Review Article

Robot-assisted ureteral reconstruction – current status and future directions

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Abstract

Robotic surgery in the treatment in certain urological diseases has become a mainstay. With the increasing use of the robotic platform, some surgeries which were historically performed open have transitioned to a minimally invasive technique. Recently, the robotic approach has become more utilized for ureteral reconstruction. In this article, the authors review the surgical techniques for a number of major ureteral reconstuctive surgeries and briefly discuss the outcomes reported in the literature.

Keywords: Robotic surgery, robotic ureteral reconstruction, robotics, ureteral injury, ureteral reconstruction

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Received: 18.06.2017, **Accepted:** 17.08.2017

INTRODUCTION

Robotic platforms have revolutionized the practice of urology. The widespread dissemination of this technology has resulted in greater patient treatment choice for various surgically treatable diseases. Ureteral reconstruction is an area of urology which has shown great benefit from robot-assisted techniques due in part to the intricate surgical manipulation required for successful completion in these operations. The robotic platform has the benefit of better three-dimensional visualization, tremor reduction, finer control, less blood loss, and shorter hospital stay. In the many cases of ureteral reconstruction where no or small pathology specimens are extracted, there is little need to extend existing incisions, which contributes to better cosmetic outcomes. Currently, short- and intermediate-term outcomes from robotic ureteral reconstruction are largely found in the literature, but with increasing adoption of this technology, there will be more long-term outcomes forthcoming.

Access this article online

Quick Response Code:

Website:
www.urologyannals.com

DOI:
10.4103/UA.UA_94_17

This article reviews robot-assisted surgical techniques for ureteral reconstruction. Specific attention will be given to procedures such as ureterolysis with omental wrapping, ureteroureterostomy, buccal mucosa graft (BMG) ureteral stricture repair, ureteral reimplantation, ileal ureter, and use of the robot in pediatric ureteral reconstruction.

PREOPERATIVE ASSESSMENT

All patients undergoing robotic ureteral reconstruction will undoubtedly benefit from a thorough history and physical examination. Care should be taken to understand the cause for ureteral disease – whether it be congenital, iatrogenic, or autoimmune. To aid in the successful and

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How to cite this article: Babbar P, Yerram N, Sun A, Hemal S, Murthy P, Bryk D, *et al*. Robot-assisted ureteral reconstruction – current status and future directions. Urol Ann 2018;10:7-14.

expeditious completion of robotic ureteral reconstruction, it is imperative to have appropriate imaging. A computed tomography (CT) or magnetic resonance (MR) urogram should provide adequate anatomical detail for surgical planning. In some cases which may preclude intravenous contrast administration (allergy, kidney disease etc.), a retrograde ureterogram and ureteroscopy can provide important anatomic detail. In cases of suspected long-standing ureteral stricture, a diuretic renogram can characterize differential renal function and confirm the presence of obstruction. If there is minimal function in the affected renal unit, one can forego stricture repair.

An important part of the preoperative assessment involves a comprehensive informed consent. Attention should be given to explaining the pathophysiology of the patient's disease and the prospect of disease recurrence. Furthermore, the surgeon should discuss the chance of operative and postoperative complications and the possibility of secondary or reoperative procedures.

INTRAOPERATIVE URETERAL IDENTIFICATION

Ureteral identification can be one of the most difficult parts of the procedure, especially in the case of robotic surgery as there is an absence of tactile feedback. Ureteral inflammation secondary to the pathology of the case and periureteral fibrosis can make ureteral identification challenging as surgical planes can be distorted. However, the outcome of a ureteral stricture case depends on this critical identification step. Excision of the entire diseased segment of ureter prevents stricture recurrence, but resection of unnecessary healthy tissue can lead to inadequate ureteral length and a tensioned anastomosis, which may be prone to stricture or breakdown. Assessment of preoperative imaging is necessary to having a roadmap for the identification of the ureter with respect to surrounding structures. Identification maneuvers (such as clamping the Foley placed preoperatively and administration of a diuretic) before dissection can help with distention and increased peristalsis of the ureter, which will aid in ureteral identification. Large ureteral masses, either intraluminal or extraluminal, are generally identifiable through intraoperative inspection. Smaller ureteral masses are more difficult to identify with robotic vision alone, but several techniques exist to assist the surgeon. For one, endoscopic techniques can be employed before the robotic aspect of the case. Options include concurrent ureteroscopy, where the surgeon guides an open ended catheter to the level of light seen. Another newer option is the use of near-infrared fluorescence imaging.[1] Indocyanine green is injected intraureterally and can be visualized under near-infrared fluorescence to help identify the proximal and distal limits of a ureteral stricture in a efficacious manner.[1]

