plane just outside the capsule. You can literally save almost every nerve fiber. Grade two is when you stay a little bit outside the vein and still you can save more than 90 percent of the nerve fibers. Grade three, what we call an incremental nerve sparing, you save what you can based on the characteristics of the tumor and how close it's coming to the nerves. And grade four is when you really cannot save too many of the nerve fibers. I will show some of the pictures of the specimen, the way it looks like. Then I'm going to show a small clip of how the grade one and grade two nerve sparing look like. So, on the left upper side is a grade one specimen. Now you are looking at upper right side, grade two nerve sparing. Then left lower is a grade three nerve sparing. And then finally, right lower is the grade four nerve sparing. Let's have a video clip at this time and hopefully we'll be able to better appreciate how the nerves look like.

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You can see the video now. This is a very early prostate cancer, and we are able to save all the nerve fibers which are in the main bundle, in the proximal neurovascular plate, in the accessory tissue, and behind the prostate. The specimen looks quite like that and the grade two is when you have to stay outside the vein and you can still save most of the nerve fibers but you don't compromise on the cancer control aspect of this operation, because at the end of the day, this is a cancer operation and the goal we have to be very cautious about is to get all the cancer out and get a negative margin. So this is a picture of how we do grade one and in grade two nerve sparing and we have developed what we call an athermal technique in which, not only do we try to save every nerve fiber, we try to stay with an athermal approach, not using too much of a cautery. I'll stop here for a while and I'll move on with my presentation, because this part is with the continence and I'll touch base on that.

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Continuing with the outcomes with the grades of nerve sparing, as I taught, obviously patients when they have a high grade cancer, they have a higher risk of an extra prosthetic extension, and they are not a good candidate for nerve sparing. But in early cancer, the risk is low and the outcome could be over 87 percent chance that if they are okay in terms of their sexual function before surgery, they can achieve that function down the road. We have also been working on reconstructing the nerve fibers just in case we couldn't save them. This is early in the research and we have published our initial experience appears promising but I think we have a long way to go about this nerve reconstruction, or what we call nerve advancement technique. We have published quite a bit of articles looking at the different anatomical principles of the nerve-sparing techniques, how to achieve these two or three competing goals, and this is the latest article looking at our nerve sparing results and also the cancer control. We'll touch upon the cancer control a little later, but before that, the sexual function doesn't just start and end with erection. I think the orgasmic function is something we need to study. We have been looking at the anatomical correlates as to why some patients have it better, and some don't, orgasmic function. We have been studying this function and actually I was surprised that some patients even without have a formal erection can get an orgasmic function. Not everyone has the same orgasmic function. There is a difference, but orgasmic function is something which we are studying and hopefully we'll have much more detail information available down the road. Let's look at continence. I think it's an important outcome. It impacts patients' quality of life quite a bit. There are several factors, including the bladder, including the bladder neck, the

sphincter, and the supporting mechanism, which contribute that the patients don't leak urine in a normal situation. But after radical prostatectomy, something happens and we looked at the factors which control return of urinary function, and one of them was actually the inherent length of the sphincter, which patients are born with. Patients who have a very short urethral length are likely to have delayed continence. This green line here tells you what is the length of the sphincter and has been measure while in pre-operative planning and rectal MRI. The other thing which we noticed, when I was doing radical prostatectomy, open or with the robot, somehow there was a significant descent of the vesicle-urethral junction, as we can see in this histogram. That itself can contribute to the return of continence. There has been data that the pelvic floor and the supporting structures, such as puboprostatic ligaments, and also the [unclear] may have a role in return of the continence and you can see three different structures and how different they look. So every individual is born with a different kind of a pelvic support mechanism and we wanted to reconstruct it all because during surgery we do damage there. So we started looking at other support mechanisms, not only the interior, and you can see here the side view of the prostate, the rectum, the pubic symphysis, and the penis, and you can see there are two supporting structures behind and in front of the prostate and the sphincter. That is what we need to restore if we want early return of the continence.

