Vesicoureteral Reflux: Surgical Treatment

61

Jack S. Elder

Vesicoureteral reflux (VUR) affects approximately 1% of children. VUR predisposes an individual to upper urinary tract infection (UTI) (that is, pyelonephritis). Repeated episodes of pyelonephritis can result in renal scarring (reflux nephropathy), hypertension, impaired somatic growth, renal insufficiency, end-stage renal disease, and complications during pregnancy. VUR can be managed medically or surgically.

Medical management is based on the principles that VUR often diminishes or resolves over time, and maintaining sterile urine minimizes the risk of reflux nephropathy. Medical management includes bladder training (encouraging regular micturition and treating symptoms of bladder/bowel dysfunction) and possibly antibiotic prophylaxis with a daily dose of an antimicrobial such as nitrofurantoin, trimethoprim, or sulfatrim. Many children undergo regular follow-up assessment with a voiding cystourethrogram (VCUG) and renal ultrasonogram (US) every 12–18 months. Medical management is continued until the VUR resolves or improves sufficiently that the VUR no longer seems clinically significant. Many clinicians consider grades I and II VUR to be benign. (*See* Fig. 60.1 for a diagram of grades I–V.)

Surgical management is generally recommended when medical management has failed—that is, the child experiences breakthrough UTI while receiving antimicrobial prophylaxis or has persistent VUR or noncompliance with the prescribed therapy. In addition, children with VUR that is unlikely to resolve, such as grade IV, V, or bilateral grade III VUR, often are managed surgically, as is VUR associated with a complete duplicated collecting system, ureterocele, ectopic ureter, or bladder exstrophy.

J. S. Elder
Division of Pediatric Urology, Massachusetts General Hospital for Children, Harvard Medical School, Boston, MA, USA
e-mail: jselder@mgh.harvard.edu

P. Puri, M. E. Höllwarth (eds.), *Pediatric Surgery*, Springer Surgery Atlas Series,
https://doi.org/10.1007/978-3-662-56282-6_61

61.1 Types of Surgical Management

Surgical management can be accomplished through an incision ("open surgical treatment"), endoscopically (subureteral injection, covered in Chap. 60), and laparoscopically or robotically with laparoscopic assistance. Because the bladder is an abdominal organ in children, open surgical therapy is easiest when the child is prepubertal. Following puberty, the bladder descends behind the pubic symphysis, and dissection of the ureters is more difficult. The decision whether the child should undergo endoscopic or open surgical management should be a joint decision between the patient's family and the surgeon. This chapter address the options for open and laparoscopic/robotic surgical management of VUR.

The principle of surgical correction of VUR is to create a 4:1–5:1 ratio of submucosal tunnel length to ureteral width. The intramural ureter should be in a fixed portion of the bladder. There are numerous ways to correct VUR; some are intravesical, some are extravesical, and some are combined. The three techniques that are used most commonly are the transtrigonal (Cohen) procedure, the Politano-Leadbetter procedure, and detrusorrhaphy. The first two are intravesical techniques, whereas detrusorrhaphy is extravesical. The advantage of the latter is that there is minimal bladder spasm and haematuria associated with the procedure, because the bladder is not opened widely. In contrast, with an intravesical approach, children typically experience a moderate amount of dysuria, urgency, and haematuria for a week postoperatively.

A modified approach may be recommended if ureteral tailoring is necessary because the ureter is too wide to achieve a 4:1 ratio. With improvements in pediatric anaesthesia and postoperative pain management, children often stay in the hospital for 1–2 days after these procedures. The success rate is 95–98% for grades I through IV VUR and somewhat lower for grade V.

61.2 Operative Principles

During open surgical correction of VUR, several principles apply:

- Optical magnification with loupes is recommended.
- It is helpful to use fine cautery (Pena tip) for the operative procedure.
- Tenotomy scissors are ideal for tissue dissection throughout the entire procedure, because the tips are fine and blunt. Metzenbaum scissors are much wider and do not dissect the tissues as easily.
- The exposed bladder mucosa should not be wiped with a sponge, and suction should not be applied to the bladder mucosa. These manoeuvres will result in significant mucosal oedema, which may make submucosal dissection difficult.
- The submucosal tunnel should be four or five times as long as the width of the ureter.
- Ureteral stents are unnecessary in routine ureteroneocystostomy, but are recommended for VUR in a solitary kidney, reoperative cases, ureteral tailoring, or if there is significant detrusor hypertrophy from posterior urethral valves, neuropathic bladder, or severe bladder/bowel dysfunction.
- If there is a duplicated collecting system, both ureters may be treated as one and re-implanted together in one tunnel. An alternative treatment is to perform a ureteroureterostomy with distal ureterectomy, in which the refluxing ureter is anastomosed to the nonrefluxing ureter, and the distal segment of the refluxing ureter is excised.

61.3 Operative Techniques

61.3.1 Transtrigonal (Cohen) Procedure

The abdomen and genitalia should be prepped with betadine or chlorhexidine, and the urethral meatus should be included in the operative field so that a catheter may be inserted or removed when necessary. Preoperative broad-spectrum antibiotics should be administered.

A Foley catheter should be inserted into the bladder and the bladder is filled manually with sterile water to push the peritoneum superiorly. A Pfannenstiel incision is made one finger-breadth above the pubic symphysis (Fig. 61.1). The limits of the incision should be the lateral borders of the rectus muscles. The incision is carried down to the external oblique fascia and haemostasis is achieved.

Make a transverse incision in the anterior rectus sheath in the line of the incision, exposing the rectus muscles (Fig. 61.2). Using the fine-tip needle electrode (Pena tip) for cautery, develop rectus fascial flaps superiorly, nearly to the umbilicus. It is helpful to grasp the superior rectus fascia with straight mosquito clamps (Fig. 61.3). Using an identical technique, the inferior rectus fascia is mobilized to the pubic symphysis.

Separate the rectus muscles in the midline with a Kelly clamp and use the cautery to incise the linea alba, the midline attachment of the rectus muscles. With tenotomy scissors, incise the transversalis fascia and expose the bladder (Fig. 61.4). The distended bladder is dissected out bluntly. The peritoneum should be swept superiorly to prevent inadvertent peritoneotomy.

The Denis Browne ring retractor is then used to hold the rectus muscles apart. Allis clamps are placed on either side of the midline of the bladder. The detrusor is incised in the midline with the cautery. Ideally, only the muscular layer should be divided first, allowing cauterization of the small arterial vessels in the detrusor. The mucosa then protrudes out and may be cut with tenotomy scissors or the cautery. The bladder is then drained. The bladder is then isolated with 4/0 or 3/0 absorbable traction sutures (placed with one tie) in the four corners of the bladder wall (Fig. 61.5), and a figure-of-eight stitch is placed in the bladder neck to prevent it from spreading open.

The Denis Browne ring retractor is then placed in the bladder. The side blades have two sizes; usually the larger size is necessary. Several moistened gauze sponges are placed in the bladder dome and the malleable blade is inserted and adjusted to retract the dome superiorly. When the malleable blade is inserted, the ureteral orifices should be easily visible. The rake retractor is placed inferiorly. In older children the Denis-Browne retractor may be too small, and instead a child-size Balfour retractor may be necessary, using the bladder blade for retraction superiorly.

The ureteral orifices are identified and cannulated with 8F or 5F pediatric feeding tubes; in infants and very young children it may be necessary to use a 3.5F feeding tube. The catheter should be passed up to the kidney and sutured to the bladder wall with 4/0 absorbable sutures. A clamp is placed on the feeding tube and suture for distal traction, which aids in ureteral dissection.

The ureter is then dissected out (Fig. 61.6). The Pena tip cautery on cutting current or a fresh number 15 scalpel is used to circumscribe the ureter. The mucosa inferomedial to the orifice is grasped with Castroviejo 4″ 0.5-mm tooth forceps, and a deep cut is made in the space between ureter and mucosa. This plane around the ureter is developed by sharp dissection, exposing the underlying detrusor muscle.

