Laparoscopic pyeloplasty versus robotic pyeloplasty for ureteropelvic junction obstruction: a series of 60 cases performed by a single surgeon

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Purpose: *To compare operative parameters and outcomes in 30 cases of robotic pyeloplasty (RP) versus 30 cases of laparoscopic pyeloplasty (LP), performed by a single surgeon, for ureteropelvic junction (UPJ) obstruction.*
Methods: *Patients with primary UPJ obstruction were included in the study. The same surgeon (AKH) performed RP (usually using a transperitoneal Anderson-Hynes technique) on 30 patients in Group I and employed LP on 30 patients in Group II, in a nonrandomized fashion. The patients were followed for 18 months postoperatively. Three robotic and one assistant port were required in Group I, and 3 or 4 ports were utilized in Group II. In Group I, 26 patients had antegrade double-J stenting, 1 patient had retrograde double-J stenting, and 3 patients had stentless RP. In Group II, 22 patients had antegrade double-J stenting and 8 patients had retrograde double-J stenting.*
Results: *The mean total operating times were 98 minutes and 145 minutes, the mean estimated blood losses were 40 mL and 101 mL, and the mean hospital stays of the patients were 2 days and 3.5 days, for patients in Group I and Group II, respectively. These patients were followed up postoperatively for 18 months. They received a clinical examination, an ultrasound, and a diuretic renal dynamic scan. At 18 months, imaging studies found no obstructions in the patients in Group I and found an obstruction in only one patient in Group II. One patient in Group II required a repeat open pyeloplasty following failed endoscopic management.*
Conclusion: *In this patient series, UPJ obstruction was managed effectively with either RP or LP, and outcomes were durable. Compared to pure LP, pure RP enabled the surgeon to achieve quicker dissection, reconstruction, and intracorporeal suturing with fine sutures and with antegrade double-J stenting. With RP, the operating time was decreased, and the procedure offered greater ergonomic convenience to the surgeon. Long term postoperative success, however, was equivalent on follow up in both patient groups.*

Key Words: robotic pyeloplasty, laparoscopic pyeloplasty, ureteropelvic junction obstruction, pyeloplasty

Introduction

Laparoscopic pyeloplasty (LP) was initially reported by Schuessler et al in 1993.[1] Kavoussi et al further developed and modified LP, which has emerged as a minimally invasive alternative to open pyeloplasty (OP), with comparable results and the advantages of a minimally invasive procedure: less postoperative pain, a shorter hospital stay, and a shorter postoperative recovery period.[2] LP requires the advanced skills of reconstructive surgery for precise tissue dissection and intracorporeal suturing. Therefore, it has a steep learning curve. Because of this, LP was initially limited to a few institutions. However, with the widespread use of laparoscopy in urology, LP is being performed at most urology centers.[3] Sung et al first reported the use of robotic pyeloplasty (RP) in an acute porcine model, and they compared this technique with LP.[4] Subsequently, other authors reported their initial experiences with RP and compared it with LP.[5-8]

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Several authors reported results from series of patients who underwent RP in different parts of the world.[9-13] These authors came to the similar conclusion that by using robotic assistance in pyeloplasty, it becomes easier to dissect and perform intracorporeal suturing, and there is a shorter learning curve. Compared with OP and LP, RP has similar safety, efficacy, and patient outcomes.[4-8] The surgeon in this article, AKH, had substantial experience with both LP and RP, which allowed us to make a robust comparison of the results from patients who underwent these procedures at a single center and were followed for 18 months.

Patients and methods

The study compared 30 cases of RP that were performed from July 2006 to July 2007 (Group I) with 30 cases of LP that were performed from 2005 to 2006 (Group II) at the same medical center. The patients had operations for primary ureteropelvic junction (UPJ) obstruction and the same surgeon performed all surgical procedures. The data were analyzed retrospectively.

The diagnosis of UPJ obstruction was based on symptoms, ultrasonography, intravenous urography, CT urogram, and/or diuretic renography. Our center is a tertiary healthcare center and most of the study patients were referred to the center after having these imaging studies done.

