

Surgery Illustrated – Surgical Atlas

Robotically assisted laparoscopic pyeloplasty

**Declan Murphy, Ben Challacombe, Oussama Elhage,
Mohammad Shamim Khan and Prokar Dasgupta**

Department of Urology, Guy's & St Thomas' NHS Foundation, London, UK

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KEYWORDS

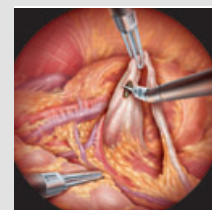
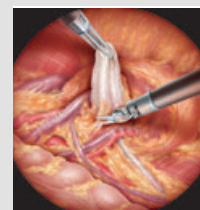
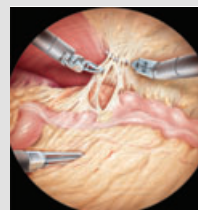
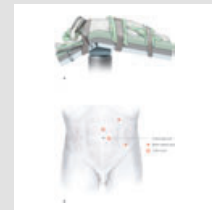
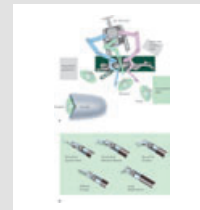
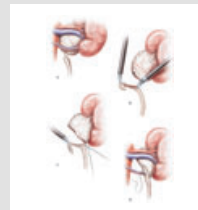
robotic, da Vinci, laparoscopy, pyeloplasty, technique

INTRODUCTION

Although several endourological, open and laparoscopic procedures have been used to manage PUJ obstruction, there remains little doubt that dismembered (Anderson-Hynes) pyeloplasty remains the preferred option in most cases (Fig. 1). It is also clear that this procedure is very well suited to the laparoscopic approach, whether by the transperitoneal or retroperitoneal route.

However, dismembered pyeloplasty via the laparoscopic approach remains a challenging procedure to those without considerable laparoscopic experience. Intracorporeal suturing skills are required to complete the reconstruction of the PUJ after resection of the adynamic ureteric segment and reduction of the distended renal pelvis. Even in large series from experienced centres, the operative duration has remained long, usually due to prolonged anastomotic times. Although there is no level I or II evidence to justify the superiority of the laparoscopic over the open approach, it appears likely that the benefits to patients of the minimally invasive approach are substantial, and that this approach is preferred where available.

The arrival of robotic technology to assist in complex laparoscopic procedures has been noteworthy. Although the da Vinci® surgical system (Intuitive Surgical Inc., CA, USA) has received most acclaim for its penetration into the radical prostatectomy market, many of its technological attributes are well suited to laparoscopic dismembered pyeloplasty. In



particular, the improved depth perception with three-dimensional vision, and increased degrees of freedom using EndoWrist® technology, appear likely to reduce the difficulty associated with certain steps of laparoscopic dismembered pyeloplasty. Several series of robotically assisted laparoscopic pyeloplasty (RALP) have been published, most of which replicate the conventional laparoscopic technique. There are no randomized controlled trials to test whether robotic assistance offers any meaningful advantages over the conventional laparoscopic approach.

In this report we outline our technique for RALP; for the purposes of illustration, a left-sided PUJ obstruction is depicted throughout, and the technical description is based on a three-arm da Vinci surgical system.

PLANNING AND PREPARATION

The indications for RALP are the same as those for laparoscopic or open pyeloplasty. Therefore, all patients with symptomatic PUJ obstruction, or with decreasing renal function in the presence of PUJ obstruction, can be considered for RALP. Patients in whom primary treatment for PUJ obstruction has failed might also be considered for RALP. There are no contraindications specific to the robotic approach.

The preparation before surgery includes a discussion about other treatment options, and the advantages and disadvantages of the robotically assisted approach. Patients are invited to view a generic video outlining this approach. A diuretic MAG3 renogram is

obtained in all patients before surgery. CT is optional but is useful for identifying the presence of calculi and crossing vessels to the lower pole. A full blood count, serum electrolytes, and mid-stream urine sample are obtained in all patients. Those with cardiac or respiratory risk factors also undergo chest radiography and an electrocardiogram. Anticoagulants are discontinued 5 days before surgery. Antibiotic prophylaxis using i.v. gentamicin (1.5 mg/kg) is administered at induction. Pneumatic compression stockings are placed on the legs to prevent deep vein thrombosis.

OPERATING THEATRE SET-UP

Depending on which kidney is to be operated on, careful thought must be given to the theatre set-up to accommodate the robotic cart. The anaesthetic equipment must be moved to the contralateral side of the patient's head, and other support equipment might need to be distributed around the operating theatre. The typical theatre layout for left-sided RALP is shown in Fig. 2a.

INSTRUMENTATION

Two 8-mm robotic ports are used for the left and right robotic arms. Two disposable 12-mm ports are used for the robotic telescope and assistant, respectively. The patient-side surgeon uses the following laparoscopic instruments:

- Maryland grasper;
- Laparoscopic needle holder;
- Laparoscopic scissors;
- Suction/irrigation system.

The following 8-mm EndoWrist® instruments are used on the robot (Fig. 2b):

- Maryland bipolar forceps;
- Monopolar cautery hook;
- Round-tip scissors;
- Large needle holders (two)

A De Bakey grasper is optional. It is particularly useful for mobilizing the renal pelvis in the presence of crossing vessels.

PATIENT POSITIONING

Once general anaesthesia has been established, the patient is placed in the lithotomy position and draped for cystoscopy. A retrograde pyelogram is taken to document the PUJ obstruction, and a 4.8 F JJ ureteric stent is positioned under fluoroscopic control. A 16 F urethral catheter is placed in the bladder.

The patient is then moved to a 60° lateral decubitus position with the affected side facing superiorly. All pressure points are carefully padded. The lowermost arm is placed on an arm-board with the elbow flexed to a comfortable position. The uppermost arm is placed in a gutter-type rest. The lowermost leg is flexed at the knee and the uppermost leg is straightened. One or two pillows are placed between the legs. The table is then flexed with the break positioned between the patient's iliac crest and costal margin. A kidney rest is not routinely used. Having ensured that all pressure points remain adequately protected, the patient is secured to the operating table using strong elastic tape (Fig. 3a).