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Looking at that, we modified our technique and we started preserving the puboprostatic ligaments, the [unclear]. We'll do the anastomosis, and we'll join that. We published a paper with an anterior reconstruction and we found that our results got better. Then we started looking at the posterior reconstruction part, and we thought that if we can combine and support the posterior to the anastomosis structure, we will possibly have better outcomes and that's exactly what we did and what we call a total reconstruction now and you can see on the left side, there wasn't significant descent before and now it seems that that descent is not that much. Has that translated into a better or an earlier continence? Yes, it has. The lower line tells us that when I was not doing any one of these reconstructions, how the continence was coming up, and the upper yellow line actually is my latest data. This all combines about more than 1,200 of the patients done just in the last two and a half, three years. Total reconstruction actually gets return of continence sooner. I don't think ultimately it matters. The other thing which we were looking for is that what happens in an obese man, because we were concerned. It seems like that disadvantage of a delayed continence in an obese man is a little bit overcome by this total reconstruction, but I still think that the patients who are very heavy take longer for the urine control to come back. This is looking at the sphincter length, and the longer the sphincter, quicker is the recovery of the function, and this is our total reconstruction technique, which has come out in a publication and we have now more than 700-800 patients who have had this technique.

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Finally, I will continue with that video to show what I mean with the posterior reconstruction for the continence. Hopefully that continence video will show how the posterior layers are reconstructed back. Can I have the video please? So here what you are seeing is the prostate has been removed. The distal [unclear] fascia is being resutured back using one stitch, which is behind the urethra, not through the nerves, just through the superficial layers of the [unclear] fascia, which has been spared at the distal part. We continue suturing this thing backwards behind the trigone in the bladder. This one stitch will reinforce the posterior support of the urethra, will take care of the empty space, which is behind the bladder. Doesn't allow much of the clots or bleeding to occur in that area. This is the bladder neck. We will take a stitch behind through a layer of tissue. We go back, take one more bite through the structures which are already there. This is being done in real time and in actuality it doesn't take that much time, maybe a couple of minutes. This actually hastens the recovery of continence significantly, even in the single surgeon's hand, I have seen that this process has improved the results. Not only that it gives a better continence, we have noted that we are having less and less of the urinary leak. If there is some minimal oozing, that seems to be very well controlled

by this technique.

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So this is our total reconstruction. I don't have to show the anastomosis. I would rather move on with my talk. And as you can see, the next topic we have to look at: the cancer control. We started this operation just to get all the cancer out, and basically we have a referee pathologist looking at all of our slides. We even had a pathologist from an outside institution who looked at our slides. We looked at the PSA [unclear]. We also looked at how many patients needed some kind of [salvage] treatment. This is our overall results in terms of the cancer control. We consistently have less than nine percent chance of all comers having any positive margin. In our recent last 200-300 patients, that rate is about eight percent. The important thing is in posterior lateral margins, and I'll talk about it, we do have a lot of patients who actually a T3 cancer. In the posterior lateral area overall we have about two percent positive margin rate. It goes down in T2 cancers in less than two percent. So, that is the area where we release the cancer or nerves, and that is where we have to be very careful because this operation is all about division. So whatever the algorithms I talked about, seems to be working well, because we have very, very minimal posterior lateral positive rates. We recently had data from Medicare in which the data from open and minimally invasive were compared, and there were some concerns as to salvage treatment and the stricture rate. What we did was to get our Medicare patients and compare the results with this table, which was published in the *Journal of Clinical Oncology* this year. As you can see, we have one-tenth of these complications on the salvage treatment. You continue with this data and you will notice that very few patients require any kind of a salvage treatment in my hand. Before I conclude, I am now going to request my learned associate, Dr. Badani, who is not only going to talk about the prostate, but will highlight his very specialized technique of doing a partial nephrectomy, how he does the polyplasty, and also radical cystectomy, and he's a true expert and you will enjoy watching through his videos. Dr. Badani, please.