ROBOTIC URETEROURETEROSTOMY

Ureteroureterostomy is a valuable procedure in the urologist's toolbox that can be used to treat most cases of mid-to-proximal ureteral obstruction. The procedure was first described in the 1950s and has been traditionally performed through an open approach using a Gibson's incision.[2] The dawn of the robotic era offers a new, minimally invasive approach to this procedure, one which has already been adopted into use in children and adults.

If not already identified with cross-sectional imaging, the location and extent of the affected ureteral segment can be identified with cystoscopy and retrograde pyelogram at the start of the case. A double-J stent is then placed at this point as well. We prefer to place a double-J stent directly into the ureter during the operative repair, eliminating the need for cystoscopy and patient repositioning. The patient is placed in a modified 60 degree flank position without any table flexion, so as to avoid undue tension on the anastomosis. The ipsilateral arm is secured at the patient's side which helps prevent robotic arm interference. Ports are then placed in a straight line configuration at the lateral border of the rectus muscle. A 12 mm camera port is placed at the level of the 11th rib. Two 8 mm robotic ports are placed – one at the anterior superior iliac spine and the other two finger–breadths below the costal margin. Between these two robotic ports and the central camera port, one or two assistant ports may be placed [Figure 1]. On the opposite side, an additional 5 mm port may be placed below the xiphoid process to aid with liver retraction, if needed. The robot is then docked 90° perpendicular to the patient. After mobilization of the colon and incision of Gerota's fascia, the ureter and gonadal vein are identified. The ureter is then carefully dissected free from surrounding tissues. The strictured

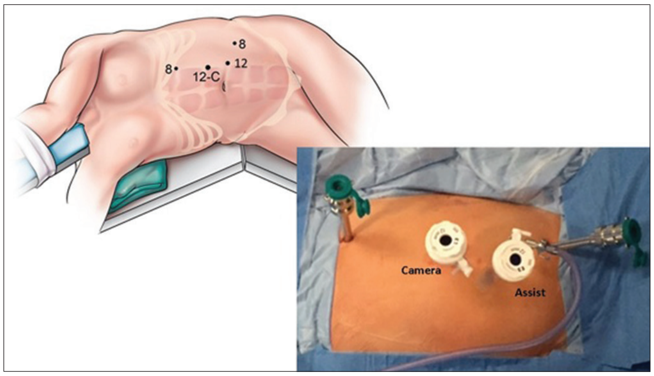

Figure 1: Basic port placement for robotic ureteral reconstruction

segment is then identified by noting inflammation and fibrosis of the surrounding tissue as well as ureteral dilation proximally. It is possible that surrounding inflammation can often make the ureteral dissection somewhat difficult. Once identified, the stricture is directly transected. Scar tissue is then subsequently resected until a healthy tissue margin is identified with well perfused, normal appearing tissue. The distal ureter is spatulated laterally and the proximal ureter is spatulated medially, opposite to the side of the blood supply of these segments. Two polyglactin sutures placed in the periureteral tissues can be used here to reduce tension on the anastomosis. The anastomosis is then performed using a 4-0 polyglactin interrupted suture. After suturing the posterior wall, a double-J stent is placed directly into the ureter with the aid of a glidewire. The remainder of the anastomosis is then completed. Following this, Gerota's fascia is closed over the fresh anastomosis. This serves two purposes: to reduce the risk of bowel adhesion to the operative bed, and to contain any possible urine leaks to the retroperitoneum. The double-J stent is usually removed at 4 week postoperatively.

