Outcomes of robot-assisted laparoscopic transperitoneal pyeloplasty procedures: a series of 18 patients

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ABSTRACT

Objective: We evaluated outcomes of our robot-assisted laparoscopic transperitoneal pyeloplasty (RALP) procedures.

Material and methods: Between July 2011 and March 2014, 18 RALP procedures were performed at our institution. Ureteropelvic junction obstruction (UPJO) diagnosis was made based on clinical presentation and intravenous urography. All patients underwent basal and diuretic isotopic renography to evaluate the degree of obstruction and impaired renal function. Anderson-Hynes dismembered pyeloplasty technique was used with a transperitoneal approach by using the da Vinci-S 4-arm surgical robot. Outcomes were assessed retrospectively.

Results: Mean patient age was 31.3±11.7 (13-62) years. Male: female ratio was 9: 9. All procedures were primary surgeries. Of 18 patients, 10 (55.5%) had a crossing vessel and 8 (44.5%) had intrinsic obstruction. Mean operative time was 150.4±17.2 (115-185) minutes. Mean anastomosis time was 21.4±5.5 (10-33) minutes. Mean blood loss during the operation was 33.6±17.3 (10-60) cc. Mean hospital stay was 2.6±1.0 (1-6) days. No conversion to open surgery was required. No intraoperative and perioperative (0-30 days) complication occurred. Readmission rate during perioperative period was 0%. Median follow-up was 16.6±10.3 (3-35) months. Postoperative intravenous urography and renography showed improved results in all cases.

Conclusion: Due to our experience, RALP is a safe and feasible minimally invasive approach in patients with UPJO with excellent surgical and functional outcomes.

Key words: Minimal invasive approach; outcomes; robotic pyeloplasty; uretero-pelvic junction obstruction.

Introduction

Ureteropelvic junction obstruction (UPJO) is the most frequently seen congenital anomaly of the urinary system, and it is seen one in nearly 20.000 live births.^[1] UPJO can be classified in 3 groups as intrinsic, extrinsic, and secondary types. Intrinsic UPJO can occur as a result of interruption in the development of circulatory musculature or alterations in the composition, and amount of collagen in muscle cells, and intercellular space.^[2] Aberrant, accessory or prematurely branched lower pole vessel is the most frequent cause of UPJO. These vessels course in front of the ureteropelvic junction or proximal segment of the ureter, and cause mechanical obstruction in 15-52% of the cases.^[2] However secondary UPJO is frequently associated with serious vesicoureteral reflux which is seen in 10% of the cases. UPJO is a urinary system abnormality which manifests itself with symptoms of pain, urinary infection, renal stone or

hypertension. Its treatment is surgical which aims to improve patient's symptoms, and preserve renal functions. Since the year 1999 when robotic pyeloplasty was firstly applied, it has been performed successfully in many centers.^[3] In our clinic robotic surgery has been used prevalently in urological surgeries. Herein, we are presenting the outcomes of the first 18 patients who had undergone robotic transperitoneal dismembered pyeloplasty in our clinic.

Material and methods

A total of 18 patients who underwent robotic pyeloplasty in our clinic between June 2011, and March 2014 were included in our study. For this study, approval of the Ethics Committee of Yıldırım Beyazıt University Faculty of Medicine was obtained. All study participants gave their written informed consent for the study. The operations were realized

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by 4 urologists. Demographic data, intraoperative parameters, and postoperative follow-up results were evaluated (Table 1). Diagnosis of UPJO based on patient's clinical manifestations, urinary ultrasonographic, and intravenous urographic (IVU) examination findings. Diuretic renograms were obtained to demonstrate severity of the obstruction, and renal dysfunction. Decrease in T1/2 time of the radioactive agent (<20 mins) or complete or nearly complete clearance of the drug as demonstrated on radiograms obtained at 2. hours was evaluated as functional success. Robotic surgery was not performed on patients who had undergone open renal surgery or upper abdominal surgery, and those with bleeding diathesis. For all patients so Vinci-S 4-arm surgical robot (Intuitive Surgical Inc., Sunnyvale, CA, USA) was used to perform transperitoneal Anderson-Hynes dismembered pyeloplasty. Intraoperative, and perioperative (postoperative 1-30 days) complications were evaluated according to modified Clavien classification.^[4] All results were evaluated retrospectively.

