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Offers 24-hr symptom control[1,2]

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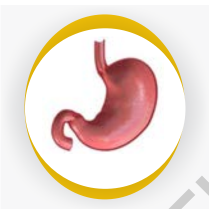

Lower C-max & Drug intake independent of food consumption[1,2]

- Better cardiovascular safety profile
- Patient compliance

Abbreviated Prescribing Information. CONTIFLOTM ICON.

GENERIC NAME: Tamsuosin Hydrochloride Prolonged Release Tablets. COMPOSITION:Each film-coated tablet contains: Tamsulosin HCI IP…0.4 mg (prolonged release.DOSAGE Form: Tablets for oral use. Description: CONTIFLO ICON contains tamsulosin hydrochloride, which is an antagonist of alphalA adrenoceptors in the prostate. Indications: For the treatment of sign and symptoms of benign prostatic hyperplasia (BPH). DOSE AND METHOD OF ADMINISTRATION: The recommended dose of CONTIFLO ICON (Tamsulosin HCI Prolonged Release Tablet) is 0.4mg once daily. It should be administered approximately one-half hour following the same meal each day. For those patients who fail to respond to the 0.4mg dose after 2 to 4 weeks of dosing, the dose of tamsulosin HCI prolonged release tablet can be increased to 0.8mg once daily. If discontinued or interrupted for several days at either the 0.4mg or 0.8mg dose, therapy should be started again with the 0.4mg once daily doseThe tablet should be swallowed whole and should not be crunched or chewed as this will interfere with the prolonged release of the active ingredient. Pregnancy: Pregnancy category B: Tamsulosin is not indicated for use in women. CONTRAINDICATIONS: Patients with known hypersensitivity to tamsulosin or any other component of this product. Reactions have included skin rash, urticaria, pruritus, angioedema and respiratory symptoms. WARNINGS AND PRECAUTIONS: Possibility of postural hypotension. Patients should be cautioned to avoid situations where injury could result should syncope occur. Tamsulosin should not be used in combination with other alpha adrenergic blocking agents. Caution is advised when alpha adrenergic blocking agents including tamsulosin are co-administered with PDE5 inhibitors. Alpha adrenergic blockers and PDE5 inhibitors are both vasodilators that can lower blood pressure. Concomitant use of these two drug classes can potentially cause symptomatic hypotension. Caution should be exercised with concomitant administration of warfarin and tamsulosin. Patients must be advised about the possibility & seriousness of Priapism. Intraoperative floppy iris syndromehas been observed during cataract surgery in some patients treated with alpha1 blockers, including tamsulosin. Advice patients considering cataract surgery to tell their ophthalmologist about use of contiflo Icon. DRUG INTERACTIONS: Tamsulosin 0.4mg should not be used in combination with strong inhibitors of CYP3A4 (e.g., ketoconazole). Tamsulosin should be used with caution in combination with moderate inhibitors of CYP3A4 (e.g., erythromycin), in combination with strong (e.g., paroxetine) or moderate (e.g., terbinafine) inhibitors of CYP2D6, in patients known to be CYP2D6 poor metabolizers particularly at a dose higher than 0.4mg (e.g., 0.8mg).. SHELF-LIFE: Please see Mfg. Date. Expiry date printed on pack. Do not use product after expiry date which is stated on packaging. Expiry date refers to last day of that month. STORAGE AND HANDLING INSTRUCTIONS: Store below 25□C, protected from light and moisture. Keep all medicines out of reach of children. For more information kindle write to : SUN HOUSE, 201 B/1,WESTERN EXPRESS HIGHWAY, GOREGAON EAST, MUMBAI-400063

1.Phillip V. Kerrebroeck, Journal compilation BJU International, 2006; 98(2): 1-2
2. M.C. Michel et al. The Pharmacokinetic Profile of Tamsulosin Oral Controlled Absorption System. European Urology Supplements , 2005; (4): 15–24

QOL= Quality of life
QOS= Quality of sleep

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Contents

1. **Robot-Assisted Laparoscopic Extended Pyelolithotomy and Ureterolithotomy** 1
Jessica N. Lange, Mani Menon, Ashok K. Hemal

2. **Robotic Rectovesical Fistula Repair** 19
Lawrence L. Yeung, James Mason, Justin Dersch

3. **Minimally Invasive Management of Urinary Reflux** 33
Charlotte Wu, Hans G. Pohl

4. **Adrenalectomy** 49
Fabio C.M. Torricelli, Rafael F. Coelho

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Robot-Assisted Laparoscopic Extended Pyelolithotomy and Ureterolithotomy

Jessica N. Lange, Mani Menon, Ashok K. Hemal

Robotic Pyelolithotomy

Patient Selection

Robot-assisted laparoscopic extended pyelolithotomy (REP) is a relatively new technique with an evolving role in the treatment of nephrolithiasis. This technique is ideally suited for instances when concomitant renal reconstructive procedures such as pyeloplasty and calyceal diverticulectomy are planned; however, it has also been used in the primary treatment of various renal and ureteral stones in patients with normal or complex anatomy. Patients who are appropriate medical candidates for traditional laparoscopy may also be offered robot-assisted surgery. Caution should be used in patients with previous abdominal or renal surgery including shock wave lithotripsy (SWL) as adhesions can make safe dissection problematic. This surgical technique has been used successfully in patients of all ages.

Robot-assisted laparoscopic surgical techniques have been developed for prostate, kidney, and bladder operations over the last two decades [1–5]. Recently, renal stones ranging from 1 to 7 cm in size have been safely treated with REP [6, 7]. However, true staghorn stones with secondary calculi have been associated with increased risk of open conversion, residual stone fragments, and the need for additional procedures to attain stonefree status. Therefore, we feel that REP is best suited for large renal pelvic stones, partial staghorn stones, or complete staghorn stones in hydronephrotic kidneys. The constraints on stone size and location stem from renovascular anatomy as well as lack of tactile sensation and angulation of the robotic approach. Through the

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use of adjunctive techniques such as intraoperative flexible nephroscopy, none of these constraints are absolute. Robotic dissection may be limited by aberrant renal vessels, and even normal renal vasculature may compromise the superior extent of renal pelvis dissection. Thus, complex upper pole stones which involve calyces at obtuse angles to the renal axis may be problematic. Most authors prefer computed tomography imaging and nuclear medicine renography to precisely define stone anatomy, evaluate renal function, and provide anatomic information prior to surgery. Stones of any composition may be safely treated via the robotic approach. Even infectious stones such as struvite or calcium phosphate may be treated provided sterile preoperative urine culture and appropriate antibiotic coverage (Table 1).

Preoperative Preparation

Urine Culture and Bowel Preparation Patients must have documented sterile urine preoperatively, as there is considerable chance of spillage of urine into the abdomen or retroperitoneum intraoperatively. Perioperative antibiotics should be selected based on recent culture data, or, if cultures are negative, empiric broadspectrum coverage should be provided against typical skin and urinary flora. Simple bowel preparation of clear liquids, the day prior to surgery, and an enema or suppository the evening prior to surgery help reduce colonic distension and facilitate dissection.

Table 1: Various applications of robot-assisted procedures in treating stone disease in different locations.

	Robotic procedure	Indication
Reconstructive + stone extraction	Pyeloplasty with pyelolithotomy	Ureteropelvic junction obstruction with secondary stones
	Ureteropyelostomy with pyelolithotomy	Duplex pelvicalyceal system with ureteropelvic junction obstruction in the lower moiety with secondary stone
	Ureteric reimplantation with stone extraction	Megaureter with ureteral stone
	Bladder diverticulectomy with stone	Stone in a bladder diverticulum
Primary stone removal	Ureterolithotomy	Impacted large ureteral calculus
	Extended pyelolithotomy	Partial staghorn renal calculus
	Nephrolithotomy	Inferior calyceal calculus with narrow infundibulum and thin overlying parenchyma
	Anatrophic nephrolithotomy	Staghorn calculus
Ablative	Simple nephrectomy	Non-functioning kidney with renal stone disease
	Nephroureterectomy with stone removal	Non-functioning kidney with impacted ureteric stone or with megaureter
	Lower pole partial nephrectomy with stone extraction	Non-functioning lower pole with inferior calyceal calculi

Informed Consent

Informed consent should address the potential complications of both laparoscopic renal surgery and traditional stone surgery. Risks of bleeding, infection, damage to kidney or abdominal viscera, loss of kidney, and conversion to open technique should be discussed. Further risks including failure to eradicate all stone fragments and stone recurrence should also be considered.

Operative Setup

Operating suite setup for REP is similar to other robotic renal surgery. Given the limited working space of most operating rooms, we prefer to have the operating table offset toward the side of the docked robot (patient's back). The robotic light source units and insufflators are in a common tower placed near the foot of the bed on the side of the patient's back. This allows ample room for a patient-side assistant, scrub nurse, and instrument table on patient's abdominal side. Additionally, the robotic console is placed remotely in the same room or adjoining room. This arrangement places all surgeons, assistants, and instruments in direct access to the working surface of the patient. Additional specialized equipment such as holmium laser units or ultrasonic/hydraulic lithotripters may be brought in as needed for fragmentation of stones if deemed necessary.

Patient Positioning and Preparation

Sequential compression devices are applied to the lower extremities and activated prior to induction of general anesthesia. An orogastric tube and an indwelling 16 French urethral catheter are inserted. For a transperitoneal approach, the patient is then placed in a modified (45°–60°) lateral decubitus position with minimal flexion of the operating table and kidney rest elevation. Slight reverse Trendelenburg is recommended with the daVinci S and Si model robots as the fourth arm and port may come close to iliac crest or collide with the patient's hip. We believe this minimizes arm collision when working in the pelvis. In contrast, with the da Vinci Xi model robot, this is not necessary.

For a retroperitoneal approach, the patient is placed in a full flank position. Care is taken to ensure adequate padding of all pressure points. An axillary roll is placed, and the patient is secured to the table with seatbelts, Velcro straps, and/or tape. Next, the urethral catheter is clamped to allow gradual distension of the urinary bladder. This facilitates antegrade placement of a double pigtail ureteral stent later in the operation, as a fuller bladder allows greater space for the distal end of the stent to coil. Additionally, the reflux of urine via the stent (seen as drops of urine emanating from the holes in the stent) provides reassurance regarding correct placement of the lower end of the stent in the bladder rather than in the distal ureter [8].

Trocar Configuration

We have performed REP via both transperitoneal and retroperitoneal approaches, but we now universally prefer a transperitoneal approach unless a compelling reason favors a retroperito-

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neal approach (i.e., prior extensive intraperitoneal surgery). The retroperitoneal approach, while theoretically superior in terms of reduced risk of peritoneal contamination with urine or stone fragments, remains an extreme technical challenge for REP, as the creation of the retroperitoneal space and appropriate placement of trocars to provide wide excursion is cumbersome. We have also found it difficult to employ a retroperitoneoscopic robotic approach in obese and shortstatured patients. However, the design of the new Xi robot is more conducive to the retroperitoneal approach.

Transperitoneal Approach

Transperitoneal and retroperitoneal robotic pyelolithotomy were developed based on principles of laparoscopic management of stone disease [9–13]. The pneumoperitoneum is established using the Veress needle by placing it in the ipsilateral hypochondrium/iliac fossa. The remaining trocar placement and trocar configuration is mapped out after the pneumoperitoneum is established and is dependant upon the individual's physical features, the chosen surgical approach (i.e., transperitoneal or retroperitoneal), and the surgeon's preference of stereoscopic lens [14].

Port Placement for da Vinci S or Si Platform

If using a 0°or 30° down stereoscopic lens, a 12 mm camera trocar is placed through the lateral edge of the rectus muscle at the level of the umbilicus, while the two 8 mm robotic trocars are placed in such a manner to form a skewed wide isosceles triangle [14]. The cranial 8 mm robotic trocar is placed an inch away from the midline ipsilaterally between the xiphoid process and the umbilicus (almost at the level of the renal hilum), and the second more caudal 8 mm robotic trocar is placed in the ipsilateral iliac fossa along the anterior axillary line at least 7–8 cm away from the camera trocar, thus minimizing instrument collisions. A 12 mm assistant trocar in the midline allows for suction, retraction, and passage of suture materials and instruments such as the specimen retrieval bag and flexible nephroscope (Fig. 1). Another optional 5 mm assistant trocar in the midline allows for liver retraction during right-sided procedures. In general, we utilize a three-armed robotic technique; however, a fourarmed robotic trocar can be added above the pubic symphysis in a paramedian location in line with the cranial robotic trocar for the purpose of retraction and dissection. This should only be utilized if felt to be necessary as it adds to the overall cost of the procedure.

Alternatively, when using a 30° up stereoscopic lens, the 12 mm camera trocar is placed at the level of umbilicus and lateral between the anterior axillary and mid-clavicular lines. The two 8 mm robotic trocars are placed alongside the rectus muscle, at a plane lower than the camera trocar and triangulated toward the renal pelvis [8, 14].

Port Placement for da Vinci Xi Platform

Pneumoperitoneum of 14 mmHg is achieved using a Veress needle in standard fashion. Trocars are placed linearly along the lateral border of rectus muscle. Port placement consists of an 8 mm

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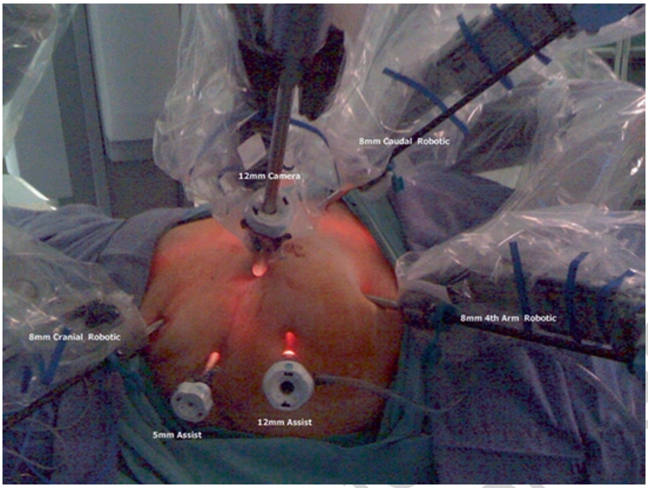

Fig. 1: Trocar placement for transperitoneal robotic extended pyelolithotomy. A three-trocar configuration consisting of the camera trocar as well as cranial and caudal robotic trocars is the minimum recommended. Additional trocars such as a fourth arm robotic, 5 mm assistant, and 12 mm assistant may be placed as needed.

camera port placed lateral and superior to the umbilicus and lateral to the rectus muscle. After placing this port, peritoneoscopy is performed, and the rest of the robotic ports are placed as dictated by the patient's intra-abdominal anatomy after inflation. The second robotic port is placed about 6 cm cranial to the camera port and lateral to the rectus muscle. The third 8 mm port is placed about 6 cm caudal to the camera port and lateral to the rectus muscle. For cost-saving purposes, stone surgery can be performed using three robotic ports inclusive of the camera port. A 12 cm AirSeal (SurgiQuest Inc, Milford, CT) assistant port is placed in the midline approximately 2–3 cm cranial to the umbilicus. For additional cost-reducing measures, AirSeal does not have to be used, and an alternative 12 mm port can be placed. The robot is docked perpendicular to the patient from the back on the ipsilateral side.

The illustrations of port placement for da Vinci Xi (Fig. 2) and da Vinci Si (Fig. 3) platform can be modified according to patient factors such as body mass index, previous surgeries, and disease factors such as large kidney and location of renal pelvis.

Retroperitoneal Approach

In this approach, the patient is placed in the full lateral flank position. The bridge of the table is elevated to flatten the lumbar region. Initially tilting the table toward the anterior side allows the peritoneum and its contents to fall forward. This maneuver helps to avoid peritoneal transgression during trocar placement. A 1–1.5 cm incision is made 2 cm above the lateral apex of the anterior superior iliac crest traversing from skin through the thoracolumbar fascia and entering into the retroperitoneal space. During this step, there must be a deliberate effort made to prevent inadvertent dissection between the subcutaneous and muscular planes, as gas extravasation can result. Blunt digital dissection can further develop this space.