The ureter has a pearly white appearance. Dissecting too close to the ureter risks devascularization, and dissecting too far away in the detrusor often results in significant bleeding. Megaureters often have a better intrinsic blood supply, and devascularization during mobilization of the megaureter is uncommon. A small, right angle clamp can be used to develop the plane between the ureter and detrusor, and the clamp may be opened to separate the muscle from the ureter. Muscular attachments to the ureter may be cauterized gently, being careful to keep the tip of the cautery away from the ureter. If there has been a recent urinary tract infection, the ureter tends to be more adherent to the muscle. The ureter is dissected out until the peritoneum is identified and can be swept away.

The ureteral hiatus must then be closed to prevent a diverticulum from forming. Three or four interrupted 3/0 absorbable sutures are placed through the detrusor muscle on each side, starting inferomedially and working superolaterally; the hiatus should not be closed too tightly.

The submucosal tunnel is then made. The mucosa medial to the hiatus should be grasped gently. Using the tenotomy scissors, with the tips pointed anteriorly, the mucosal attachment to the underlying detrusor is incised to establish the submucosal plane. Next, the tenotomy scissors are passed into the plane and spread gently (Fig. 61.7). The scissors should be opened approximately twice as wide as the ureteral diameter. The submucosal tunnel is gradually lengthened. When the tunnel length is four or five times as long as the width, the tips of the scissors should be used to elevate the mucosa. The scissors should be opened slightly and the cautery should be used to open the mucosa. The tips of the scissors are advanced through the mucosa and opened further.

The tip of the feeding tube in the ureter is cut off. A right-angled or curved mosquito clamp is passed backward through the opening in the mucosa toward the ureteral hiatus and the

tip of the feeding tube is grasped. The tip of the feeding tube is then pulled through the submucosal tunnel (Fig. 61.8).

The suture holding the feeding tube is cut and the tip of the ureter is trimmed slightly, being careful to excise any portion of the ureter that seems devascularized. If both ureters are being re-implanted, it is appropriate to place them in the same submucosal tunnel.

The ureter is spatulated slightly. With the feeding tube in place, the ureter is sutured to the bladder mucosa with interrupted 5/0 or 6/0 absorbable sutures; the two distal apical sutures should be placed through the bladder muscle also, to help fix the ureter in place. There should be no tension on the ureter. Small mosquito clamps are placed for traction on the proximal and distal apical sutures to allow easy identification of the new ureteral orifice. The feeding tube should be removed and then reinserted into the ureter; the feeding tube should pass easily through the submucosal tunnel (Fig. 61.9). After the ureter(s) is fixed in place, the bladder mucosa is closed with running 5/0 absorbable sutures. It is unnecessary to leave the ureter stented unless there is significant bladder wall oedema, the ureter is draining a solitary kidney, or the patient is undergoing a secondary procedure.

If a satisfactory submucosal tunnel cannot be made because of mucosal oedema, the mucosa may be incised and peeled back, creating a trough in which to lay the ureter. In fact, the mucosal edges may be sutured to the edge of the ureter, and the epithelium will grow over the ureter, creating a submucosal tunnel.

The bladder is then closed. A two-layer closure is performed. The muscular layer is closed with a running 2/0 polyglycolic acid (PGA) imbricating stitch (Connell); a second layer uses a running 2/0 PGA Lembert stitch. The rectus muscles are approximated with interrupted 3/0 chromic catgut. The rectus fascia is closed with a running 2/0 PGA or PDS (polydioxanone). A Foley catheter is left in place overnight.

If a unilateral transtrigonal ureteroneocystostomy is performed, there is a 10% risk of contralateral reflux, probably secondary to destabilization of the contralateral ureter during mobilization of the refluxing ureter. The risk is 50% if the contralateral ureter refluxed in the past but is no longer refluxing. This complication may be prevented by performing bilateral ureteroneocystostomy or by performing a contralateral Gil-Vernet ureteral reimplant (contralateral ureteral meatal advancement).

After cannulating the ureteral orifice with a feeding tube of appropriate size and suturing it in place, a Y-shaped mucosal incision is made from the medial surface of the ureter medially to the midline of the bladder trigone (Fig. 61.10). The medial wall of the ureter is dissected out, separating it from the underlying detrusor muscle. The medial extension of the mucosal incision is opened also, exposing the detrusor. The ureteral meatus is moved medial, to the midline. The ureteral meatus is fixed to the mucosa and underlying detrusor with several 5/0 absorbable sutures.