Figure 1

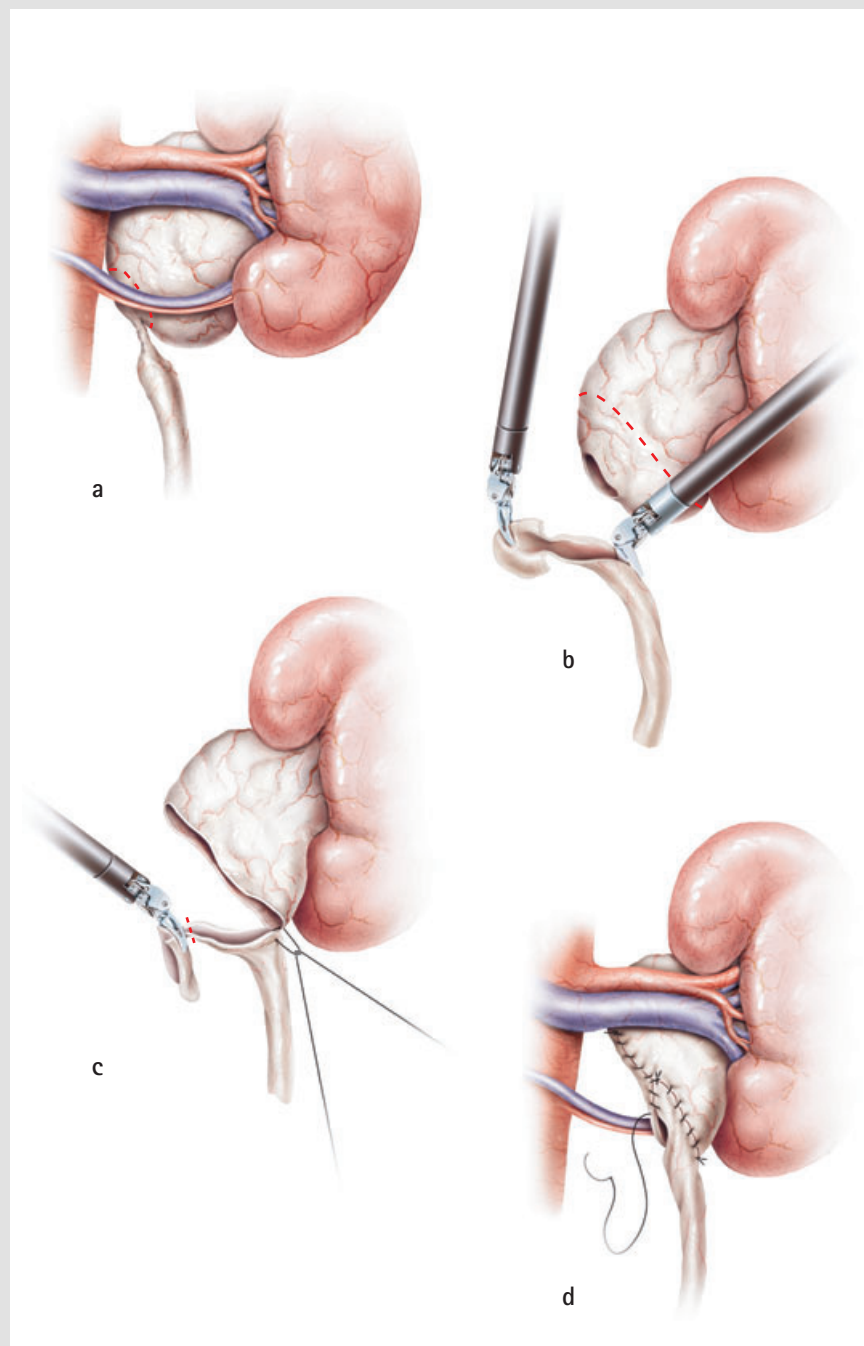
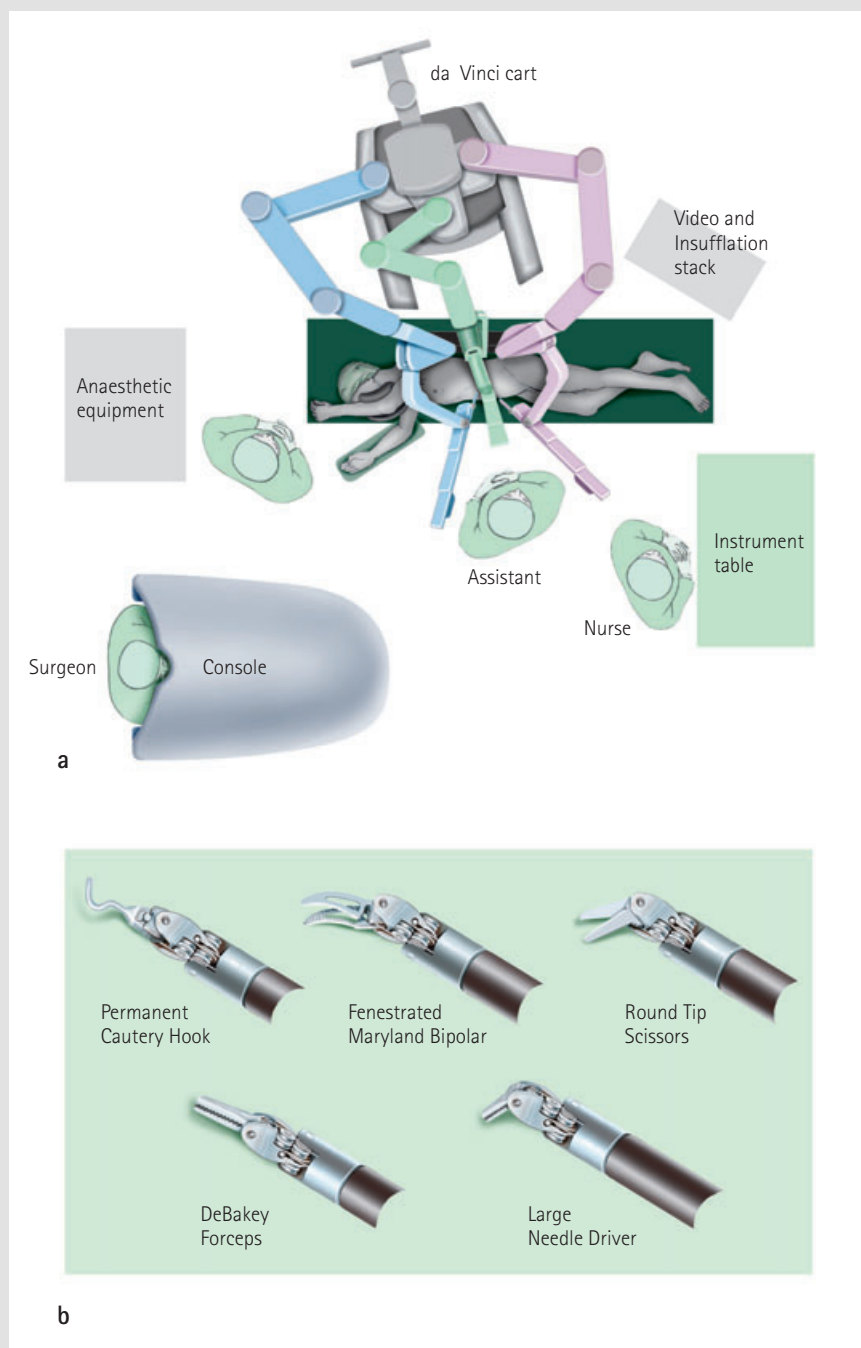


Figure 2

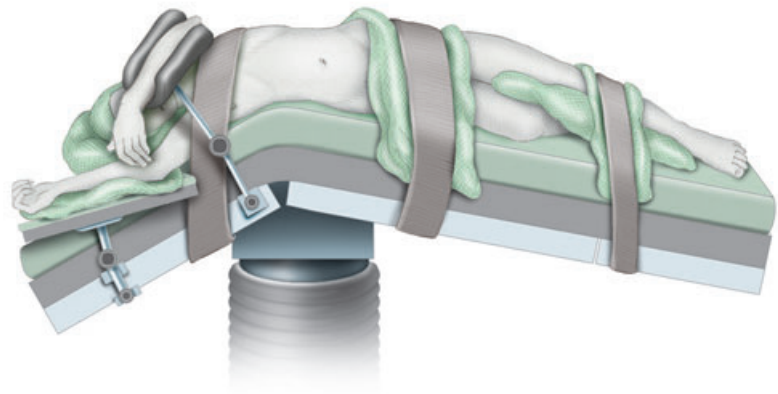


SURGICAL TECHNIQUE

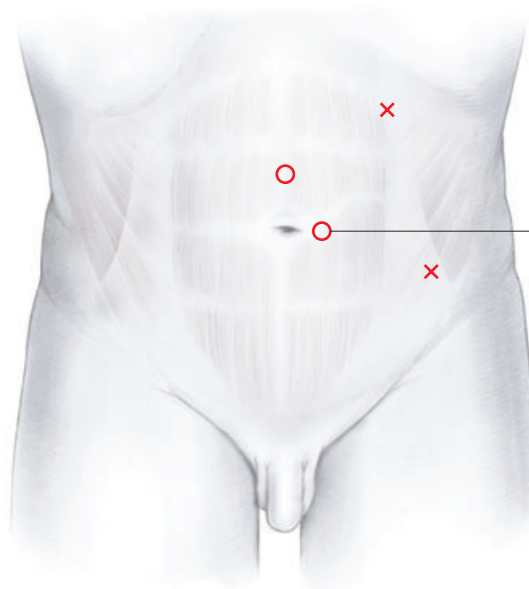
STEP 1

Figure 3

Fig. 3b: A four-port transperitoneal approach is used. Pneumoperitoneum is established using a para-umbilical Hasson technique. Intra-abdominal pressure is maintained at 14 mmHg throughout the surgery. A 12-mm port is used for the da Vinci telescope; in more obese patients this port is positioned at the lateral border of the rectus muscle. Two further 8-mm da Vinci ports are placed under laparoscopic control, triangulating with the camera port. Each port must be ≥ 8 cm from the camera port and 3 cm from the iliac crest and costal margin, respectively. A 12-mm assistant port is placed in the upper midline, allowing the passage of sutures and laparoscopic instruments for the patient-side surgeon.



