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UPJ OBSTRUCTION

■ EPIDEMIOLOGY AND ETIOLOGY

Ureteropelvic junction (UPJ) obstruction is the most common cause of hydronephrosis in neonates and remains a relatively common problem seen in adult urologic practice. Antenatal hydronephrosis is the most common anomaly detected on ultrasonography and is seen in approximately one per 100 live births. Of these, at least two-thirds of cases of hydronephrosis are attributed to congenital UPJ obstruction. Although the majority of cases do not require intervention, clinically significant congenital UPJ obstruction is estimated to occur in approximately one per 1500 live births. Acquired obstruction presents additional clinically significant cases ultimately requiring surgical intervention.

Possible causes of UPJ obstruction include intrinsic causes such as remnant valves, folds, or the more popular theory of disorientation of smooth muscle at the UPJ, resulting in peristaltic discontinuity. This theory is based on the histopathologic finding of an abundance of longitudinal muscle fibers and an interruption of circular fibers at the UPJ in affected patients. Extrinsic causes may include angulation or high insertion of the ureter, bands, kinks, or crossing vessels. Although the vast majority of infants have an inherent smooth muscle defect, we find that the incidence of a crossing vessel significantly increases with age. [Figure 37-1](#) illustrates a left lower pole crossing vessel located anterior to the UPJ. Acquired or secondary obstruction may result from vesicoureteral reflux, ureteral stricture from previous trauma, stone disease, or instrumentation. The ability to ascertain the etiology may help determine which treatment options are most likely to succeed, thus avoiding complications.

■ NATURAL HISTORY

Obstruction of the UPJ results in chronic dilation of the renal pelvis and calyces and may lead to irreversible loss of

renal function. Because of this chronicity, some patients may not experience the classic symptoms of renal colic, nausea, and vomiting. Patients may report symptoms that occur during periods of increased fluid intake or diuresis (Dietl's crisis). Urinary stasis can lead to calculus formation and predispose to infection, which may cause the clinical presentation of UPJ obstruction to include hematuria or pyelonephritis.

It has been well documented by observational studies from the pediatric literature that a large number of cases of "incidental" UPJ obstruction diagnosed by antenatal ultrasonography will resolve or result in no loss of function. Although most pediatric patients present with antenatal hydronephrosis, a few may still present with failure to thrive, poor intake, sepsis, urinary tract infection, hematuria, or stone disease. Prior to the widespread use of ultrasound, the most common presentation was a palpable abdominal or flank mass.

■ DIAGNOSIS

Patients should undergo a focused urologic history and physical examination, paying particular attention to symptomatology and timing. Laboratory studies should include a serum creatinine measurement and urinalysis. Urine cultures, when appropriate, should also be done to rule out infection. Anatomic and functional imaging of the upper urinary tract is pivotal to making the correct diagnosis and treatment plan. Computed tomography allows for visualization of the renal pelvis and ureter, associated calculi, as well as any extrinsic obstructions including crossing vessels or tumors. Radionuclide diuretic renography is also often helpful to confirm the diagnosis, quantify the degree of obstruction, and compare split renal function. Intravenous pyelography may also be useful in evaluating anatomy of the renal pelvis and ureter. Retrograde pyelograms may be useful to delineate the anatomy at the time of reconstruction.

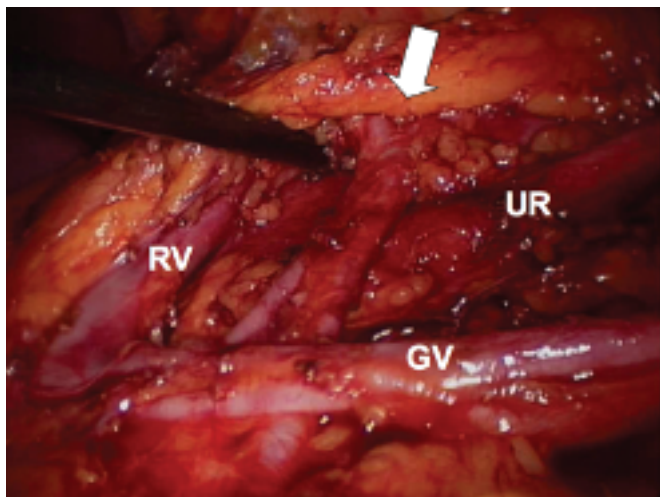


FIGURE 37-1. Intraoperative photograph demonstrating left-sided ureteropelvic junction obstruction because of lower pole crossing vessels (white arrow). Renal vein is labeled RV, gonadal vein is labeled GV, and ureter is labeled UR.