Several cases of robotic ureteroureterostomy have been reported in both the adult and pediatric literature. Several case reports are found in pediatrics, for indications such as cross-fused renal ectopia,[3] retrocaval ureter,[4] lower pole crossing vessel,[4] and ureteral duplication.[5] Among adult patients, groups have reported success with the procedure in the treatment of nephrolithiasis-related postendoscopy stricture[6] and as a part of segmental ureterectomy for upper tract urothelial carcinoma.[7] Lee *et al*. performed a direct comparison of open versus robotic ureteroureterostomy in a pediatric population.[1] They compared 25 robotic procedures with 19 open procedures and found equivalent operative times, blood loss, complications, and outcomes. Hospital stay in the robotic group was slightly shorter by 0.5 days ($P = 0.04$). In our opinion, robotic ureteroureterostomy is a safe and effective procedure with equivalent outcomes to the traditional open approach. As urologists become more comfortable with the use of the robot, the use of this approach is likely to increase further.

ROBOTIC URETEROLYSIS

Ureterolysis is a relatively rare surgical procedure intended to free the ureter from its surroundings to treat external sources of ureteral compression. Extrinsic obstruction of the ureters can be caused by both benign and malignant processes, with the most common etiologies being retroperitoneal fibrosis (RPF) and ureteral endometriosis refractory to medical therapy.[8]

While RPF has multiple causes including medications, infections, malignancy, prior surgeries, radiation therapy, and inflammatory conditions, about 70% of cases are considered idiopathic.[9,10] Fibroinflammatory plaques in this chronic, progressive disorder can encase one or both ureters resulting in obstruction. The compression can be caused by direct ureteral involvement or by the overlying peritoneum that is affected by the disease.[11]

Although open ureterolysis had been the standard surgical approach in the past, minimally invasive techniques have been established as successful surgical alternatives since Kavoussi performed the first laparoscopic ureterolysis in 1992[12] In a large-series comparing open ureterolysis (OU) versus laparoscopic ureterolysis (LU), Srinivasan *et al*. found that both groups had similar complication rate (8.3% in OU vs. 8.8% in LU) and comparable resolution of obstruction on postoperative imaging (97.1% in OU vs. 94.3% in LU). In addition, when subgroup analysis was performed on patients with idiopathic RPF, the study found that the laparoscopic approach had some improved outcomes including shorter hospital stay (3.4 days in LU vs. 10.8 days in OU) and lower transfusion rates (3.7% in LU vs. 13.7% in OU).[13]

Advents in robotic surgery have been quickly adopted in the treatment of extrinsic ureteral obstruction as it helps prevent the complications associated with open surgery while affording the advantages of minimally invasive surgery, which include rapid convalescence, lower analgesic use, and quicker return of bowel function.[9,14]

The first robotic ureterolysis with laparoscopic omental wrap was performed by Mufarrij and Stifelman in 2006. After reporting a 5-patient pilot case series in 2008, the same group went on to publish the largest series to date of minimally invasive ureterolysis and the only series of robotic ureterolysis, where the entire procedure was performed robotically, including the omental wrapping, for patients with RPF in 2011.[15-17]

After a retrograde pyelography is performed to identify the side and level of ureteral obstruction, the patient is placed in a modified semi-lateral decubitus position before the trocars are inserted. The entire ureter is exposed by medially reflecting the colon to the aorta from the spleen to the bladder on the left side and by medializing the colon and duodenum to the vena cava from the liver and the bladder on the right side. After the healthy portions of the ureter are isolated, the encased segment is freed by splitting the fibrous capsule until the adventitia of the ureter is visible. A portion of the posterior peritoneum is then mobilized and placed to "peritonealize" the ureter, thus completing the omental wrapping.