a



b

Endoscope port

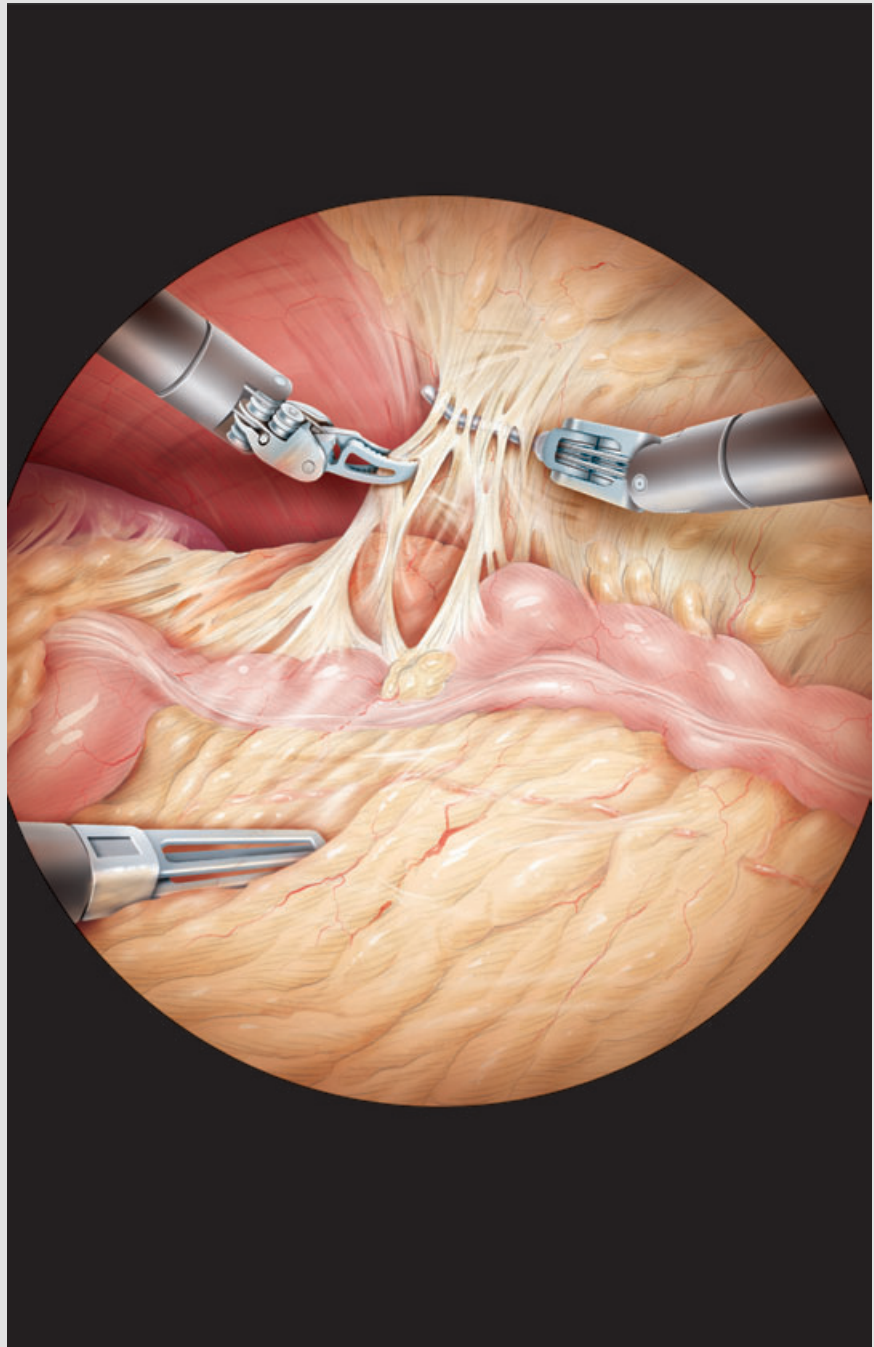
× 8mm robotic port

○ 12mm port

STEP 2

Figure 4

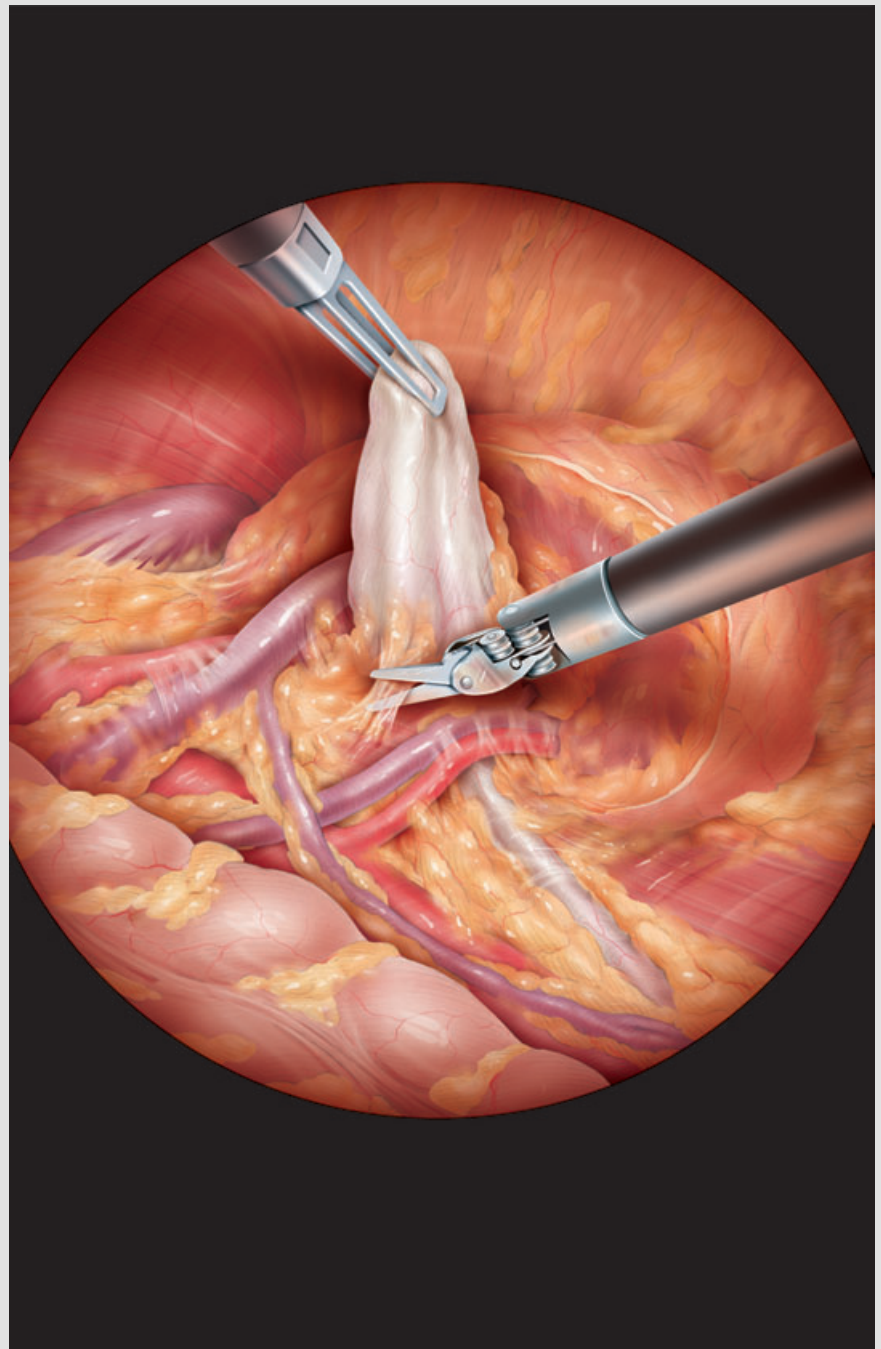
The colon is mobilized using the EndoWrist monopolar cautery hook on the right arm and the Maryland bipolar forceps on the left. The assistant provides medial counter-traction on the colon using a Johannes grasper.