A trocar-mounted pre-peritoneal dissection balloon (round OMS-PDB1000; kidney-shaped OMSPDBS2, Covidien, Minneapolis, MN) is introduced into the incision. With this balloon, the retroperitoneal space is created under direct vision, and the balloon is left inflated for 5 min to

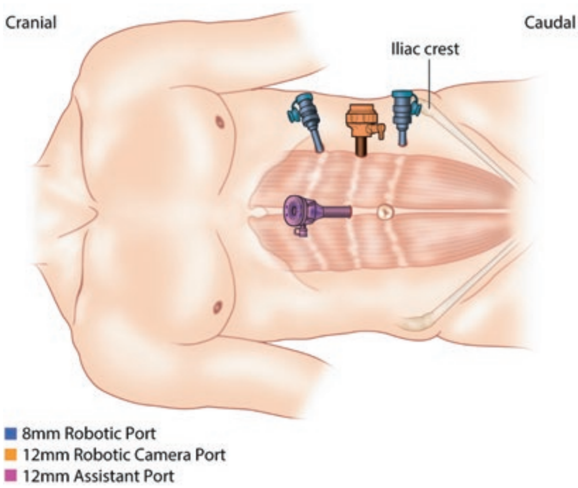

Fig. 2: Transperitoneal Ports for daVinci S or Si.

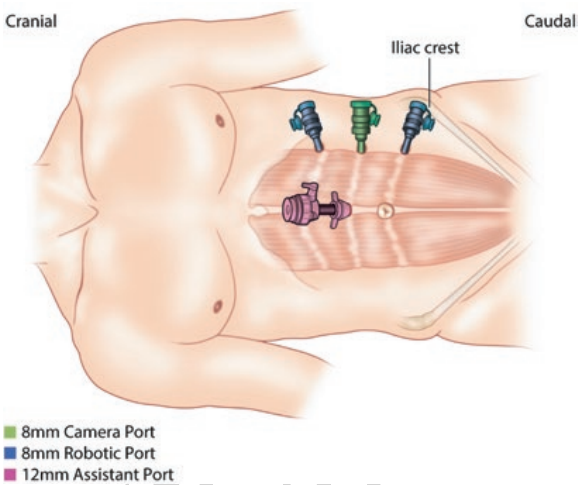

Fig. 3: Transperitoneal Ports for da Vinci Xi.

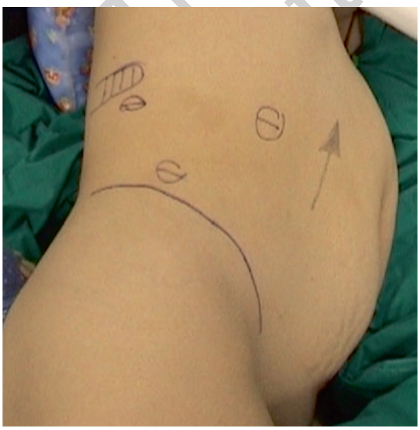

Fig. 4: Trocar configuration for retroperitoneal robotic pyelolithotomy. The 12 mm camera trocar is placed immediately above the iliac crest with the two more 8 mm robotic trocars 8–10 cm cephalad along the anterior and posterior axillary lines. Arrow points in the direction of the patient's head, and the tip of the 12th rib is indicated.

ensure adequate hemostasis. After verifying that an adequate working space has been created under laparoscopic vision, the balloon is deflated and replaced with a 12 mm blunt tip Hasson camera trocar (Covidien, Minneapolis, MN). Two additional 8 mm robotic trocars are subsequently placed under vision equidistant (approximately 8–10 cm) from the camera trocar at a right angle to each other along the anterior and posterior axillary lines, respectively (Fig. 4). A 5 mm assistant trocar is placed at the same level as the 12 mm camera trocar toward the anterior abdominal wall and equidistant from the 8 mm robotic trocar. The robot is docked and further extraperitoneal space is created as needed. Of note, the da Vinci Xi robot is more facile for this approach as it allows for swapping the camera among any of the ports. If you are using Xi system, the camera port is 8 mm, and you may want to use a homemade balloon by tying a finger stall over a rubber catheter.

Instrumentation and Equipment List

The robotic instruments required for the procedure include: Maryland bipolar or plasma kinetic forceps on the left-hand side and "hot" curved monopolar scissors on the right side which can be interchangeable with a needle driver. While using the da Vinci Xi, we use fenestrated or Maryland bipolar forceps as plasma kinetic forceps are currently not available with this platform. The instrument configuration may change according to dominant hand of the surgeon. Limiting the number of robotic instruments to three improves cost-effectiveness. Alternatively, two needle drivers for ease of suturing; a hook for blunt dissection of the Gil-Vernet's plane, and a ProGrasp™ forceps may be used.

Equipment

- da Vinci® Surgical System (S, Si, or Xi; threeor four-arm system; Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® Maryland bipolar forceps or PK dissector (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® curved monopolar scissors (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® ProGrasp™ forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® needle drivers suture cut (1) (Intuitive Surgical, Inc., Sunnyvale, CA)
- InSite® Vision System with 0° and 30° lens (Intuitive Surgical, Inc., Sunnyvale, CA)
- 5 mm Laparoscopic lens

The equipment needs are the same for the Xi model as for the S and Si except the camera is placed through an 8 mm port. Instrument names are the same other than PK dissector is not yet available for Xi.

Trocars

- 12 mm Blunt tip trocar (1)—alternatively 8 mm for Xi

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- 8 mm Robotic trocars (2)
- 5 mm Trocar (1)—optional

Recommended Sutures

- 5-0 Poliglecaprone on an RB-1 needle cut to 10 cm in length

Instruments Used by the Surgical Assistant

- Laparoscopic scissors (not necessary if you are using suture cut needle driver)
- Blunt tip fenestrated grasper
- Suction irrigator device
- 17 French flexible cystoscope (optional)
- Nitinol stone basket or flexible stone graspers (optional)
- Pre-peritoneal distention balloon (round OMS-PDB 1000, kidney-shaped OMSPDBS2, Covidien, Minneapolis, MN)
- Blunt tip trocar with sealing device
- 10 mm Specimen entrapment bag
- 16 French urethral catheter
- Double pigtail ureteral stent
- 10 or 15 French Jackson–Pratt drain

Step-by-Step Technique

Step 1: Mobilization of the Ipsilateral Colon (Table 2)

The procedure is initiated using a Maryland bipolar forceps on the left side and a curved scissor on the right. Upon inspecting the abdominal cavity, if adhesions exist, these should be lysed sharply with minimal electrocautery in order to avoid inadvertent bowel injury. The electrocautery settings are 30 W for monopolar scissors and 25 W for bipolar forceps. In contrast, for the Xi robot, monopolar cut is set to 2–3 dry cut, monopolar coagulation is set to 2–3 forced coag, and bipolar cautery is set to 2–3 soft coag. The insufflation pressure used throughout the procedure is maintained at 15 mmHg. On the left side, a limited mobilization of the colon overlying the kidney and renal pelvis is performed by incising along the white line of Toldt. In a thin individual, sparse mesocolic fat may allow a trans-mesocolic approach wherein a window is created in the mesocolon overlying the renal pelvis. The renal pelvis may be identified as a bulge due to the presence of a stone within it with or without hydronephrosis. On the right side, an additional 5 mm liver retractor placed below the xiphoid may be required to elevate the right lobe of the liver and provide better visualization of the renal hilum and renal pelvis. The lateral peritoneal attachments of the hepatic flexure are incised to mobilize the ascending colon and duodenum providing access to the renal hilum. Contrary to the open technique, entire mobilization of the kidney (especially the lateral attachments) is avoided to prevent it from falling medially and hampering vision.

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Table 2: Mobilization of the ipsilateral colon: surgeon and assistant instrumentation.

Surgeon instrumentation		**Assistant instrumentation**
Right arm	Left arm	• Suctionirrigator
• Curved monopolar scissors	• Maryland bipolar grasper	
Endoscope lens: 0°, 30° down or 30° up depending on surgeon preference and trocar configuration		

Step 2: Dissection of Ureter and Renal Pelvis

The next step is identification of the ureter. This is followed cranially in order to identify the renal pelvis (Fig. 5). It is important to dissect the renal pelvis free of its surrounding peripelvic fat, which may be adherent, especially, in patients who have undergone prior SWL or PCNL or have a history of pyleonephritis. This dissection is important to correctly develop the Gil-Vernet's plane which allows exposure of the infundibulae of the major calyces, especially in cases of intrarenal pelves. Due to a transperitoneal approach, the renal vessels (renal vein in particular) are found to lie abutting the cranial edge of the renal pelvis. This tends to limit the superior extension of the pyelotomy to the superior infundibula. Correct dissection of the peripelvic fascia facilitates mobilization of the renal pelvis away from the vessels. Stone identification may be difficult given the presence of adhesions and inflammation, thus dissection of the renal pelvis should occur in a gentle, careful, and cautious manner. This allows for identification and preservation of the renal vessels, especially the anterior branch of renal artery or vein which may be closely abutting the renal pelvis, thus preventing vascular injury at the time of pyelolithotomy. Complete skeletonization of the main renal vessels is only performed in cases where entry into the renal parenchyma is required or when contemplating an anatrophic nephrolithotomy or extended pyelolithotomy.

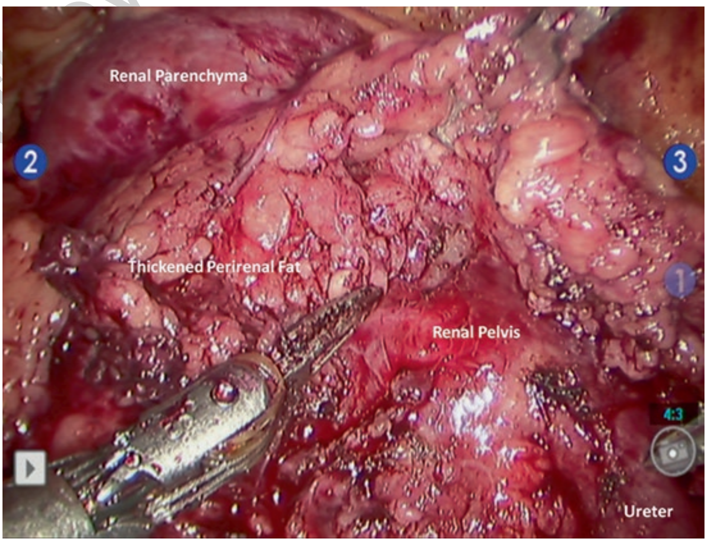

Fig. 5: Right transperitoneal robotic extended pyelolithotomy: exposure of the renal pelvis. The perirenal fat is notably thickened, as is common with prior inflammation and scarring associated with large renal stones and prior procedures.

Step 3: Pyelotomy, Infundibulotomy, and Removal of Stones (Table 3)

Once the pelvis is adequately dissected, a V-shaped pyelotomy is performed with or without extension into the inferior infundibulum (Fig. 6). However, depending upon the stone size and configuration, pyelotomy is extended into the superior or inferior infundibulum of the kidney to prevent inadvertent injury to the renal vessels. In addition, the laparoscopic assistant may carefully retract the vessels superiorly using a blunt suction tip. Once an adequate pyelotomy is created, the tip of the cold scissors is used to dissect the pelvic mucosa off of the stone, allowing it to be maneuvered into a position such that its smallest diameter aligns with the pyelotomy. This allows delivery of one end of the stone out of the pyleotomy first. This is followed by manipulation of the opposite end of the stone until the stone is fully delivered (Fig. 7). Secondary calyceal calculi are retrieved under direct vision as one has ability to move the camera into the pyelotomy incision and remove the stones using the Maryland bipolar forceps or by having the assistant use a laparoscopic grasper. Stones are then placed in the paracolic gutter for later retrieval.

Step 4: Adjunctive Maneuver to Remove Calyceal Calculi (Table 4)

After retrieval of the pelvic stone, attention is directed at calyceal calculi. The camera is moved close to pelvicalyceal system allowing some calyceal calculi to be removed under direct vision. Next, the calyces are flushed with saline using the suction-irrigation device, further dislodging any remaining fragments. If needed, a flexible cystoscope can be used to assist with further extraction of calyceal calculi. The flexible cystoscope can be introduced into the abdomen through the cranial 8 mm robotic or midline assistant 12 mm trocar. To access different calyces, pressure irri-

Table 3: Pyelotomy, infundibulotomy, and removal of stones: surgeon and assistant instrumentation.

Surgeon instrumentation		Assistant instrumentation
Right arm	Left arm	• Suctionirrigator
• Curved monopolar scissors	• Maryland bipolar grasper	• Laparoscopic fenestrated grasper
Endoscope lens: 0°, 30° down or 30° up depending on surgeon preference and trocar configuration		

Table 4: Adjunctive maneuver to remove calyceal calculi: surgeon and assistant instrumentation.

Surgeon instrumentation		Assistant instrumentation
Right arm	Left arm	• Suctionirrigator
• Curved monopolar scissors	• Maryland bipolar grasper	• Laparoscopic fenestrated grasper
		• 17 French flexible cystoscope
Endoscope lens: 0°, 30° down or 30°up depending on surgeon preference and trocar configuration		• Nitinol stone basket or flexible graspers

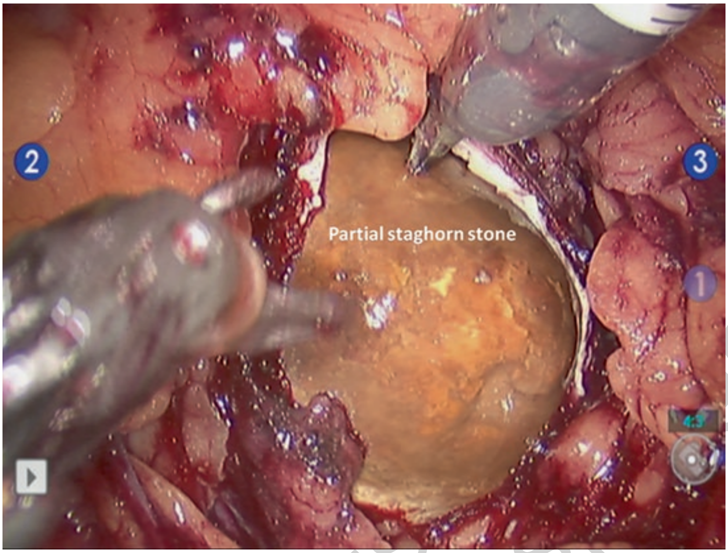

Fig. 6: Right transperitoneal robotic extended pyelolithotomy. Incision of renal pelvis may be extended into an infundibulum to allow branches of a staghorn to be removed.

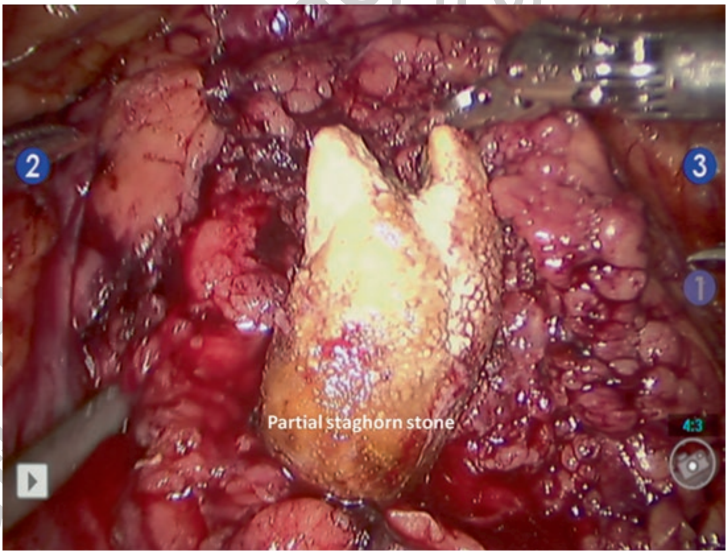

Fig. 7: Right transperitoneal robotic extended pyelolithotomy. The stone is grasped with robotic forceps and gently manipulated from the renal pelvis.

gation is required. If needed, a nitinol basket or flexible graspers can be used for stone extraction. Small stone fragments may be immediately removed from the body, and any larger fragments can be left along the paracolic gutter for later retrieval.

Step 5: Antegrade Ureteral Stenting (Table 5)

Once the stones are removed, an antegrade double pigtail ureteral stent is placed over a guide wire introduced through the 5 mm assistant laparoscopic trocar. It is easily manipulated into the ureter with the robotic instruments (Fig. 8). This avoids the need for cystoscopy and ureteral stent placement and change in patient position prior to docking the robot. With the bladder now distended due to previous plugging of the urethral catheter, urine should emanate from the proximal end of the stent once it is in proper position within the bladder. The guide wire is removed, and the proximal end of the stent is then placed within the renal pelvis prior to closure.