In addition to a thorough preoperative workup, which includes a detailed history and physical, rheumatology workup, MR imaging urogram and a diuretic renal scan, Keehn *et al*. stressed the importance of conducting a deep tissue biopsy which is sent for frozen and permanent pathologic analysis to establish the primary diagnosis. If pathology confirmed RPF, then they proceeded with primary ureterolysis (PU) at the time of the biopsy. 100% of patient undergoing PU showed resolution of obstruction at 6-month postoperative imaging. They also commented that prophylactic treatment of the uninvolved contralateral ureter is not necessary as the risk of RPF spreading to the uninvolved ureter is not substantial.[15] This was supported by Fugita *et al*., in 2002 and later by Simone *et al*., in 2008 where no patients who underwent unilateral ureterolysis went on to develop contralateral involvement.[9,18]

Over the years, robotic ureterolysis has established itself as a reliable intervention for treating extrinsic sources of ureteral obstruction. Although the literature is relatively sparse surrounding the technique, multiple case series and retrospective studies have shown that, in the hands of an experienced surgeon, robotic ureterolysis is a safe and effective procedure with good surgical outcomes. However, larger randomized comparative studies with long-term follow-up will be necessary to further validate its efficacy.

ROBOTIC URETERAL STRICTURE REPAIR WITH BUCCAL MUCOSA GRAFT

Ureteral strictures can be caused by ischemia, trauma, iatrogenic injury, malignancy, impacted kidney stones, periureteral fibrosis, infection (such as tuberculosis), and idiopathic conditions.[19] After obtaining a history and physical examination in the evaluation of a patient with concern for ureteral stricture, imaging to evaluate the location and length of the stricture should be performed with antegrade or retrograde pyelography, CT urography, or diagnostic ureteroscopy. Treatment of ureteral strictures with ureteral stents or balloon dilation is rarely definitive. Until recently, for complex, long, or multifocal strictures of the proximal ureter, ileal ureter transposition, and renal autotransplant were the primary methods for surgical management. These procedures, however are at risk of significant morbidity.[20,21]

BMGs have been used for repair of urethral strictures since the early 1990s; the qualities of BMG, including thick epithelium and highly vascular underlying lamina propria, make it highly successful for these repairs.[22] In 1999, Naude reported the first usage of BMG for the repair of ureteral strictures; Naude noted 6 patients undergoing open ureteroplasty and reported positive results.[23] Several other case reports and small series have reported similar success with the use BMG for repair of ureteral strictures in both transperitoneal and retroperitoneal open approaches with short term and intermediate follow-up.[24-27] Utilizing a robot-assisted technique for BMG ureteroplasty, however, can allow for smaller incisions, stabilization of instruments, improved surgeon ergonomics, and enhanced visualization with three-dimensional imaging,[28] while maintaining the benefits of the BMG. In 2015, Zhao *et al*. were the first to report a robot-assisted technique for ureteral reconstruction using BMG.[29]

The first step before the stricture repair is identifying the stricture intraoperatively. Zhao *et al*. reported performing ureteroscopy after dissection down to the ureter with stent placement following BMG only.[29] Alternatively, at our institution, retrograde pyelogram with ureteral stent placement can be performed before docking the robot.

After docking the robot, the colon is medialized and ureterolysis is subsequently performed. A ureterotomy is then made at the distal level of the ureteral stricture with the fibrotic tissue dissected until healthy proximal and distal ends are noted. Alternative to Lee *et al*.'s use of intraureteral indocyanine green for ureteral identification,[30] Zhao *et al*. notes using intravenous indocyanine green, as described by Bjurlin *et al*.,[31] to detect the proximal extent of the stricture and dissect up to healthy tissue. The length of the defect is measured, and an appropriately sized BMG is harvested from the cheek. The BMG harvest is performed similar to the technique described by Morey *et al*.[32] The BMG is prepped and then brought into the surgical field through a robotic trocar. The BMG is oriented in the correct position with the mucosal surface facing the ureteral lumen. The apices of the BMG are sutured to the distal and proximal ends of the ureterotomy. Running absorbable suture is performed along either end of the BMG and ureterotomy creating the anastomosis. An omental flap, which had been mobilized during the initial dissection, is then secured around the anastomosis at the psoas muscle. A drain is placed adjacent to the anastomosis and is typically removed before the discharge. Ureteral stent is removed 4-6 weeks after surgery with pyelogram performed to confirm patency of the ureter.