STEP 3

Figure 5

The ureter and lower pole of the kidney are identified. The ureter can usually be found by tracing the psoas medially from the lower pole of the kidney. Any crossing vessels are identified and preserved. The PUJ is fully mobilized using a combination of blunt and sharp dissection. In the presence of crossing vessels, we find the DeBakey grasper particularly helpful to mobilize the PUJ from behind the vessels. Its fine tip allows tremendous precision during this step. The decompressed renal pelvis is also fully mobilized at this stage.

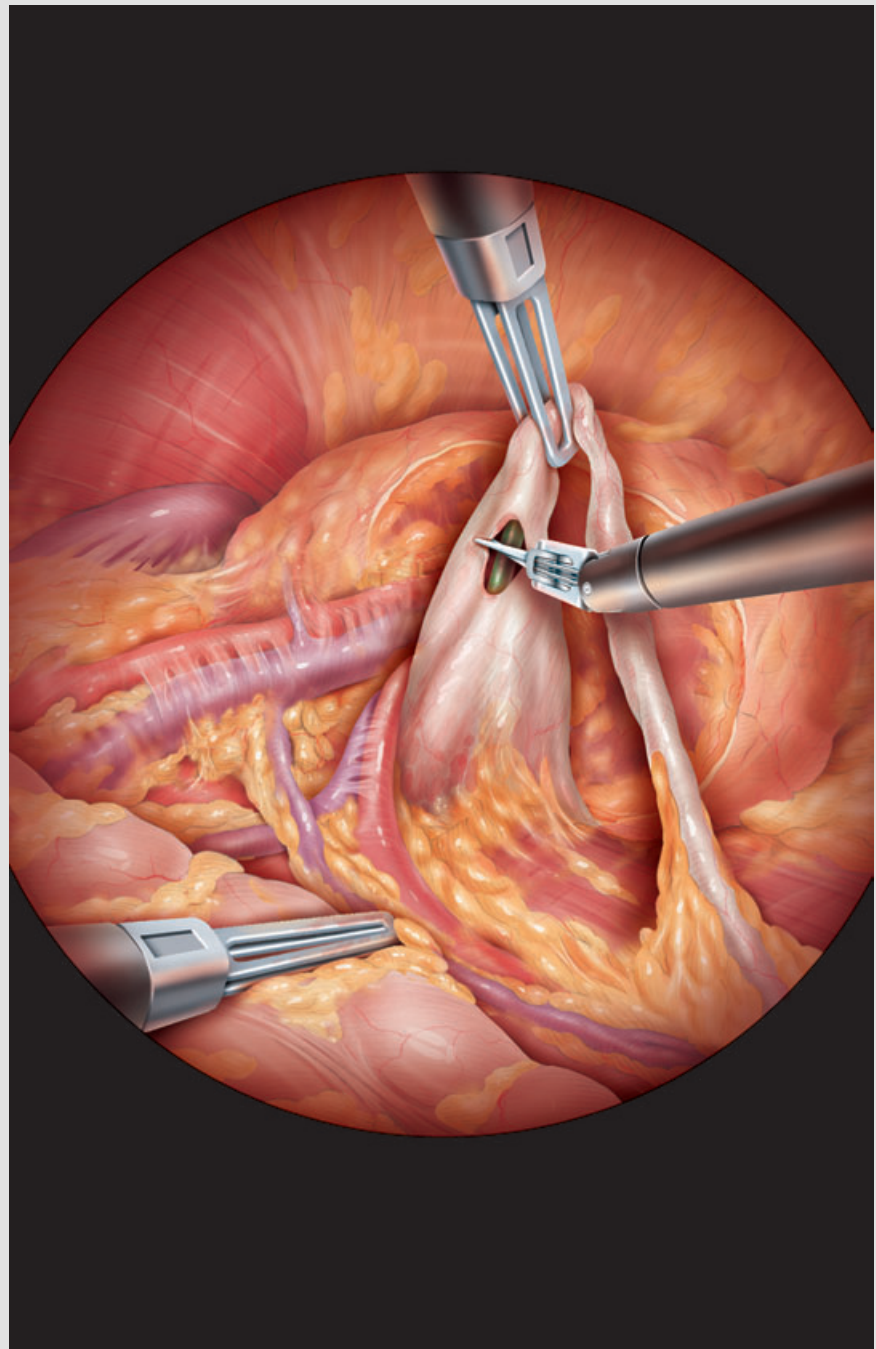


STEP 4

Figures 6 and 7

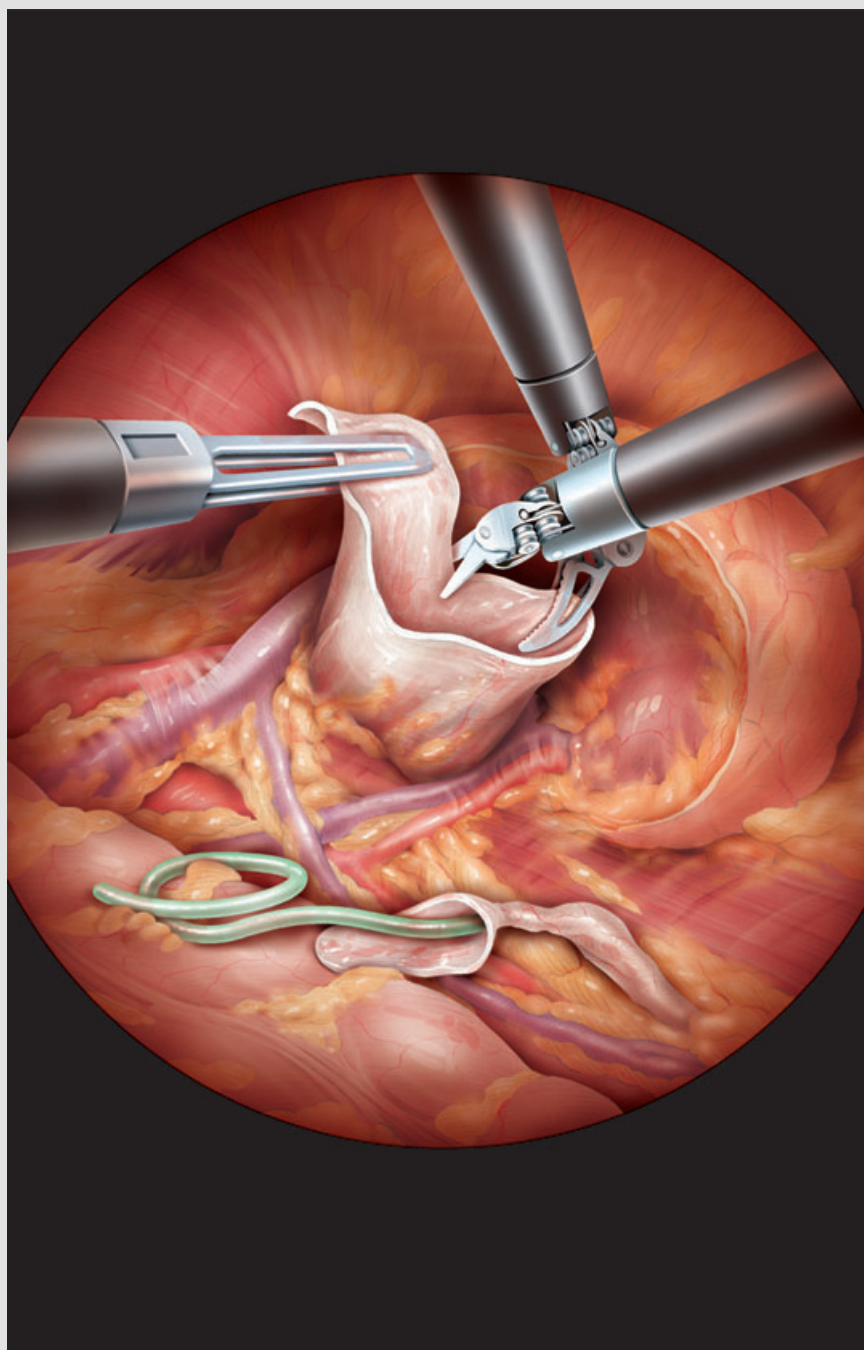
The ureter is now divided above the PUJ using the round-tip scissors. Care is taken not to cut the indwelling JJ stent.