Otherwise, they should be avoided to prevent the introduction of bacteria into an obstructed system. Endoluminal ultrasonography may also be useful to help identify crossing vessels at the time of surgery.¹ Pediatric and selected adult patients should undergo a voiding cystourethrogram (VCUG) to rule out associated vesicoureteral reflux.

■ INDICATIONS FOR TREATMENT

The primary indications for laparoscopic or robotic-assisted laparoscopic pyeloplasty are identical to those for open surgery. These include symptomatic UPJ obstruction (flank pain), recurrent infection, calculi, or progressive loss of renal function. Relative indications include progressive worsening of hydronephrosis or severe obstruction, as documented by time-activity curves on nuclear renal scintigraphy.

■ CONTRAINDICATIONS

Contraindications to pyeloplasty include a small intrarenal pelvis or poor renal function ($\leq 15\%$) in the presence of a normal contralateral kidney. While technically challenging, secondary UPJ obstruction is not a contraindication to laparoscopic or robotic-assisted laparoscopic pyeloplasty. Likewise, previous abdominal surgery is not a contraindication, but a retroperitoneal approach can be considered to avoid intraperitoneal adhesions.

■ TREATMENT OPTIONS

A number of treatment options exist for repair of UPJ obstruction. While the gold standard treatment for UPJ

obstruction is dismembered pyeloplasty, other techniques have evolved that are aimed to decrease the morbidity associated with open surgery. The success rate of open pyeloplasty in most modern series is greater than 95%, a high benchmark with which to compare newer less invasive techniques.²⁻⁵ Alternatives include open⁶ intubated ureterotomy and antegrade and retrograde endopyelotomies using either cautery-wire balloon (Acucise™, Applied Medical, Rancho Santa Margarita, CA) techniques or direct vision techniques with Holmium laser, cold knife, or cautery. While morbidity is certainly decreased compared to open pyeloplasty, the success rate of endopyelotomy varies from 60% to 80%, even in well-selected patients with only mild-to-moderate hydronephrosis and no evidence of crossing vessels.⁷⁻⁹ Perhaps the most appropriate role for endopyelotomy at this time is recurrent obstruction following prior UPJ treatment, with success rates ranging from 40% to 60%. Desai et al.¹⁰ recently reported a minimally invasive hybrid technique of percutaneous antegrade endopyeloplasty using an endoscopic suturing device (EndoStitch™, AutoSuture USSC, Norwalk, CN) to close a vertical endopyelotomy in a horizontal fashion. As of this time, long-term follow-up is not yet available.

Dismembered pyeloplasty remains the most versatile and successful technique, allowing the surgeon to deal with intraoperative findings such as crossing vessels, a large redundant renal pelvis, or high-insertion and make appropriate adjustments in the repair. The excellent results achieved with formal reconstruction of the UPJ led to the laparoscopic approach, simultaneously reported by Schuessler et al.¹¹ and Kavoussi and Peters in 1993.¹² Both reported success rates of 100% with minimal blood loss and no complications; however, their operative times ranged from 3 to 7 hours. Jarrett et al.¹³ reported a 96% success rate with the first 100 cases at Johns Hopkins. Mean hospital stay was 3.3 days, and morbidity was decreased compared to contemporary open pyeloplasty series. Although operative times decreased with experience, the mean operative time remained 4.2 hours. Some laparoscopic surgeons with extensive experience have attempted to reduce the morbidity of the procedure further. Razdan et al.¹⁴ reported a three-trocar laparoscopic pyeloplasty using 5-mm trocars in 15 patients. They concluded that their technique may offer decreased operative time with fewer ports, thus obviating the need for fascial closure improving patient discomfort and cosmesis.

Several pediatric case series have also shown that laparoscopic pyeloplasty can be safely performed in children with success rates greater than 90%, with significant improvements in hospital stay and narcotic use.¹⁵ While the benefits

of laparoscopic pyeloplasty over open pyeloplasty in infants remain debated, it clearly has a role in younger children or adolescents and offers less morbidity and better cosmesis than open surgery.

Overall outcomes data support the superiority of laparoscopic pyeloplasty over open surgery in terms of morbidity and cosmesis, but the steep learning curve and long operative times have prevented greater acceptance and utilization. These advantages are much more apparent in adults compared to children.