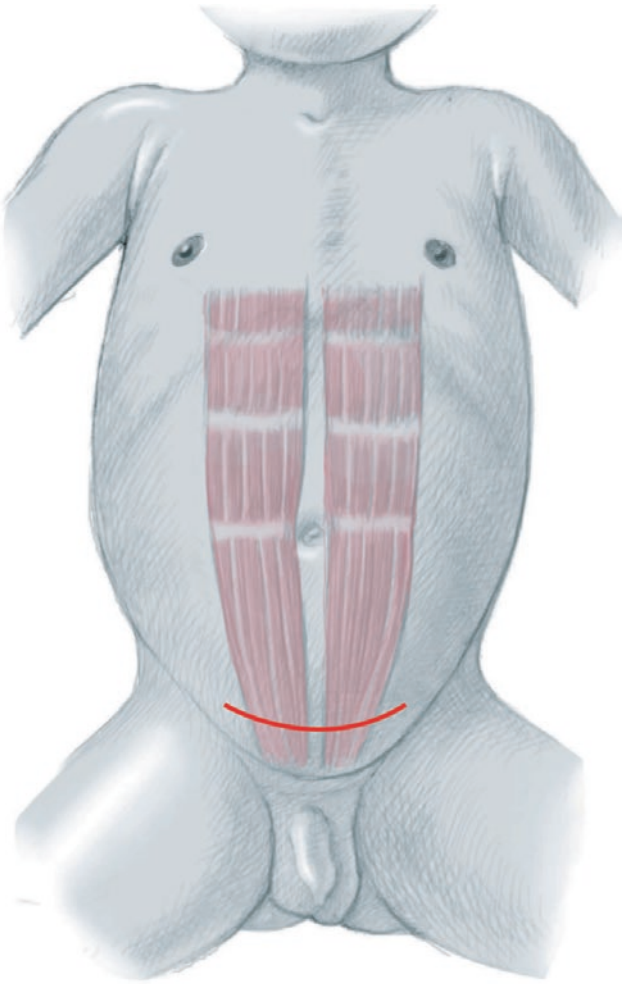

Fig. 61.1 Pfannenstiel incision for transtrigonal procedure

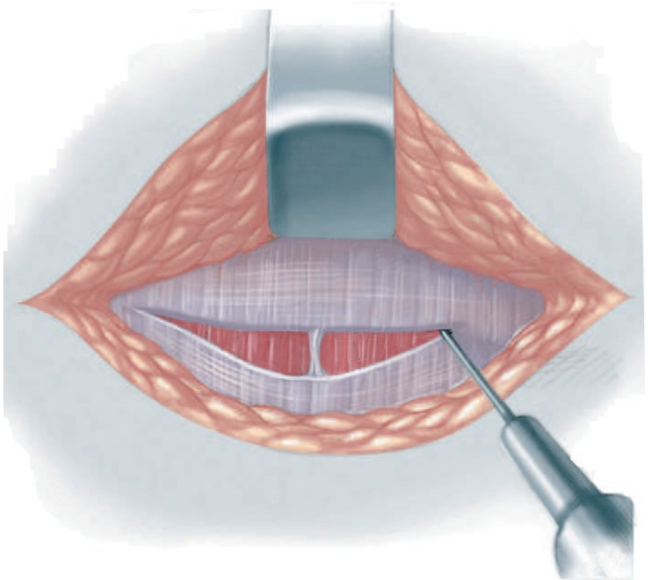

Fig. 61.2 Transverse incision in the anterior rectus sheath

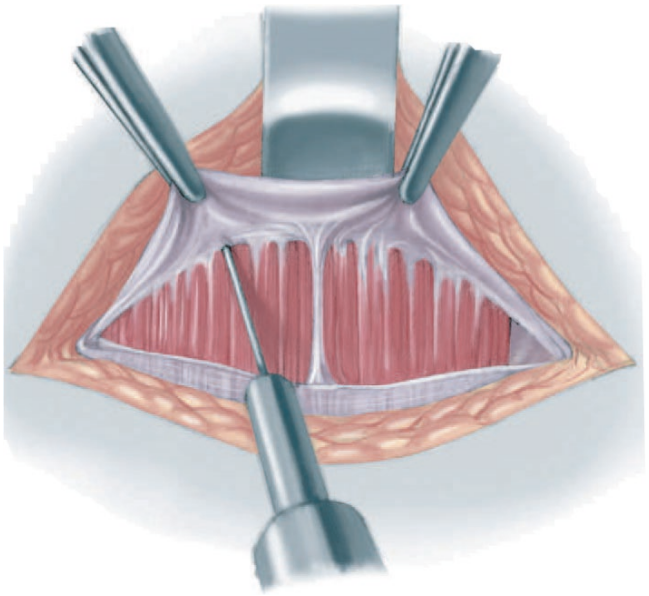

Fig. 61.3 Developing rectus fascial flaps superiorly

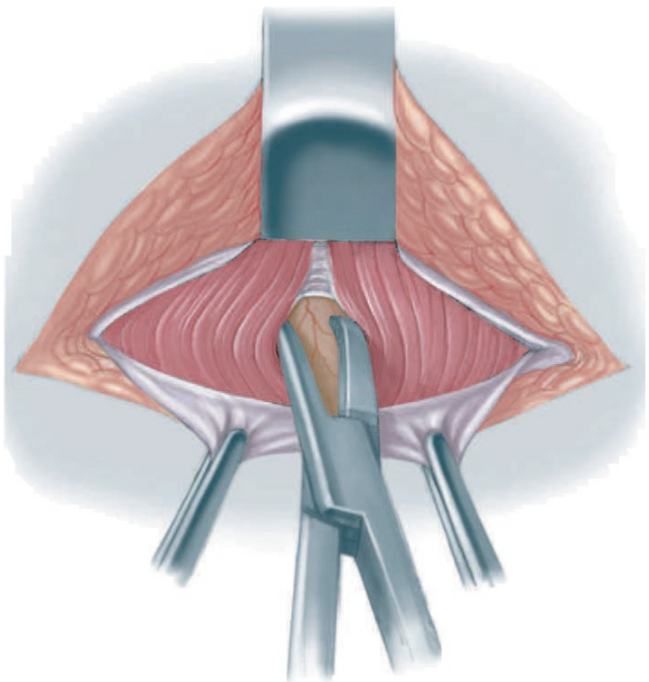

Fig. 61.4 Exposing the bladder

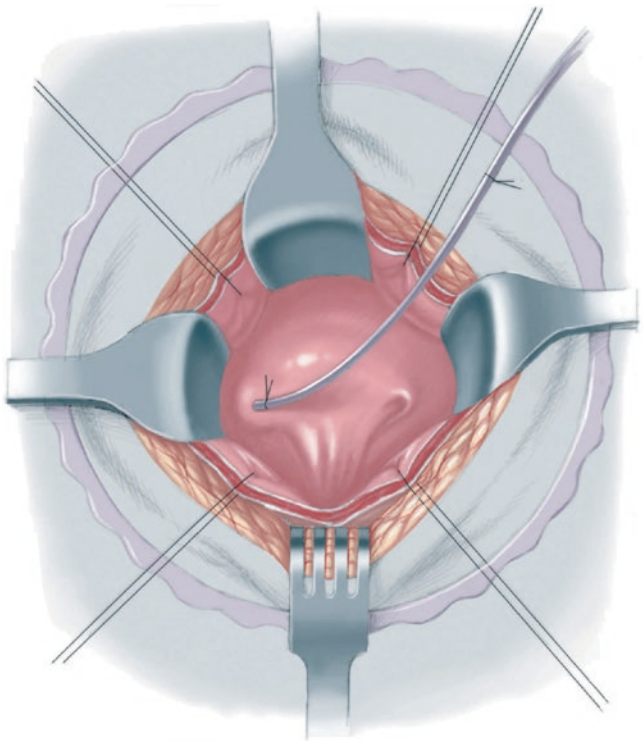

Fig. 61.5 Cannulation of the ureteral orifice, with ring retractor in place

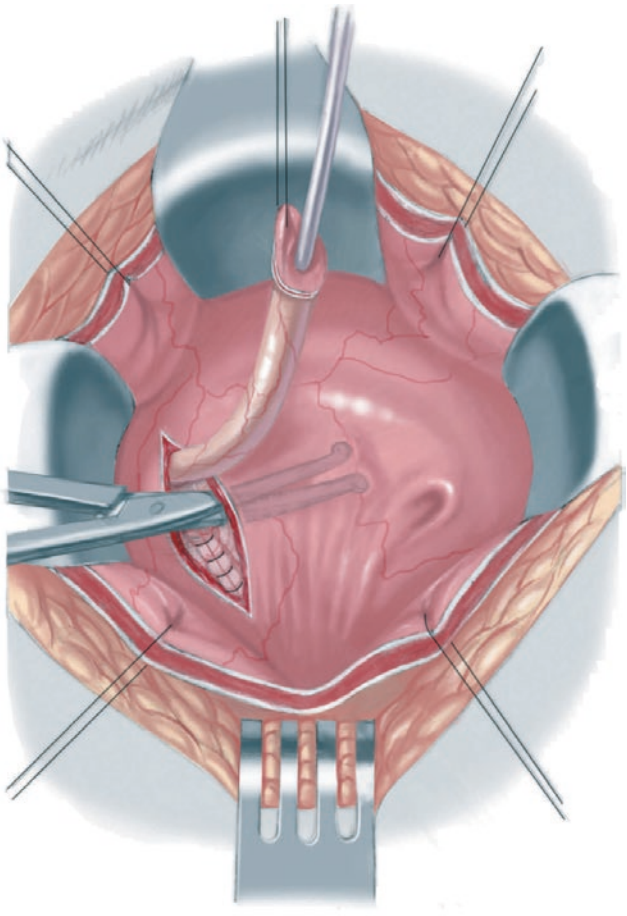

Fig. 61.7 Creating the submucosal tunnel

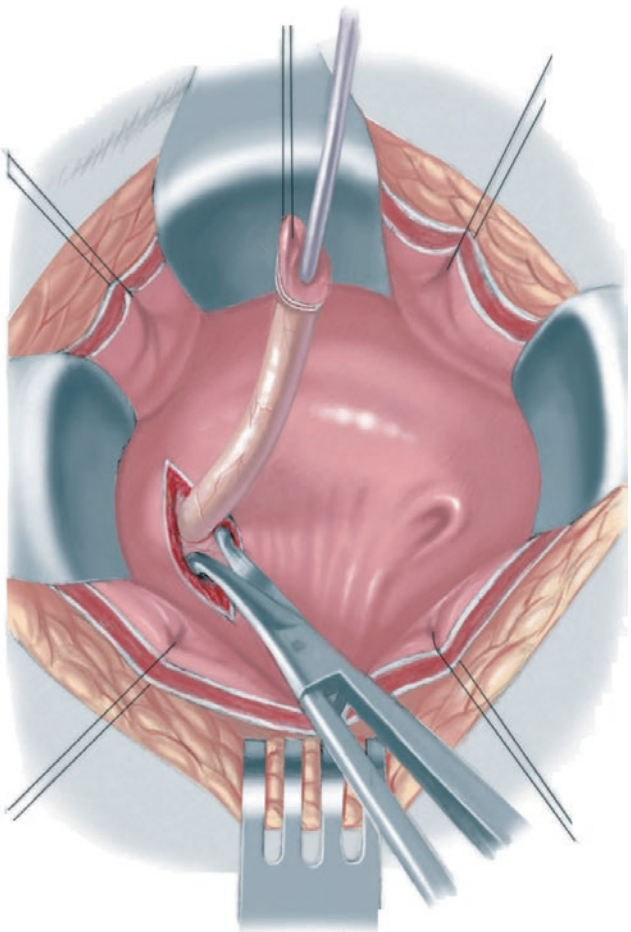

Fig. 61.6 Dissecting out the ureter

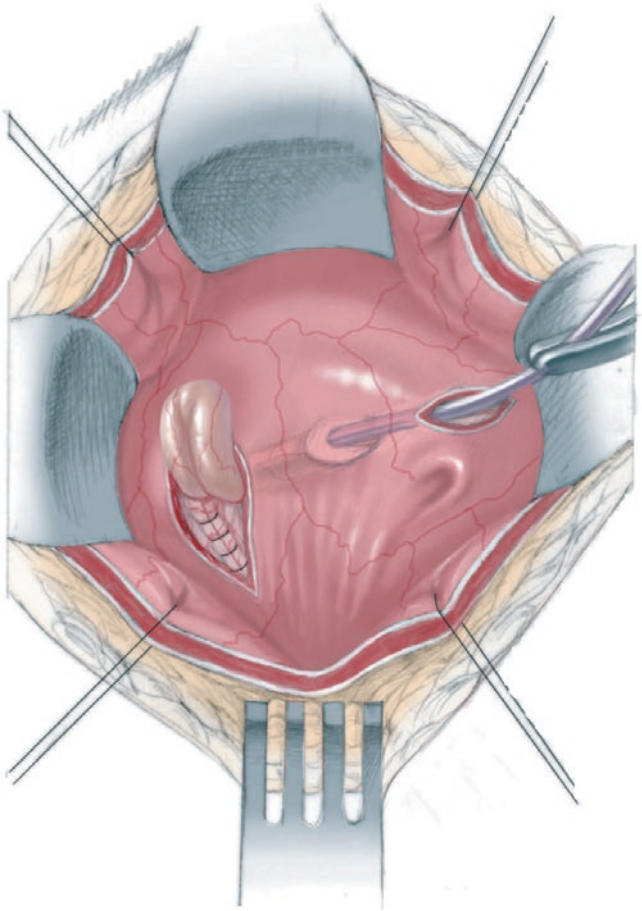

Fig. 61.8 Pulling the feeding tube through the submucosal tunnel