Step 6: Repair of the Infundibular and Pyelotomy Incisions (Table 6)

The infundibular and pyelotomy incisions are sutured in a running fashion using 5-0 poliglecaprone on an RB-1 needle cut to 10 cm (Fig. 9). Moreover, the peripelvic fat is reapproximated to cover the repaired pyelotomy. Gerota's fascia is used to ensure that the perinephric space is closed off from the peritoneal cavity. An intraperitoneal 10 or 15 French Jackson-Pratt drain is placed through the 5 mm assistant trocar.

Step 7: Retrieval of Stones from the Body (Table 7)

The stone fragments are retrieved from the paracolic gutter using a 10 mm specimen entrapment bag inserted through the 12 mm assistant trocar (Fig. 10), taking caution not to risk losing fragments. The robotic instruments, camera, and robot are removed and undocked, and a 5 mm 30° laparoscope lens is placed through the 5 mm assistant trocar to provide laparoscopic vision. The specimen bag is retrieved by enlarging the 12 mm assistant trocar site. This avoids making another incision to remove the bag from the peritoneal cavity. Finally, the fascia along the12 mm trocar is closed primarily, and subcuticular closures are performed at all skin incision sites.

Table 5: Antegrade ureteral stenting: surgeon and assistant instrumentation.

Surgeon instrumentation		**Assistant instrumentation**
Right arm	Left arm	• Suctionirrigator
• Needle driver	• Maryland bipolar grasper	• Laparoscopic fenestrated grasper
Endoscope lens: 0°, 30° down or 30° up depending on surgeon preference and trocar configuration		• Double pigtail ureteral stent

Table 6: Antegrade ureteral stenting: surgeon and assistant instrumentation.

Surgeon instrumentation		**Assistant instrumentation**
Right arm	Left arm	• Suctionirrigator
• Needle driver	• Needle driver	• Laparoscopic fenestrated grasper
Endoscope lens: 0°, 30° down or 30° up depending on surgeon preference and trocar configuration		• Double pigtail ureteral stent

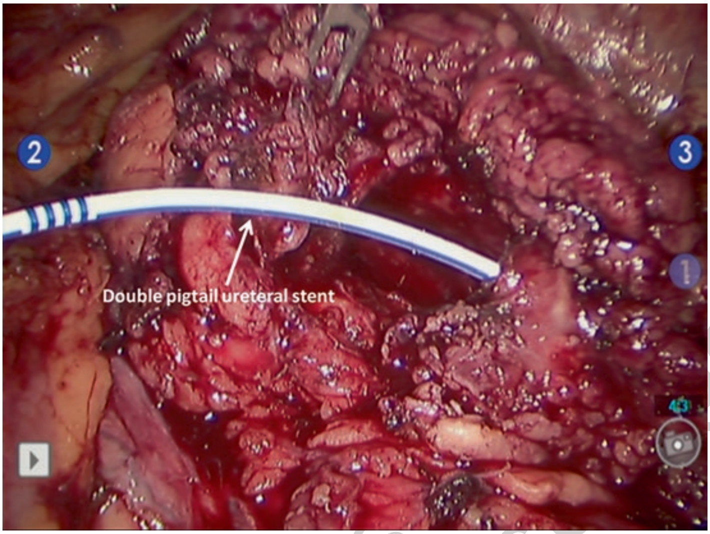

Fig. 8: Right transperitoneal robotic extended pyelolithotomy. A double pigtail ureteral stent is placed in an anterograde fashion over a guidewire through the assistant trocar.

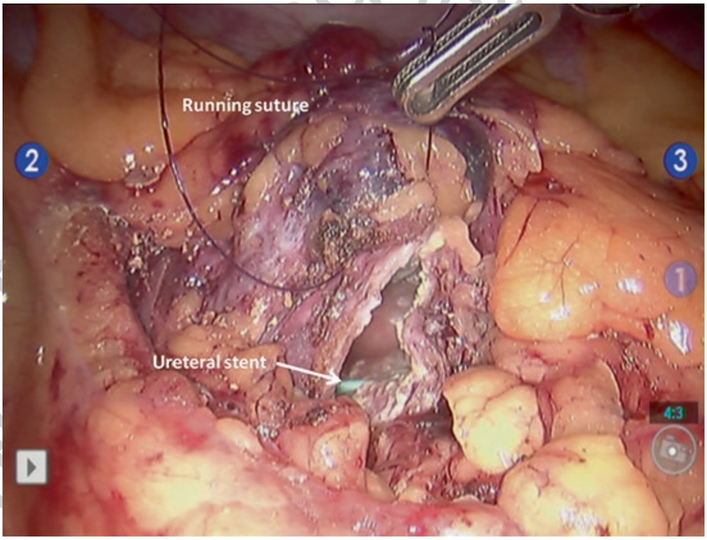

Fig. 9: Right transperitoneal robotic extended pyelolithotomy. The pyelotomy is closed with 5-0 suture in a running or interrupted fashion. Care is taken to avoid inclusion of the proximal stent in the suture line.

Table 7: Retrieval of stones from the body: surgeon and assistant instrumentation.

Surgeon instrumentation		**Assistant instrumentation**
Right arm	Left arm	• Suctionirrigator
• Needle driver with suture cut	• Optional needle driver (Prograsp or bipolar forceps can be used to reduce cost)	• 10 mm specimen entrapment bag
Endoscope lens: 0°, 30° down or 30° up depending on surgeon preference and trocar configuration		

Robotic Anatrophic Nephrolithotomy

The operative setup and technique for robotic anatrophic nephrolithotomy is similar to that used for REP. The procedure begins with mobilizing the kidney and exposing the renal hilum. Renal vascular control is obtained using bulldog clamps. A vertical incision is made along Brodel's line with cold monopolar scissors, and stones are identified and removed with robotic forceps. The collecting system is then closed in a running fashion with 3-0 Vicryl, and the renal parenchyma is closed with 2-0 V-Loc (Covidien, Mansfield, MA) suture in a horizontal mattress fashion. This technique was successfully described in seven patients [15]. The authors have also found use of barbed suture safe and effective in our experience [16]. Recently, indocyanine green has been used to visualize Brodel's avascular plane in a pig model for robotic anatrophic nephrolithotomy [17]. This may be an area of future exploration in robotic surgery.

Robotic Ureterolithotomy

The operative setup and technique for robotic ureterolithotomy is similar to that used for REP. Once the ureter is identified, it is traced to the site of the stone. Usually the calculus is large enough to be visually identified, appearing as a ureteral bulge. The portion of ureter containing the stone is dissected with scissors and bipolar forceps, taking care not to skeletonize the ureter and compromise its blood supply. A longitudinal ureterotomy is performed with a cold curved scissors. At this stage, the stone is freed from the ureteral mucosa with the tip of the scissors or with bipolar forceps. After stone retrieval, the ureterotomy is closed with interrupted intracorporeal sutures of 5-0 poliglecaprone (Figs. 11 and 12). If double pigtail ureteral stenting is deemed necessary, it is performed in an antegrade fashion as described previously. The remaining steps are the same as for robotic pyelolithotomy.

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Postoperative Management

After REP and robotic ureterolithotomy, patients are initially given clear liquids and advanced to regular diet as tolerated. Pain is usually wellcontrolled with scheduled ketorolac in addition to narcotics as needed for breakthrough pain. We routinely provide oral anticholinergics as needed for stent colic. Ambulation is encouraged as soon as tolerated. The surgical drain is left to gravity drainage rather than suction, and it is removed when there has been less than 30 cm^3 drainage per 8 h, which is usually on postoperative day one. The urethral catheter is removed just prior to discharge. With this regimen, most patients are generally able to go home within 24 h postoperatively (rarely 48 h later).

Special Anatomical Considerations

REP has been performed on patients with complex renal anatomy such as collecting system duplication, horseshoe kidney, and even crossed fused ectopia. These special cases are challenging

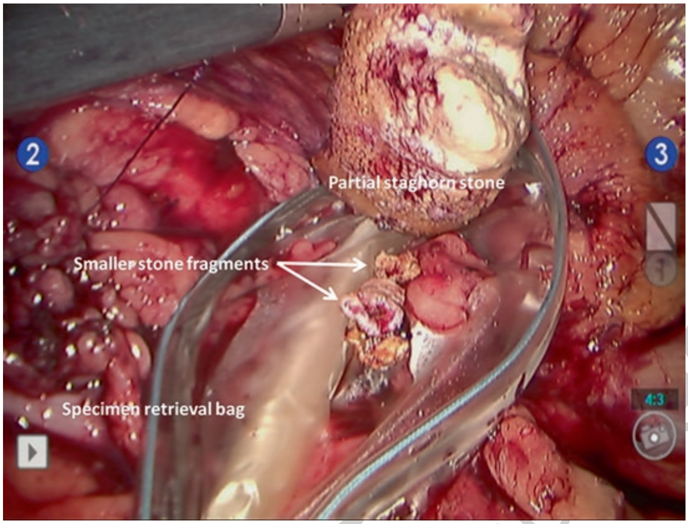

Fig. 10: Right transperitoneal robotic extended pyelolithotomy. All stones are moved from the paracolic gutter into the specimen retrieval bag.

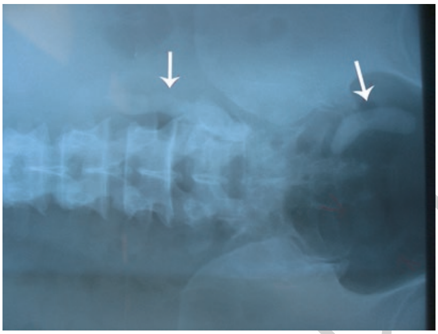

Fig. 11: Preoperative abdominal X-ray demonstrating multiple radiopaque large left ureteric stones (*arrows*).

Fig. 12: Retrieved multiple ureteric stones by left robotic ureterolithotomy.

Table 8: Current published world experience with robotic pyelolithotomy.

			Stone type				
	Number of patients (n)	**Intra-renal pelvis configuration**	**Partial staghorn**	**Complete staghorn**	**Mean stone size (cm)**	**Operative time (min**	**Associated procedures**
Badani et al. [6]	13	6	12	1	4.2	158	Lower polar nephrolithotomy-2
Nayyar et al. [8]	3	3	3	–	3.5	85	Secondary calculi in inferior and middle calyx-2
Lee et al. [7]	5	–	–	4		315.4	Open conversion-1 concurrent pyeloplasty-1
Hemal et al. [20]	50	–	6	–	3.5	106	–

regardless of approach and should be considered only after considerable experience with robotic surgery. More commonly, those with intrarenal pelves are encountered and represent about half of all REP patients in some series [6]. Retroperitoneal laparoscopic robotic pyelolithotomy has also been performed in select cases based on principles of retroperitoneal laparoscopy [18].

Current World Experience and Results

Presently, there are insufficient data to formulate specific usage of robotics for treating stone disease primarily. The combined world experience in published literature remains limited (Table 8). Earlier series laid the ground work for feasibility and safety of performing REP [6]. The authors achieved a 100% clearance in cases of partial staghorn renal calculi, irrespective of the renal pelvis configuration with a mean robotic operative time of 108 min (range 60–193). None of the patients experienced postoperative fever or urine leak. In a later smaller series, we were able to further reduce operative time and incorporated modifications in cases that presented with intrarenal pelves [8]. An alternative trocar configuration was employed with a 30° downward viewing lens using the da Vinci S robot. Stone retrieval was performed using a homemade endobag or Endo Catch I bag (Covidien, Minneapolis, MN) via the robotic camera trocar (12 mm) by providing laparoscopic vision with a 5 mm laparoscope placed through the 5 mm trocar. Lee et al. reported their experience with robotic pyelolithotomy for staghorn calculi in four children (mean age 16.6 years) with cystine staghorn calculi [14]. Of these, three were rendered stone free, while one had a 6 mm residual lower pole stone. One patient required conversion to open surgery due to inability to retrieve the stone from the pyelotomy. In our experience, a flexible cystoscope through the robotic trocar or assistant trocar can be used to extract the stones from calyces; however, it is cumbersome and a tedious maneuver and can also lead to spillage of fluid into the peritoneal cavity.

An article was recently published in which 16 patients with large (>2 cm), impacted lower ureteral stones underwent robotic-assisted laparoscopic ureterolithotomy [19]. Stone-free rate was 100%, and there were no major postoperative complications. Mean follow-up time was only 13 months (longest 20 months), so long-term complications such as ureteral stricture formation could not be properly assessed.

Limitations of the Procedure

Robotic pyelolithotomy currently involves a transperitoneal approach in most cases, which is contrary to existing norms of treating urolithiasis. Due to this anterior approach, the renal vessels present a major limiting factor to superior infundibulotomy. The inherent position of the patient and the robot precludes the satisfactory use of intraoperative fluoroscopy to assess residual calculi. The lack of haptic feedback makes it difficult to perform a nephrolithotomy. We have performed retroperitoneoscopic robotic pyelolithotomy; however, we do not perform this routinely as it is challenging in morbidly obese patients and in those patients with unusual body habitus or stature.

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Discussion

Although endoscopic techniques are the mainstay of treatment of large renal calculi, laparoscopic surgery is an acceptable minimally invasive alternative [1–5, 9–13]. Meria et al. compared PCNL and laparoscopic transperitoneal pyelolithotomy for renal pelvic stones >20 mm and found comparable results (82% vs. 88% 3-month stone-free rate) but significantly longer operative time and different postoperative morbidity [20, 21]. While bleeding was the predominant complication in the PCNL group, open conversion and urinary leakage were seen in the laparoscopic group. They concluded that, though PCNL remains the gold standard for most large pelvic stones, specific indications needed to be determined for each of the techniques. Transperitoneal laparoscopic pyelolithotomy was successfully utilized in children with large pelvic renal calculi with failed SWL therapy in whom a percutaneous access failed [22]. Laparoscopic management of stone disease has been described extensively in the literature [9–13].

REP is a feasible and safe technique for renal stone surgery [6]. It provides a combination of a minimally invasive technique and the surgical principles of renal parenchyma-sparing surgery [23, 24]. Clearly, bulky renal pelvic stones within an extrarenal pelvis are ideal candidates for the robotic approach; however, wristed instruments and magnification allow the procedure to be completed in intrarenal pelves as well. Despite transperitoneal access, no adverse sequelae of the inevitable minimal urine spillage have been reported [20]. The procedure attempts to replicate the principles of open stone surgery in a select group of patients (i.e., bulky renal pelvic stones) without transgression of the renal parenchyma, thus obviating its associated inherent complications [8]. REP may thus serve as an additional technique in the armamentarium of the urologist in treating large renal calculi [20, 25].

Patients on anti-platelet therapy and Jehovah's witnesses represent additional indications for robotic stone removal. This approach allows direct entry into the renal pelvis alleviating the need to traverse the renal parenchyma and thus minimizing chances of bleeding. This renal parenchyma-sparing approach may also prove useful in patients with bulky renal pelvic stone disease and impaired renal function with decreased renal functional reserve.

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Robotic Rectovesical Fistula Repair

Lawrence L. Yeung, James Mason, Justin Dersch

Standardized Terminology

1. da Vinci® Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA) as first citation then da Vinci® thereafter. The use of the da Vinci Si HD (versus standard, S or Xi) robot is assumed in each of the chapters unless specifically required or dictated by the procedure. As the Si HD is currently the most commonly used system, it is preferable to avoid describing procedures performed with standard or Xi systems as these are less relevant to the audience.
2. Trocar (not port)
3. Urethral catheter (not Foley catheter)
4. Electrocautery (not cautery)
5. Polyglactin (not Vicryl)
6. Hasson trocar (not Hassan)
7. Hem-o-lok (not Hemolok

Patient Selection

The indications for robotic rectovesical fistula (RVF) repair and open rectovesical fistula repair are identical. They include symptoms of RVF, which can include pneumaturia, fecaluria, and/or leakage of urine per rectum. The presence of rectovesical fistula can be confirmed with radiographic or endoscopic evidence (cystoscopy or colonoscopy) of a communication between the rectum and the bladder. Radiological studies that are useful include computed tomography with bladder or rectal contrast. Absolute contraindications to repair by the robotic approach include uncorrect-

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able bleeding diatheses or the inability to medically tolerate general anesthesia. A transabdominal robotic-assisted laparoscopic technique also should not be used in patients with a more distal rectourethral fistula as the approach will likely give inadequate exposure for a successful repair.