HISTORY OF ROBOTIC-ASSISTED LAPAROSCOPIC PYELOPLASTY

Robotic-assisted surgery has experienced intense growth and enthusiasm in the past 5 years. Robotic assistance has been used to facilitate complex laparoscopic reconstructive procedures, in particular those involving intracorporeal suturing. Yohannes et al.¹⁶ compared complex skills in the inanimate laboratory setting and found that the use of the robot allowed for faster suturing and dexterity skills as compared to standard laparoscopy. The use of the robot has also been shown to be beneficial in the setting of training and complex skills acquisition. Hubert et al.¹⁷ showed that surgeons without advanced laparoscopic training develop laparoscopic pyeloplasty skills more rapidly and with less fatigue in the porcine training laboratory. In addition, the feasibility of robotic assistance for telerobotics laparoscopic surgery to novice surgeons has been done across the Atlantic Ocean.¹⁸

The first urologic surgical procedure to be completed with robotic assistance was a transurethral prostate resection.¹⁹ The AESOP™ robot (Computer Motion, Goleta, CA) was introduced to facilitate laparoscopic camera holding and movement. Partin et al.²⁰ reported the first use of robotic assistance in 17 successfully completed laparoscopic urologic procedures using AESOP, including three pyeloplasties.

The Zeus™ system (Computer Motion, Goleta, CA) was the first commercially available surgical robot with a master–slave system consisting of two arms, and AESOP. Limitations of Zeus were the need to mount the unit to the operating table and the instruments that were limited to four degrees of freedom, similar to standard laparoscopic instruments. Sung et al.²¹ performed robotic-assisted laparoscopic pyeloplasty in six porcine kidneys and compared them to standard laparoscopic pyeloplasty done in four porcine kidneys. They found that operative and anastomotic times, number of suture bites per ureter, and immediate watertightness was comparable between the two groups.

The da Vinci® Surgical System (Intuitive Surgical, Mountain View, CA) was FDA approved to perform laparoscopic procedures in July 2000. It is a master–slave robot that integrates a comfortable surgeon console with a portable patient-side cart consisting of a camera arm and two robotic instrument arms. The unique instrument “wrists” have seven degrees of freedom, which eliminate the long fulcrum of standard laparoscopic instruments that tends to exaggerate movements in pelvic laparoscopy. The robotic arms move in the same direction as the surgeon’s hands, in contrast to conventional laparoscopic instruments. Subsequent modification of the patient-side cart now also offers an optional third instrument arm or “fourth arm,” which can be used to aid in retraction.

The da Vinci optics include 6–10× magnification and three-dimensional stereoscopic visualization, which allows for improved depth and shadow perception. An analogy that demonstrates this advantage is to attempt to thread the eye of a needle with one eye closed. The improved depth perception allows for more rapid and precise fine movements like suture placement. Other advantages that improve precision include tremor filtering and motion scaling. Finally, the comfortable sitting position at the surgeon console helps to reduce surgeon fatigue, a significant factor in laparoscopic cases with long operative times that require focus and concentration for accurate intracorporeal suturing.

Disadvantages of the da Vinci Surgical System include high cost and a lack of haptic feedback, which impairs tactile evaluation of tissue and suture tension. Sung and Gill²² compared the Zeus and da Vinci systems in a porcine model and found that the learning curve and operative times were shorter with the da Vinci Surgical System than with the Zeus.

In the first series reported of robot-assisted laparoscopic pyeloplasty, Gettman et al.²³ showed that in their initial six cases, operative times decreased to 140 minutes from a mean of 235 minutes for standard laparoscopy. The most significant contribution to decreased operative time appears to be a decreased anastomotic suturing time (Table 37-1). Subsequent reports have consistently shown excellent results comparable to open and standard laparoscopic pyeloplasty, with significantly decreased operative times. More recently, a few preliminary case series have also shown that the procedure can be effectively accomplished in children with similar improvements in operative time as compared to standard laparoscopic pyeloplasty (Table 37-2).

OPERATING ROOM SETUP

The patient is positioned in the flank position with the affected side up. The patient-side cart approaches the

Table 37-1. Reported Case Series' of Robot-Assisted Laparoscopic Pyeloplasty in Adults

Reference Year	Institution	No. of Patients	Operation Time (min)	Suture Time (min)	Hosp Stay (d)	Technique	Approach	Conv Rate	Complications	Success Rate	Mean F/U (months)	Comments/Conclusions
Yohannes J Endourol 2003	Creighton	1	300	45	4	A-H	TP Running 3-0 Stent 1 week	0	0	No F/U reported		First case, feasible, safe
Gettman, Peschel Eur Urol 2002	Innsbruck Mayo	Six robot vs. six pure lap	140/78	70/13	4	A-H (4)/	TP	0	0	100%	3	Robot faster, especially w/A-H
			235/100	120/28	4	Fenger (2) A-H (4)/ Fenger (2)	Running 4-0 vicryl Stent 3-6 weeks					
Gettman, Peschel Urology 2002	Innsbruck	9	139	62	4.7	A-H	TP	0	One open repair renal pelvis leak	89	4.1	
Peschel, Gettman Urol Clin North Am 2004	Innsbruck Mayo	49	124	NR	NR	A-H (40)	TP	0	One open repair renal pelvis leak	97%	7.4	10 patients with secondary UPJ
						Y-V (7) Fenger (2)	Running 4-0 vicryl Stent 6 weeks					
Hubert Curr Urol Rep 2003	CHU DeNancy	12	153 (console time)	47	NR	A-H	TP	0	0	62.5% Five of eight with normal F/U IVP	NR	Two clearly improved, one slightly improved on IVP (continued)