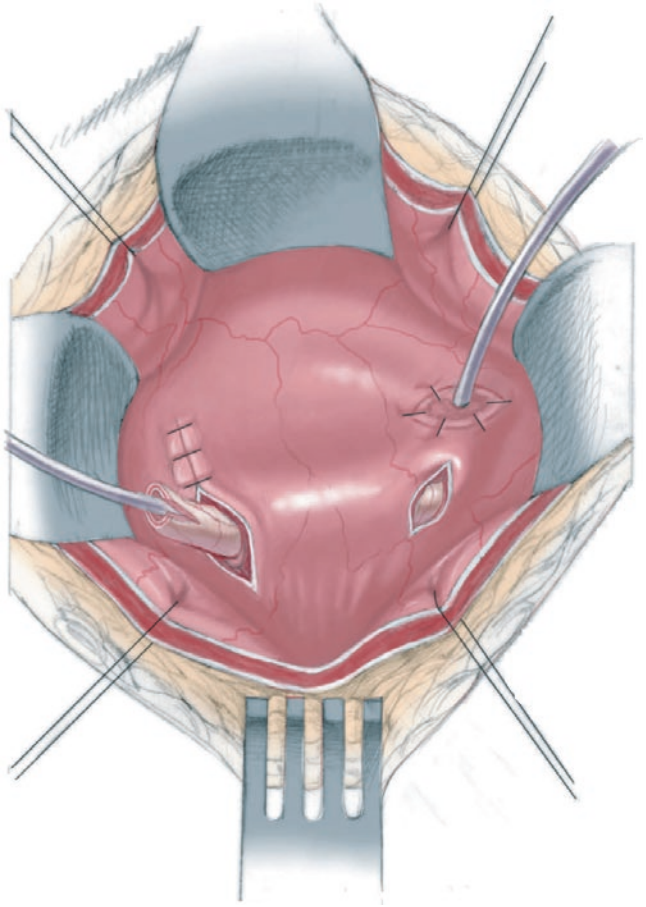

Fig. 61.9 Fixing the slightly spatulated ureter in place

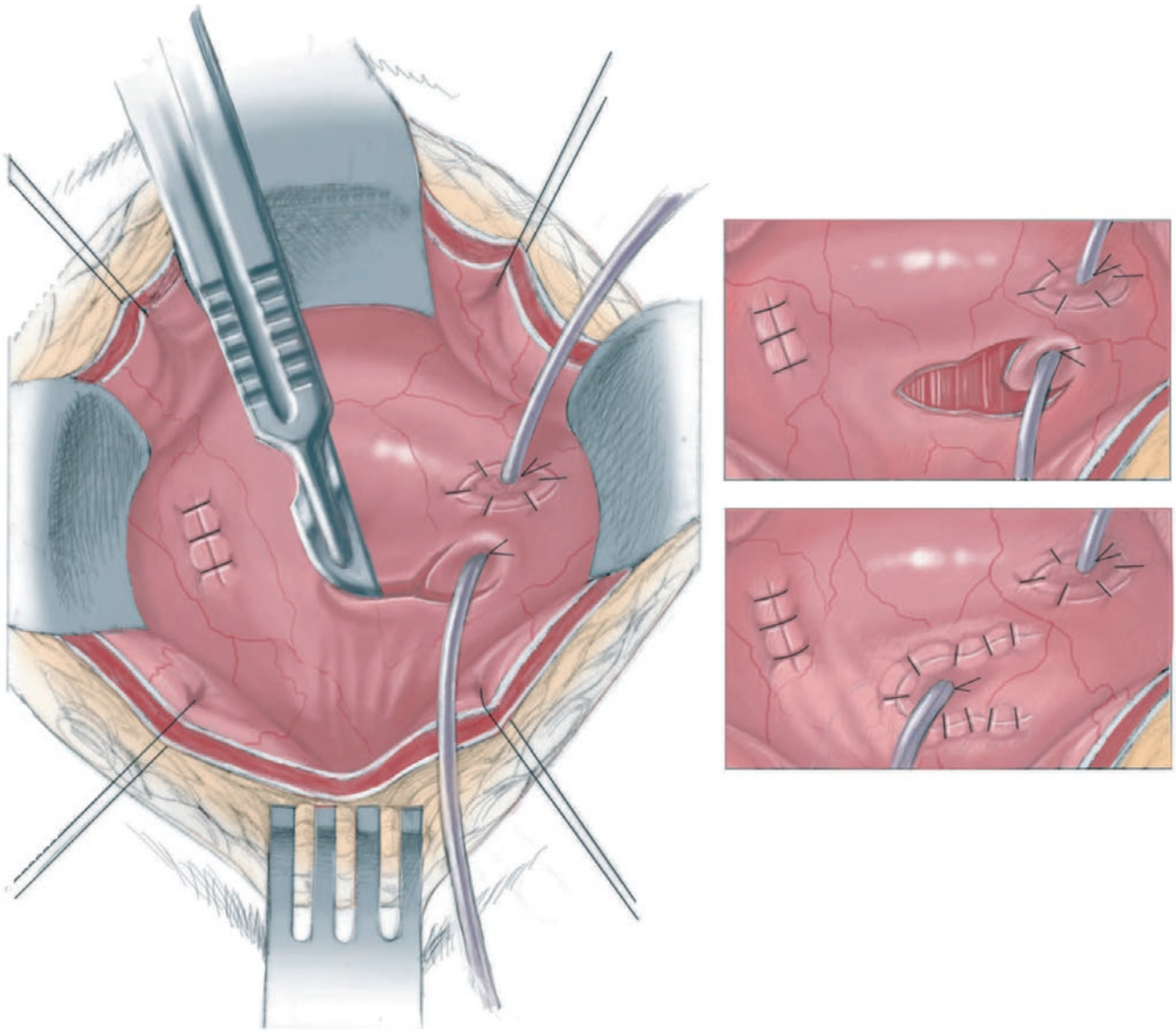

Fig. 61.10 Performing a contralateral Gil-Vernet ureteral reimplant (contralateral ureteral meatal advancement)

61.3.2 Detrusorrhaphy

The ureter may be reimplanted using an extravesical technique, termed *detrusorrhaphy*. This technique evolved from the Lich-Gregoir procedure. The success rate is identical to that of intravesical procedures. Following unilateral detrusorrhaphy, the incidence of contralateral VUR is less than 5%. With bilateral detrusorrhaphy, there is a small but significant risk of temporary (or even permanent) atonic bladder requiring clean intermittent catheterization. Consequently, many use this procedure only for unilateral reflux.