Since rectovesical fistulas are generally iatrogenic in nature, the effects of prior abdominal and pelvic surgery are often encountered. Morbidly obese patients pose the additional challenges of respiratory compromise while in the steep Trendelenburg position, more limited working space, and instrument length limitations. Repeat RVF repairs are found to be even more complex and these scenarios should be avoided in a surgeon's early experience with robotic RVF fistula repair. Patients with prior surgical removal of the omentum or prior use of omental flaps may pose a greater technical challenge when attempting to interpose a vascularized flap, but this is not an absolute contraindication depending on the skill and experience of the surgeon as alternative vascularized flaps may be used.

Preoperative Preparation

Preoperative testing for surgical clearance is typically obtained within 30 days of surgery. This includes a complete blood count, basic metabolic panel, coagulation profile, EKG, chest x-ray, and urinalysis with culture as indicated. For more medically complex patients it is important to address their medical conditions prior to surgery, therefore general medicine or other medical subspecialties may need to be consulted for comprehensive preoperative medical optimization. Anticoagulants are held at least 7–10 days prior to surgery.

Imaging

A cystogram and retrograde urethrogram should be obtained to ascertain the location of the fistula between the rectum and urinary tract. A computerassisted tomography (CT) cystogram is also useful in preoperative planning and provides more anatomic detail than a plain film cystogram. If the fistula is suspected and cannot be demonstrated by CT cystogram, a CT of the pelvis with rectal contrast can be performed in an attempt to identify the fistula.

Bowel Preparation

Starting the day before surgery patients are directed to take only clear liquids along with one bottle of citrate of magnesium. A Fleet Enema (C.B. Fleet Company, Inc., Lynchburg, VA) is administered the morning of surgery to ensure the rectal vault is clear of stool.

Informed Consent

Patients should be counseled on the known risks of surgery such as bleeding, infection, postoperative pain, incisional hernia, and the need of transfusion. They should also be aware of the potential for conversion to open surgery. A thorough discussion about the risk specific to robotic rectovesi-

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cal fistula repair should also be had. This includes the risk of damage to adjacent intraabdominal organs, recurrent fistula, urinary leak, bowel leak, new or worsened impotence, and new urinary or bowel symptoms.

Operative Setup

Operating room setup (see Fig. 1) for transabdominal robotic rectovesical fistula repair. Operating room setup for robotic rectovesical fistula repair is similar to other robotic pelvic cases with the addition of equipment needed for the cystoscopy portion to start the case. Fluoroscopy is needed for the initial cystoscopic portion, and once this is completed the room can be adjusted for robotic use. Figure 18.1 illustrates the typical room layout for the robotic portion of the case. The surgeon console is in the corner of the room. The surgical assistant is at the patient's right with the surgical technician at the patient's left. The back table is typically placed to the left of the patient near the surgical technician with an additional table to the patient's right near the assistant with instruments available for quick access such as surgical clips.

Patient Positioning

Patient in split leg position on operative table (See Fig. 2). Note proper padding to protect all sites susceptible to pressure injury. The patient undergoes induction of general anesthesia and then positioning begins. First, the patient is placed in the dorsal lithotomy position using stirrups for the cystoscopic portion of the procedure as described later.

Next, the patient is placed in the supine split leg position as illustrated in Fig. 2. Foam padding is placed under each knee to prevent the legs from lying flat on the table and they are secured with tape. The legs are then split approximately 45° to allow for docking of the robot base near the foot of the bed. The left leg is lowered approximately 20°–30° so the fourth arm will not be in contact with the patient's left foot. After the lower body is positioned, foam padding is placed under the elbows and each arm is tucked along the patient's side. The patient's hands are covered with foam padding for protection during the case. The patient's upper body is secured to the table with foam padding and heavy tap across the upper chest.

Once the patient is fully secured we perform a test Trendelenburg position to ensure the patient does not slide. Next, the patient is prepped and draped and a 16 Fr urethral catheter is placed on the field. An oral gastric tube is placed by the anesthesia team and removed at the end of the procedure prior to extubation.

Trocar Configuration

Trocar configurations (See Fig. 3) for robotic RVF repair. Once pneumoperitoneum is established, the working trocars are placed. As shown in Fig. 3, a total of six trocars, including the camera port,

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are used: one 12 mm trocar for the camera, three intuitive 8 mm metal robotic trocars for the robotic arms, and a 5 and 12 mm trocar on the patient's right side for the assistant ports.

As is commonly recommended for transperitoneal robotic prostatectomy, we measure the distance between each trocar, ensuring there is at least 8 cm from the camera port to the first and third robotic arm ports and 8 cm between the third and fourth robotic arm ports. The assistant ports are offset from the first robotic arm port to the patient's right with the 12 mm trocar about 8 cm lateral to the first arm port and the 5 mm port about 8–10 cm cephalad and triangulated between the first robotic arm, the 12 mm assistant port, and the base of the penis.

Instrumentation and Equipment List

Equipment

- da Vinci Si Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist curved monopolar scissors (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist ProGrasp forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist bipolar Maryland forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist needle driver (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist mega suture cut needle driver (Intuitive Surgical, Inc., Sunnyvale, CA)
- InSite Vision System with 0° and 30° lens (Intuitive Surgical, Inc., Sunnyvale, CA)

Trocars

- 8-mm robotic trocar (3 if using a four-armed technique)
- 12-mm trocar (2)
- 5-mm trocar (1)

Recommended Sutures

- Rectal fistula closure: 2-0 polyglactin on UR-6 needle cut to 6 in.
- Bladder fistula closure: 2-0 polyglactin on UR-6 needle cut to 6 in.
- Bladder closure: 2-0 polyglactin × 2
- Suturing of omental flap: 2-0 polyglactin × 3
- Drain stitch: 2-0 nylon
- Skin Closure: 4-0 Monocryl

Instruments Used by the Surgical Assistant

- Laparoscopic needle driver
- Laparoscopic Scissors
- Blunt tip grasper

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- Suction irrigator device
- Small, Large, and Extra Large Hem-o-lok clip appliers
- SURGICEL hemostatic gauze (Ethicon, Inc., Cincinnati, OH)
- 18 French urethral catheter
- Jackson-Pratt closed suction drain
- 10 mL syringe
- 60 mL catheter tip syringe
- 6 French JJ ureteral stent (length determined by measurement) (2)

Additional Equipment

- Rigid cystoscope, 22 French sheath and 30° lens for placement of nonconductive wire through the fistula and bilateral ureteral stent placement
- Open-End Flexi-Tip Ureteral Catheter, 5 Fr. (Cook Medical, Bloomington, IN) (1)
- Bentson Cerebral Guidewire (Cook Medical, Bloomington, IN) (1)
- Hydrophilic Guidewire (1)
- 16 French urethral catheter
- 10 mL syringe
- Fluoroscopy for ureteral catheter placement

Step-by-Step Technique (Figs. 1, 2, 3, 4, 5, 6, and 7)

Step 1: Cystoscopy, Bilateral Ureteral Stent Placement, and Fistula Canalization

For robotic laparoscopic rectovesical fistula repair with a combined retrovesical and transvesical approach, the patient is initially positioned in dorsal lithotomy position for cystoscopy and passage of a nonconductive wire (or ureteral catheter) through the fistula into the rectum to help later identify the fistula tract intraoperatively.

The bladder is entered transurethrally with a 22 F ridged cystoscope and 30° lens. Both ureteral orifices are identified as well as the fistula tract. A 6 F double J ureteral stent is placed into each ureter over a guidewire. Care is taken to place an appropriately sized stent to prevent the coil from obscuring the fistula site. This measurement is performed by using an end hole catheter to determine the distance from the ureteral orifice to the ureteropelvic junction. Two centimeters are subtracted from this measurement to choose the appropriate stent length. The placement of open-ended ureteral catheters is not optimal as they would obscure visualization of the fistula.

A nonconductive hydrophilic wire is then passed through the fistula tract cystoscopically. The surgeon's finger is placed into the rectum to pull the wire out and clamp it to the urethral end of the wire to achieve through-and-through access across the fistula tract. The external portion of the nonconductive wire is wrapped in a sterile towel, as this will be within the field during the robotic portion of the procedure. The patient is then undraped and repositioned as seen in Fig. 2 in the supine split leg position.

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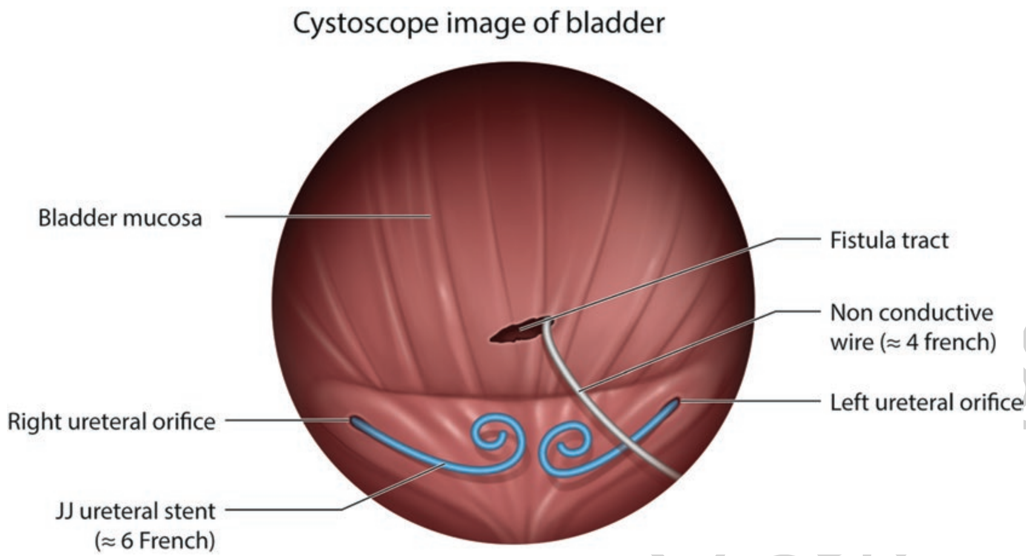


Fig. 1: Insertion of nonconductive wire through fistula tract via cystoscopy.

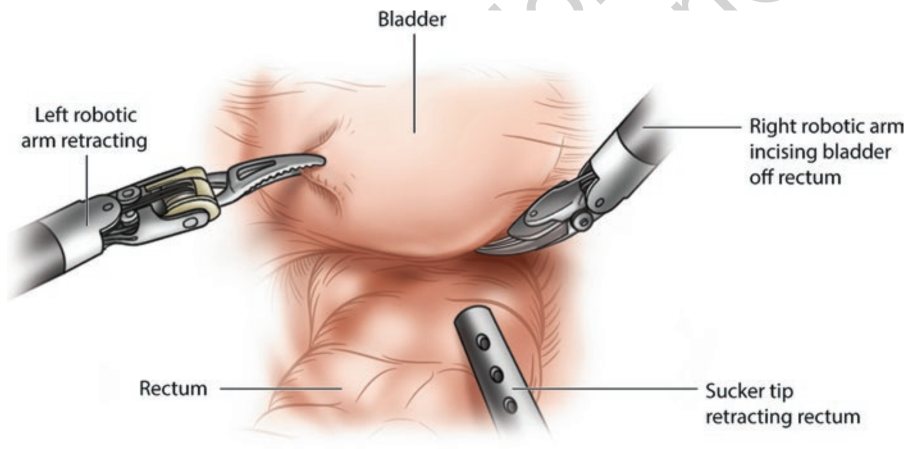


Fig. 1: Mobilization of bladder off rectum.

Refer to the section on patient positioning for specific directions on safely positioning the patient. An 18 F urethral catheter is placed transurethrally into the bladder on the sterile field.

Step 2: Trocar Placement and Robot Docking

Pneumoperitoneum is generally established with the Veress needle or alternatively the Hassan technique if there is concern for abdominal wall adhesions from prior surgery. The Veress needle

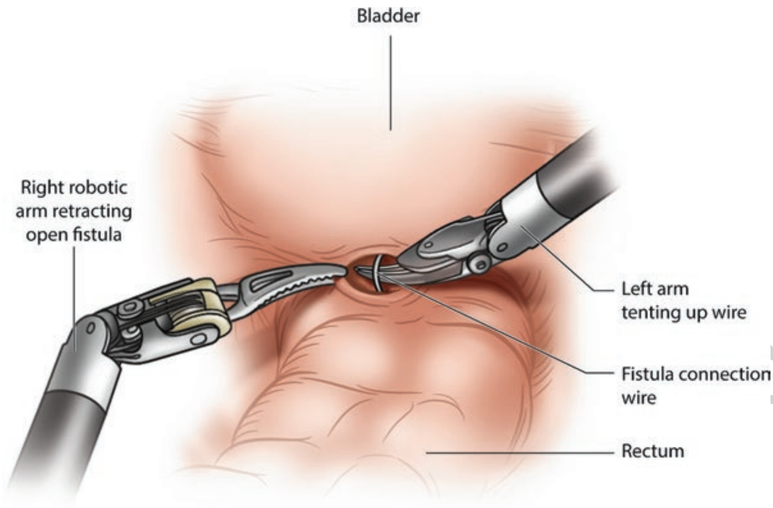


Fig. 3: Identification of nonconductive wire through fistula.

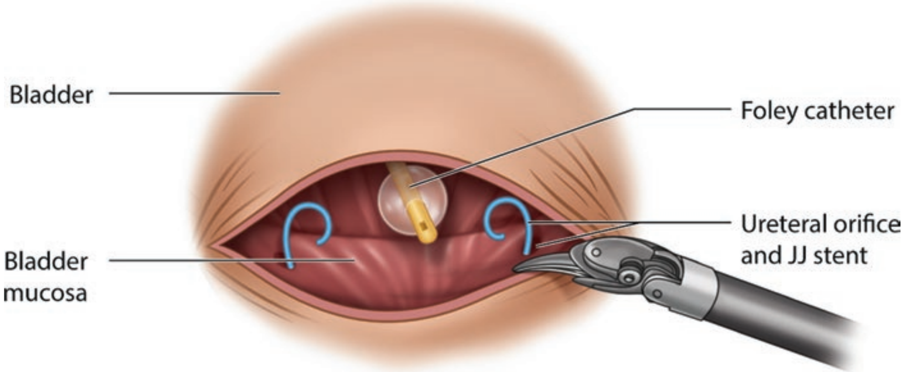


Fig. 4: Transverse cystotomy.

is placed in the midline just below the umbilicus. Once sufficient insufflation to 15 mmHg is obtained, a 12-mm camera port is placed with a visual obturator and 0° camera lens just superior to the umbilicus, taking care to stay within 17 cm above the pubis as the robotic instruments are limited to a working length of 25 cm. Once inside the abdomen, the Veress needle is identified and removed. Inspection of the surroundings for injury secondary to Veress needle placement or bowel adhesions is quickly performed. The remaining trocars are placed under laparoscopic vision.

As shown in Fig. 3, a total of six trocars, including the camera port, are used: one 12 mm trocar for the camera, three 8 mm metal robotic trocars for the robotic arms, and a 5 and 12 mm trocar on the patient's right side for the assistant ports. Refer to the section on trocar configuration for specifics regarding trocar location.

Fig. 5: Intravesical fistula dissection.

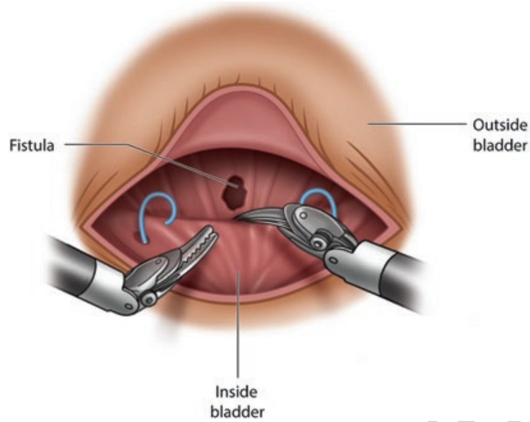
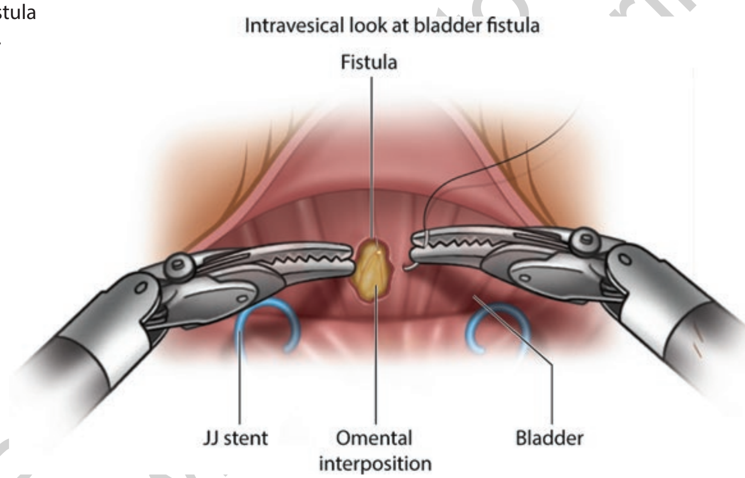


Fig. 6: Closure of intravesical fistula after omental flap interposition.