Statistical analysis

Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) 16.0 (IBM, Armonk, NY, USA) program. For the analysis of descriptive characteristics means, standard deviation, minimum, and maximum values were used.

Preparation, and positioning of the patient

During surgery in order to decrease the risk of bleeding, drugs of the patients on antiaggregant or anticoagulant therapy were discontinued at least one week before the procedure. Preoperatively all patients underwent urinalysis, and their urine cultures were obtained to confirm the absence of urinary tract infection. Following intratracheal general anesthesia, and insertion of a urethral Foley catheter, the patient was laid in a 60° flank position with the operated side on top. After cleansing the operation site with povidine-iodine solution, all patients were given antibiotic prophylaxis with ciprofloxacin (500 mg IV). From nearly 1 cm lateral to the umbilicus intraperitoneal access was performed either via open surgery or using Veress needle based on surgeon's preference. Through an access track a 12 mm robotic camera trocar was inserted, and pneumoperitoneum was achieved with a insufflation pressure of 15 mmHg CO₂. Then, an 8 mm robotic port was placed nearly 4 cm cranio-medial to the spina iliaca anterior superior (SIAS) for the first, and an 8 mm robotic port was placed at the intersection point between midclavicular line, and costal arch under direct vision for the second robotic arm. A 10 mm assistant port was created through an access tract opened 2 cm medial to the line joining robotic, and camera ports. Finally if a 4. robotic arm had to be used based on the preference of the surgeon, through this robotic port constructed nearly 2 cm inferior to SIAS, the 4. robotic

Table 1. Demographic characteristics, and surgery-specific data of the patients

Age (year)	31.3±11.7 (13-62)
Gender (F/M)	9/9
Laterality (right/left)	5/13
Presentation	
Pain	14
Infection	2
Incidental cases	2
Crossing vessel	10/18
Operative time (min)	150.4±17.2 (115-185)
Anastomosis time (min)	21.4±5.5 (10-33)
Bleeding (mL)	33.6±17.3
Hospital stay (day)	2.6±1.0 (1-6)
Follow-up period (month)	16.6±10.3 (3-35)
Use of the 4. arm	4
Intraoperative complication n	0
Perioperative complication (0-30 days)	0
Residual stone(s)	
Multiple stones	3
Single stone	-
Reduction of pelvic size	13/18

arm was inserted under direct vision. For right, and left kidneys the same port placement procedures were applied. Afterwards, robotic unit was approached to the back of the patient at a 15° angle, robotic arms were connected to robotic ports, and we proceeded with the operation.

Surgical technique

Intraabdominal adhesions on the surgical field were freed with sharp dissection, and the colon was medialized. In the retroperitoneum, gonadal vein, and ureter were identified, and traced up to the kidney. Dissections were made along the ureter, and renal pelvis was approached. All patients underwent Anderson-Hynes dismembered pyeloplasty. If an anteriorly crossing vessel was identified as the cause of UPJO, then anterior transposition of the pelvis was ensured so as to preserve this vessel (Figure 1). Any preexisting stricture and extremely dilated redundant pelvis tissue was excised, and pelvis was reduced in size before anastomosis (Figure 2). All excised redundant tissue specimens were sent for histopathological examination. In all operations a 4.7 F 26 cm -long double J stent was placed through antegrade route (Figure 3). A double J stent was delivered into the abdominal cavity through a 10-mm assistant port, and advanced from ureter into the bladder through assistant port using robotic arms. Ureteropelvic anastomosis was performed using continuous 4-0

Figure 1. Aberrant vessel (arrow) crossing over anterior aspect of the renal pelvis

Figure 2. Preanastomotic excision of the extremely enlarged renal pelvis

vicryl sutures. After completion of the anastomosis, Gerota's fascia was closed over renal pelvis using 4-0 vicryl sutures. At the final stage, intraabdominal gas pressure was dropped down to 5 mmHg, and hemostatic controls were performed. An 18 F Foley catheter was advanced through an 8 mm trocar into the surgical field to be used as a drain, and the procedure was terminated. Robotic unit was disconnected, all trocars were withdrawn, and trocar entry sites were closed respecting anatomic layers.