It is often helpful to perform cystoscopy and insert a ureteral catheter into the refluxing ureter(s). This manoeuvre facilitates identification of the ureter after the bladder is exposed.

A tremendous asset for this procedure is the robot retractor, which attaches to the operating table and holds retractors placed to retract the bladder and peritoneum, allowing exposure of the ureter.

The urethral meatus should be included in the operative field. A Foley catheter should be inserted at the beginning of the procedure and the bladder should be filled to a moderate degree manually.

For bilateral cases, the bladder should be exposed through a Pfannenstiel incision as described above. For unilateral cases, a unilateral 5-cm inguinal (modified Gibson) incision may be made.

The lateral wall of the bladder is mobilized by blunt dissection and muscular traction sutures are placed using 3/0 absorbable sutures. These traction sutures allow the bladder to be "rolled" medially, facilitating identification of the ureterovesical junction. The bladder may need to be emptied partially to facilitate this dissection. A Deaver retractor is inserted to retract the bladder medially. If the ureter is not immediately apparent, the obliterated umbilical artery is identified, ligated, and divided with 3/0 absorbable sutures. The ureter is just deep to the obliterated umbilical artery.

The ureter is isolated with a vessel loop (Fig. 61.11). By blunt dissection, the ureter is followed to its junction with the detrusor, termed the ureterovesical junction (UVJ). PGA 3/0 traction sutures are placed distal to the UVJ.

A right-angle clamp is inserted into the plane between the detrusor and bladder mucosa (Fig. 61.12), and the detrusor may be incised with the cautery. It is important to keep the cautery tip away from the mucosa. The junction of the ureter with the bladder mucosa is dissected out circumferentially in this manner.

The detrusor is separated from the mucosa inferomedially and incised with the cautery. A submucosal tunnel is developed superior to the hiatus for several centimetres, to a length four or five times as long as the ureteral width (Fig. 61.13). If the underlying bladder mucosa is cut inadvertently, interrupted 6/0 or 5/0 absorbable sutures should be placed through the open mucosal defect. Interrupted 3/0 absorbable traction sutures should be placed on either side of the detrusor incision. The bladder is emptied further and the ureteral catheter should be removed.

The ureter should be anchored inferiorly to stabilize the UVJ during bladder filling. One or two 4/0 PGA "U" stitches are placed from the distal detrusor muscle, proximally through the inferior edge of the UVJ, and distally through the detrusor (Fig. 61.14). These sutures are tied down.

The ureter is then laid into the trough created by opening the detrusor (Fig. 61.15), and the detrusor is brought together over it with interrupted 3/0 absorbable sutures (Fig. 61.16). The sutures should be tied down as they are placed.

Periodically a right angle clamp should be placed superficial to the intramural ureter to be certain that the tunnel is not too tight (Fig. 61.17). When the tunnel is completed, a suture should be placed between the detrusor muscle and the muscular layer of the ureter as it enters the tunnel, to prevent it from everting during bladder filling. The Foley catheter is then drained.

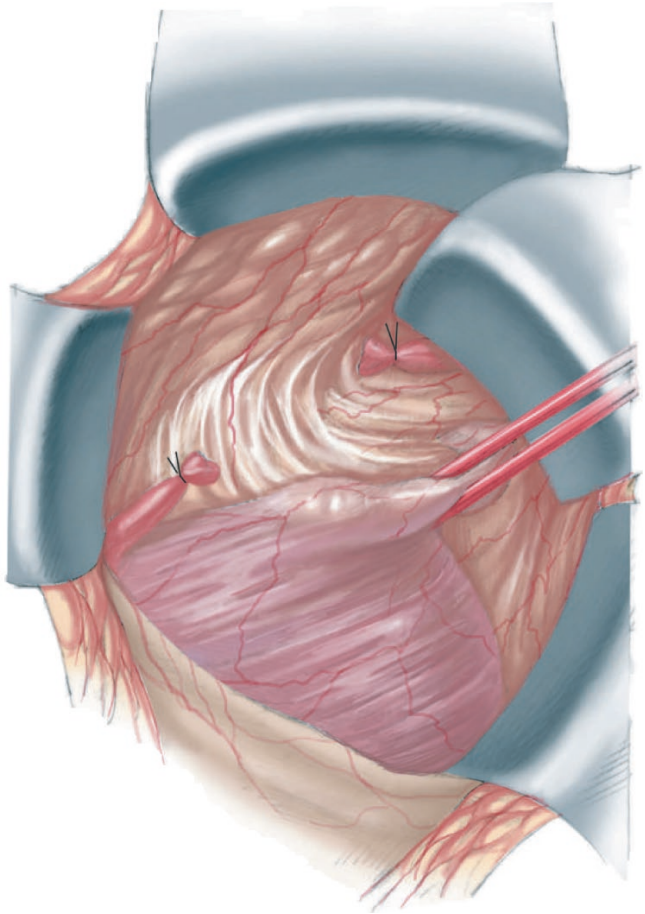

Fig. 61.11 Isolating the ureter with a vessel loop after division of the umbilical artery

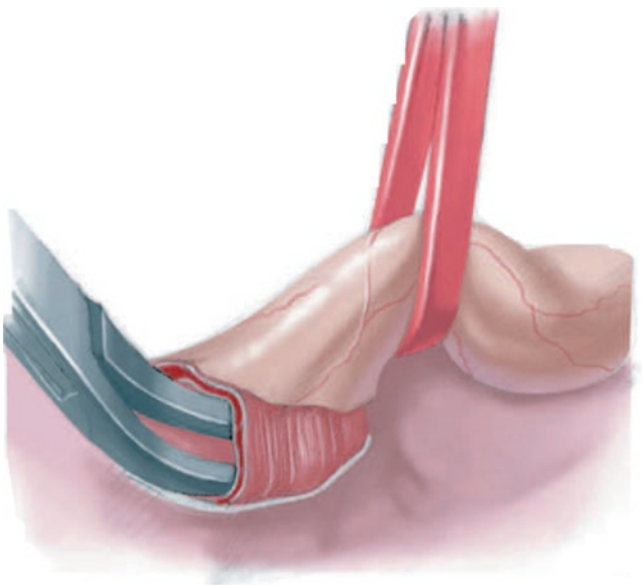

Fig. 61.12 Using a clamp to dissect out the junction of the ureter with the bladder mucosa