Prior to making incisions for the robotic and assistant trocars, insufflation to 15 mmHg is established, 0.25% Marcaine is injected at each site, and the trocars are placed. Care is taken to adjust the assistant trocars based on the patient's body habitus to give the assistant a straight access to the pelvis. If the 12 mm assistant trocar is placed too laterally, there will be difficulty working along the ipsilateral side of the patient within the pelvis. Also, the 5 mm assistant trocar must be placed cephalad enough to allow the assistant to use both the 12 and 5 mm ports simultaneously without clashing with the external robotic arms. In many patients, the 5 mm assistant trocar will be within a several centimeters of the costal margin.

Once the trocars are placed, the patient is placed in a steep Trendelenburg position. The robot is moved into position between the patient's legs taking care to bring the base of the robot in close enough so that the camera port is within the working limits. Next, the robotic arms and instruments are inserted as well as a 30° lens in a downward configuration. The monopolar scissors are placed in the first robotic arm while the bipolar forceps are inserted into the left robotic arm. Both monopolar and bipolar electrocautery are set at 45 W throughout the procedure.

Step 3: Mobilization of Omentum (Table 1)

The initial step, after abdominal access, is mobilization of the omentum. Any adhesions between the omentum and the anterior abdominal wall or small bowel segments are lysed. Care must be taken to preserve the distal omentum and its blood supply for later use as a vascularized flap for interposition. A long tag suture may be placed in a dependent portion of the omentum to assist in bringing the omentum down to the pelvis when needed for interposition between the bladder and rectum.

Step 4: Separation of Bladder and Rectum

Next, attention is turned to the pelvis and the fourth arm is used to retract any redundant colon or small bowel that is lying in the pelvis. Adequate lysis of any adhesions may be necessary at this point to allow good mobility of bowel structures out of the pelvis.

The assistant can apply intermittent traction to the urethral catheter to assist the surgeon in identification of the plane between the bladder and rectum. This plane is carefully developed caudally with a combination of monopolar electrocautery via the scissors and sharp dissection. The assistant uses the suction irrigator device to maintain visibility by clearing the field of electrocautery smoke and blood. As the surgical plane is developed, the Maryland forceps are used to retract the bladder anteriorly while the assistant uses the suction irrigator device to provide countertraction posteriorly on the rectum.

Step 5: Identification and Mobilization of Fistula

The dissection of the bladder–rectal plane is continued caudally until the fistula tract is encountered. Care must be taken during transection of the fistula tract to preserve the nonconductive wire in place that serves to localize the fistula. The dissection should be carried out past the fistula tract caudally and laterally to allow for adequate mobilization of the rectum for closure.

Fig. 7: Cystotomy closure.

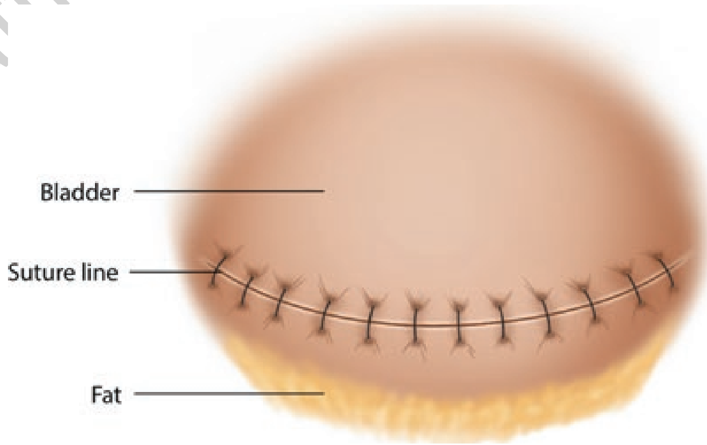


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Table 1: Mobilization of omentum: surgeon and assistant instrumentation.

Surgeon instrumentation			Assistant instrumentation
Right arm	**Left arm**	**Fourth arm**	• Suctionirrigator
• Monopolar scissors	• Maryland forceps	• ProGrasp forceps	• Hem-o-lock clip applier and clips
Endoscope lens: 30° down			

Step 6: Cystotomy

Once the plane between the bladder and rectum is adequately dissected, the next step is opening the bladder to provide better access and dissection of the most distal part of the fistula tract, which is typically difficult to expose via the retrovesical approach. A transverse cystotomy is created at the dome that is wide enough to allow movement of the camera and the two robotic working arms into the bladder.

Step 7: Intravesical Fistula Dissection (Table 2)

Once the cystotomy has been completed, the surgeon identifies stents in the ureteral orifices and notes their location so as to preserve them and avoid accidental injury. Next, the balloon of the urethral catheter is deflated followed by removal of the catheter. This permits visualization of the nonconductive wire as it emerges from the bladder neck and continues through the rectovesical fistula posteriorly.

The surgeon now sharply incises the bladder mucosa circumferentially around the intravesical portion of the fistula without the use of cautery.

The surgical assistant should provide optimal visualization by using the suction irrigation device to retract the bladder when necessary and clear the field of urine and blood. The bladder wall is undermined circumferentially to a distance of 1–2 cm around the fistula to allow for a tension-free closure of the bladder and rectal walls. This distance can be estimated with the knowledge that the scissor tips are approximately 1 cm in length. Care must be taken to avoid ureteral injury while undermining the bladder wall during this step.

Step 8: Rectal Defect Closure (Table 3 and 4)

Next, attention is turned to closure of the rectal defect via the retrovesical plane. The edges of rectal mucosa are trimmed back to healthy tissue. The fistula must be adequately mobilized circumferentially to allow for a tension-free, watertight closure with apposition of healthy rectal mucosa.

A 2-0 polyglactin suture on a UR-6 needle cut to 6 in. is used to close the rectal defect in an interrupted fashion. The side of the fistula closest to the bladder neck can be difficult to access via the retrovesical approach, and it may be easier to close this location transvesically. Watertight closure of the rectal defect can be confirmed by filling the pelvis with water from the suction irrigator and then insufflating air into the rectum.

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Table 2: Intravesical fistula dissection: surgeon and assistant instrumentation.

Surgeon instrumentation			Assistant instrumentation
Right arm	**Left arm**	**Fourth arm**	• Suctionirrigator
• Monopolar scissors	• Maryland forceps	• ProGrasp forceps	• 10 cm^3 syringe
Endoscope lens: 30° down			

Table 3: Rectal defect mobilization: surgeon and assistant intrumentation.

Surgeon instrumentation			Assistant instrumentation
Right arm	**Left arm**	**Fourth arm**	• Suctionirrigator
• Monopolar scissors	• Maryland forceps	• ProGrasp forceps	• 10 cm^3 syringe
Endoscope lens: 30° down			
• Mega suture cut needle driver	• Needle driver	• ProGrasp forceps	• Laparoscopic needle driver
Endoscope lens: 30° down			• 2-0 Polyglactin suture

Table 4: Rectal defect closure: surgeon and assistant instrumentation.

Surgeon instrumentation			Assistant instrumentation
Right arm	**Left arm**	**Fourth arm**	• Suctionirrigator
• Monopolar scissors	• Maryland forceps	• ProGrasp forceps	• Laparoscopic needle driver
Endoscope lens: 30° down			• 2-0 Polyglactin suture

Step 9: Omental Interposition

After the rectal defect is closed, a vascularized omental interposition flap is interposed to decrease the chance of recurrence by eliminating overlapping suture lines. This is accomplished by identifying the previously mobilized omentum and bringing it to the pelvis. Four to five 2-0 polyglactin sutures are passed through the rectal wall superficially in a location distal to the closed rectal defect, and then the sutures are passed through the distal end of the omental flap and tied down. It is important to ensure complete interposition of the flap between the rectal and bladder repairs.

Step 10: Intravesical Fistula Neck Closure

After the omental flap has been interposed, the bladder side of the fistula is closed via the transvesical approach. This is performed with interrupted 2-0 polyglactin sutures on a UR-6 needle cut to 6 in.

Step 11: Bladder Closure

The next step of the procedure is cystotomy closure. This is done with a two-layer running closure using 2-0 polyglactin suture. First, an 18 French urethral catheter is placed through the urethra until the tip and balloon portion are within the bladder. The balloon is not inflated at this point to prevent the risk of puncturing it while closing the cystotomy. The first layer of the closure is performed by reapproximating the mucosal layer in a running fashion. For the second layer, the muscularis and serosa are run closed in an imbricated fashion. Once the cystotomy closure is complete, the integrity of the bladder closure is tested by injecting 150–200 mL of normal saline through the urethral catheter using a 60 cm^3 catheter tip syringe. Any leaks noted in the suture line are over sewn with 2–0 polyglactin suture in a figure of eight fashion. The urethral catheter balloon is then inflated with 10 mL of sterile water.

Step 12: Surgical Drain Placement and Exiting the Abdomen

The final step is placement of a surgical drain and exiting the abdomen. Surgical drain placement is important to monitor the bladder repair for a urine leak and to evacuate any fluid and blood in the pelvis. The surgical assistant passes a 10 French Jackson Pratt drain through the 12 mm assistant port. The surgeon grasps the end of the drain and places it within the pelvis but away from the cystotomy closure or fistula repair so as to prevent direct suction on these areas which could lead to fistulization. The drain is secured to the skin with a 2-0 nylon suture, and the robotic instruments and camera are removed and the robot is undocked. The 8 and 5 mm trocars generally do not require fascial closure, and the skin incisions are closed subcutaneously with a 4-0 monofilament absorbable suture. The fascia of the 12 mm camera trocar also generally does not require formal closure if a nonbladed, selfdilating trocar is used.

Postoperative Management

Postoperative pain control is titrated to provide the patient with enough comfort for good mobility, taking care not to cause excessive drowsiness or delayed return of bowel function. Intravenous narcotics are used as the mainstay for pain control with the addition of intravenous nonnarcotics such as ketorolac (as bleeding risk and renal function permit) or acetaminophen (as liver function permits) to minimize the narcotic need. The patient is transitioned to oral narcotics once return of bowel function is demonstrated. A clear liquid diet is given on postoperative day 1 and is advanced to a regular diet as tolerated. Stool softeners are given postoperatively and continued until postoperative day 14 to prevent constipation, which could cause failure of the rectal repair.

The pelvic drain is removed prior to discharge if the output is low, and there is no concern for a urinary leak. If the drain output is high, the fluid should be sent for creatinine. If the fluid is consistent with urine, the drain should be taken off of bulb suction and placed to gravity drain to prevent further siphoning of urine out of the bladder. The patient is discharged home with the urethral catheter in place to gravity drain for a duration of 14 days. A cystogram is performed on postoperative day 14 to ensure a successful repair. If a persistent urine leak is noted, the cystogram is repeated weekly until healing is demonstrated prior to urethral catheter removal.

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Special Considerations

The surgeon attempting to perform robotic rectovesical fistula repair may encounter complex situations that they should be prepared to manage. For example, patients who have had prior bowel surgery may present with absent or shortened omentum that may not reach the deep pelvis. In this case, reasonable alternatives for tissue interposition include a peritoneal flap or epiploic appendage. Successful use of peritoneal flaps has been described for vesicovaginal fistula repairs. Fistula location must be considered as peritoneal flaps generally work best when fistula location is high enough for a well vascularized peritoneal flap to reach without requiring overly extensive dissection. An alternative option is a lengthy epiploic appendage found on a mobile cecum or caudally draping transverse colon.

Large fistula tracts can be more challenging to manage with a possible increased risk of failure. In cases of fistulas greater than 2 cm or in tenuous repairs, fecal diversion along with suprapubic catheter placement should be considered. Our preference for fecal diversion is with a laparoscopic diverting loop ileostomy performed by our colorectal surgeons. The ileostomy can be reversed 3–4 months after successful healing of the fistula. Placement of a suprapubic catheter allows for extended bladder drainage if needed, while avoiding additional irritation to the vesical fistula closure site from the urethral catheter balloon as it enters the bladder neck. These additional steps may lead to improved repair success and avoidance of the need for further repair attempts in an increasingly hostile abdomen from multiple surgeries.

Potential Complications and Steps to Avoid Them

There are several potential complications to avoid during robotic rectovesical fistula repair. This section aims to address situations that, if avoided, can improve the success and durability of fistula repair.

1. Omental devascularization—Knowledge of omental vascular anatomy can prevent damaging a good omental interposition flap while obtaining pedicle length. If there is difficulty with obtaining sufficient omental length to reach the pelvic repair for interposition, the pedicle can be lengthened. Division of one of the gastroepiploic arteries and gastric attachments often allows for adequate pedicle length. Generally the right gastroepiploic artery is more robust. Therefore, division of the left gastroepiploic artery and short gastric arteries can be performed to lengthen the flap. Care must be taken to avoid gastric injury or ligation of the contralateral gastroepiploic artery.
2. Additional rectal injuries—This can occur during development of the plane between the bladder and rectum. It is critical to perform this step carefully as additional rectal injuries increase the size of defect needing closure, which can lead to increased risk for failure of the repair.
3. Ureteral injury—This can occur during separation of the bladder and rectum or during undermining of the bladder tissue during the transvesical approach. Placement of ureteral

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stents at the beginning of the case can aid in ureteral identification and help prevent these injuries.

4. Inadequate fistula closure—In a patient with a rectovesical fistula, further surgery becomes increasingly difficult. Therefore, the best chance for a durable repair is with the first attempt. The principles of fistula closure should be applied during a robotic rectovesical fistula closure to maximize chances of success. Those principles include a tension-free anastomosis, water or airtight closure, adequate mucosa to mucosa apposition, and nonoverlapping suture lines.

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Source: Lawrence L. Yeung, James Mason, Justin Dersch. Robotic Rectovesical Fistula Repair. Yeung L.L., Mason J., Dersch J. (2017) Robotic Rectovesical Fistula Repair. In: Su LM. (eds) Atlas of Robotic Urologic Surgery. Springer, Cham, pp 339-349. DOI 10.1007/978-3-319-45060-5_24. © Springer International Publishing Switzerland 2017.

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Minimally Invasive Management of Urinary Reflux

Charlotte Wu, Hans G. Pohl

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Introduction

Vesicoureteral reflux (VUR) is the retrograde flow of urine from the bladder to the upper urinary tract through a defective ureterovesical junction (UVJ). Primary reflux is considered to occur as a congenital defect, not associated with any form of bladder pathology resulting in increased intravesical pressure. By contrast, secondary reflux occurs when high bladder pressures, such as in the context of neurological dysfunction or bladder outlet obstruction, overwhelm a normally functioning UVJ. This difference between primary and secondary reflux becomes less distinct when one considers that many children (mostly girls) who are found to have primary VUR in the context of a UTI evaluation also have inherent bladder dysfunction.

Reflux has been described as uncommon among the general pediatric population with an estimated prevalence of less than 1 % [1]. This figure is now thought to be an underestimation. True data on the prevalence of VUR has been difficult to gather as the diagnosis is made almost exclusively in select patients who trigger a workup, such as those with prenatal hydronephrosis, UTI, or family history of VUR. No large population studies have been performed [2]. Also, the natural history of VUR is such that it tends to resolve with time; therefore, prevalence of the condition depends largely on age.

VUR is significantly more common among children presenting with febrile UTI with an incidence in this group estimated at 30–70 %. In one meta-analysis, the prevalence of reflux was estimated to be 30 % for children with UTI and 17 % without infection [3]. Factoring in the epidemiology of UTIs in children, boys and girls tend to present with reflux at different ages. In the neonatal period, UTIs are more common in uncircumcised boys, and VUR is more commonly diagnosed in boys in the neonatal age group [4]. In school-age children, the incidence of UTIs and VUR is higher in girls. VUR is 5–6 times more common in girls than boys after 1 year of age. VUR is also tenfold more common in Caucasians than in African Americans, with fair-skinned, red-haired children being most affected [5]. There is a genetic component, though the exact method of inheritance remains unknown. Reports have suggested a predilection for younger siblings to be affected [6].