Table 37-1. Reported Case Series' of Robot-Assisted Laparoscopic Pyeloplasty in Adults (*continued*)

Reference Year	Institution	No. of Patients	Operation Time (min)	Suture Time (min)	Hosp Stay (d)	Technique	Approach	Conv Rate	Complications	Success Rate	Mean F/U (months)	Comments/Conclusions
Munver, DelPizzo JLTEMI 2003	Cornell	10	168	42	3	A-H	TP	0	0	90% 9/10 One stricture, endo-pyelotomy	3	
Palese, Munver, Stifelman, Dinlec, DelPizzo J Endourol 2005	Cornell NYU Beth Israel	35	216	63	2.9	A-H	TP Running or Int 4-0 Stent 4-6 weeks	0	One UTI, two pyelo, and one gluteal compartment	94% 33/35 One 15% fxn failure, went on to nephrectomy One stricture, endopyelotomy	7.9	Multi-institutional
Palese, Dinlec, Stifelman, DelPizzo JSLS 2005	Cornell NYU Beth Israel	38	225	64	2.9	A-H	TP Running or Int 4-0 Stent 4-6 weeks	0	One UTI, two pyelo, one gluteal compartment	94% 36/38 One 15% fxn failure, went on to nephrectomy One stricture, endopyelotomy	12.2	Multi-institutional One horseshoe kidney, two stones
Bentas World J Urol 2003	JW Goethe Univ Frankfurt	11	197	NR	5.5	A-H	TP Int 3-0 vicryl Stent 5-6 weeks	0	One patient w/pain after stent removal, replaced; patient now asym, stent free	100%	12	No prior lap experience, operation times improved with experience

Mendez-Torres, Thomas J Endourology 2005	Tulane	32	300	NR	1.1	A-H (31) Fenger (1)	TP	Running 4-0 vicryl retrograde stent 6 weeks	0	One UTI, one migrated stent repositioned	16 of 18 with F/U ≥6 months One pain unobstructed One obstructed	8.6	Five patients stone rem, one pt w/renal bx Operation times improved with experience, suggest retrograde stent, subxiphoid assistant port
Atug, Thomas Int J Clin Pract 2006	Tulane	37	219 279	NR	1.1 1.2	A-H (44)	TP	Running 4-0 vicryl Stent 6 weeks	0	0	100%	13.5 10.7	RALP feasible for secondary UPI, but longer operation times
Bernie, Sundaram JSLS 2005	Indiana	Seven robot vs. seven pure lap	324 312	NR	2.5 3	A-H (4), ND (3) A-H (6), ND (1)	TP	Running 4-0 PGA Stent 6 weeks	0	One feb UTI, one hematuria Two leaks, resolved	100%	10 24	No difference with prior lap experience

(continued)

Table 37-1. Reported Case Series' of Robot-Assisted Laparoscopic Pyeloplasty in Adults (*continued*)

Reference Year	Institution	No. of Patients	Operation Time (min)	Hosp Stay (d)	Technique	Approach	Conv Rate	Complications	Success Rate	Mean F/U (months)	Comments/Conclusions
Siddiq, Bird J Endourol 2005	Miami	26	245	2	A-H (23) Y-V (3)	TP preop stent	0	One febrile UTI, one leak, one hernia	Subj 95% Obj 100%	6 (median)	Four patients with secondary UPJ
Patel V Urol 2005	Urology Centers of Alabama	50	122	1.1	A-H	TP Running 3-0 monocrystal Stent 3 weeks	0	One patient w/pain after stent removal, replaced, now asym, stent free	100%	11.7	Largest series Operation times improved with experience

Key to abbreviations: NR, not reported; A-H, Anderson-Hynes; ND, nondismembered; TP, transperitoneal.