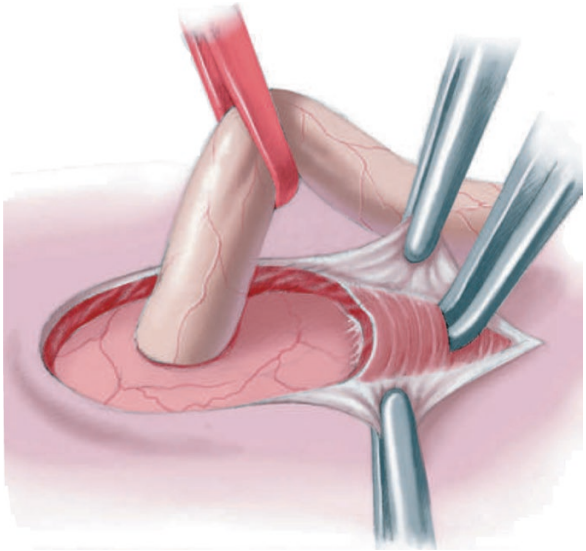

Fig. 61.13 Creating a submucosal tunnel

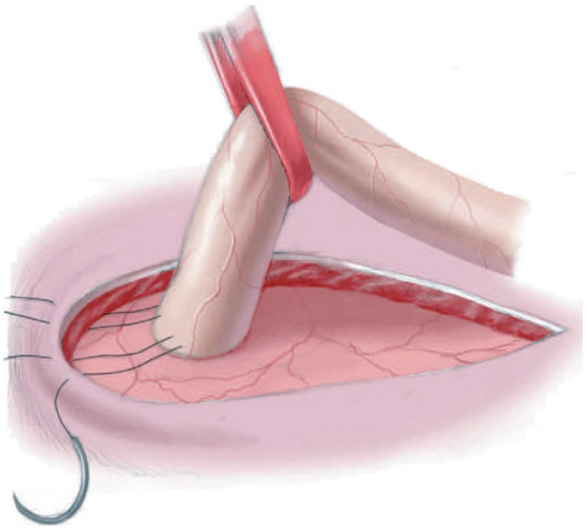

Fig. 61.14 Anchoring the ureter inferiorly

Fig. 61.15 Laying the ureter into the trough

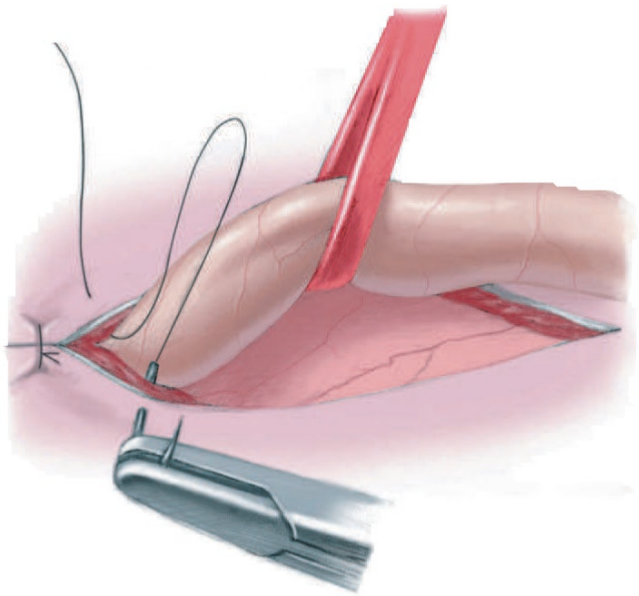

Fig. 61.16 Bringing the detrusor together over the ureter

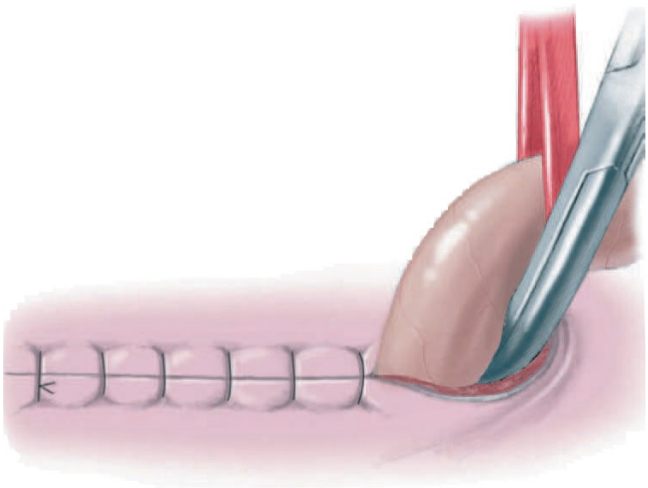

Fig. 61.17 Ensuring that the tunnel is not too tight

61.3.3 Politano-Leadbetter (P-L) Procedure

This technique is another form of intravesical antireflux surgery. It may also be performed as a combined intravesical/extravesical procedure. The operation involves creating a new ureteral hiatus superiorly in the bladder and bringing the ureteral opening near its original location.

The bladder is opened and the ureters are mobilized identically as described above. A vein retractor or small Army-Navy retractor is placed in the medial wall of the hiatus. The peritoneum is teased away with either a large right angle clamp or a Kitner dissector (Fig. 61.18, *top*). A new position for the hiatus should be made in a fixed portion of the bladder base several centimetres superior to the original hiatus.

From outside the bladder, the right angle clamp is used to indent the bladder, the clamp is opened slightly, and the overlying bladder mucosa is cauterized, exposing the tip of the clamp (Fig. 61.18, *bottom*). The right-angle clamp is then opened to create a new hiatus of satisfactory size.

A second right-angle clamp is passed from the inside of the bladder outside through the new hiatus, the feeding tube in the ureter is grasped (Fig. 61.19), and the ureter is brought into the bladder. It is important for the ureter to travel in a relatively straight direction.

At times it is necessary to perform an extravesical dissection also. If so, the Denis Browne retractor must be taken out and the outside wall of the bladder retracted medially. The obliterated umbilical artery should be identified; it is a firm white structure extending from the dome of the bladder toward the hypogastric artery. The artery is ligated and divided with 3/0 absorbable suture. The bladder may then be mobilized further. Beneath the obliterated umbilical artery is the ureter. This extravesical dissection facilitates the establishment of a new hiatus with minimal risk of bowel injury.

After the ureter is brought into the bladder, the original hiatus should be closed with three or four 3/0 absorbable sutures placed through the detrusor.

A submucosal tunnel is created. Tenotomy scissors are used to incise the mucosal attachment off the underlying detrusor in the old hiatus, and then the submucosal tunnel is created toward the new hiatus by gently spreading the tenotomy scissors between the mucosa and detrusor. The width of the tunnel should be approximately twice as long as the ureteral width, and the length is four to five times as long as the width.

When the new hiatus is reached, a right-angle clamp is passed through the tunnel and the feeding tube is grasped. The submucosal tunnel may be extended distally toward the bladder neck if necessary to create a tunnel of sufficient length. The ureter is pulled through the new submucosal tunnel. The feeding tube should be removed and the distal aspect of the ureter resected. The ureter is then spatulated slightly.

With the feeding tube in place, the ureter is sutured to the bladder mucosa with interrupted 5/0 or 6/0 absorbable

sutures; the distal apical suture should be placed through the bladder muscle also, to help fix the ureter in place. There should be no tension on the ureter. Small mosquito clamps are placed for traction on the two apical sutures to allow easy identification of the new ureteral orifice. The feeding tube should be removed and then reinserted into the ureter; the feeding tube should pass easily into the kidney. It is unnecessary to leave a feeding tube in the ureter postoperatively. After the ureter(s) is fixed in place, the bladder mucosa is closed with running 5/0 absorbable sutures (Fig. 61.20). The bladder is then closed as described in the above section.

The success rates of the P-L and the Cohen (transtrigonal) techniques are similar. The advantage of the P-L is that the ureter is much easier to catheterize for retrograde pyelography and ureteral endoscopy because the ureteral opening of the Cohen is on the opposite side of the bladder. The disadvantage is that in creating the new ureteral hiatus, there is a blind spot behind the bladder, and a peritoneotomy or even bowel injury may occur, particularly in reoperative cases.