There are very few reports of robot-assisted ureteroplasty using BMG. Zhao *et al*. demonstrated 100% success as evidenced by no extravasation on pyelogram and no hydronephrosis on follow-up ultrasound in four patients with follow-up ranging 10.7–18.6 months.[29] The BMG onlay techniques described include dorsal and ventral onlays in addition to an augmented anastomotic ureteroplasty for an obliterated segment of proximal ureter. Zhao *et al*. also reported a multiinstitutional study of robotic BMG ureteroplasty with seven patients, all of whom had no ureteral obstruction on follow-up.[33] Although the data is sparse, robotic-assisted ureteroplasty with BMG may be a useful option for repair of complex and proximal ureteral strictures. Further study is needed to evaluate the success of the technique.

ROBOTIC URETERAL REIMPLANTATION

Historically, open ureteral reimplant was regarded as the gold standard of surgical treatment. However, with the advent of the robotic platform, minimally invasive repair of the distal ureter has become more common. Since the first published report of a laparoscopic ureteral reconstruction was published in the early 1990s,[34] many methods and techniques have been published for minimally invasive ureteral reimplantation. Port placement and positioning, while they can vary depending on the surgeon, was described in an earlier section of this review. After port placement, the ureter of interest is identified laterally and dissected with adequate tissue remaining on the ureter itself. Preservation of the ureteral blood supply is imperative for a successful repair. The bladder is not mobilized at this time to allow for adequate traction during the ureteral dissection. The distal ureter is transected just proximal to the diseased area. If necessary, a frozen section can be sent to rule out malignancy. In addition, a clip can be placed on the distal ureter to prevent seeding of cancerous cells into the peritoneum. Next, attention is drawn to the bladder. The bladder is mobilized by diving the urachus and then developing the space of Retzius. Full bladder mobilization is not necessary but is dependent on the length of the remaining ureter. Next, the bladder is filled to about 200cc's, and the area around the ureteral stump is scored. If it is felt that there will be tension on the anastomosis, a psoas hitch or even a Boari flap can be performed. The bladder is then incised with a healthy margin around the ureteral orifice if done for oncologic reasons. Reimplantation of the ureter is always performed on the posterior wall of the bladder just lateral to the dome. A ureteral stent is advanced up the ureter in a retrograde fashion with one loop in the renal pelvis and the other in the bladder. Mucosa of the ureter and bladder are approximated with absorbable suture. At our institution, the closure is completed in two layers to ensure a watertight closure. For full bladder decompression during anastomotic healing, patients are discharged with a ureteral stent and Foley catheter in place. Foley catheter is removed in 2–3 weeks while the stent is typically removed at their 4–6 week postoperative visit.

Evidence in support of minimally invasive robotic surgery for ureteral reimplant has gained wide acceptance in recent years. In the published paper by Patil *et al*.,[35] the author describes 12 patients operated on by three surgeons. Mean operative time was 208 min and mean estimated blood loss was 48 mL. No patients had any intraoperative or postoperative complications. This report was similar to the study published by Lee *et al*.[36] In this series, stricture disease was treated successfully in all patients with no postoperative complications. The authors reported all patients were well and pain free at last follow. Further, in a more contemporary series by Wason *et al*.,[37] the authors demonstrated in their study that all patients had a successful robotic ureteral reimplantation. With a mean follow-up of 10 months, all patients had a resolution of their hydronephrosis due to benign stricture disease. Overall, the body of literature demonstrates that robotic ureteral reimplant is feasible and produces a comparable surgical outcomes to open repair.