Table 37-2. Reported Case Series' of Robot-Assisted Laparoscopic Pyeloplasty in Children

Reference Year	Institution	No. of Patients	Mean Age (y)	Operation Time (min)	Suture Time (min)	Hosp Stay (d)	Technique	Approach	Conv Rate	Complications	Success Rate	Mean F/U (months)	Comments/Conclusions
Olsen, Jorgensen J Urol 2004	Denmark	15	6.7	173	No information	2	A-H	Retroperitoneal Running 5 or 6-0 Sent 3-4 weeks	0	One patient required nephrostomy for nonfxn stent, one proximally migrated stent	100%	3	1st pediatric series, safe and effective, short f/u
Atug, Woods, Burgess, Castle, Thomas J Urol 2005	Tulane	7	12	184	39	1.2	A-H	TP Running 4-0 vicryl Stent 4 weeks	0	0	100% (six of seven with f/u)	3	Safe in pediatric patient population
Lee Retik, Borer, Peters	Boston Children's	33 robot vs. 33 open	7.9	219	NR	2.3	A-H	TP (32) Retroperitoneal (1) Running	0	One missed crossing vessel in robotic	97%	10	Safe and effective
			7.6	181		3.5	A-H				100%	20	Decreasing operation (continued)

Table 37-2. Reported Case Series' of Robot-Assisted Laparoscopic Pyeloplasty in Children

Reference Year	Institution	No. of Patients	Mean Age (y)	Operation Time (min)	Suture Time (min)	Hosp Stay (d)	Technique	Approach	Conv Rate	Complications	Success Rate	Mean F/U (months)	Comments
J Urol 2006								5-0, 6-0, or 7-0 monocrystal 20/32 used nephrostomy or Stent 3-6 weeks		retro-peritoneal patient, underwent successful redo transperitoneal robotic pyeloplasty			time with robot experience
Yee Urol 2006	UC Irvine	Eight robot vs. eight open	11.5	363 248	NR	2.4 3.3	A-H A-H	TP Running 4-0 vicryl Stent 4 weeks	0	One ileus, resolved	100% 86%	15 53	Decreased hosp and narcotics, longer operation times

Key to abbreviations: NR, not reported; A-H, Anderson-Hynes; TP, transperitoneal.

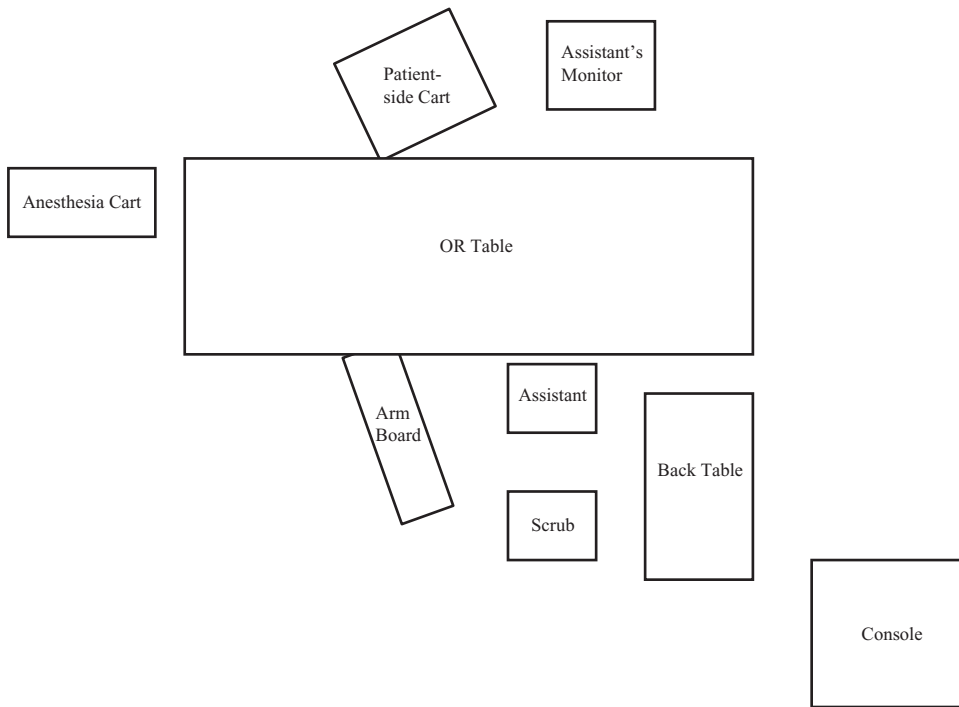


FIGURE 37-2. Diagram of template for operating room setup and robot positioning for left-sided robotic-assisted laparoscopic pyeloplasty.

patient’s back from the shoulder toward the umbilicus at a 45-degree angle, as shown in [Figure 37-2](#). Once docked, the robotic arms will reach across the flank and angle back toward the upper quadrant. The assistant’s monitor may be positioned adjacent to the patient-side cart.