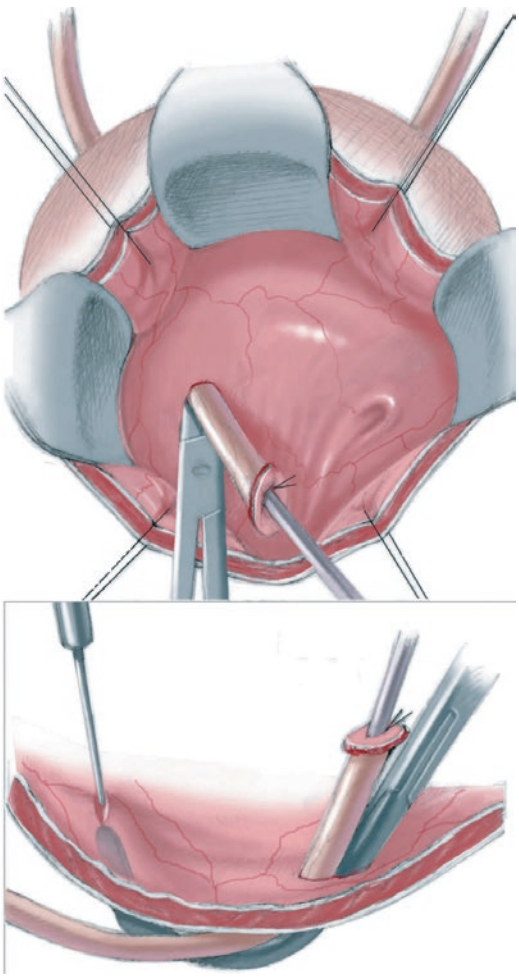

Fig. 61.18 Teasing away the peritoneum (*top*) and creating a new hiatus (*bottom*)

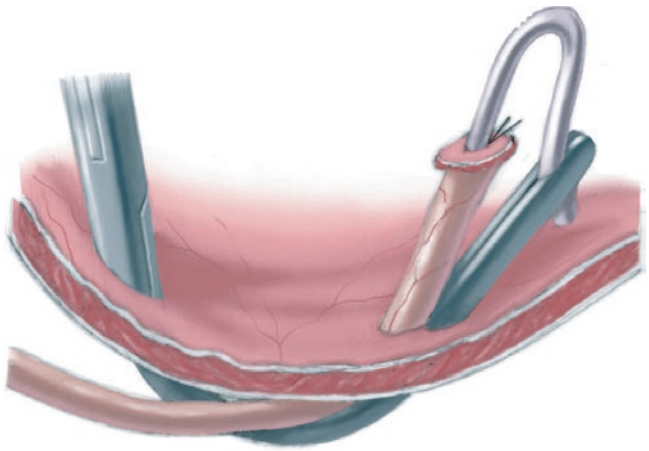

Fig. 61.19 Preparing to bring the ureter into the bladder

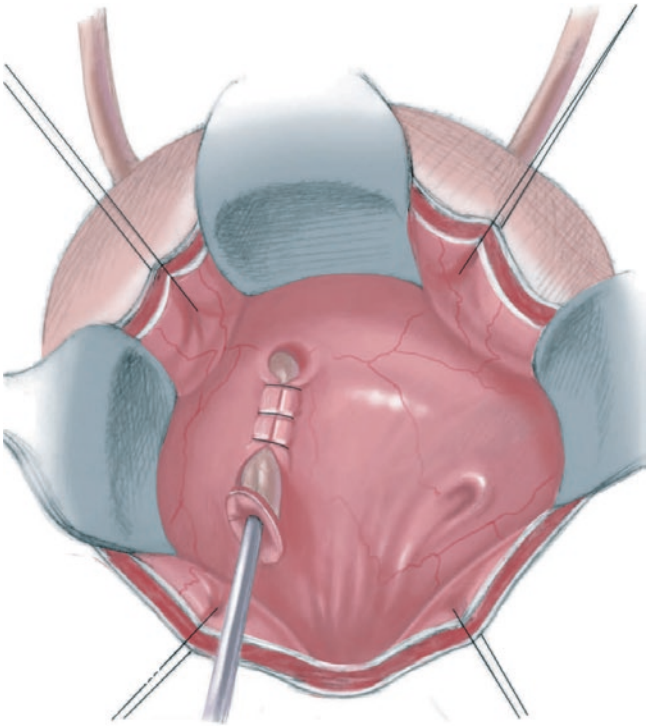

Fig. 61.20 Completing the P-L procedure

61.3.4 Laparoscopic/Robotic Extravesical Ureteral Reimplantation

The child is placed in modified lithotomy position with Allen stirrups. One setup is used. Cystoscopy is performed and the refluxing ureter(s) is cannulated with a 4F ureteral catheter. A Foley catheter is inserted and the bladder is drained. The Foley and ureteral catheter(s) are kept in the sterile field. The child is placed in Trendelenburg position. The camera port is inserted at the umbilicus and 5-mm ports are placed at the level of the anterior superior iliac spine just lateral to the rectus muscle. A 5-mm assistant port is placed lateral to the 5-mm port, contralateral to the refluxing ureter. Maryland grasping forceps and a hook cautery are used. In girls, the ureter is identified in the pelvis just inferior to the fallopian tube. The ureter is mobilized inferior to the uterine artery to its junction with the bladder. An attempt should be made to identify the pelvic plexus, particularly in children undergoing bilateral extravesical ureteral reimplantation. The tissue plane between the medial aspect of the ureter and the internal genitalia is bluntly dissected from the ureter. The ureter is then retracted medially, and the tissue medial and caudal to the ureter is retracted laterally and anteriorly, to expose the nerves from the pelvic plexus. The ureter is then dissected circumferentially from the detrusor, keeping the nerves in sight and away from the dissection.

The bladder is distended with 50–100 mL of saline; some use carbon dioxide to distend the bladder. The detrusor is incised just anterior to the ureterovesical junction. Using the hook dissector, the detrusor muscle is incised around the ureter down to the level of the mucosa (Fig. 61.21). A submucosal tunnel four or five times as long as the width of the ureter is then planned. A 3–0 or 4–0 Vicryl "hitch" stitch on an RB-1 needle is placed percutaneously through the abdominal wall. It is placed through the detrusor just above the planned submucosal tunnel. The detrusor is incised along this pathway down to the level of the mucosa. Lifting the muscle fibers and then cauterizing is useful. If the mucosa is incised inadvertently, it is closed with a 6–0 Vicryl on an RB-1 needle. The tunnel should be sufficiently wide to allow the ureter to be placed comfortably against the mucosa. The ureteral catheter is removed. The ureter is lifted and can be fixed to the tip of the submucosal tunnel with a 4–0 Vicryl stitch. Next, the ureter is pushed into the mucosa and the seromuscular layer at the UVJ is fixed to the detrusor with a 4–0 Vicryl stitch. This suture is left long; the assistant can grasp it for traction. The assistant places tension on the external detrusor hitch stitch and the stitch at the ureterovesical junction, which creates a diagonal or horizontal submucosal tunnel to close. The detrusor is closed over the ureter with a running or interrupted 3–0 or 4–0 Vicryl suture (Fig. 61.22). It may be useful to place the distal stitch through the seromuscular layer of the ureter to fix it in place. The bladder is drained.