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While reflux is not typically harmful in the absence of bacterial contamination or high bladder pressures, children with reflux and bacteriuria are at a much higher risk for pyelonephritis. It is important to note that in most cases reflux is not a cause of UTI, but rather facilitates bacterial ascent in the urinary tract. Some, however, do regard very high-grade VUR as possibly increasing the risk for UTI based on urinary stasis: the high volume of urine ascending into the upper urinary tract drains back into the bladder as retained residual urine. While this hypothesis seems logical, the degree to which this residual contributes to the risk for UTI is unproven. Repeat episodes of pyelonephritis have been linked to acquired renal scarring, hypertension, renal dysplasia, and progressive renal failure. Reflux nephropathy is the cause of endstage renal failure in an estimated 3–25 % of children [7]. These all highlight the importance of diagnosis and treatment in the affected pediatric population.

Preoperative Evaluation

History

Children with VUR commonly present with febrile UTI. Parents may report fussiness, lethargy, poor feeding, and fevers. Older children may report dysuria or flank pain. In some instances, there may be episodic unexplained febrile illnesses without a history of documented UTIs. In this patient population, there have been reports of mistakenly treating the child for other conditions such as otitis media, highlighting the importance of urinalysis and culture in the workup for all children with unexplained fever.

As prenatal screening sonography is now routine, hydronephrosis is often detected in utero. About 10–15% of prenatal hydronephrosis cases are later diagnosed as reflux [8]. If the hydronephrosis is confirmed after birth, it is standard of care to begin suppressive antibiotics until additional workup can be completed.

Urinary reflux often occurs in children with other urologic anomalies, such as in the context of reflux into the lower pole moiety of a duplicated collecting system, ureterocele, or reflux into an ectopic upper pole ureter located at the bladder neck or urethra. Secondary VUR is found in children with a history of posterior urethral valves, bladder exstrophy, prune belly syndrome, or neurogenic bladder [9, 10]. These conditions are associated with bladder dysfunction that may perpetuate primary reflux or cause secondary reflux. Children with behavioral dysfunctional bladder emptying can have similar consequences if the condition is not addressed [11].

Grading

A universal grading system for urinary reflux exists to prognosticate the course of disease at varying degrees of severity. There are five grades of classification, and these depict the appearance of the ureter, renal pelvis, and calyces as seen on voiding cystourethrogram (VCUG). Grade 1, the least severe, is the reflux of urine into a non-dilated ureter. This is followed by grade 2, reflux into the pelvis and calyces without dilatation; grade 3, mild to moderate dilatation of the ureter,

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renal pelvis, and calyces with minimal blunting of the fornices; and grade 4, moderate ureteral tortuosity and dilatation of the pelvis and calyces. The most severe is grade 5, gross dilatation of the ureter, pelvis, and calyces, loss of papillary impressions, and ureteral tortuosity. Generally, low-grade reflux (grades 1–2) tends to resolve spontaneously with time provided intact function of the lower urinary tract dynamics. Grade 3 reflux resolves in approximately 50 % of cases [12]. High-grade reflux infrequently resolves spontaneously with reported 9–25 % of grade 4–5 cases resolving [13] (Fig. 1).

Exam

The child with reflux typically has a normal physical exam. Symptomatic patients have an exam concerning for cystitis or pyelonephritis. This includes lethargy or fussiness, abdominal tenderness, costovertebral angle, or suprapubic tenderness. The urine may be foul-smelling. The child often has a fever or, in rarer instances, high blood pressure if renal damage is present from long-standing disease.

Labs

Basic chemistry panel may reveal elevated creatinine or electrolyte abnormalities from chronic renal failure in severe cases. Complete blood count may reveal leukocytosis if an infection is present. Urinalysis demonstrates the presence of leukocytes and/or nitrites with microscopic evaluation revealing urine WBC, RBC, or bacteria. Urine culture should be obtained and may confirm infection.

Imaging

The gold standard diagnostic study for VUR is a voiding cystourethrogram (VCUG). After urethral catheterization, the bladder is passively filled with contrast agent. Fluoroscopy is used to

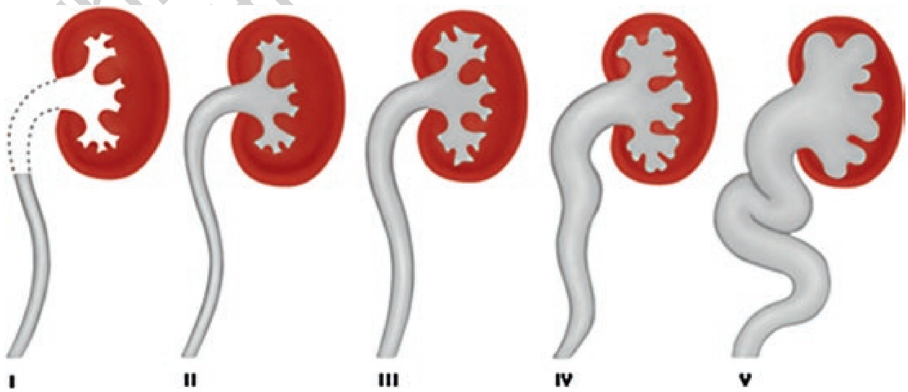

Fig. 1: International classification of vesicoureteral reflux (VUR). From Tullus K. Vesicoureteric reflux in children. *Lancet*. 2015;385(9965):371–9. Reprinted with permission from Elsevier Limited.

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assess for reflux during the filling phase and during the voiding phase when there is active bladder contraction. Several cycles of filling and voiding are sometimes needed to make the diagnosis as VUR may not occur with every void [14]. It is customary to delay obtaining a VCUG until the patient has had at least several days of antibiotics and is no longer febrile, for the simple reason that performing an invasive test on an acutely ill child serves only to further suffering. Typically, the VCUG is performed 1–2 weeks later [15] following recovery from the acute illness. The drawback to this method is that it can miss the diagnosis in individuals with transient VUR that might only manifest during UTI. In these children VUR may not be present in the uninfected bladder, but in the setting of cystitis, inflammation and edema can compromise the borderline valve mechanism at the UVJ. These children may have repeat episodes of pyelonephritis but test negative for reflux on VCUG during uninfected periods. Only then is VCUG during active infection considered.

Radionucleotide cystogram allows for imaging and detection of reflux without the need for urethral catheterization and additionally only requires 1 % the radiation exposure delivered by VCUG [16]. Contrast, usually Technetium Tc99, enters the bladder indirectly by renal excretion and is detected on scintigraphic gamma camera imaging. This study is prone to false-positive results due to contrast not originating from the bladder and misreading of contrast remaining in the ureter or renal pelvis as a sign of reflux. It also is a poor modality for grading the degree of reflux and particularly in diagnosing lower grades of reflux. Given its higher sensitivity as compared with contrast cystography, radionucleotide cystography is most useful to rule out presence of VUR and therefore is most commonly used in children with known history of reflux for follow-up and identification of reflux resolution.

Renal-bladder sonogram is excellent for the initial detection and grading of hydronephrosis. Hydroureteronephrosis in a child with an infection often suggests VUR though is nondiagnostic. Given that ultrasound is a benign testing modality in children, it is the test of choice for initial evaluation of the pediatric patient with symptomatic UTI but should not be considered a proxy for VCUG as it is rarely positive [17]. Renal sonography is also used by some during the follow-up of VUR patients to assess renal growth. In very experienced hands, abnormalities in corticomedullary differentiation and/or renal size are suggestive of renal dysplasia and long-standing reflux.

Nuclear renal scintigraphy is the gold standard for imaging functioning renal parenchyma and renal scar detection. The study is performed by using 99 m Tc-labeled DMSA, which is taken up only by functioning renal cortical tissue (proximal tubules). Renal cortical abnormalities are visualized on DMSA scans as areas of photopenia, and acute pyelonephritis (APN) is distinguished from renal scars based on the persistence of the renal contour or its absence suggesting the loss of cortical volume (scar). Thus, it is useful both in the diagnosis of APN and for long-term assessment of renal cortex health. In fact, DMSA scintigraphy has been found to be more accurate than sonography for the detection of APN [18].

Other Tests

Urodynamic evaluation allows for assessment of bladder functional status, including emptying characteristics. It is particularly valuable for the detection of whether the bladder outlet is func-

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tioning properly or whether there is presence of higher resistance during voiding which could lead to abnormally high bladder voiding pressure. These conditions may worsen existing urinary reflux or delay spontaneous resolution.

Surgical Indications

Both medical and surgical managements are geared toward reducing infections and preventing renal cortical scarring. Once reflux is diagnosed, patients are continued on daily low-dose prophylactic antibiotics with regular follow-up and imaging until the reflux resolves or is corrected surgically. Common practice has been to allow all grades of reflux ample time to resolve spontaneously while on suppressive antibiotics, with the understanding that this approach is less successful in high-grade reflux. Some have advocated immediate surgical repair when the likelihood of resolution is slight, such as with bilateral grade IV reflux or unilateral grade V reflux, but this author prefers to observe all children initially. Children with secondary reflux should first be offered a management strategy that includes addressing bladder overactivity with anticholinergics, constipation with laxatives or fiber supplements, and poor emptying with timed voiding or catheterization, as appropriate.

Surgical intervention is typically warranted after medical management has been unsuccessful. In children with recurrent pyelonephritis on antibiotic prophylaxis, including those with breakthrough infections with resistant organisms, medical noncompliance or intolerance, or persistence of reflux with renal scarring, surgical correction is usually advised. Decision to operate will also be dependent in certain circumstances on the sex of the child. As the prime age of post-pyelonephritic renal scarring occurs in children up to age 5, asymptomatic low-grade VUR has less clinical significance in the older child [19]. In boys older than 5 years who have persistent VUR though no prior UTIs on antibiotic prophylaxis, antibiotics may be discontinued, and the child may not need future formal follow-up. In girls, surgical intervention may be recommended to prevent complications associated with APN during future pregnancies, although that recommendation should be tempered by the child's history of UTI and grade of VUR [20, 21]. Ultimately the decision to proceed to surgery and the type of surgical intervention to be undertaken will depend on many factors including the psychosocial needs of the child and family [22].

Technique: Laparoscopic and Robotic Surgery for Vesicoureteral Reflux

Extravesical Ureteral Reimplantation

Special Considerations

Laparoscopic and robotic-assisted laparoscopic surgery has been popularized in recent years with the primary goal of reducing perioperative morbidity associated with surgery while maintaining success rates. Laparoscopic correction of VUR using the Lich-Gregoir extravesical technique, the

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most commonly performed procedure for laparoscopic correction of reflux, was initially reported in 2000 [23]. With this technique, the bladder is approached from the retroperitoneum, and the distal ureter is dissected from the detrusor, leaving the ureteral orifice intact. Dissection of the detrusor is then carried out cephalad from the ureteral orifice to create a new submucosal tunnel. The ureter is positioned in the new tunnel, and the detrusor is re-approximated over the ureter. The technique has a steep learning curve. Another downside is potentially exposing the child to longer operative times [24, 25].

This same laparoscopic surgery is now done using robotic assistance, called robotic-assisted laparoscopic extravesical ureteral reimplantation (RALUR) using the da Vinci® Surgical System [26]. The robotic surgical system has facilitated performance of laparoscopic surgery and has risen in popularity among pediatric urologists for its ease in dissection and intracorporeal suturing.

Anatomy

The distal ureter passes through a submucosal tunnel in the bladder wall prior to its entry into the bladder lumen at the trigone. With bladder filling, this portion of the ureter stretches, thins, and is compressed against the detrusor back wall, preventing reflux of urine into the upper tracts. Inadequate length of the intramural distal ureter or inadequacy of the detrusor back wall leads to an incompetent valve mechanism. This has been the basis for all surgical interventions performed for surgical correction of VUR. In healthy, non-refluxing ureters, the tunnel length to ureteral diameter is 5:1. For success in definitive reflux correction surgery, the minimum tunnel length to ureteral diameter ratio should be at least 3:1.

Positioning

The patient is placed supine with the lower extremities abducted and frog-legged. Rolls are placed under the bilateral knees to offset the pressure from external rotation of the hips. Older children may be placed in lithotomy. The abdomen, pelvis, and perineum are prepped. Often, a cystoscopy is first performed and bilateral ureteral stents placed. A Foley catheter is left in place. The patient is then repositioned to Trendelenburg for the duration of the surgery.

Instruments

- Laparoscopic [23]:
  - 5-mm trocar
  - 3-mm working port x2
  - 5-mm working port
  - 5to 3-mm reducer seal
  - 3or 5-mm 0-degree laparoscope (or 30-degree)
  - 3-mm curved scissors
  - 3-mm tapered curved jaw dissectors x2

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    - 5-mm Babcock forceps, ratcheted
    - 3-mm Allis grasper, ratcheted
    - 3to 5-mm lap needle driver
    - Synthetic absorbable suture on a tapered needle
- Robotic [24]:
    - da Vinci® Surgical System
    - 8.5-mm robotic port
    - 5-mm robotic ports x2
    - Hook electrocautery
    - Maryland grasper
    - Hot scissors
    - Needle driver
    - 4-0 Prolene® (polypropylene, Ethicon) suture
    - PDS® (polydioxanone, Ethicon) suture
    - 5-0 Monocryl® (poliglecaprone, Ethicon) suture

Steps

A 5-mm, 0-degree laparoscope is inserted through the umbilicus and pneumoperitoneum is achieved. Traditionally, three working ports have been placed under direct vision along the line of a Pfannenstiel incision at the middle and two ends. The middle port is usually 5-mm and the two end ports 3-mm (Fig. 2). The ureter is identified at the pelvic brim and followed down to the distal aspect. The overlying peritoneum is incised. The ureter is identified and grasped with Babcock forceps and freed from the surrounding tissue. Ureteral stents, if placed previously, would be removed at this point. A vessel loop or Diamond-Fox retractor can then be passed around the ureter.

Next, the submucosal tunnel is developed. The direction of the tunnel is marked using electrocautery. A traction suture using 4-0 Prolene® is placed at the proximal end of the detrusor tunnel using a straight needle, and the needle is passed back externally through the abdominal wall. This suture can be manipulated externally to achieve the desired tension and elevation of the bladder. The incision of the tunnel is then performed in a proximal to distal manner. This dissection is carried down to but not violating the detrusor mucosa, using scissors rather than cautery to prevent injury to bladder innervation. Detrusor flaps are then created along this plane and elevated for a distance of approximately 4–5 cm. The ureter is placed in the tunnel, and a 5-0 Monocryl® suture is placed at the most proximal end and the detrusor is then closed (detrusorrhaphy) from distal to proximal starting at the ureteral orifice. A recent modification to this technique by Gundeti et al. includes a U-stitch of 5-0 PDS® incorporating the detrusor muscle and ureteral adventitia at the apex of the tunnel, followed by a continuous running suture, incorporating the ureteral adventitia in every other throw [27]. The traction suture is released, the bladder is filled, and the position of the ureter is reassessed. A catheter is left in the bladder for 12–24 h postoperatively.