TECHNIQUE

Patients are given an oral mechanical bowel preparation the evening before surgery and provided appropriate antibiotic and thromboembolic prophylaxis as indicated. After adequate general anesthesia, the patient is positioned in lithotomy and a double-J stent is placed in the standard fashion if not previously. Alternatively, the stent may be passed antegrade through a laparoscopic trocar, although we find

this to be a more cumbersome approach. The patient is repositioned in the flank position, on a bean bag with all pressure points carefully padded to prevent neuromuscular injury. Initial access to the peritoneum is typically achieved using the Veress needle in the umbilical or paramedian location. Using the standard concept of triangulation, trocars are placed as shown in [Figures 37-3 and 37-4](#). A 10–12-mm trocar is placed at the umbilicus for the camera, and an 8-mm robotic port is placed at least 8 cm above in the midline. Another 8-mm robotic port is placed in the midclavicular line at least 8 cm lateral and away from the camera port. A 10–12 assistant port is placed between the camera port and inferior 8-mm port, at least 8 cm away from each to prevent interference with the robot. A separate dedicated laparoscopy setup is used to perform the initial dissection

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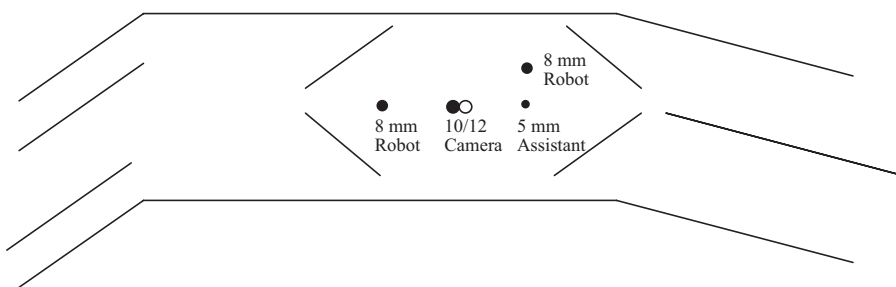


FIGURE 37-3. Diagram of template for trocar placement for left-sided robotic-assisted laparoscopic pyeloplasty.

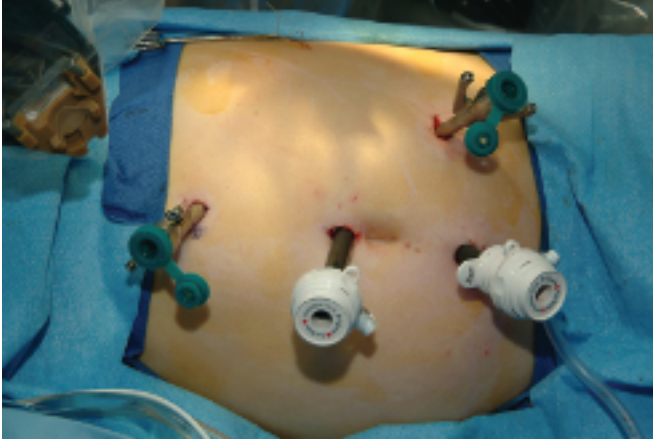


FIGURE 37-4. Intraoperative photograph demonstrating trocar placement for left-sided robotic-assisted laparoscopic pyeloplasty.

and exposure. We have found that the large sweeping movements necessary for mobilization of the kidney and ureter are most rapidly performed with standard laparoscopy, while the robot is most useful for precise suturing and dissection in a limited working area. Therefore, the initial steps of the procedure are purely laparoscopic. The colon is mobilized medially along the white line of Toldt, and the anterior surface of Gerota's fascia is exposed. Attention is turned to the inferior pole of the kidney, and the psoas muscle, gonadal vein, and ureter are identified. The ureter is retracted upward and dissected from the gonadal vein. Care is taken to preserve blood supply to the ureter, as it is dissected toward the renal pelvis. The dissection continues to expose the inferior portion of the renal pelvis, and any crossing vessels are identified. A stay suture can be placed through the abdominal wall and the anterior surface of the renal pelvis to aid in retraction if needed. This is accomplished by passing a 4-0 vicryl suture on a Keith needle through the abdominal wall, the anterior wall of the renal pelvis, and back out through the abdominal wall. The suture is then secured with a hemostat that may be used to adjust tension (Figure 37-4). If concomitant laparoscopic pyelolithotomy is necessary, then a small longitudinal pyelotomy can be made to facilitate stone extraction using a flexible nephroscope. The robot is then docked and positioned as shown in Figures 37-2 and 37-5. The UPJ is transected precisely, taking care to avoid the indwelling stent. The Potts scissors are used to spatulate the ureter laterally and resect any redundant renal pelvis. The pyeloplasty anastomosis is then completed using a double-armed running suture of 4-0 monocryl on RB-1 needles. The proximal end of the stent is replaced into the renal pelvis just prior to closing the anterior wall of the anasto-