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KETAN K. BADANI, M.D.: Thank you, Dr. Tewari. That was a wonderful presentation. [coughs] So, what I'd like to do is talk about some of the advances in robotic surgery, what we're doing with robotic surgery in adult urology today. I'm going to talk about four procedures, radical prostatectomy, of course being the most common, but I'll just touch on that briefly since Dr. Tewari did such a superb job at explaining current techniques and current outcomes in radical prostatectomy. Then I'll talk about partial nephrectomy and kidney surgery, pyeloplasty for ureteral-pelvic junction obstruction, and finally radical cystectomy. I have video clips for all four of these procedures on patients that I've done in the recent couple months, just to show you the breadth of what we're doing with robotics. Here I'm listing the top cancers you see in men on the left side. As you can see, urologic cancer really plays a major role in male cancer health, prostate being number one, bladder cancer being number four, and kidney and renal pelvic cancer being number seven. So it really does top the list here in what we're dealing with as urologic oncologists. So first I want to talk briefly about -- I want to show you, so that the audience can see, the difference in nerve sparing techniques. Dr. Tewari did a great job talking about the zonal concept. On this patient, this particular video, I'm going to show all of his biopsies that were positive on the right side. So I do a traditional posterior lateral nerve sparing operation so as to not get too close to the cancer cells. On the left side, a lateral prostatic fascia sparing, or enhancer of sparing. So if we can run the video, this will be a good demonstration. Here's the right side of the prostate. This is the pedicle of the prostate being clipped. Then we transect the pedicle and we spare the posterior lateral portion of the prostate. This is what's traditionally been done for nerve sparing. You can see there's a small margin of tissue of safety because this is where the positive biopsies were on the right side of the prostate. Still, a good bundle spared. On the left side here, we're doing a much closer lateral prostatic fascia sparing where we're gently peeling off all of the lateral nerves that were seen on the histological slide Dr. Tewari showed earlier. Here, we're tolerating a little bit more blood loss because we want to be athermal in our technique and not damage the nerves, but

it's relative. We're just talking a very small, small amount. You can see all these nerves are being gently peeled away off the capsule of the prostate. Again, this is a patient selection criteria. This is a low risk patient and no positive biopsies on the left side. Now that all those nerves are peeled away, we're left with just the pedicle to clip. All the nerves have been gently swept away from the prostate and maximal preservation has occurred of these nerves. Then, a few more attachments that are easily, gently swept away or sharply divided. You can see there's very little vasculature when you're this close to the capsule of the prostate. So now, when the specimen is free and you can see the lateral surface of the prostate cleanly swept, here's the right neurovascular bundle, well-preserved in a traditional posterior lateral fashion. On the left side you see a much more robust neurovascular bundle with the lateral prostatic fascia intact and it goes all the way up to the lateral aspect of the urethra. So it's a visual difference between what you can do with the nerve sparing operation. It does translate to better outcomes and better sexual function after surgery. Importantly, you want to preserve this techniques for the right risk category of patients.

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So this is work I published with Dr. Menon of the Vattikuti Urology Institute and this is five-year follow up data on PSA recurrence, and you can see here if you see here if you select the right patients for the right type of nerve sparing operation, you have a very good and low PSA recurrence rate of 91 percent at five years, and of course it gets worse with the more aggressive cancers. But overall, compared to historical series, this is a very good outcome. It's the responsibility of the surgeon to properly counsel and select the patients that are candidates for this. We're going to move on to retroperitoneal and kidney surgery, which I think is a very exciting area of robotic surgery and minimally invasive technology in general. Briefly I'm going to talk about the second generation da Vinci S system because I think this aides us in the way we're approaching the kidney minimally invasively. One, it has smaller arms and what that allows is a great range of motion and it minimizes collisions on the outside of the body, as you can see. The arms, there's three instrument arms and a camera arm and you really want to maximize your port placement so that you have the greatest range of motion possible. There are some other advancements, including improved vision. As we go along, I'll show that to you. Using these concepts, published a manuscript this year showing the optimal port placement that's allowed us to do over 50 renal and adrenal procedures that have ranged from partial nephrectomy, radical nephrectomy, pyeloplasty, adrenalectomy, and even nephroureterectomy, where you go all the way down to the bladder to remove the entire ureter, all with a single port placement without needing to convert any of these patients to an open or standard laparoscopic operation. One last very interesting feature of the da Vinci S system is called TilePro, and what it is is essentially a picture in picture that you would have on your television if you were watching two sports at the same time. Here is the actual console view of the operation. You see a box on the top with the kidney and you see an ultrasound image on the bottom, and this is an auxiliary input and for kidney we like to use ultrasound because it helps us map the operation. Here you see both views at the same time, or you can alternate views. I'd like to run this video just so you get a real-time appreciation of what this does. So here the assistant is doing an ultrasound and at the same time, with the real-live image, it's translated below with the ultrasound image, so you can gauge how deep the tumor may be or at what margin you want to excise the tumor because you're trying to excise the cancerous part, but of course save as much of the healthy kidney as possible.