Table 1 summarizes patient demographics and intraoperative, perioperative, and postoperative findings. In Group I, one patient had a horseshoe kidney with UPJ obstruction of the right moiety, and another patient had a right UPJ obstruction with kidney malrotation and a small, 6 mm renal calculus. In Group II, one patient had a UPJ obstruction in the left kidney, and another patient had a UPJ obstruction in the right kidney with a renal cyst and a small, 5 mm renal calculus. Crossing vessels at the UPJ were seen in three patients in Group I and in two patients in Group II.

Patients were followed up at 3 months, 6 months, 12 months, and 18 months. Follow up consisted of noting clinical symptoms, performing a physical examination, and performing imaging studies.

Conventional LP was performed as previously described.[14] Briefly, a 10 mm camera port was placed at the umbilicus, and two working ports were inserted in the ipsilateral midclavicular line. A 5 mm port was placed in the anterior axillary line for manual lateral retraction. For cases of right-sided UPJ obstruction, the ascending colon was reflected medially, which does not require much mobilization on the right side. For left-sided UPJ obstructions, the descending colon was reflected by dividing along the line of Toldt, or surgery was performed via a transmesocolic approach. The upper ureter and pelvis were identified and dissected paying close attention to the presence of crossing vessels. If crossing vessels were present, these were dissected, and subsequently, transposition was carried out. In our technique of dismembered pyeloplasty, the UPJ obstruction was excised, the pelvis was substracted, and the ureter was spatulated laterally. The reconstruction of the UPJ was done by placing an apical suture and a few posterior sutures before excising the pelvis for reduction, since the attached piece of pelvis helps in retraction while suturing. If the double-J stent was not placed in a retrograde manner, at this stage, it was placed in an antegrade manner and then anastomosis was completed. A drainage tube was placed. Non-dismembered pyeloplasty was performed using either Foley Y-V or Fengerplasty techniques.

Robotic pyeloplasty was performed using a transperitoneal transmesocolic approach on the left side and via retrocolic access on the right side by reflecting the ascending colon. Robotic pyeloplasty was performed through 4 ports. A 12 mm port was placed at the umbilicus or periumbilically for the stereoscopic robotic camera, and two 8 mm robotic ports were placed in the midclavicular line. A 5 mm trocar port for retraction, suction, and suture cutting was placed infra-umbilically in the midline or on the contralateral side. The robot was docked after placing the ports. The type of repair (Anderson-Hyne, Foley, or other type of flap repair) depended on the size of the pelvis, length of the UPJ stricture, presence of a crossing vessel, and the degree of renal function. Robotic assistance was used from the outset to dissect and mobilize the colon, ureter, and renal pelvis. It was also used for reconstruction of the flaps, for neo-UPJ anastomoses, and for antegrade double-J stenting. In one case, a retrograde stent was placed beforehand, and in three cases, anastomosis was done without a stent. A Jackson-Pratt drainage tube was placed in all cases prior to port closure.

A transmesocolic approach provides a direct approach to the UPJ after incising the mesocolon in an avascular plane, precluding colon and kidney mobilization. The UPJ is recognized by the dilated pelvis or by tracing the ureter. The author prefers minimal desired dissection in this area with maintenance of periureteral blood supply. Crossing vessels are preserved and transposed as indicated. The most common repair is Anderson-Hyne (dismembering

TABLE 1. **Operation characteristics and postoperative outcomes in 60 patients who underwent RP or LP for UPJ obstruction**