Redundant renal pelvis is reduced by excising the excess tissue on the medial aspect of the decompressed renal pelvis. Any stones within the collecting system can also be removed at this time.



MURPHY *ET AL.*

Figure 7

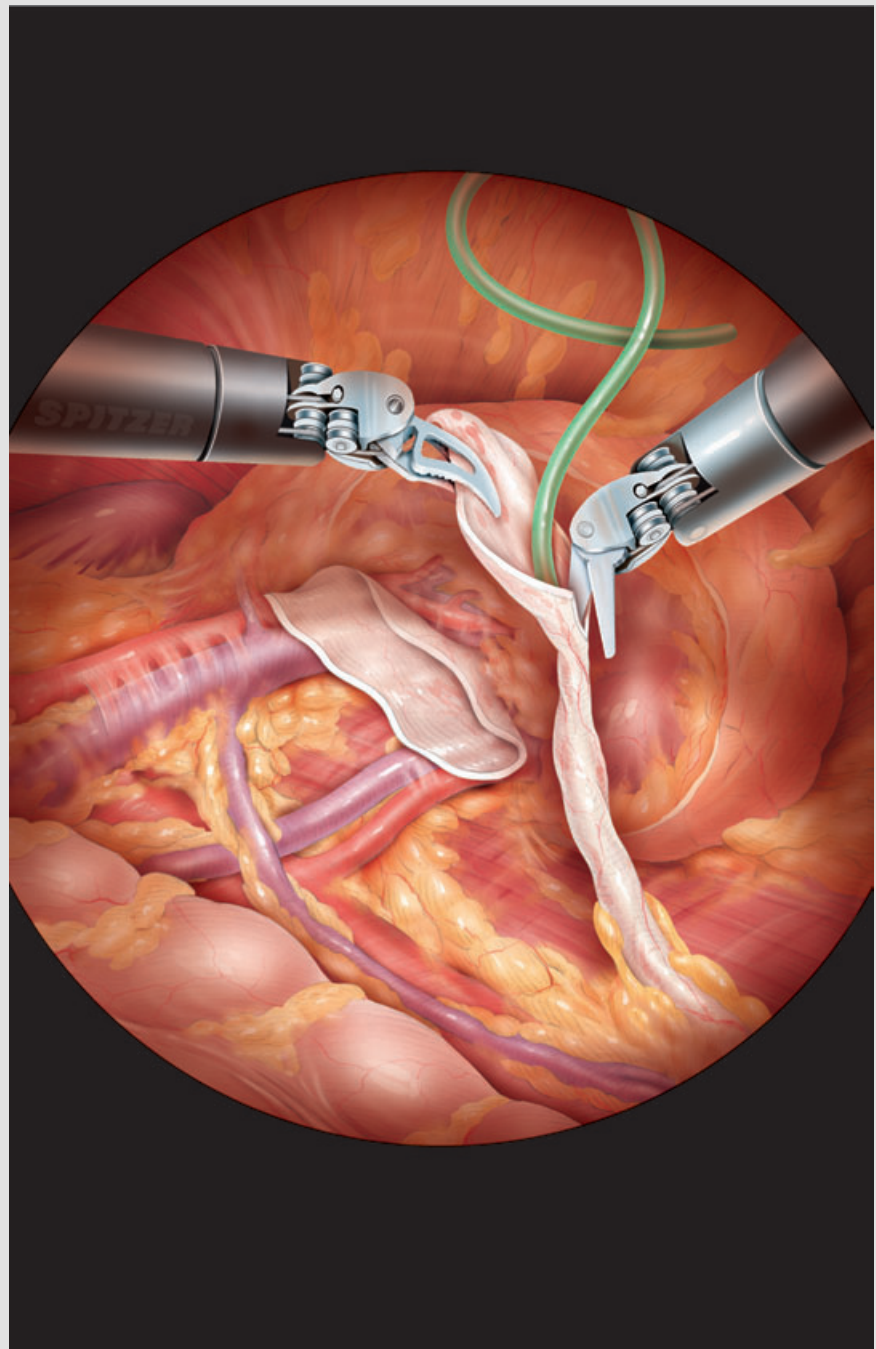


STEP 5

Figure 8

The ureter is spatulated on its posterolateral aspect through the stenotic PUJ until 1.5–2 cm of normal ureter has been incised. The diseased PUJ is excised, although a small flap can remain connected to the ureter as a 'handle', reducing unnecessary contact with the area of ureter to be anastomosed. This flap is excised towards the end of the procedure.