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So, I'm going to talk and show you a brief video clip on robotic partial nephrectomy, which I think is the most important application for kidney cancer, because of the complex reconstruction that's required of partial nephrectomy. Once you cut out the tumor, you have to reconstruct the kidney for fear of bleeding or urine leak and you want that kidney to be healthy and remain in the patient's body for the rest of his or her life. So, this is where the power of the robot is, it's in the reconstruction. So on the left, this is just an example of how the patient is positioned and the robot is in place. On the right is a CT scan. We see the circle in the right

kidney that is a small, enhancing renal mass that would typical for a partial nephrectomy. I'm going to show two videos back to back and they both demonstrate the same concept, and that's the reconstructive power of the robot. The first video is the robotic partial nephrectomy and then I'm going to show you the pyeloplasty, which again highlights the same reconstructive power. So why don't we run the same reconstructive power. So why don't we run the robotic partial nephrectomy video first. So here I'm incising along the white line atoll to reflect the colon. This is transperitoneal going into the retroperitoneum. You want to find that plane, just like you would laparoscopically on Gerota's fascia, which you can see here. This is the gonadal vein. These are all the same concepts that you would follow in traditional laparoscopy. You can see the instruments are moving freely. Here I've found the ureter and I'm holding the gonadal vein and I'm pushing it down. Since this is the right side of the patient, we don't need to sacrifice the gonadal vein, and I'm just pushing it out of the way very gently and following the ureter to the renal hilum. The ureter is above on the screen. It's what I'm pushing on right there. This should lead us to the renal hilum, the main renal artery and vein. It's very easy movements. There's no clunky movements and the magnification is superb. Really close to the tissue so you can do a very delicate dissection. So here we're coming onto a renal artery. This happens to be an accessory renal artery, but nonetheless, it's something that you don't want to damage. You want to preserve it as much as possible, because it may feed a very important part of the kidney that you're not excising. This particular tumor is an upper pole tumor, so it's even more important that we preserve this lower pole artery. But the demonstration here is the precision and accuracy at which this is being done. I'm using the hook monopolar cautery, because one there is small vaso vasorum, or small arteries that surround the main artery that you don't want to bleed and obscure your vision. This is an operation based mainly on vision and so it's a very important aspect and the hook is a very good instrument to do blood dissection and keep your field dry so you can see. You can appreciate here is a renal artery being dissected and skeletonized very cleanly and delicately and without any issues of compromise of control.

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So now I'm going to follow these tissues in this plane down to find the main renal vein, which again, should be approaching us. I'm dissecting millimeter by millimeter. You don't want to cause damage to these structures; these are vital structures to the kidney. You can see it's as controlled as is possible, and probably even more possible than open surgery. This is a very magnified image, so even these small movements are being grossly exaggerated because of magnification. Even these little tiny drops of blood you see are exaggerated because of the magnification. Here we're approaching the renal vein and the renal vein is actually a very delicate structure and it's easy to tear it. You can see how -- what looks like manipulating the tissues and really just gently teasing off these tissues from the renal vein so we can cleanly put a clasper on it. Ultimately you want to occlude the blood supply to the kidney before you excise the tumor, for fear of bleeding and you want to have again, complete control over the operation. You can potentially lose control if you don't do this step. So cleanly coming around the renal vein so that I have a good idea of where it is and I can put a nice clamp on it. Here is the TilePro image. This is exactly what I would see as I'm operating. Both top and bottom, to assess the size, depth, and location of this tumor, and of course look for any satellite small tumors that may exist that aren't as easily visible. So, based on the ultrasound guidance, I'm scoring out the tumor on the kidney, keeping a margin of healthy tissue, because of course I don't want to leave a positive margin of cancer. So I'm taking a healthy margin of tissue and I'm just scoring circumferentially 360 degrees around this tumor. This is an upper pole tumor. These are hard angles to get. Even in open surgery, these are hard angles to reach. Here I'm taking a wider margin than I ordinarily would and there is a little cyst, a little hole that's leading to a cyst. So instead of risking it, I course correct and take a slightly wider margin of tissue, very easy to course correct. You can appreciate how much my wrist is bending to make that tough curve right there. Very hard to do with traditional laparoscopic instruments. Here you have all seven degrees of freedom and the technical aspects of this operation are essentially