	RP	LP	P value
Patient characteristics			
Age	24.85 (12-62)	28.1 (12-47)	.421 (t test)
Sex Male	20	21	0.78
Female	10	9	(chi-squared test)
Side Right	11	10	0.79
Left	19	20	(chi-square test)
Operation characteristics			
Mean total operating time (minutes)	98.54 ± 29.2 (63-200)	145.25 ± 44.35 (85-300)	0.001 (t test)
Suturing and antegrade stenting time (minutes)	33.21 ± 2.88 (20-80)	57.11 ± 11.22	0.001 (t test)
Dissection time (minutes)	33.11 ± 14.25 (15-75)	51 ± 16.83	0.001 (t test)
Robot docking time (minutes)	9.68 ± 2.85 (4-15)		
Mean estimated blood loss (mL)	40.36 ± 18.10 (10-75)	101 ± 120.73	0.035 (t test)
Presence of crossing vessel	3	2	
Anderson Hyne's pyeloplasty	28	27	0.84 (Pearson chi-square test)
Foley's Y-V pyeloplasty	1	2	
Fenger's pyeloplasty	1	1	
Antegrade stenting	26	22	0.027 (Pearson chi-square test)
Retrograde stenting	1	8	
Stentless	3	-	
Transperitoneal, transmesocolic access for left UPJ obstruction	19	20	0.54 (Pearson chi-square test)
Retrocolic approach	11	9	
Conversion	-	1	
Postoperative outcomes			
Mean length of hospital stay (days)	2.5 ± 83 (2-5)	5.5 ± 3.76 (3-20)	.036 (t test)
Analgesic requirement (mg pethidine)	75 ± 19.87 (50-100)	75 ± 34.41 (50-175)	1.000 (t test)
Recovery to painless activity (days)	9.95 ± 2.93	13.35 ± 6.9	.05 (t test)
Resumption of oral diet (days)	14.6 ± 2.52	16.3 ± 3.69	.097 (t test)

LP = laparoscopic pyeloplasty; RP = robotic pyeloplasty; UPJ = ureteropelvic junction

with excision of the UPJ obstruction), which also allows subtraction of the dilated renal pelvis and a dependent watertight UPJ anastomosis. The ureter is spatulated medially to anastomose with the refashioned renal pelvis laterally using a 5-0 polyglecaprone suture with antegrade double-J stenting.

The drainage tube was removed on the first or second postoperative day, and the patients were discharged with a urethral catheter, which was removed after 2 to 3 days following the removal of the drainage tube. The double-J stent was removed at 4 weeks, as an outpatient procedure.

Results

In all 30 cases of pure robotic pyeloplasty (Group I), the operation was performed through transperitoneal access, using either a transmesocolic or retrocolic approach. The 30 cases of conventional LP (Group II) were also done through a transperitoneal route, mostly by a colon reflecting approach and sometimes by transmesocolic access.

The patient and operation characteristics are summarized in Table 1. The total operating time was defined as the time from placement of the first port to placement of the last suture in both groups. The mean total operating time was 98 minutes and 145 minutes for patients in Group I and Group II, respectively. The mean operation blood loss was 40 mL and 101 mL for patients in Group I and Group II, respectively. The mean hospital stay was 2 days and 3.5 days for patients in Group I and Group II, respectively.

In the LP group, one patient developed postoperative fever, jaundice, and pain in the abdomen. Imaging revealed a misplaced stent coiled in the renal pelvis leading to partial obstruction and jaundice. This was rectified by replacing the double-J stent. Another patient had an ureterovesical junction (UVJ) obstruction, which did not allow antegrade passage of a stent, and this patient went on to receive open surgery. This patient had thalassemia minor and preoperative bilirubinemia. He also had postoperative fever and postoperative bilirubinemia. One patient had minor drainage from the drain site after removal of the drainage tube, which subsided after 48 hours, and another patient had paralytic ileus, which resolved with conservative treatment.

In Group I, at their 6 month follow up checkups all patients were asymptomatic and diuretic renograms showed unobstructed drainage. Subsequent follow up was unremarkable at 18 months. In Group II, two patients had pain in the abdomen at 3 months. A diuretic renogram at 3 months showed UPJ obstruction in one patient who then underwent balloon dilatation and stenting. At their 18 month follow up examinations, 29 patients in Group II had unobstructed drainage, and one patient who had obstructed drainage was offered a repeat pyeloplasty with robotic assistance.