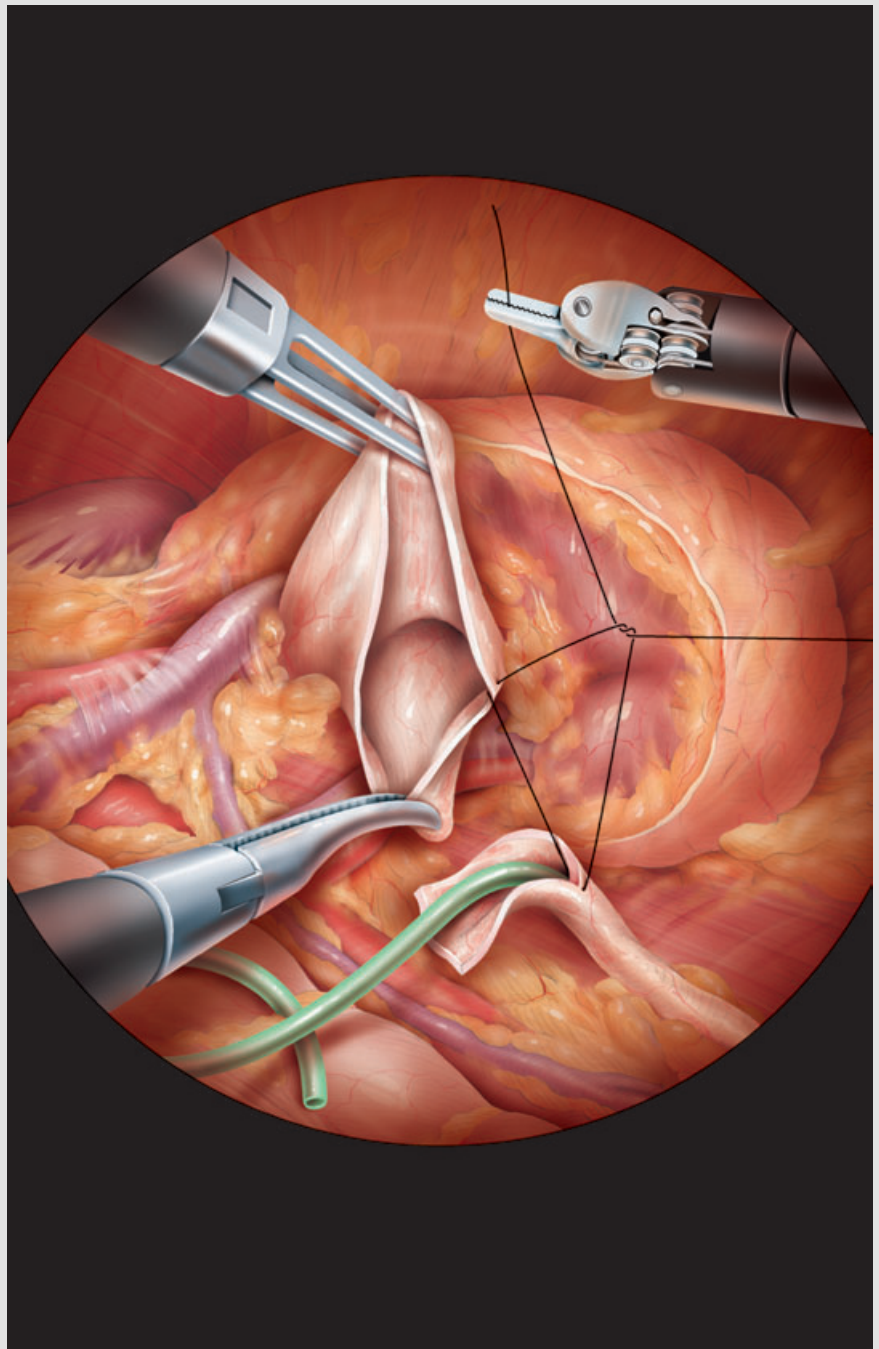
Using the maximum angulation offered by the EndoWrist round-tip scissors, the instrument behaves like a Potts scissors. This allows excellent control of the degree and length of spatulation.



STEP 6

Figure 9

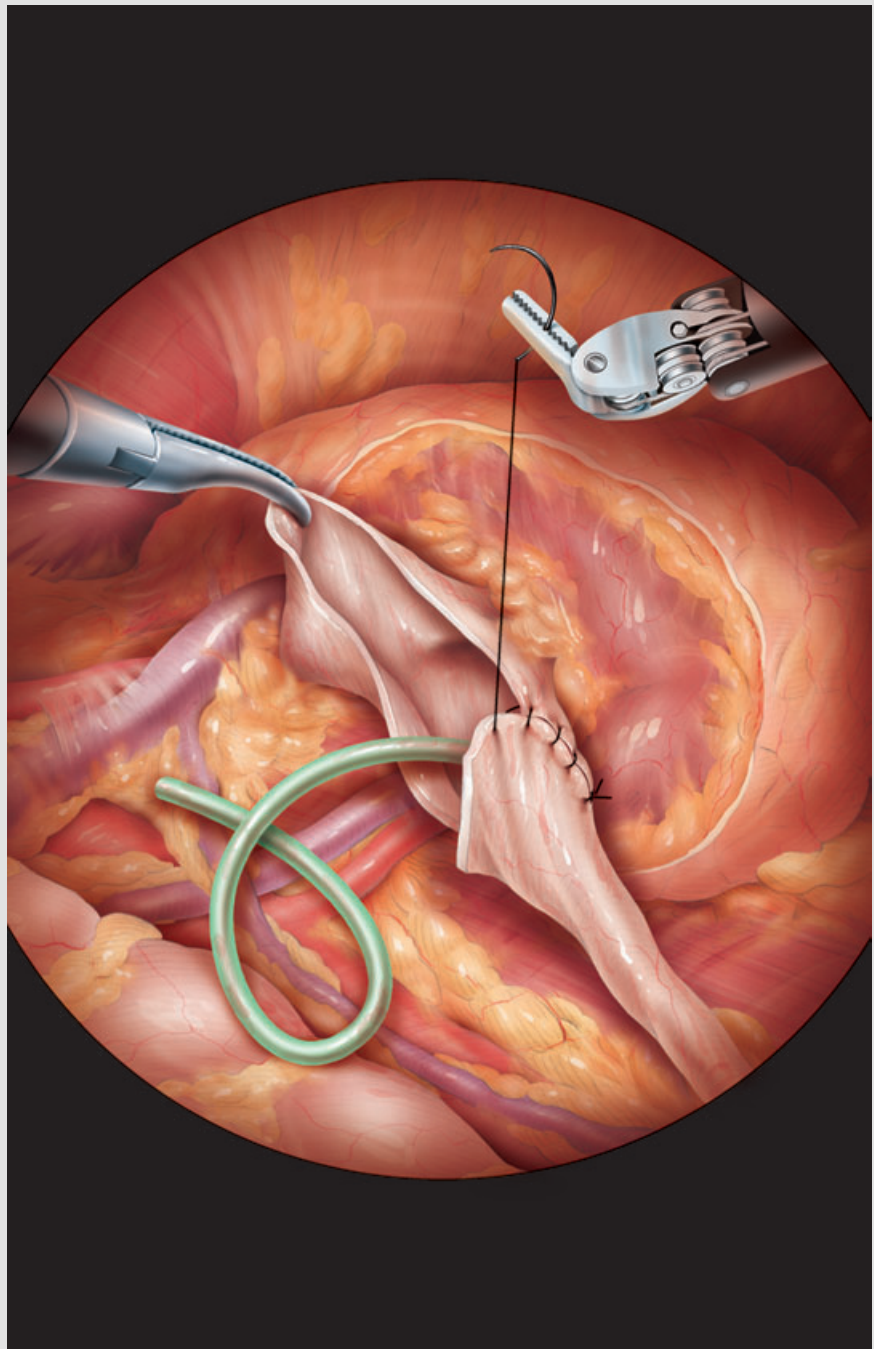
This figure shows the first suture of the anastomosis. Using 4/0 polyglactin on a 26-mm blunt needle, the apex of the spatulated ureter is joined to the dependent portion of the renal pelvis using a single interrupted knot. A 4-cm length of suture material is left in continuity to allow subsequent rotation of the anastomosis.