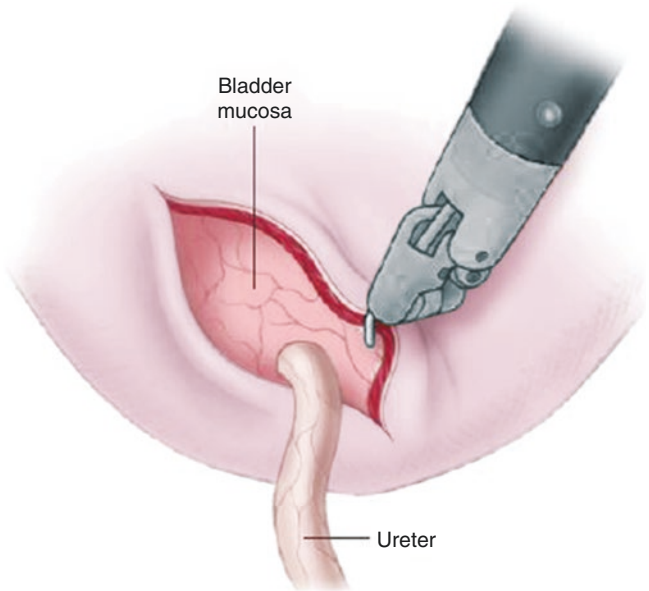

Fig. 61.21 Robotic extraperitoneal exposure of the ureterovesical junction

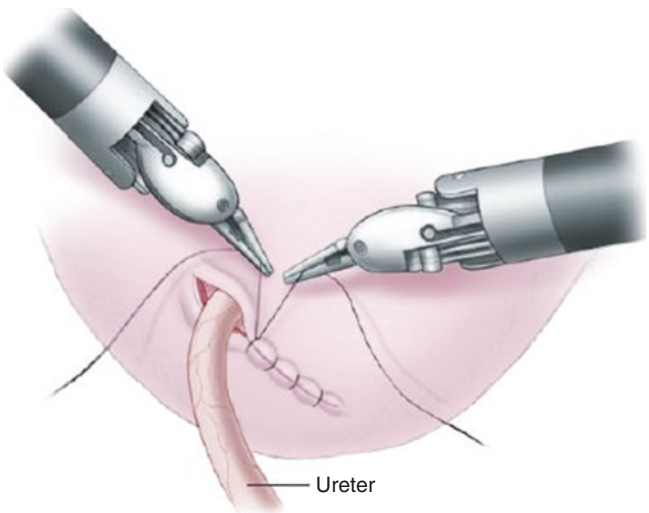

Fig. 61.22 Robotic closure of the ureterovesical junction

61.3.5 Ureteral Tapering (Tailoring)

When the refluxing ureter is too wide to reimplant it into the bladder with a 4:1 or 5:1 length:width ratio, the ureter should be narrowed. The most common surgical technique is with ureteral tapering, in which the ureteral wall is excised. Tapering the ureter is performed on its lateral aspect, because the main collateral blood supply is along its medial wall. Further, when the suture line for tapering is closed, it should be placed posteriorly next to the detrusor muscle when the ureter is reimplanted into the bladder, thus reducing the likelihood that a fistula into the bladder will form. Using sharp, straight scissors, the strip of ureter is removed; it must not be too wide (Fig. 61.23). Trimming the ureter excessively will make it too narrow and jeopardize its blood supply. The ureteral closure is performed with a running, imbricating 4–0 absorbable suture. The dilated ureter is long, and part of the distal end will be excised. When approximately two thirds of the ureteral closure has been performed, the remaining closure should be performed with interrupted sutures, to avoid having to transect part of the tapered ureter that was closed with a running suture. The closure should be performed over an 8F or 10F catheter. The ureter should be implanted with at least a 3:1 or 4:1 length-to-width ratio, using any of the techniques described above. In selected cases, the superolateral corner of the bladder may be fixed to the psoas muscle (termed a psoas hitch) to facilitate a straight ureter, avoiding ureteral kinking. A temporary double-J stent should be left.

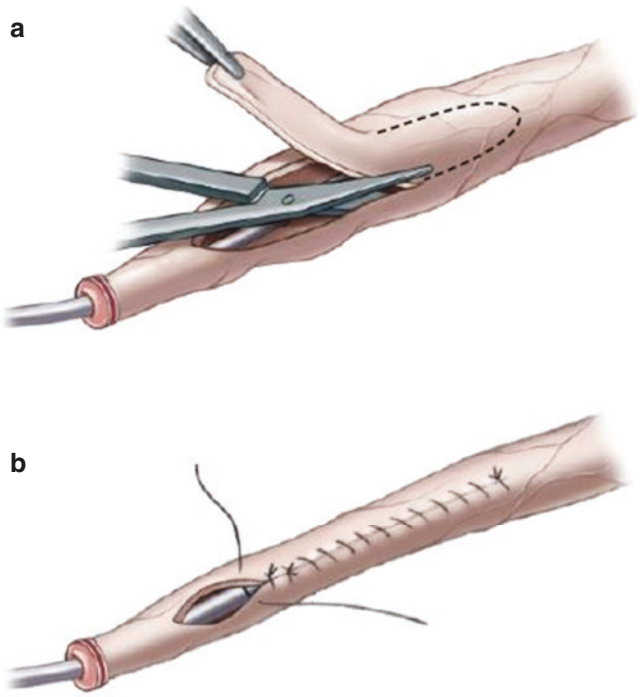

Fig. 61.23 (**a**) Excision of ellipse of ureteral wall over catheter to reduce its diameter. (**b**) Closure of ureter with running absorbable suture proximally and interrupted sutures distally

61.4 Postoperative Management

The most common complications of extravesical ureteroneocystostomy are persistent VUR and ureteral obstruction. Persistent VUR results if the submucosal tunnel is too short or if the ureter is not laid against the bladder mucosa. Ureteral obstruction may result if the ureter sustains a thermal injury during mobilization, if the submucosal tunnel is not straight, or if there is undiagnosed distal ureteral narrowing. An atonic or hypotonic bladder may occur following bilateral extravesical ureteroneocystostomy if the ureters are overmobilized near the pelvic plexus. In these children, a urethral catheter should be left for 4–7 days.

Urine output is measured in the post-anaesthesia care unit and the patient should be hydrated until the output is 1–2 mL/kg per hour. Pain control is established: (1) A caudal block is performed at the beginning and the end of the procedure; (2) Intravenous ketorolac is administered at a dosage of 0.5 mg/kg (maximum 30 mg) during wound closure and is continued at a dosage of 0.25 mg/kg every 6 h for 48 h; and (3) Intravenous morphine is administered at 0.1 mg/kg every 3 h, or a patient-controlled analgesic (PCA) pump can be used for children over 6 years. A regular diet may be prescribed. The Foley catheter is removed the day following the surgical procedure. Discharge is appropriate when the patient is comfortable and afebrile. Following intravesical ureteroneocystostomy, the child may experience moderate or significant bladder spasm, and oral administration of oxybutynin chloride three times daily for 10–14 days often is helpful.

The child should continue to take prophylactic antibiotics for 4 weeks after surgery, at which time a renal sonogram should be performed. Whether to perform a postoperative VCUG depends on the surgeon's experience. Because the success rate of ureteroneocystostomy is over 95%, many surgeons choose to perform a postoperative VCUG only if the child has a febrile UTI suggestive of pyelonephritis or if there is hydronephrosis suggestive of obstruction or persistent reflux.

61.5 Results and Conclusions

The goal of surgical correction of VUR is to minimize the risk and complications of upper tract infection, including new renal scarring, reduced renal function, impaired somatic growth, and complications of pregnancy. In the International Reflux Study, medical and surgical therapy was compared for grades III and IV VUR. The incidence of new renal scarring (approximately 15%) was similar between the two groups, but the incidence of pyelonephritis was 2.5 times higher in the medical group. In the European arm, many of the surgical patients who experienced complications were not operated on by full-time pediatric urologists; no surgical morbidity occurred in the United States arm. More contemporary series with high surgical success rates have shown that the incidence of new renal scarring is probably around 1–2%. The RIVUR Trial demonstrated a benefit of antibiotic prophylaxis in children with VUR, but did not address the role of surgical treatment. Ureteral reimplantation continues to be indicated for children with VUR when medical therapy fails.

The success rate for ureteroneocystostomy is generally over 95% for grades I to IV VUR, regardless of technique. Consequently, many surgeons do not perform a routine postoperative VCUG unless the child develops an upper tract UTI; instead, they monitor their patients with serial renal sonograms. Even with successful surgical correction, however, approximately 5–10% will develop a febrile UTI over the following 10 years.

The late sequelae of ureteroneocystostomy continue to be studied. A disadvantage of the transtrigonal technique is that subsequent endoscopic ureteral manipulation is difficult if an upper tract ureteral calculus occurs, whereas the ureteral orifice is in normal position with the detrusorrhaphy and Politano-Leadbetter techniques.

Suggested Reading

Elder JS. Guidelines for consideration for surgical repair of vesicoureteral reflux. Curr Opin Urol. 2000;10:579–85.

Flickinger JE, Trusler L, Brock JW 3rd. Clinical care pathway for the management of ureteroneocystostomy in the pediatric urology population. J Urol. 1997;158:1221–5.

Peters CA, Skoog SJ, Arant BS Jr, Copp HL, Elder JS, Hudson RG, et al. Summary of the AUA guideline on management of primary vesicoureteral reflux in children. J Urol. 2010;184:1134–44.

Trial Investigators RIVUR, Hoberman A, Greenfield SP, Mattoo TK, Keren R, Mathews R, et al. Antimicrobial prophylaxis for children with vesicoureteral reflux. N Engl J Med. 2014;370:2367–76.

Weiss DA, Shukla AR. The robotic-assisted ureteral reimplantation: the evolution to a new standard. Urol Clin North Am. 2015;42:99–109.