eliminated. It's really all in the setup and that's why the focus of this work was in how to set this up. Now I'm excising the tumor and again you can use hot excision, cold excision, a combination of both, whatever is the surgeon preference. I'm excising a margin of tissue to see if there's any cancer left. I'll have the pathologists look at this tissue and tell me if any more needs to be taken. This happened to be normal kidney. Then, here's the beauty of the instrument, the reconstruction. I'm placing sutures in a very difficult location, exactly where I want to place them, just like I would in open surgery. This is a Surgicel bolster, something to just fill the space where the tumor used to be. Just like I would do an open surgery, I'm taking the needle, placing it where I want, taking a small piece of the bolster. Look at just a little couple fibers of that without any problem. I've got all the dexterity I want with this system. Then take my bite on the other side of the kidney, again up high and closing that corner of the kidney just the way I want it. This would be an extremely technically difficult maneuver to do with standard laparoscopy, and even in open surgery it's difficult. You don't see it as well as you see it here.

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Then I'm tying the suture down. You can tie the suture or clip it or use Weck clips, Hem-o-lok clips, whatever your preference. I like tying because I think it's efficient and I tie faster than I can clip it. Again, you have to keep in mind that the kidney is clamped. There is no blood supply to the kidney, or it's very minimal right now. So you want to minimize the damage to the kidney by minimizing the time that it's on clamp. This is warm ischemia time. So you want to be efficient in your moves and that's what we're able to do with the robot. We're very efficient in the way we're taking the stitches, but we're not compromising how we're taking the stitches. We're taking exactly what we want to reconstruct this kidney so it will last the rest of this patient's life and continue to work, for fear that perhaps something else may happen to the other kidney and then this person will rely on this kidney alone. So here's an example of putting a Hem-o-lock clip on the suture to hold it in place, just to show you another example. Completing the reconstruction. This is a hemostatic agent to aide as a second line agent for hemostasis. So why don't we roll straight into the pyeloplasty video because this will demonstrate the reconstructive capability even further of the robotic system. This is an 18-year old boy that I operated on recently who had a ureteropelvic junction obstruction. He was riding an ATV, had an accident, had a CT scan, and this was found. So what you see is you see the renal pelvis on the left and the ureter on the right. You see the junction right there, right where the hook is, and that structure to the left is a crossing vessel. That is an artery and vein that's accessory to the main renal artery and vein that's causing this young boy's obstruction. So, obviously you don't want to damage that artery because again, it may be feeding an important part of the kidney. So we're gently dissecting the artery and vein away from the kidney to expose the ureteropelvic junction, which you see right there. That blue line is a very interesting technique that the new da Vinci S system has. It's called a telestrator. I'll show you a little bit more of that in a second, but what you can do is you can actually write, just like John Madden would write on Monday Night Football, you can write on the screen that the consult surgeon is watching. So if you're another surgeon in the room, or a consultant, you can actually use the touch screen and the consult surgeon will see exactly what you're doing in his or her view of the operation. So here we have the ureter that's been cut open, but I'm actually going to rewind back to before this was incised, to demonstrate the dexterity that you can cut with and the precision you can cut with with this needle driver. So here is the scissors cutting the ureteropelvic junction where the obstruction was, because we want to cut this apart, dismember it completely, so that we can bring it around that artery so the artery doesn't cause an obstruction again. I don't want to cauterize these edges because I want them to stay healthy. We want this to heal without stricture. This is a young boy. This has to be a durable operation for him. I placed a stent before we started this part of the procedure. So there, I cut down to the stent and now I change directions and cut exactly the way I want to cut, with the angle I want to cut at, which is the power of this system. You have all seven degrees of freedom. Now I want to cut downward, so I just flick my wrist and I can cut exactly where I

want to cut. Even a little bit off to the side where I think it's a more important incision to make there.