STEP 7

Figure 10

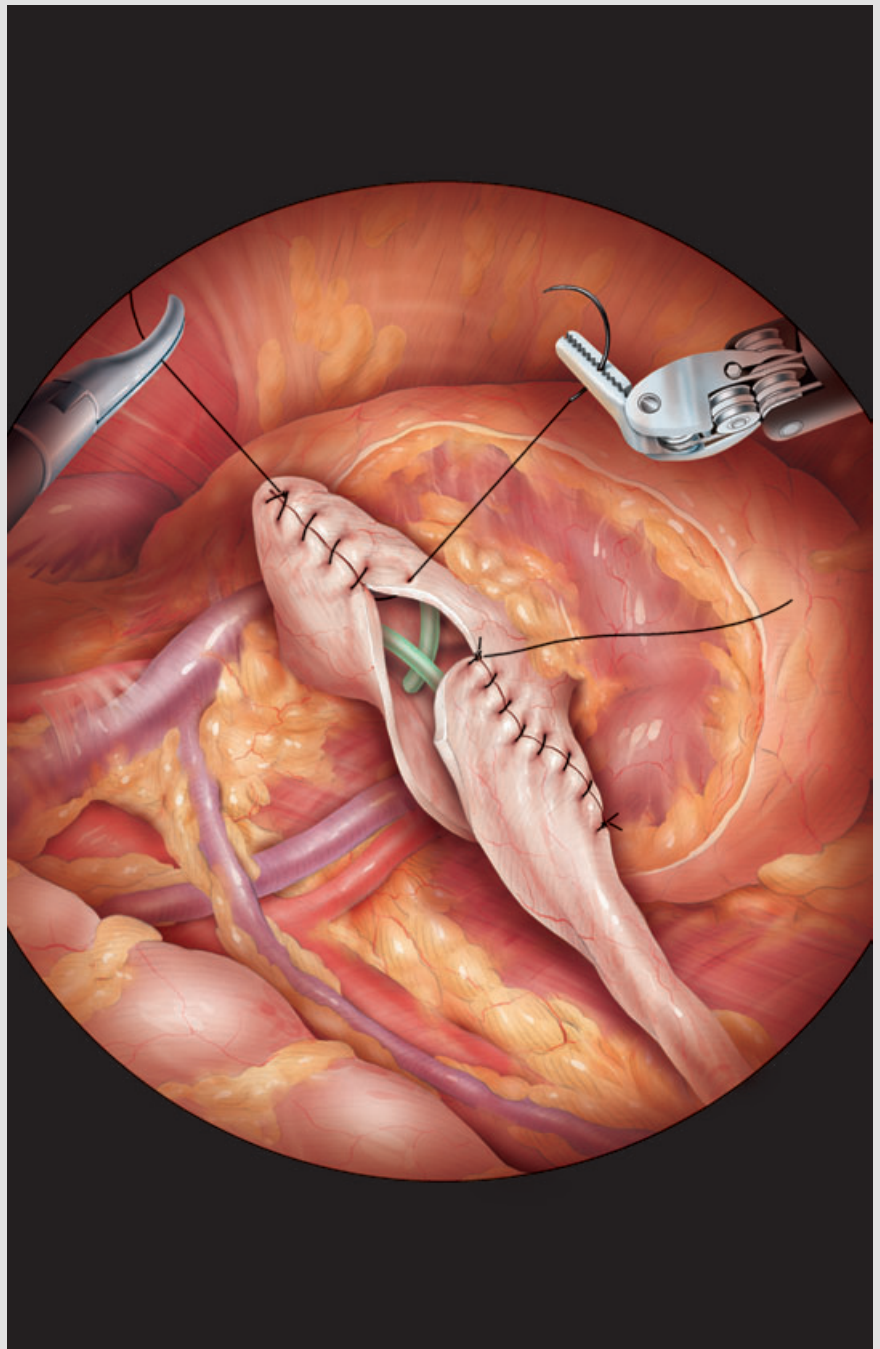
We prefer to complete the anterior wall next. Using a continuous 4/0 polyglactin suture cut to 15 cm long, the anterior lip of the renal pelvis is joined to the anterolateral wall of the ureter. When the superior portion of the anastomosis is reached, the suture is tied and a 4-cm loose length is left to allow a subsequent suture to be secured to it.



STEP 8

Figure 11

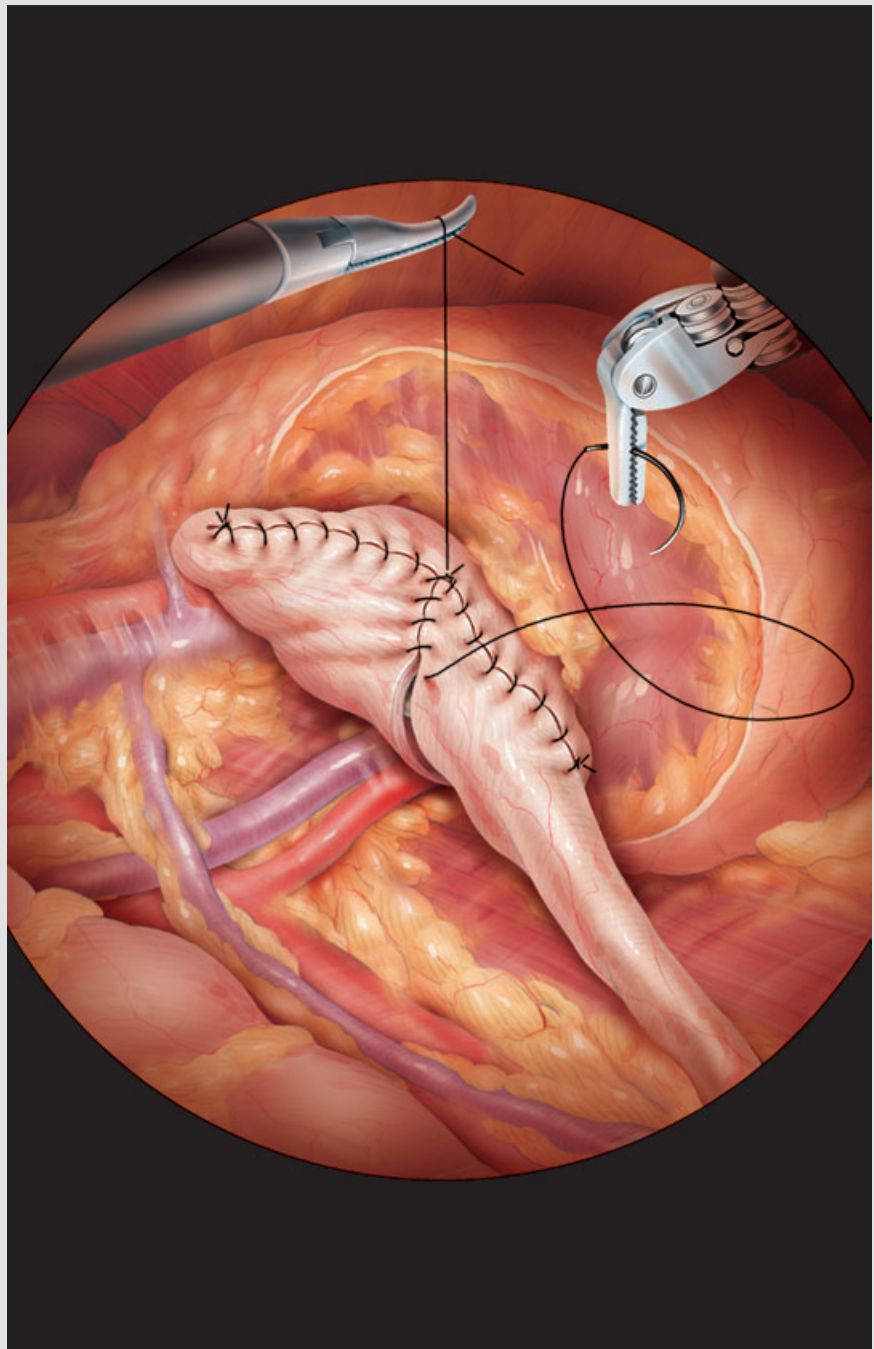
The pyelotomy superior to the pelvi-ureteric anastomosis is now closed. Using a 20-cm 4/0 polyglactin suture, the renal pelvis is closed with a running suture starting from the superior aspect of the defect. When the running suture reaches the previous suture (at the superior aspect of the anterior uretero-pelvic anastomosis), it is tied to the loose end.