Discussion

The evolution of laparoscopic surgery in urology has been limited by the challenges inherent with manual laparoscopic suturing techniques. LP is considered a minimally invasive alternative to open pyeloplasty, but this technique is technically challenging, since it requires the surgeon to be proficient in advanced suturing.

Robotic pyeloplasty has been adopted by a number of surgeons who have access to a robot. The technical benefits of robotic assistance in laparoscopic surgery are well known, and to the novice, it offers a means of overcoming some of the major impediments of laparoscopic surgery.

Several studies of RP have reported different values for procedure parameters, such as different mean total operating times.[5-8] In these studies, suturing times ranged from 20 minutes to 76 minutes, mean blood loss during the operation ranged from 40 mL to 150 mL, and length of stay in the hospital by the patient ranged from 1.1 days to 4.7 days. All these studies, however, reported excellent success rates, ranging from 94% to 100%. In another study of RP, Palese et al reported an operation success rate of 94.7%, a mean operating time of 225.6 ± 59.3 minutes, a mean operation blood loss of 77.3 ± 55.3 mL, and a mean hospital stay of 69.6 hours.[10] Patel et al, in a series of 50 cases of robotic assisted laparoscopic dismembered pyeloplasty, reported a 100% success rate, with a mean operating time of 122 minutes and a mean operation blood loss of 40 mL.[12] Weise and Winfield compared RP versus LP and found that the procedures had similar outcomes, and surgical training had a significant impact on outcomes.[15] In a recent study, Link et al found that compared to LP, the mean operating time for RP was 19.5 minutes longer, and the mean cost for RP was 2.7 times higher.[16] Compared to surgeons working in other centers, those working in a teaching center are likely to have more expertise in performing LP. If a robot is available, however, these surgeons are likely to perform RP.

We compared pure robotic pyeloplasty with conventional LP performed by a single surgeon who is an expert in both techniques. The mean total operating time was significantly longer in the LP group than in the RP group, since with the robot, it was much faster to dissect, refashion the pelvic flap, and re-anastomose with the laterally spatulated ureter. The mean total blood loss was also significantly greater in the LP group. In addition, LP required significantly longer operating times. One patient in the RP group had a misplaced stent (upmigration of the stent) leading to prolonged drainage and postoperative fever that subsided after the stent was negotiated into a proper position endoscopically. The mean length of hospital stay was significantly longer for patients in the LP group than in the RP group. In the LP group, two patients had long hospital stays: one patient had a misplaced stent in the pelvis and had postoperative fever, jaundice, and abdominal pain, and another patient, who had open surgery because of UVJ obstruction, also had postoperative fever and bilirubinemia.

The reason for short operating times with robotic pyeloplasty in our series was due to the use of the robot from the beginning of the surgical procedure until the end of the anastomosis, which helped the surgeon in making a precise dissection, excising the flap, suturing, and in faster antegrade stenting. It also eliminated the need for preoperative cystoscopy, thus reducing the total operative time. Even with an experienced laparoscopic surgeon, compared to LP, pure RP appears to provide shorter operating times and better long term outcomes. A recent meta-analysis of articles published in English about RP versus LP reveals that over the past 8 years, RP has been successfully performed worldwide, and it is a minimally invasive procedure that is safe and effective, with results that are as good as, or better than, results with open surgery or LP.[17]

In our experience, preoperative cystoscopy and placement of a double-J ureteral stent is not necessary when performing RP. The procedure may be done using either a transperitoneal or retroperitoneal approach, and in the author's experience, the later approach is more cumbersome and does not provide any additional benefits.[18] Transperitoneal access for RP involves using either a transmesocolic approach or colonic mobilization on the left side. However, transperitoneal access cannot be used in patients with a thick mesentery or in patients requiring repeat repair surgery.[18]

Conclusion

In this comparative study of RP versus LP in 60 patients, pure RP was associated with shorter operating times due to greater ease in dissection, tailoring of flaps, and suturing (resulting in flawless sutures). It was also associated with less blood loss during the operation, quicker patient recovery, and a shorter hospital stay. However, both RP and LP can be performed safely and effectively, with durable outcomes. □

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