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So here's a very difficult corner. I'm trying to suture this corner of what I incise. I'm using my right hand, I'm a right-handed surgeon, and I place my stitch in that corner because that's the best way it goes. Now I flip to my left hand and I take the back stitch in this direction because again it is the best way to close this corner. I'm not taking a stitch based on what's easy for me. I'm taking a stitch that's right and I'm using both my right and my left hand. I can't do that with a pen. I can't write with my right or left hand, but I can sew with da Vinci with my right or left hand. That's truly amazing, and the angles you can take. Again, take the first stitch with my right hand, and then I want to turn the corner, I take my left hand. I have my assistant expose it for me. You can see how difficult this corner could be and I take my stitch left-handed, exactly where I want it. Then, just continuing on with the closure of the renal pelvis. We had to excise some of the excess renal pelvis, which happens after a prolonged obstruction. You get dilation and excess size of the renal pelvis, so we do a reduction plasty. That's what we're doing here and just closing this up. Again, very efficiently and quickly so as to minimize time. My assistant is exposing for me and this is the last stitch. Again, I'm tying it. I like tying because the robot lets me tie very efficiently. But again, you can use clips or whatever your preference is. So, the last procedure I want to talk about is robotic cystectomy or cystoprostatectomy on this slide. This slide represents a series of six consecutive patients I've done in the last couple months. The point I want to make here is, if you look at this carefully, these are very complex and challenging operations and the reason why I've been able to do this successfully is because we translate the radical prostatectomy experience operating on the pelvis and we're able to extend it to difficult pelvic operations like cystoprostatectomy. This first patient, for example, 55-year old who has a 12-centimeter posterior diverticulum filled with tumor. That's about the same size as his actual bladder. This is a technically very difficult operation, but despite that, he only lost 500 cc's for his entire operation. Even more notable is the next patient, who's an 83-year old gentleman who actually had so many other comorbidities, including severe heart disease, that he was rejected from open cystectomy, which he truly needed because he was too sick to have this operation. So he underwent radiation and chemotherapy. Unfortunately it recurred with muscle-invasive bladder cancer, so I did a cystectomy on him after radiation and he had 125 cc's of blood loss. He tolerated it just fine even though he was rejected and he was probably even more sick when I did his operation than when he initially presented. That is minimally invasive surgery. It is less trauma to the body, less physiological stress, so that older and sicker patients, which actually do compromise the majority of radical cystectomy patients can tolerate this operation. You can see the rest of these procedures, a patient who had neoadjuvant chemotherapy, another posterior diverticulum, another person who had external beam radiation therapy. So we're doing very complex surgery.

00:43:20

I'll show you a small clip of a ureteral dissection, which is the last video clip I have during a radical cystectomy. You can see the dexterity with which you can dissect the ureter. So here's the right pelvic side wall and you can start to see the impression of the ureter right there. We're going to follow that down to the bladder, because after the bladder's out, you have to create a new bladder and you want to maximize the length of ureter available to create the new bladder. So I've dissected this down all the way to where it almost enters into the bladder, place a clip there to maximally preserve how much ureter is left, and you can see I have a rim of healthy tissue around the ureter itself. The ureter is not exposed because you want to keep that healthy vaso vasorum intact so the ureter has its own blood supply. Then we continue on with the pedicle. Here I'm individually dissecting out the arteries and veins that go to the bladder, which ordinarily you just never see, you just take these and block. But here I'm individually dissecting them out. This is a LigaSure device, but again you can clip, cauterize, cut, depending on how much nerve preservation you want to do during radical cystectomy.

Here again, cutting the distal-most part of the ureter, right where it almost inserts into the bladder. Here his tumor is on the left side, so I left a little margin of tumor -- I'm sorry, a little margin of ureter so as to not get too close. So with that, I'd like to wrap up my Power Point presentation and I'd like to open the floor up to any questions or thoughts that, Dr. Tewari, you may have.

00:44:52

ASHUTOSH K. TEWARI, M.D.: I think this was an amazing presentation and it gave a wide variety of procedures which you have been doing and I think it opens up the entire field of robotic surgery as to what other procedures could be done. But before I come to my thoughts, I have a specific question for you from the audience. That question reads, "Dr. Badani, do you suture down the bolster into the resection fascia, as a first hemostatic maneuver, no sutures placed directly into the fascia for the bleeding vessels?" Someone I think does this procedure and has a question about how exactly we control the bleeders. Before I ask Dr. Badani, I will say that this was a small clip and he has shown the highlights of this entire procedure, but if there is a major bleeder, he will suture it with the small [unclear] before he comes to the bolster, but I'll leave Dr. Badani to expand on this concept.

00:45:50

KETAN K. BADANI, M.D.: Right, that's a savvy question and I didn't show the complete video, but certainly one of the best things about the robotic system is, just like in open surgery, if you have individual bleeders, you can throw a figure of eight suture, a small 3-0 or a 4-0 suture, do a figure of eight, just to suture that bleeder down. Same thing with the collecting system. You can individually close holes in the collecting system if you put a ureteral catheter ahead of time, you can visualize those holes or you can see them with the magnification and vision the robot allows. So you can do two or three layer reconstructions of the renal defect and still minimize your warm ischemia time.