FIGURE 37-5. Intraoperative photo demonstrating operating room setup and robot positioning for left-sided robotic-assisted laparoscopic pyeloplasty. Note docked patient-side cart illustrating angle of approach from ipsilateral shoulder toward umbilicus.

mosis. A 3/16" round closed-suction drain is brought out through the lateral port and secured. The colon is secured back to the lateral peritoneum. Fascial defects 10 mm or larger are closed, and the abdomen is desufflated. Patients are given 24 hours of parenteral antibiotic prophylaxis and monitored in the hospital for 23 hours. The drain is generally removed when output is less than 100 mL per 24 hours. Oral antibiotic prophylaxis is continued until the stent is removed at 6 weeks. Follow-up includes a radionuclide renal scan at 3 months and again at 1 year.

RESULTS

Based on our review of the literature, we found a total of 14 reports of robotic-assisted laparoscopic pyeloplasty in adults to date. The results are summarized in Table 37-1. Several of these include multiple series updates by the surgeons at the Mayo and Innsbruck groups and the New York City hospitals. In 2002, Gettman et al.²⁴ reported a series of nine patients who underwent Anderson-Hynes robotic-assisted laparoscopic pyeloplasty. At the 4-month follow-up, success rate was 89%. One patient required open repair of a renal pelvis leak. Yohannes and Burjonrappa²⁵ also reported a single case of successful robotic-assisted laparoscopic pyeloplasty shortly after Gettman's initial report. While operative time was prolonged, 5 hours, they completed the procedure successfully with no complications. Gettman et al.²³ compared six robotic-assisted laparoscopic pyeloplasties to six standard laparoscopic pyeloplasties. These were done using either an Anderson-Hynes or a Fenger technique in each group. They found that use of the robot significantly decreased both operative and anastomotic time, especially in the Anderson-Hynes group. The

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success rate in those patients with no complications was 100%. Hubert²⁶ also reported a series of 12 patients with a mean operative time of 153 minutes, defined as “console time,” and a success rate of 100% with no complications. Bernie et al.²⁷ performed a similar study comparing seven robotic-assisted vs. seven standard laparoscopic pyeloplasties. They found no difference in operative times, hospital stay, or overall outcome, with a success of 100% in both groups. The standard laparoscopy group did have two patients with anastomotic leaks that resolved.

The Innsbruck group updated their experience in 2004,²⁸ with a total of 49 patients and a review of the literature. Forty-one patients were evaluated at a mean follow-up of 7.4 months, and their success rate was 98%, with a mean operative time of 124 minutes. Ten of their patients had secondary UPJ obstruction as the indication for surgery. Munver et al.²⁹ reported on their first 10 patients at Cornell, and operative time was 168 minutes. Their success rate was 90%, with one patient requiring endopyelotomy to treat postoperative UPJ stricture. Palese et al.^{30,31} reported a multi-institutional experience from Cornell, NYU, and Beth Israel hospitals in New York City. They described 38 patients with a mean operative time of 225 minutes, hospital stay of 2.9 days, and success rate of 94%, with a mean follow-up of 12 months. The two failures included one patient with preoperative renal function of only 15% who had persistent symptoms and later underwent nephrectomy. The other was a patient who developed a stricture and underwent secondary endopyelotomy. Other complications reported include one UTI, two cases of pyelonephritis, and one patient who developed gluteal compartment syndrome caused by obesity and prolonged positioning. Their series also included one horseshoe kidney and two with stones requiring pyelolithotomy. We feel that this group’s patient demographic and results most closely represent our experience with this technique at a tertiary referral center.

Bentas et al.³² found that a group of surgeons with no previous laparoscopic experience were able to shorten the learning curve and decrease operative time with the use of the robot. Mean operative time in their series of 11 patients was 197 minutes, and they reported a success rate of 100% at the 12-month follow-up. Mendez-Torres et al.³³ reported the experience from Tulane in 32 patients and, like others, found that their operative times also decreased with experience. Their mean operative time was 300 minutes, and five patients underwent concomitant stone extraction, while one patient also underwent renal biopsy. They found that placing the stent retrograde and the assistant port in a sub-xiphoid location facilitated the procedure. They reported success rate of 88% in 16 of 18 patients, with follow-up

greater than 6 months. One patient had persistent pain but was radiographically unobstructed, and another patient remained obstructed. Siddiq et al.³⁴ did 26 cases with a mean operative time of 245 minutes and reported a subjective success rate of 95% and an objective success rate of 100%, with median follow-up of 6 months. The largest reported series by Patel³⁵ included 50 patients operated by a single surgeon, with a mean operative time of 122 minutes, hospital stay of 1 day, and success rate of 100% at mean follow-up of 12 months.