Figure 3. Implantation of a double J stent into ureter through antegrade route

Postoperative follow-up

The patients were prescribed intravenous fluid, and analgesics, and mobilized on the postoperative 1st day, then oral regimen was initiated. When the amount of daily drainage decreased down below 50 cc, priorly urethral catheter, then the drain were removed. Immediately after the operation, and on the 1st postoperative day, routine biochemical tests, and hemograms were performed. At the 1st postoperative month, double J stent was withdrawn under local anesthesia, and cystoscopic control. and the patients were reevaluated at postoperative 3. months using diuretic renogram or IVP.

Results

Mean age of a total of 18 patients was 31.3 ± 11.7 (13-62) years. Our series consisted of 9 (50%) male, and 9 (50%) female patients. In these patients flank pain (n=14), and pyelonephritis (n=2) were detected incidentally during imaging modalities performed for other indications. Based on the preference of the surgeon, the 4th robotic arm was used in a total of 4 patients, while in 14 patients the operations were carried out using 3 robotic arms. Mean operative, and ureteropelvic junction anastomosis times were 150.4 ± 17.2 (115-185) mins, and 21.4 ± 5.5 (10-33) mins, respectively. In a total of 3 patients, UPJO was accompanied by renal pelvis stone(s). The residual stone (s) was (were) extracted, and complete stone-free rates in all patients before anastomotic procedures were achieved. In a total of 13 patients, extremely enlarged renal pelvis was detected. Redundant pelvic tissue was excised, and the pelvis was prepared for anastomosis. In a total of 10 (55.5%) patients, vessels crossing over ureter

were detected and all of these vessels were preserved by anterior transposition procedures. Assessments using Clavien complication scale couldn't reveal any complication during intra-, and peri-operative (postoperative 1-30 days) periods. Besides, none of the patients felt the need to re-consult to the clinic because of development of any complication. Mean hospital stay, and follow-up period were detected as 2.6 ± 1.0 (1-6) days, and 16.6 ± 10.3 (3-35) months, respectively. During postoperative follow-up period, the patients were evaluated using diuretic scanning (n=4), and IVU (n=14) in consideration of examinations performed during preoperative period. T $\frac{1}{2}$ times of the scanned patients improved when compared with the preoperative scanning findings, and dropped below 20 minutes. IVUs obtained at 2nd hour postoperatively demonstrated complete or nearly complete renal drainage.

Discussion

In the management of ureteropelvic junction obstruction, open pyeloplasty operations have been successfully performed for years as gold standard treatment modalities with 90-100 efficacy rates.^[5] With time open surgical techniques as Y-V plasty, and Scardino, Andersen-Hynes dismembered pyeloplasty have been developed.^[6] Despite their improved outcomes, because of their longer healing period, and higher morbidities, the need for minimally invasive treatment modalities have arisen. With the development of laparoscopic surgery, laparoscopic pyeloplasty procedures have been used since the year 1993.^[7] Although its success rates are comparable to those of open surgery, it has provided the advantages of lower mortality rates, and shorter hospital stays.^[8,9] Various studies have indicated the success rates of laparoscopic pyeloplasty as 88-100 percent.^[10] However widespread use of laparoscopic pyeloplasty has been restricted because of its challenging technique, and longer learning-curve.

Robotic pyeloplasty has gained prominence in that it offers the advantages of 3-dimensional magnified images, robotic instruments with higher manipulation facilities, higher rates of success in intracorporeal suturing, and shorter operative times. In a study which compared robotic urological surgeries (radical prostatectomies, pyeloplasty, partial nephrectomy, and nephrectomy) with open, and laparoscopic methods, the investigators stated that robotic, and laparoscopic procedures resulted in lower mortality, and complication rates, need for transfusion, and shorter hospital stays with the expense of higher costs incurred by robotic surgeries.^[11] In another study, surgical, and functional outcomes of 20 patients who had undergone minimally invasive transperitoneal pyeloplasty (13 robotic, and 7 laparoscopic procedures), and 22 cases who experienced open pyeloplasty were compared.^[12] Operative times did not differ significantly between groups, while amount of bleeding, hospital stay, and time to removal of the drain were found to be sig-

nificantly shorter in the minimally invasive group. Radiological, and symptomatic improvement rates were detected as 95.5, and 95% in the open surgery, and minimally invasive groups, respectively. In another study where robotic pyeloplasty was compared with open, and conventional laparoscopic methods, robotic pyeloplasty was demonstrated as an effective procedure with shorter hospital stays, and healing periods, lower surgical morbidity, and higher success rates.^[13] However this study did not analyze, and evaluate cost-effectiveness of the robotic surgery. In addition to its intraoperative advantages, and improved surgical outcomes, higher costs of robotic procedures are more frequently criticized.^[14,15] However with increasing rates of adaptation to developing technologies to clinical practice, it is an undeniable fact that cost-effectiveness of this brand new robotic technology will come closer to that of other procedures. In Table 2, the outcomes of some selected robotic pyeloplasty series cited in the literature are summarized. According to the outcomes of these studies robotic pyeloplasty confers important advantages as higher success rates, lower amounts of bleeding, and shorter hospital stay.^[13,16-23]