00:46:27

ASHUTOSH K. TEWARI, M.D.: Especially since we are trying to run for warm ischemia time and for wanting to bring it down, one of the aspects is in bleeding. The small veins can bleed in that field. But for the robot and for that laparoscopy, the pneumoperitoneum is not only giving us a magnification, it's giving us a relatively dry field. So you can focus on an artery and very specifically go and suture control or any which way you want to do. That was an elegant presentation. We really learned and everyone learned a lot. I think there's one question and I think it's someone who is learning about prostate cancer and the questions says, "I was told that the tactile sensation was critical during a prostatectomy in order to detect firmness in the nerves and the surrounding tissue. How can you do that if you are using a robot?" I think this is one question we have heard so many times. I'll try to give my perspective. If you saw the dimensions and the delicateness of the nerves, you will appreciate the fingers with the two gloves on cannot detect with certainty that the nerve has got a cancer cell wrapping around. That literally is a microscopic phenomenon. Changes in the texture could happen not just because it's cancerous, but it could happen because of inflammation, could happen because of fibrosis, and if I have to excise everything which appears a little abnormal, I'll be excising lot many nerves when they're not involved with the cancer. You saw that we could see the planes relatively much more cleaner. If there is a doubtful area, we take a piece of that as a frozen section biopsy, put it under the microscope, wait for that 20 minutes and then decide whether or not that nerve can, should, or must be saved. Then of course, when we take the prostate out, we examine the are exactly where the cancer was and we can feel that. That is how we decide as to how nerve sparing should be done in an intensely visual platform. I don't feel any compromise in terms of whether or not I can save the nerves and that's the reason I showed those data about the posterior lateral margin. That [unclear] lateral margins are pretty comparable if you look at from the other published series standpoint. What do you think is your perspective?

00:49:24

KETAN K. BADANI, M.D.: I think that was very elegantly stated. We have to keep in mind that

the patient is there for cancer. We're there to cure them and we don't want to compromise their cancer control to spare their nerves, but in open surgery, as you know, and you did for many years, you rely a lot on tactile sensation to do the operation. You can't see very well doing open radical prostatectomy. Well, here you're trading tactile sensation for improved vision. I think you're overcompensating with improved vision. You actually are seeing better and you're doing things that were just not imaginable before. So yes, you've lost tactile sensation, but you've gotten even better with the vision you're seeing and we're all doing a better operation because of it.

00:50:05

ASHUTOSH K. TEWARI, M.D.: Thanks. I think that should clarify a lot of these questions, which prospective patients have in their mind. There is another questions which I think is more philosophical. "How far is the difference in damaging neurovascular bundles with the da Vinci operation in normal bilateral nerve-sparing prostatectomy?" I think I get asked this question very often. My response is I don't think it's because of a particular instrument. It's lot dependent on the surgeon and the technique. I know so many great open surgeons who can preserve the nerves without needing a da Vinci and da Vinci just simply gives me an asset. But I need to know the technique and the steps of this operation. So I'm not going into comparisons because there has been no randomized studies comparing the outcomes. I think surgeon is the most important variable in this entire equation about nerve-sparing cancer control and the continence preservation.

00:51:17

KETAN K. BADANI, M.D.: I have a few questions here as well, so maybe we can address a few of these. One question is, "How long is the typical recovery time for a prostatectomy procedure and using a robotic approach, would that improve the outcome?" So, maybe I'll just briefly mention and then I'll have you mention that I think that in our series, 96 percent of men go home the next day ambulatory, but I'd say that recovery time depends on what your end point is. I think if your end point is returning to normal activities, that certainly happens within a month's time period after this operation. In some men it's two weeks, some men it's three weeks, but most men are back to work, even labor jobs, by the end of a month. More importantly, since the blood loss is so low, that aides in their recovery. Their energy is better and they're ambulatory and feeling better overall.

00:52:17

ASHUTOSH K. TEWARI, M.D.: I think, Dr. Badani did summarize this end point very well. I would just say that this is a very soft end point. You don't get this operation done so that you can get back within two weeks or three weeks. You get it because you want to get a cancer control. We want to get the urinary function back as soon as it's possible and we want to save as many nerve fibers as we can. Yes, because of less bleeding and smaller incisions, patients do bounce back to normal activities sooner, but that's a soft end point and we should focus on important things.