Few comparative studies exist that evaluate differences between open ureteral reimplatation versus robotic ureteral reimplatation. Kozinn *et al*., published a retrospective study comparing 10 robotic reimplantations to 24 open reconstructions.[38] While not robust in its sample size, the study showed a decrease in estimated blood loss and length of hospital stay in the robotic reimplatation group ($P < 0.05$). No patients were found to have a recurrence of their stricture disease at over 2 year follow-up. Similarly, in a study published by Elsamra *et al*.,[39] the authors analyzed over 100 open, laparoscopic, and robotic ureteral reimplants between 1997 and 2013. They noted a decrease in estimated blood loss in the laparoscopic and robotic groups when compared to the blood loss in the open group. In addition, operative times were equal in all groups, but hospital length of stay was lower in the minimally invasive cohort ($P < 0.002$). While no prospective, randomized trials exist to compare the true effectiveness of the robotic ureteral reimplant to open reimplant, it is our opinion that robotic reimplantation is both a safe and effective option for patients in the hands of an experienced robotic and laparoscopic surgeon.

ROBOTIC ILEAL URETER

Ileal ureteral substitution is generally used in times of extensive ureteral disease and is seen as a last resort when many of the aforementioned options are either nonfeasible or have failed. Patients with an ileal ureter have to be counseled on the postoperative risk of UTI, pyelonephritis, and metabolic complications from the use of bowel in the urinary tract. A few varying techniques for robotic ileal ureter have been described in the literature, but for a completely intracorporeal approach, the patient is initially placed in the modified flank position, and the ureter is isolated and possibly excised. The patient is then repositioned in the supine position, and the robot is then redocked. Next, a 20 cm segment of ileum is identified with care taken to preserve vascularity. The bowel anastomosis is performed intracorporeally using a stapling device. The bladder is then mobilized and a psoas hitch may be performed if necessary. A cystotomy is performed at the bladder dome and care is taken to orient the ileum in an isoperistaltic configuration. The patient is then repositioned in the modified flank position, and the proximal pyeloileal anastomosis and distal ileal-vesicular anastomosis are performed with polyglactin suture.[40]

Robotic ileal ureter was first described in 2008 by Wagner *et al*.[41] They described a patient with a solitary kidney and cystinuria with recurrent ureteral stricture disease who underwent an uncomplicated robotic ureterectomy with ileal ureter creation. The urologic anastomoses were done intracorporeally, but the bowel anastomosis was done in an extracorporeal fashion. The case took 9 h, and the patient did well at 48-month follow-up. Our center described the first completely intracorporeal technique for robotic ileal ureter in 2014 on a patient with multiple proximal ureteral strictures. After careful workup, the aforementioned procedure was performed in 7 h, and the patient had a cystogram on postoperative day 12 which showed no extravasation. The patient was doing well at 2 year follow-up. Chopra *et al*. reported three cases of completely intracorporeal robotic ileal ureter with a median operative time of 450 min. Two patients were without complication while one patient experienced ileal ureter necrosis due to an occluded blood supply requiring exploratory laparotomy and small bowel resection on postoperative day 4. The patient had ureteral reconstruction with appendix and cecum and is now doing well.[42] The first case of pediatric robotic ileal ureter was recently described with good intraoperative and postoperative outcomes.[43]

ROBOTIC RETROCAVAL URETER REPAIR

Retrocaval ureter is a congenital abnormality characterized by the right ureter coursing posterior to the inferior vena cava (IVC) and is caused by a persistent posterior cardinal vein on the right side[44] [Figure 2]. It generally presents in adulthood with flank or lumbar pain from obstruction, secondary urolithiasis, hydronephrosis, or recurrent urinary tract infections. The mainstay of treatment in symptomatic patients had been open repair but with the advent of minimally invasive surgery, there are isolated reports of robotic retrocaval ureteral repair. First, appropriate imaging studies are conducted to diagnose the condition and also define relationship of the ureter to adjacent structures such as the renal vein and IVC. Next, The patient is placed in the lateral decubitus position, and then, a transperitoneal approach is taken toward the kidney and ureter of interest. The ureter is identified, and this is easiest done by tracing it from the dilated collecting system. The course of the ureter is traced with attention given to its relationship with the IVC. The ureter is then divided, spatulated, and anastomosed in the standard fashion of an ureteroureterostomy with absorbable suture making sure to extricate the ureter from its retrocaval course.