STEP 9

Figure 12

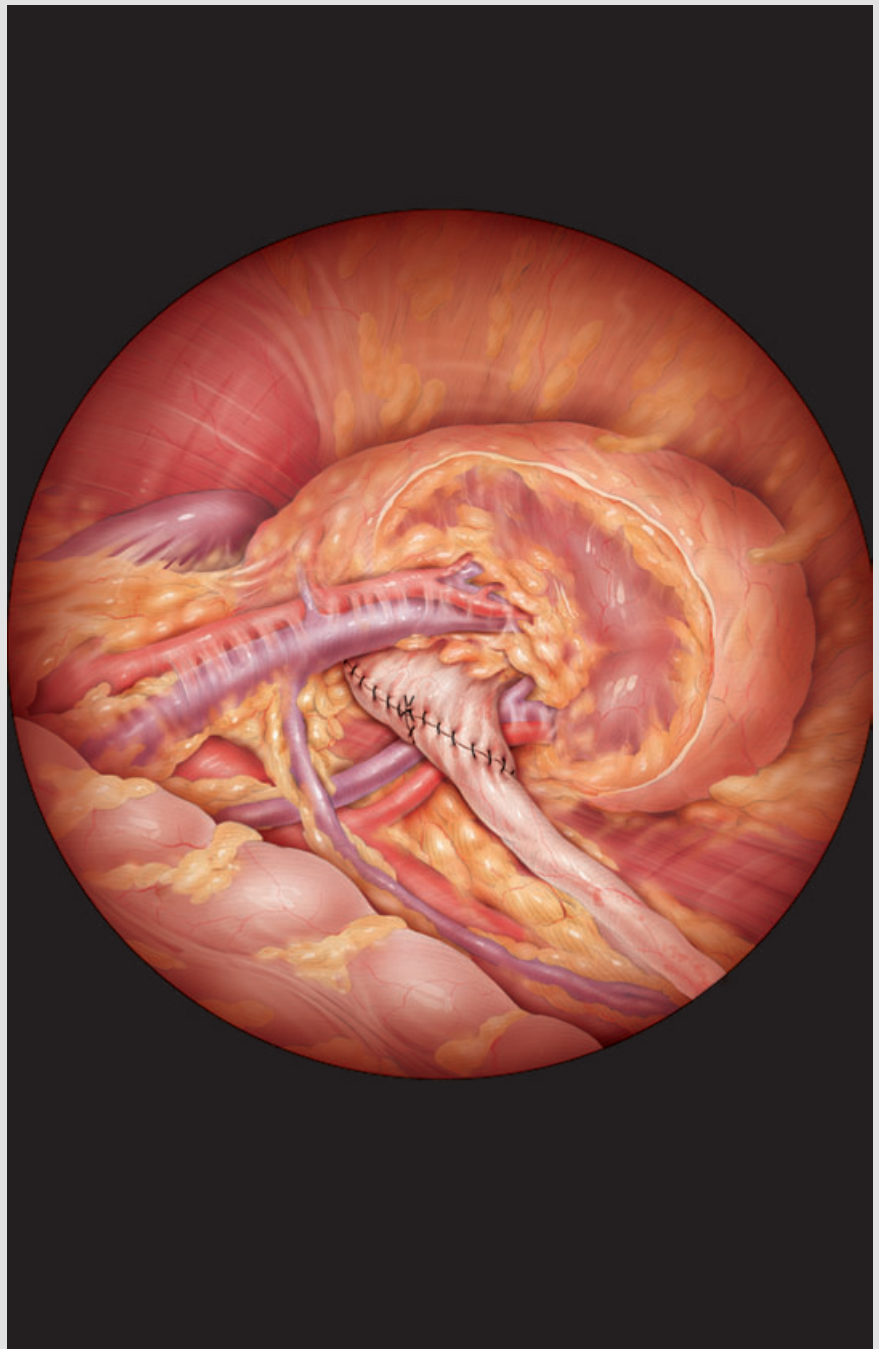
The final step in the reconstruction is the posterior wall of the uretero-pelvic anastomosis. Before this step, ensure that the top end of the JJ stent is replaced in the renal pelvis. A further 15–20 cm 4/0 polyglactin suture is then used for a running anastomosis, starting from the superior part of the defect where the previous suture has been tied.



STEP 10

Figure 13

The finished appearance shows the reconstructed PUJ now located anteriorly to the crossing vessels. A non-suction 20 F tube drain is placed through the lateral robotic port. The deep fascia of the 12-mm camera port is closed using 1/0 polyglactin, and Dermabond™ (Ethicon Ltd, Livingston, UK) liquid skin adhesive is used to close the port sites.



POSTOPERATIVE CARE AND FOLLOW-UP

Many patients are fit for discharge within 24 h. Analgesia requirements are minimal. Patients are fully ambulatory at discharge and can return to light exercise within a few days. Normal daily activities are resumed within a week. The urethral catheter is removed at 48 h, and if there is minimal drainage from the abdominal drain, this is removed within the following 24 h.

The JJ stent is removed at 6 weeks; our policy is to remove this at rigid cystoscopy under general anaesthesia, thereby allowing us to take a retrograde study to confirm the patency and anatomy of the reconstruction. A MAG3 renogram is obtained at 12 weeks after surgery.

FROM SURGEON TO SURGEON: THE DIFFICULT CASES

A history of previous intervention for PUJ obstruction is not a contraindication for RALP, but it should certainly prompt some caution about the probability of success and possibility of complications in such cases. Whether the previous management was endourological, open or laparoscopic, there will certainly be associated fibrosis around the PUJ, rendering the dissection more difficult. Similarly, the presence of a JJ stent for any prolonged period before RALP will generate some peri-ureteric reaction.

Among the more challenging RALPs we have encountered in our series are those for horseshoe kidneys. CT with reconstruction of the vascular anatomy is essential to plan the approach. We have found that positioning all ports 3–4 cm more inferior than usual allows good access to the area of interest.

THINGS TO MAKE LIFE EASIER

Correct port positioning and robot docking are crucial to the successful outcome of this procedure. The robot tower, camera arm, and target organ must all be in correct alignment. For a transperitoneal approach, the robotic cart must therefore approach the posterolateral aspect of the patient over the ipsilateral shoulder (Fig. 2a). To avoid robotic arm collisions, the instrument arms must be 8–10 cm from the camera port.

LOWS: THE WORST CASE

RALP for secondary PUJ obstruction is particularly challenging. Our most difficult case to date was for a right-sided secondary PUJ obstruction in a patient who had had a previous open pyeloplasty. Dense fibrosis surrounded the renal pelvis and mobilization of the duodenum was very difficult. Surgeons must be aware of the risks of injury to the bowel and other adjacent structures in such cases.

SUPPORT STRATEGIES FOR INTRAOPERATIVE PROBLEMS

As with other robotically assisted laparoscopic procedures, it is very important to have a laparoscopically skilled surgeon at the patient-side. Apart from trouble-shooting operative or positional difficulties in the sterile field, such assistance allows the procedure to continue laparoscopically without robotic assistance in the unlikely event of machine malfunction.

COMMENTS

First, the da Vinci surgical system is a useful tool for laparoscopic dismembered

pyeloplasty. We have been impressed with the enhanced three-dimensional vision and, in particular, by the EndoWrist instruments. The additional degrees of freedom are not only useful for the reconstructive aspect of this procedure, but also for mobilizing the renal pelvis, especially when crossing vessels are present. The additional angulation provided by the robotic instruments facilitates prompt progression throughout the dissection. The benefits of wristed instruments for laparoscopic suturing are well recognized and are particularly useful when complex reconstruction is required, such as in dismembered pyeloplasty.

Second, we prefer to suture the anterior wall of the anastomosis initially, rather than the posterior wall as most authors suggest. This small technical detail is useful because it simplifies the reconstruction. Traditionally, the posterior wall has been sutured first as it was deemed difficult to access later in the procedure. However, the anterior wall is easier to suture, thereby allowing a technically satisfactory and watertight anterior anastomosis at the outset. Improved vision and increased dexterity with the robotic instruments has rendered the posterior edge more accessible, and we have had no difficulties suturing the posterior wall in our series to date.

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Correspondence: Declan Murphy, Department of Urology, 1st Floor Thomas Guy House, Guy's Hospital, London SE1 9RT, UK. e-mail: decmurphy@doctors.net.uk