Currently, in centers with adequate experience, and technological facilities, cases with UPJO are tended to be more frequently managed with minimally invasive methods as laparoscopic, and robotic pyeloplasties. In a single-center study, minimally invasive methods used in pyeloplasties were compared. In this study outcomes of the patients who had undergone laparoscopic (n=74), and robotic (n=74) pyeloplasty operations were compared, and any difference between groups as for operative times, perioperative outcomes, and surgical success was not detected. Longer anastomosis times were found in the laparoscopy group, because of difficulties encountered during laparoscopic procedures. Complex cases as secondary UPJO combined with renal stone(s) were more numerous in the robotic pyeloplasty group, and total operative times were comparable between both groups.^[6] However in this study it was not reported whether or not surgical reduction of pelvic size which will decrease urine passage time, and contribute to surgical success with its effects on total procedural time, was performed. General approach in cases with secondary pyeloplasty favours open pyeloplasty. In a published study, the place of secondary UPJO in robotic surgery was analyzed.^[24] Patients who had undergone primary (n=37), and secondary (n=7) pyeloplasty operations were compared, and any difference between both groups as for amount of bleeding, hospital stay, and surgical success rates was not detected. However operative times in the secondary pyeloplasty group were found to be significantly longer. In our study, any case in our patient group had not been previously operated with the indication of UPJO. However irrespective of using open surgery or minimally invasive methods, pelvic dissection is obviously challenging especially in previously intervened cases with residual stones, and urinary infection. In these cases, advantages

Table 2. Outcomes of some selected robotic pyeloplasty series cited in the literature

Authors	Year	Patients, n	Operative time (min)	Amount of bleeding (mL)	Hospital stay (day)	Success rate (%)
Patel et al. ^[17]	2005	50	122	40	1.1	100
Lucas et al. ^[18]	2012	465	204	30	*B	96.8
Gupta et al. ^[16]	2010	85	121	45	2.5	97
Minnilo et al. ^[19]	2011	155	198	*B	1.95	96
Thom et al. ^[20]	2012	55	194	100	1.7	98
Niver et al. ^[21]	2012	119	218	62	2.5	96.1
Singh ve ark. ^[22]	2012	34	105	30	*B	97
Sivaraman et al. ^[23]	2012	168	134	49	1.5	97.6
Başataç et al. ^[13]	2014	15	114	28	2	93.3

*B: Not indicated

of robotic surgery carried out under 3-D magnified visualization of the surgery field using robotic instruments which offer the surgeon greater manipulation possibilities, and superiorities of performing meticulous, and careful dissection should not be disregarded.

One of the inconveniences encountered during robotic pyeloplasty operations is that operation tables used for robotic surgeries are not suitable for fluoroscopic use. During intraoperative stone extraction or implantation of a double J stent, inability to use fluoroscopy to identify presence of a residual stone or stent migration, can delay or make impossible solution of these complications. In a study where a total of 86 cases with robotic pyeloplasty were followed up, the investigators reported prolongation of urinary drainage (n=3), and presence of residual stones.^[16] In our cases, we did not encounter perioperative stent migration or retention of residual stones. However in studies performed with higher number of patients, these complications may be seen more frequently.

Nowadays, free urinary drainage without obstruction on diuretic renograms and/or intravenous urograms obtained at 3. month of the follow-up period is accepted as an indicator of successful operation.^[25] In our study none of our patients demonstrated any obstructive manifestations on their radiograms obtained at postoperative 3. months. However our data which reflect our primary results retrieved from limited number of patients should be reinforced by assessments made in longer term studies.

In conclusion, robotic dismembered pyeloplasty used in the management of UPJO is an effective minimally invasive method with shorter hospital stay, and improved surgical outcomes.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Yıldırım Beyazıt University Faculty of Medicine (16.07.2014).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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