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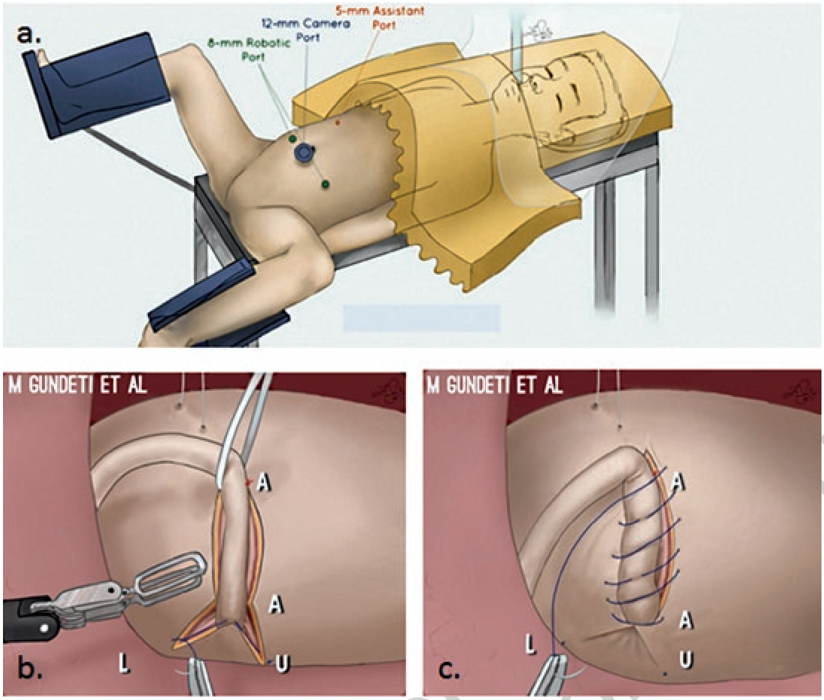

Fig. 2: (**a**) Patient positioning for RALUR (not shown is robot docking between the legs). (**b** and **c**) Creation of detrusorrhaphy with closure. From Gundeti MS et al. Robot-assisted laparoscopic extravesical ureteral reimplantation: technique modifications contribute to optimized outcomes. *Eur Urol*. 2016. Epub ahead of print. Reprinted with permission from Elsevier Limited.

In the robotic-assisted approach, the endoscope port at the umbilicus is placed with a 30-degree 12-mm scope. The two working ports are placed at the midclavicular line; in children <3 years old, placement is slightly above the umbilicus and in children 3 or older at the level of the umbilicus. The remainder steps in the surgery are the same.

Pearls/Pitfalls

The extravesical approach does not require cystotomy or ureteral anastomosis, thereby eliminating morbidity associated with these. Laparoscopic extravesical reimplant surgery, compared to the open extravesical approach, additionally allows for decreased hospital stay, reduced incisional pain, improved cosmesis, and decreased use of postoperative narcotics. Another benefit of the extravesical approach is that the child's anatomy remains favorable for endoscopic instrumentation later in life should the child need ureteroscopy for stones or other indications.

While many studies have demonstrated feasibility and safety of the laparoscopic approach, the drawback of this approach continues to be long operative times and a steep learning curve [25]. Some challenges worth highlighting are difficulty with exposure of the ureter, trauma to the ureter, and difficulty developing the extravesical tunnel. Laparoscopic ureteral reimplantation, despite high success rates, failed to become widely adopted given the technical challenges [24] and did not show significantly decreased morbidity compared to the open technique [25, 28]. With the addition of the robotic-assisted technology, first described in 2004, there has been improved visualization and suturing techniques over the purely laparoscopic approach.

Another notable pitfall is postoperative urinary retention [24, 29]. In one study, there were no reported cases of postoperative urinary retention in a group of 41 patients, attributed to improved visualization and preservation of the neurovascular bundle lateral to the ureteral hiatus using the robotic-assisted technique [29]. Despite this, other studies have reported difficulty identifying these nerves [24] and that even as the nerves are identified and preserved, the incidence of retention was unchanged [30]. Additional reports both critical and supportive of widespread use of RALUR have acknowledged increased operative times, and subsequently increased cost, versus the open approach. Peters et al. reported that for bilateral ureteral reimplantation, the average time for the open approach was 210 min versus 262 min for RALUR. There has been, however, no finding of significant increased operative times when comparing robotic unilateral reimplantation to robotic bilateral reimplantation.

Postoperative Care (Extravesical)

Most children are kept in the hospital for one night after the surgery. Diet is started right away and advanced as tolerated. Intravenous fluids are kept on until the child demonstrates ability to tolerate oral intake sufficiently. The Foley catheter is removed the day after surgery and the child discharged once voiding spontaneously with a post void residual that is no more than half of the voided volume. The child then follows up in 1 month with an ultrasound.

In experienced hands, the robotic technique has offered similar success rates (reportedly 77–100 %) as the open technique [27]. In one study the success rate of RALUR (as defined by resolution of reflux) was 97.6 % [29], and in one single-surgeon study comparing RALUR to open intravesical ureteral reimplant, the success rate was 97 % versus 100 %, respectively [24]. Two separate reports, one by Schomburg et al. [31] and another by Casale et al. [29], even suggested postoperative VCUG could be avoided given the high success rates in their experience, though other reports by skilled surgeons warned against adopting this approach until a larger series is available to confirm success rates similar to the open technique [24, 25].

As it currently stands, there is insufficient evidence to suggest that RALUR is at a point where it is clearly a superior option to the open technique. Some experts have suggested it may be particularly advantageous in bilateral cases and in cases of older children who would benefit most from the improved pain control [25, 31].

Intravesical Ureteral Reimplantation

Special Considerations

Another minimally invasive technique for VUR correction is endoscopic intravesical (or "transvesical") ureteral reimplantation. The approach was first described in 2005 using standard lapa-

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roscopic instruments and combines laparoscopic and endoscopic techniques. A roboticassisted approach was described the same year by Peters and Woo [32]. This approach is unique in that it does not require transperitoneal access, relying instead on carbon dioxide insufflation of the bladder or pneumovesicum. It has been supported for its potential to reduce postoperative bladder spasms, reduced incisional pain, improved cosmesis, and earlier postoperative catheter removal compared to the standard open ureteral reimplantation technique. The major components of this surgery are dissection of the ureter, creation of the submucosal tunnel, and ureteral neocystostomy similar to open Cohen cross trigonal reimplantation. Robotic assistance has facilitated the delicate dissection and suturing required for this procedure and has improved overall efficiency.

Positioning

The patient is placed supine with the lower extremities abducted and frog-legged or in dorsal lithotomy.

Instruments

- Laparoscopic [33]:
  - 0 or a 30-degree lens cystoscope
  - 4-0 Prolene® suture
  - No. 1 monofilament suture (traction suture)
  - 5-mm step port x1
  - 3to 5-mm working ports x2
  - 5-mm 30-degree lens endoscope
  - 4-Fr to 6-Fr catheter
  - Hook electrocautery
  - Endoscopic scissors
  - Endoscopic blunt and fine graspers
  - 3-0, 5-0, 6-0 Monocryl® suture
  - 5-0 PDS® suture
- Robotic [32]:
  - da Vinci® Surgical System
  - 12-mm 0-degree telescope
  - Hook cautery
  - DeBakey forceps
  - Round-tip scissors
  - Fine-point needle driver
  - 12-mm VersaStep radially expanding cannula
  - 5–10-mm InStep radially expanding sheath
  - 5-mm laparoscopic grasper

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Steps

Cystoscopy is first performed and the bladder filled with saline. A traction suture is placed percutaneously to the bladder dome under vision. This serves as an anchor so that the bladder does not pull away when the camera port is placed. A 5-mm port is inserted under cystoscopic guidance, a 5-mm 30-degree lens endoscope is inserted into the port site, and a Foley catheter is placed to decompress the bladder. Carbon dioxide pneumovesicum is established to 10 mmHg pressure, and the Foley catheter is clamped. Two additional 3-mm working ports are placed on either side of the bladder under vesicoscopic guidance.

Next, a 5-Fr feeding tube catheter is inserted into the ureter and secured with a 4-0 Prolene® suture similar to that of the Cohen open procedure. Hook electrocautery is used to incise circumferentially around the ureteral orifice for ureteral mobilization, and 3-mm endoscopic scissors are used to develop the plane of dissection and to mobilize the ureter 2.5–3.0 cm to the extravesical space. The muscular defect in the ureteral hiatus was repaired using 5-0 PDS®.

The submucosal tunnel is then created similar to that in the open Cohen procedure. Hook cautery is used to make an incision at the site of the new ureteral orifice just above the site of the contralateral ureteral orifice across the back wall of the bladder. The submucosal tunnel is developed from the site of the ipsilateral ureteral orifice to the site of the new orifice. The feeding tube is used to pull the ureter through the tunnel. Ureteroneocystostomy was then performed under vesicoscopic guidance with intracorporeal suturing using interrupted 5-0 or 6-0 Monocryl® sutures. Port sites were then closed with 3-0 absorbable sutures. A Foley catheter was left in place for bladder drainage for 24–48 h postoperatively.

Pearls/Pitfalls

This technique essentially allows the open Cohen cross trigonal ureteral reimplantation technique to be performed using minimally invasive techniques. The large open bladder incision and forceful retraction, however, can both be avoided, and this likely has contributed to the significantly lower incidence of postoperative bladder spasms observed with this technique. Superior intravesical vision and excellent ergonomics have also been described owing to the ease of pneumovesicum and drainage of any fluid or blood out of the working space through the gravity-dependent Foley catheter [33, 34].

Despite its advantages, this procedure proves to be extremely challenging technically, even for experienced laparoscopic surgeons. The most difficult steps are dissection of the intramural ureter and intravesical suturing. Fortunately, these challenges have been offset substantially with increased use of robotic-assisted technology.

Finally, a pitfall for both the laparoscopic and robotic-assisted transvesical approaches is the small working space of the bladder, particularly in very young children. In the study by Kutikov et al. of 32 patients, a larger proportion of complications or failures occurred in patients age 2 years or younger with bladder capacity less than 130 ml [34]. For this reason, and with consideration of more recent data, a minimum bladder capacity of 200 ml and a minimum age of 4 years have been recommended [35].

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Postoperative Care (Intravesical)

Postoperative course is similar to that for extravesical RALUR except that on postoperative day one, a VCUG is typically performed to rule out a bladder leak. If negative, the Foley catheter can be removed [35]. Recovery is similar to that of other minimally invasive surgery in pediatric urology.

With regard to outcomes and surgical success, Yeung described reflux resolution in 15 of 16 patients [33], and Peters described five in six patients [32]. In a larger series by Jayanthi and Patel of 103 patients, a 94 % success rate was described [36], and later Valla and colleagues reported 95 % success rate in 72 vesicoscopic reimplants [37]. The patterns seem to indicate that this approach, similar to extravesical RALUR, is associated with a shorter hospital stay and decreased use of post-operative analgesics; however, it may be associated with more bladder leaks and a success rate that approaches, but does not yet equal, that of the open technique.

Technique: Endoscopic Antireflux Surgery

Special Considerations

Despite the near assurance of success for the open gold standard approach, endoscopic antireflux surgery has emerged as a popular alternative given its relative ease and low morbidity. The endoscopic surgery refers to the periureteral injection of a bulking agent, which acts to support the intramural ureter in its antireflux mechanism.

Anatomy

For endoscopic antireflux surgery, the key is familiarity with normal bladder anatomy from a cystoscopic viewpoint. The bilateral ureteral orifices should both be identifiable at the trigone. Additional note should be made for identification of anatomic anomalies such as additional ureteral orifices, ureteroceles, ectopic ureter, and bladder diverticulum, which may hinder the operation.

Positioning

For endoscopic treatment of vesicoureteral reflux, the ureteral orifice is approached from the urethra cystoscopically. The patient is placed in dorsal lithotomy.

Instruments

A standard 0or 30-degree lens cystoscope and a 3.7-Fr to 5-Fr flexible needle are all that is needed for the endoscopic procedure. In the USA, only Deflux® (dextranomer/hyaluronic acid copolymer, Salix Pharmaceuticals, Inc.) is approved for use as the injectable bulking agent. Other products

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used around the world include bovine collagen, Macroplastique® (polydimethylsiloxane, Cogentix Medical), and coaptite.

Steps

A cystoscopy is first performed and the bladder should be cleared of any inflammatory changes. The needle is placed through the scope and visualized with the bevel up. The mucosa is then injected 2–3 mm distal to the UVJ, advancing the needle in the submucosal plane for a distance 4–5 mm. An alternative, also widely accepted approach particularly for higher-grade reflux, is to insert the needle directly inside the ureter to increase the length of the intramural portion. Injection should result in the formation of a mound, which may become apparent after injecting 0.1– 0.2 ml if the needle is appropriately positioned. The mound should take on a "volcano" appearance, and the ureteral orifice should sit just on top of it [38]. Injection is carried out until the ureteral orifice appears crescent or slit shaped. Injection should occur slowly, and the needle should be kept in position after injection for 1 min to prevent leaking of material from the injection site. The bladder is emptied and lidocaine gel is placed in the urethra. After the procedure, the patient is brought to the recovery room for a brief period and is discharged home the same day.

Pearls/Pitfalls

Historically, a concern for this procedure was particle migration to distant sites, erosion, lack of durability of the injection material, or severe allergic reactions. Deflux®, which has been FDA approved in the USA since 2001 does not migrate, does not cause anaphylaxis, has not been shown to cause obstruction, and is biodegradable [7, 39].

The procedure takes approximately 15 min, including anesthesia time, and requires no skin cuts. Procedure-related complications are extremely rare. There is minimal postoperative pain and there is no associated hospital stay. After one or more injections, endoscopic surgery has the potential to eliminate the need for, and therefore further morbidity of, repeat VCUGs and daily prophylactic antibiotics. In some cases, it can also eliminate the need for ureteral reimplantation. Given its ease and minimal risk of morbidity, endoscopic surgery has been advocated as a first-line therapy following reflux diagnosis by some pediatric urologists [39, 40].

The argument against the widespread use of endoscopic surgery as first line treatment is overtreatment. In light of the natural history of spontaneous resolution, not all cases of reflux are clinically significant to warrant surgical intervention. The indications for correction of reflux should remain unchanged despite the technologic advances available for its correction.

Postoperative Care (Endoscopic Deflux®)

Endoscopic Deflux® injection has been shown to be safe, simple, and effective in the treatment of vesicoureteral reflux. Success rates of endoscopic Deflux® injection are lower than for open surgery, with reported 74 % success rate after one injection and 85 % with one or more injections.

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The approach is generally more successful in patients with lowergrade reflux. For grade IV reflux, the reported success rate is 63 % after first injection and for grade V, 51 % [41]. Also, lower success rates have been reported for endoscopic correction of VUR in children with bladder and bowel dysfunction [42].

In general, the child is maintained on antibiotics for 3 months. At that time, they follow up with a repeat ultrasound and VCUG. If reflux is persistent, a repeat injection is considered 6 months after the initial injection. Definitive surgery is recommended if there is still no resolution.

Experts have additionally questioned the stability of Deflux® with time, warning of late failure that disproportionately affects those with higher-grade reflux. For this reason, longer follow-ups (>1 year from the time of injection) have been advocated [43], particularly for patients with higher-grade reflux who would be at greater risk of renal damage when endoscopic treatment is not durable [44].

Summary

- The minimally invasive techniques used for correction of VUR are:
  - Laparoscopic or robotic-assisted laparoscopic extravesical ureteral reimplantation
  - Laparoscopic or robotic-assisted laparoscopic intravesical ureteral reimplantation
  - Endoscopic surgery with Deflux® injection
- Robotic-assisted laparoscopic extravesical ureteral reimplantation (RALUR) is the most commonly performed minimally invasive surgery to permanently correct reflux and, in experienced hands, produces success rates approaching that of the standard open technique. The major drawbacks to this surgery are increased operative time and postoperative urinary retention. Advantages commonly seen are shortened length of hospitalization, improved cosmesis, and decreased postoperative need for analgesics. The procedure has been shown to be safe and efficient though there is insufficient evidence to suggest that RALUR is at a point where it is clearly a superior option to the open technique.
- Laparoscopic or robotic-assisted intravesical ureteral reimplantation uniquely utilizes vesicoscopic technology and pneumovesicum, avoiding the need for transperitoneal access. An advantage of this procedure is that it achieves a Cohen cross trigonal ureteral reimplantation surgery using minimally invasive technique and without the need for a large cystotomy or forceful bladder retraction. It is associated with lower incidence of postoperative bladder spasms, shorter hospital stay, early Foley removal, and decreased postoperative need for analgesics. The major drawback is the technical challenge of the surgery, particularly in smaller bladders, and is therefore recommended primarily for patients over age 4 years with minimum bladder capacity of 200 cc. This procedure is feasible and safe though has been associated with increased incidence of bladder leak, and success rates approach but do not reach that of the open technique.
- Endoscopic surgery with Deflux® injection is the quickest, simplest approach. It is associated with low morbidity and rare proceduralrelated complications. The most significant drawback is that, while effective, it pales in success rate for VUR resolution (51–85 %) when compared

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to the gold standard open technique (97–100 %). It is not thought to be a definitive VUR correction surgery, though occasionally one or more Deflux® injections may promote VUR resolution and prevent the need for definitive surgery.