Although not the primary focus of this chapter, several investigators have also recently demonstrated the feasibility and efficacy of pediatric robotic-assisted laparoscopic pyeloplasty (Table 37-2). Olsen and Jorgensen³⁶ first reported on 15 children who underwent robotic-assisted laparoscopic pyeloplasty via a retroperitoneal approach. Their patients’ mean age was 6.7 years, and their operative time was 173 minutes, with a 100% success rate at 3 months. Atug et al.³⁷ reported their experience at Tulane with seven cases that were completed using the da Vinci robot. They reported an operative time of 184 minutes and, in six of seven patients with follow-up, a 100% success rate. Lee et al.³⁸ reported a case-control study of 33 robotic-assisted laparoscopic pyeloplasties compared to 33 open cases. Their mean age was 7.9 and 7.6 years, respectively. The operative time was 219 minutes for the robotic group and 181 minutes for the open group; however, hospital stay decreased from 3.5 to 2.3 days with the robotic technique. Their success rate was 97% in the robotic group, with a single case that was performed via a retroperitoneal approach in which a crossing vessel was missed. The case was then successfully redone via a transperitoneal approach using the robot. Based on this experience, they recommended against the retroperitoneal approach. Yee et al.³⁹ also reported a similar case-control series in 2006 with eight robotic cases compared to eight open cases. Likewise, they found that while operative times were longer in the robotic group, hospital stay was shorter and they actually had better results in the robotic group as compared to open (100% vs. 86%).

Robotic-assisted laparoscopic pyeloplasty has been reported to be safe and effective in more complex situations as well. Atug et al.⁴⁰ reported successful concomitant stone extraction (laparoscopic pyelolithotomy) in eight patients undergoing robotic-assisted laparoscopic pyeloplasty. The same group reported seven cases of secondary UPJ obstruction that were all successfully managed with robotic-assisted laparoscopic pyeloplasty.⁴¹ Chammas et al.⁴² described three patients with horseshoe kidneys, two of whom also had stones and were managed successfully with robotic-assisted laparoscopic pyeloplasty and pyelolithotomy.

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DISCUSSION

Without question, laparoscopic pyeloplasty offers excellent and equivalent results as compared to open surgery. Although the decreased morbidity is well documented, the difficulty in acquiring advanced laparoscopic skills necessary for laparoscopic suturing has prevented more widespread utilization of the technique. In addition, operative times still may be excessively long, even in experienced hands. The access to surgical robots with the popularity of the da Vinci Surgical System has facilitated the transition to laparoscopic surgery for a number of open surgeons not previously trained in routine laparoscopy. Telementoring may also allow surgeons without direct access to training centers to acquire skills even across long distances. Conversion to the robotic-assisted technique has facilitated a reduction in operative times even by some experienced laparoscopic surgeons. The ease of suturing, speed, and precision are all advantages of the robot-assisted versus pure laparoscopic technique. These advantages of the robot may lead to more widespread application and acceptance of the laparoscopic technique.

Although reports of large series are primarily originating from a few select centers, evidence is growing, which supports equivalent success rates between open, laparoscopic, and robotic-assisted laparoscopic pyeloplasty. A few pediatric centers that have also been pioneers in robotic-assisted surgery have demonstrated the feasibility, safety, and efficacy of the technique in children. While the feasibility of the procedure in children has certainly been demonstrated, we feel that those most likely to benefit from decreased morbidity of laparoscopic surgery include adolescents and adults.

Arguments against the use of the robot include the significant increase in cost and a learning curve, which remains steep when compared to open surgery or endourologic techniques. In addition, the robot is somewhat bulky, and, for optimal results, a dedicated team is needed to keep operative times reasonable. Finally, a lack of haptic feedback limits tactile sensation for the surgeon, which can be a problem initially. In our experience, with time, the surgeon learns to compensate with visual cues analogous to tissue and suture handling in microsurgery. Experience with robotic-assisted laparoscopic prostatectomy has also significantly improved our ability to perform robotic-assisted laparoscopic pyeloplasty.

CONCLUSIONS

Use of the da Vinci robot for reconstruction of the UPJ has been shown to be feasible, safe, and effective. A number of large series have now shown that the operative time and

learning curve are decreased compared to pure laparoscopic pyeloplasty, while maintaining excellent outcomes. While the use of the robot is associated with several disadvantages, namely increased cost, future advances in technology are expected to resolve these issues and drive down the cost. Robotic-assisted laparoscopic pyeloplasty is our preferred method for treatment of UPJ obstruction.

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