There is very limited literature on this procedure due to the relatively rare incidence of this condition. There are isolated reports of robotic retrocaval ureter repair with good postoperative outcomes, short length of stay, and resolution of obstruction.[45,46] Gundeti *et al*. described the first report of robotic retrocaval ureter repair in a pediatric patient with resolution of hydronephrosis at 6 month follow-up visit.[44] In the hands of an experienced minimally invasive urologist, robotic retrocaval ureter is feasible and efficacious.

ROBOTIC PEDIATRIC URETERAL RECONSTRUCTION

Although the robotic platform was initially used in adult urologic surgery, pediatric urologists have

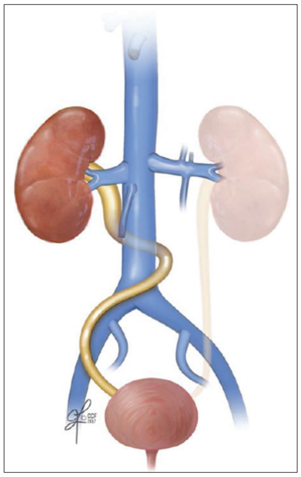

Figure 2: Anatomical view of retrocaval ureter

also adopted robotic surgery for extirpative and reconstructive procedures. While pyeloplasty is the most commonly performed pediatric robotic surgery, Bowen *et al*. have reported that robotic ureteral reimplantation is becoming increasingly popular, representing approximately 5% of all pediatric ureteral reimplantations by 2012.[47]

The "gold standard" repair for vesicoureteral reflux is either intravesical or extravesical open surgery, with success rates >95%. Robotic ureteral reimplantation is most feasible extravesically, by recreating the Lich-Gregoir technique.[48] Smaller, single institution reports note success rates similar to open, but larger single institution and multi-institution studies demonstrate success rates between 70% and 90%.[49-53]

This large difference in outcomes is commonly attributed to technique and learning curve, but examination of the literature shows differences from surgeon to surgeon in terms of the procedure. In general, the patient is positioned in the dorsal lithotomy position, and the robot is docked between the legs of the patient. The camera port (8–12 mm) is placed at the umbilicus or 1 cm infraumbilically and working ports (5 mm or 8 mm) are placed lateral or slightly inferolaterally to the camera port in the midclavicular line, at the level of the anterior superior iliac spine or even lower in larger children.[49,52,54,55] An assistant port may or may not be utilized.

The bladder and ureters are accessed with a transperitoneal approach and the ureters are identified and mobilized distally to the ductus deferens or uterine artery. Cautery must be used with precision to minimize thermal injury to periureteral tissue and the neurovascular bundle, a theorized cause of postoperative urinary retention.[48] Classically, a detrusorotomy that is five times the ureteral diameter is created; elevating the bladder anteriorly through a suprapubic hitch stitch may be of assistance. The ureter is subsequently placed in the submucosal detrusor tunnel, with the detrusor musculature closed over the ureteral in a continuous or interrupted fashion.[52,54]

Gundeti *et al*. have reported on the LUAA technique, a series of modifications implemented over a 7-year period in 83 ureters to improve VUR resolution rates from 67% to 87%.[52] This includes a detrusor tunnel length of 4–5 cm regardless of ureter caliber (L), placing a U-stitch at the distal end of the Y-shaped detrusorotomy to advance the ureter (U), aligning the ureter in the detrusor tunnel with a permanent apical stay stitch (A), and incorporating adventitia in every other throw of the continuous detrusorraphy (A). Overall, the body of evidence presents in the literature supports the use of the robotic platform for ureteral reimplantation in the pediatric population.

CONCLUSION

Robotic platforms have provided an impetus for innovation in surgery while preserving patient safety and postoperative outcomes. Ureteral reconstruction has shown great benefit from use of the robot with the fine tissue manipulation required and the promise of improved cosmesis and minimal blood loss. The aforementioned robot assisted procedures are efficacious in experienced hands and are an option to counsel patients about when discussing surgical avenues for ureteral reconstruction.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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