The choice in surgical approach must be individualized for each patient with regard to the age of the child, the severity of the child's condition, and the family's preferences. These must be balanced with consideration of the surgeon's experiences and outcomes. In light of the natural history of reflux and its tendency to spontaneously resolve, not all cases require surgical intervention. Technologic advancement and increasing ease of intervention should not change the indications for intervention.

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Adrenalectomy

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Introduction

The first robot-assisted laparoscopic adrenalectomy (RALA) was described in 1999 by Piazza et al. [1], and since that time, several papers have been published showing its safety and feasibility [2–4]. It combines advantages of minimally invasive laparoscopic procedures, such as less postoperative pain, shorter covalence time, and better cosmetic appearance [5], with benefits from da Vinci robotic system, i.e., three-dimensional vision, filtration of tremor, and 7 degrees of freedom (EndoWrist technology) [6]. A systematic review and meta-analysis have demonstrated that although laparoscopic and robotic adrenalectomy have similar conversion rate (odds ratio [OR] 0.82; 95% CI 0.39–1.75; $p = 0.61$) and operative time, RALA has a shorter hospital stay as well as a lower blood loss when compared to conventional laparoscopy [7].

Currently, RALA is indicated to nonfunctioning tumor >4 cm, primary hyperaldosteronism, pheochromocytoma, functioning adenomas, metastatic lesions, adrenocortical carcinoma, and rare infectious diseases. Partial adrenalectomy is also feasible and seems to be a promising application of robotic-assisted adrenalectomy especially for the treatment of hereditary pheochromocytomas [8]. Relative contraindications are large tumors (> 12 cm), invasion of adjacent organs, involvement of vascular structures, vena cava thrombus, and disseminated metastatic disease.

Conversion and perioperative complications are rare in RALA, but they have been reported in few cases. The aim of this chapter is to review and discuss these undesirable events.

Complications

Conversion

It is defined as a procedure completed using a technique different from the one initially planned, thus any surgery not robotically finished. The conversion rate of RALA ranges widely from 0 to 40% in the literature [9]; however, in most of the published papers, it is low. In a meta-analysis

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including nine studies and 600 patients comparing robotic with laparoscopic adrenalectomy, the conversion rate was only 4.4% for the robotic group [7]. There are many causes that can lead surgeons to decline robotic technique to complete the adrenalectomy, including intense intra-abdominal adherence due to previous surgery or tumor infiltration, unexpected bleeding following vascular or organ injury, and patients' hemodynamic alterations (i.e., pheochromocytoma). Although the reasons to conversion may vary, most of the time, they are related to surgeon inexperience with da Vinci system, as described by Morino et al. that reported four conversions in a series of ten cases, three of them among the first five cases [10]. These authors noted a statistically significant decrease in the conversion rate with increasing surgical experience.

Minor Complications (Clavien I and II)

Most of the complications after RALA are Clavien grade I or II, including fever, hydroelectrolytic disorders, nausea and vomiting, wound infections, urinary tract infection, pneumonia, and blood transfusion. The overall complication rate for RALA has been reported between 0 and 20% [9]. In a recent publication describing the main steps of RALA and analyzing the authors experience with 30 procedures, the overall complication rate was 20% [11]. Five of six complications were minor, including one case of hyponatremia, an episode of nausea and vomiting, a postoperative bleed requiring blood transfusion, a wound infection, and an atrial fibrillation. In a systematic review and meta-analysis comparing robotic and laparoscopic adrenalectomy, the complication rate was higher in the laparoscopic group (6.8% vs. 3.6%), although it did not have achieved significant statistical difference (OR 0.04; 95% CI −0.07 to −0.00; $p = 0.05$) [7].

Major Complications (Clavien III–V)

Severe complications after RALA are extremely rare and do not achieve 5% of cases. A metaanalysis comparing laparoscopic and robotic adrenalectomy showed that there are more severe complications in the laparoscopic group, according to the Clavien grading system, including three deaths (Clavien grade V), two resulting from respiratory failure due to severe pulmonary hypertension [3, 12] and one from cardiac arrest [13]. You et al. reported two grade IV complications in the laparoscopic group (acute kidney failure and cerebral infarction) requiring intensive care unit treatment [14]. In the robot-assisted group, there was only one grade III complication in two studies [3, 15]. Brandao et al. reported only one major complication in 30 RALA, and it was also classified as a Clavien grade III, an extensive postoperative bleeding that required surgical intervention under general anesthesia [11]. Asher et al., in a study including 15 cases of robot-assisted laparoscopic partial adrenalectomy for pheochromocytoma, a disease with an intrinsic higher risk of perioperative complications, reported also only one major complication [16]. There was one conversion to open partial adrenalectomy due to severe adhesions to the liver and repeated vena cava injuries requiring initially robotic and then open repairs. The same patient had a bile leak that required a temporary drain for 5 days.

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Most of the complications after RALA appear to be related to the pathology (pheochromocytoma and adrenal cortical carcinoma) and patient's medical condition prior to surgery (severe systemic disease), rather than to the procedure itself [9].

Table 1 summarizes conversion and postoperative complication rates.

Risk Factors for Conversion and Complication

- Inexperienced surgeon
- Prior abdominal surgery (adherence)
- Severe medical condition (pulmonary or cardiac disease)
- Pheochromocytoma or adrenal cortical carcinoma
- Large adrenal tumors

Preventing Complications

In order to avoid complications, it is important that patient and surgeon are prepared to the procedure. Patient need to have all his/her comorbidities well evaluated and appropriately treated before the adrenalectomy. Aldosteronoma can result in hypokalemia that may require potassium repletion and administration of potassium-sparing diuretic. Hypertension should also be treated before surgery. With a pheochromocytoma, α-adrenergic blockade should be started 2 weeks before surgery. Some patients with tachycardia may benefit from concurrent β-blockade. Alternatively, an α1-selective blocker such as prazosin or doxazosin can be used. Intraoperatively,

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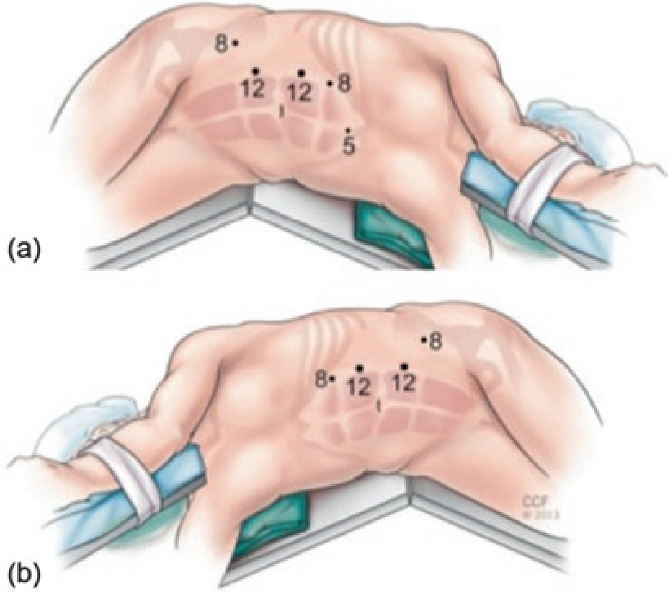
Table 1: 1 Perioperative complications.

Study	Year	No. of cases	Operative time (min)	Estimated blood loss (ml)	Conversion (%)	Postoperative complications (%)
Agcaoglu et al. [17]	2012	24	159.4 ± 13.4	83.6 ± 59.4	1 (4.1%)	0
Agcaoglu et al. [18]	2012	31	163.2 ± 10.1	25.3 ± 10.3	NA	0
Aksoy et al. [3]	2013	42	186.1 ± 12.1	50.3 ± 24.3	0	1 (2.4%)
Aliyev et al. [13]	2013	25	149 ± 14	26 ± 12	1 (4.0%)	0
Brandão et al. [11]	2014	30	120 ± 33	50 ± 50	0	6 (20%)
Brunaud et al. [15]	2008	50	189 ± 43.7	49	4 (8.0%)	5 (10%)
Karabulut et al. [12]	2012	50	166 ± 7.0	41 ± 10	1 (2.0%)	1 (2.0%)
Morino et al. [10]	2014	10	169 ± 19.7	NA	4 (40%)	0
Pineda-Solis et al. [19]	2013	30	189.6 ± 32.7	30 ± 5	0	0
You et al. [14]	2013	15	183.1 ± 48.7	NA	0	2 (13.3%)

NA not available

Fig. 1: Patient's position and port placement. (**a**) Right and (**b**) left adrenalectomy [11] (*Reprinted with permis- sion from Elsevier*).



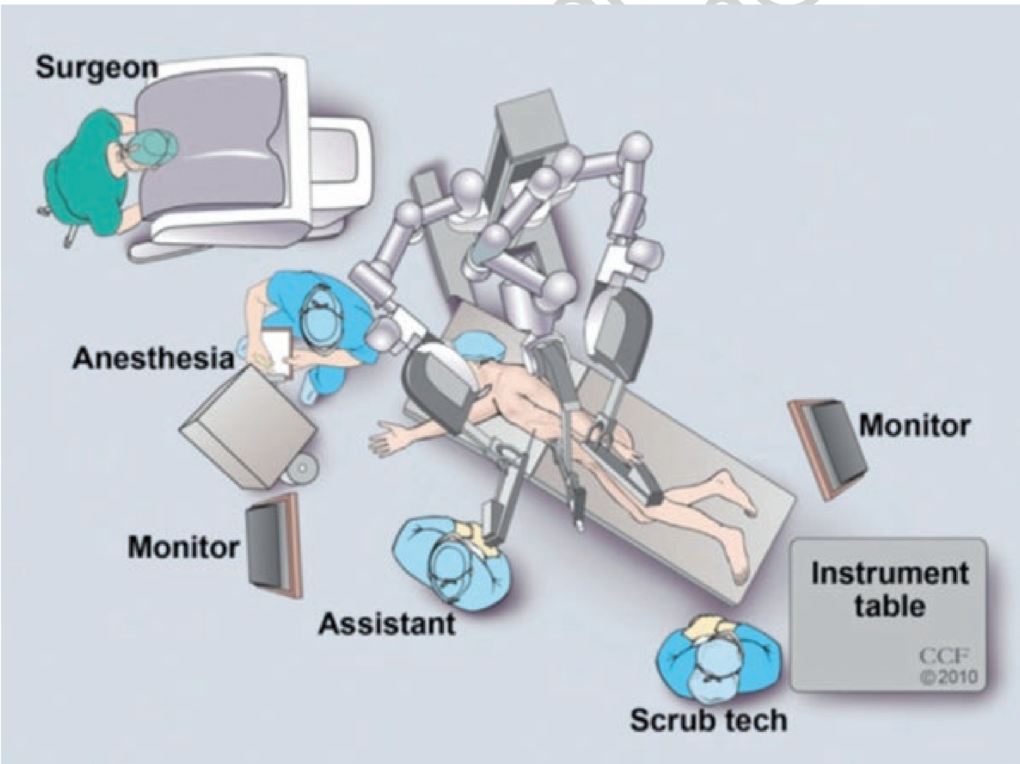


Fig. 2: Operation room setup [11] (*Reprinted with permission from Elsevier*).

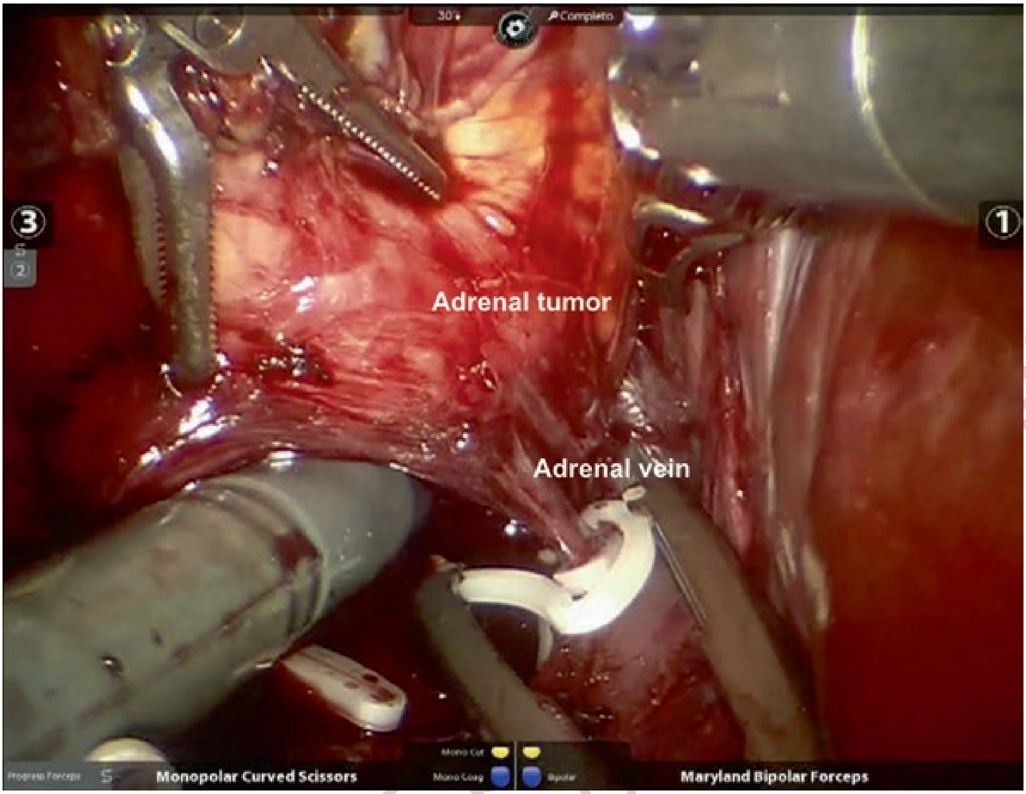


Fig. 3: Intraoperative view.

high blood pressure can be treated with nitroprusside or a short-acting β-blocker like esmolol. Volume repletion is important to prevent the postoperative hypotension secondary to loss of tonic vasoconstriction after removal of a pheochromocytoma. Patients with Cushing's syndrome require correction of electrolyte abnormalities and hyperglycemia before surgery. These patients may benefit from administration of adrenolytic agents such as mitotane or aminoglutethimide.

Bowel preparation is not routinely necessary and should be performed only in cases of complex surgeries (i.e., large mass or intense intra-abdominal adherence). Retroperitoneal surgery may not require this bowel preparation. All patients should receive appropriate preoperative antibiotics. A nasogastric or orogastric tube should be placed. The placement of a urinary catheter to help measure urine output and to decompress the bladder is mandatory.

Surgeon must have experience with the robotic system. If he/she is not familiar with the robotic adrenalectomy technique, a proctor is strongly recommended.

Patient positioning, port placement, and docking are all important steps that have to be carefully done. Patient is placed in a 60° flank position and appropriately draped. Port placement is illustrated in Fig. 1. An extreme flank position, with axis of the shoulders close to a 90° angle to the operating table, is an option for large tumors. The robot is docked over patient's shoulder, so its axis makes an obtuse angle in relation to patient's axis. Figure 2 shows operation room setup.

Initially, spleen, bowel, and pancreas have to be mobilized to expose the left adrenal gland. Attention must to be paid to the tail of the pancreas because it can be mistaken for the adrenal gland. On the right side, liver, colon, and duodenum have to be mobilized to expose the vena cava and the right adrenal gland (Fig. 3). The next step is the adrenal vein identification and control. The left adrenal vein is a branch from the left renal vein, whereas the right adrenal vein is a short and oblique branch from the vena cava. Careful dissection, followed by clipping and resection are important steps for a safety procedure with no bleeding. Once the adrenal vein is properly controlled, the adrenal gland is circumferentially dissected off, close to kidney upper pole, diaphragm, and psoas muscle. Then, the specimen is placed in a laparoscopic bag and removed. Lastly, hemostasis is checked by lowering the pneumoperitoneum, and all ports are removed under direction vision. Following all these surgical principles, the chances of intraor postoperative complications are minimized.

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Notes:

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*IPSS (8-19), Prostate volume >/30mL QoL : Quality of Life FDC : Fixed dose combination of dutasteride and tamsulosin

Ref: Claus G. Roehrborn, et al. Efficacy and safety of a fixed-dose combination of dutasteride and tamsulosin treatment (Duodart®) compared with watchful waiting with initiation of tamsulosin therapy if symptoms do not improve, both provided with lifestyle advice, in the management of treatment-naïve men with moderately symptomatic benign prostatic hyperplasia: 2-year CONDUCT study results. BJU Int. 2015; 116: 450–459.

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