00:52:54

KETAN K. BADANI, M.D.: Next question, and actually it's a very good question. I'd like to hear your opinion and your philosophy as it may or may not be the same as mine. "What are your opinions on the role of penile rehabilitation in the post-radical prostatectomy patient?"

00:53:08

ASHUTOSH K. TEWARI, M.D.: I think it's very important. I start patients on a very aggressive penile rehab, starting with an [unclear] medications the day after surgery.

00:53:19

KETAN K. BADANI, M.D.: The day after?

00:53:20

ASHUTOSH K. TEWARI, M.D.: The day after surgery and if they are not showing some promising response in a couple of weeks, I start involving other means of treatment, such as intracavernosal injections, or intraurethral devices, and I basically believe that these patients need to be on sexual rehab for an extended period of time if they want to maximize their own

chance of getting the sexual function back. I think it's good for the oxygenation of the tissue. When nerves wake up, they are dealing with a much more healthier supple and vascularized cavernous tissue and it helps.

00:54:00

KETAN K. BADANI, M.D.: Yeah, I agree with you. I think the technical part of the operation, the actual nerve sparing, is only half the story. I think the other half of the story is the recovery. You know as much as any of us that if you do the same nerve-sparing operation in three different people, they still have variable results because there is other factors involved. Their anatomy may be different or their recovery is different. So I think when you start PD-5, and I usually start two weeks after surgery, you get an active blood flow to the penis that improves oxygenation, but I also use a vacuum erection device, and I think that gives the other element, which is the passive blood flow. So you have an active blood flow in the evening and in the morning you do a passive blood flow and you continually stretch the erection chambers so that they don't contract and collapse as you don't use them. So I'm a very firm believer in doing this for my patients, at least the patients that are motivated to do it.

00:54:55

ASHUTOSH K. TEWARI, M.D.: I think we must continue being very aggressive in the penile rehab. It makes a difference.

00:55:04

KETAN K. BADANI, M.D.: Let's see. I have, "What kind of research is New York-Presbyterian currently conducting to improve outcomes, specifically potency?"

00:55:14

ASHUTOSH K. TEWARI, M.D.: Research is on several fronts. One of them is we are trying to identify nerves which are important for sexual function. Secondly, we are trying to improve our imaging capabilities intraoperative and we are collecting the orgasmic functional data and that's a very important sexual end point. Then finally, we are looking at the long-term return of sexual function in relation to these sexual or penile rehab programs. We have a group of about 15-20 researchers who are very actively involved in this basic, animal, and clinical outcomes research.

00:55:56

KETAN K. BADANI, M.D.: Yeah, this is a huge area of research and we have a group of basic scientists at our institution and we're trying to develop fluorescent markers for prostate cancer. I think if you have markers for the nerves and you have markers for prostate cancer, it makes the job of balancing nerve control and cancer control very easy. Right now, we're doing it based on preoperative risk factors, but if we were able to reliably fluoresce cancer cells, then we know who gets a zone one nerve-sparing versus a zone two, versus a zone three. I think this is where the future lies.

00:56:31

ASHUTOSH K. TEWARI, M.D.: Absolutely. A lot of exciting things are happening here at this institution.

00:56:35

KETAN K. BADANI, M.D.: So, I think we're running short on time now but I'd like to thank you for your presentation. That was a very, very nice job.

00:56:44

ASHUTOSH K. TEWARI, M.D.: So, let me at this point try to conclude this session and I will start with thanking the audience for staying with us and listening to our presentations at this odd hour in the evening and we are all very hungry and ready to go home. I want to thank the leadership of New York-Presbyterian Hospital, both at the Columbia and Cornell campus for putting together this exciting program which showcases the exciting work which is being done across two campuses. I also want to thank the two literally giants in the field who have helped us in kind of developing these robotic procedures. One of them is Manny Menon at Henry Ford, which Dr. Badani and I both combine our gratitude and also giants such as Dr. Patrick Walsh who helped in devising the nerve sparing overall. So without any further ado, I'm going to

thank Dr. Badani, the rest of the webcast team, my research team, for putting it all together.
Thank you very much and good night.

00:58:01

KETAN K. BADANI, M.D.: Thank you. Good night.

00:58:05

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