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Pyeloplasty in Ureteropelvic Junction Obstruction with Mini Review: Laparoscopic or Open?

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ABSTRACT

Introduction: Ureteropelvic junction obstruction (UPJO) can lead to symptoms such as hydronephrosis and progressive renal damage. We explain our primary experiences about laparoscopic pyeloplasty (LP) as the new probable gold standard in the treatment of UPJO in comparison with open pyeloplasty (OP).

Methods: Between March 2008 and August 2009, after confirming the diagnosis of UPJO, 21 patients underwent transperitoneal dismembered LP and 25 patients underwent dismembered OP. This selection was not randomized and was related to the surgeon's experience. Success was assessed by IVU and diuretic renograghy 3 months after surgery. Important parameters were compared between 2 groups. $P < 0.05$ was considered statistically significant.

Results: No significant differences were seen in the mean age and gender between the 2 groups. LP (280 ± 95 minutes) had a significantly ($p = 0.003$) higher mean operating room time than OP (204 ± 59 minutes). The mean indwelling duration of drainage (LP: 2.5 ± 1.56 days; OP: 2.1 ± 1.14 days; $p = 0.31$) and the mean postoperative hospital stay (LP: 4.6 ± 1.76 days; OP: 4.3 ± 1.55 days; $p = 0.934$) were similar between the 2 groups. The mean dosage of postoperative analgesics and complication rates in LP (26.25 mg; 23.8%) were lower than OP (38.33 mg; 36%). But these differences were not significant. The mean duration of return to normal activity after discharge in LP was significantly lower than OP (3.9 versus 5.2 days; $p = 0.002$).

Conclusion: Despite a shorter operating room time of OP, LP is a gold substitute for OP even in primary experiences due to cosmetic advantages, faster returns to normal activity, and comparable results. Laparoscopic pyeloplasty can be the gold standard treatment for UPJO if LP is performed by experienced and skillful surgeons.

INTRODUCTION

Ureteropelvic junction (UPJ) obstruction (UPJO) is defined as a functional or anatomical obstruction of urine flow from the renal pelvis to the upper ureter [1,2]. This matter can lead to symptoms, hydronephrosis, and progressive renal damage, and it may be diagnosed at any stage of life [1-3]. Congenital UPJO is due to an anatomic or physiologic defect in the upper ureter and is considered primary UPJO [3]. Acquired UPJO may be due to reactive fibrosis and annular stricture following trauma, ischemia, instrumentation, and stone and upper tract infection [3]. Also, abnormal insertion of the ureter, the crossing of aberrant vessels, and retroperitoneal fibrosis can cause extrinsic compression and UPJO [1,3].

KEYWORDS: Laparoscopic pyeloplasty, open pyeloplasty, ureteropelvic junction obstruction

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original study

Flank pain, acute renal colic with or without nausea, and chronic back pain are the major symptoms of UPJO in adults. Other presentations of UPJO consist of accidental ultrasonographical diagnosis, prenatal hydronephrosis, hematuria, vaguely related gastrointestinal complaints, urinary tract infection, pyelonephritis, and stone disease [1,2,4]. The UPJO is diagnosed by ultrasonography and is confirmed by intravenous urography (IVU) and isotope diuretic renography [2,3]. Contrast CT scans and retrograde ureteropyelography are applied for the detection of aberrant vessels and an anatomical view of the ureter, respectively [2,3].

The relief of symptoms, the continued existence of urinary flow, and the preservation of renal function are the main reasons for treatment. Surgery is considered in the patients with the worsening of the renal function, progressive or severe symptoms, recurrent stone formation, or infection [3]. Open pyeloplasty (dismembered, non-dismembered), antegrade or retrograde endoscopic procedures (endopyelotomy, acucise catheter incision, balloon dilatation), and transperitoneal or retroperitoneal laparoscopic procedures with or without robotic or hand-assist techniques (dismembered Anderson-Hynes, Foley Y-V plasty, Fenger pyeloplasty) are used in the surgical management of UPJO [2,3,5-14]. Dismembered pyeloplasty has remained the standard technique [1,11,13]. Although the transperitoneal approach provides more space for working and suturing, the retroperitoneal approach has benefits, including direct reach to the urinary tract, a lack of manipulation of the intraperitoneal structures, a lower risk of intraperitoneal organ injury and lower peritoneal cavity-related complications after operation, less occurrence of ileus after operation, effortless dissection in patients with prior intra-abdominal surgery, and operations with less possible retraction [11,13]. The intraoperative insertion of a ureteral stent or a nephrostomy tube is controversial in pediatric and adult cases [1].

Open pyeloplasty (OP) was described by Andersen and Hynes [15] and has remained the gold standard surgical treatment of UPJO with a long-term success rate of more than 90% [16]. This method is an invasive procedure with significant trauma to the abdominal wall, postoperative pain, increased perioperative morbidity, prolonged convalescence, scar formation, and undesired cosmetic outcomes [11,17-19].

Compared with open pyeloplasty, laparoscopic pyeloplasty (LP) seems to have comparable success rates ($\geq$ 90%), lower postoperative pain and morbidity, shorter hospital stay and convalescence, a quick return to activity, and improved cosmetic outcomes according to multiple experiences in the last 2 decades [6,12,13,17,18,20-22]. But LP is a complex surgical technique and is associated with the experience and skill of the surgeon [13]. The disadvantages of LP may be a long learning curve and prolonged operative time [13,17,21,22], although Zhang et al. reported shorter operative times for LP than OP [23]. It seems that laparoscopic pyeloplasty is the new probable gold standard in the management of UPJO [2,24]. Although robotic surgery has been posed as a newer tecnique with benefits such as 3-dimensional views, the feasibility of complex movements, better dissection, lower tissue handling, less surgeon fatigue, and shorter hospital stay in comparison with conventional LP, robotic-assisted LP may have similar outcomes regarding operative times, success rates, and complication rates in the treatment of UPJ obstruction [13,14].

In this study, we explain our primary experiences about laparoscopic pyeloplasty in the treatment of UPJ obstruction compared with open pyeloplasty. We compare our results with others studies.

METHODS

Between March 2008 and August 2009, pyeloplasty was performed in 46 patients who were referred for the surgical treatment of UPJ obstruction. The procedures were performed in a teaching hospital by several surgeons. Twenty-one patients underwent transperitoneal laparoscopic dismembered pyeloplasty and 25 patients underwent open dismembered pyeloplasty. This selection was not randomized and was related to the surgeon's experience. Before operation, renal ultrasonography, intravenous urography (IVU), and diuretic renograghy were done in all patients for the evaluation and confirmation in the diagnosis of UPJ obstruction. Narcotic analgesic (meperidine) was used in the relief of postoperative pain. The success of the operation was assessed in all patients by IVU and diuretic renograghy 3 months after operation.

The important parameters, including age, gender, the reason of referral, operating room time, dosage of postoperative analgesic, indwelling duration of the drain, postoperative hospital stay, complications, and return to normal activity after discharge were assessed and compared between the 2 groups. Software SPSS version 17 was applied for statistical analysis. An independent t-test, Mann-Whitney test, chi-square test, and Fisher's exact test were used for analysis of data, and $p < 0.05$ was considered significant. Our ethical committee approved this research.

RESULTS

Laparoscopic pyeloplasty and open pyeloplasty were performed

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Table 1. Reason for referral in patients with UPJ obstruction.
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Reason for Referral	LP	OP	Total
patients, n	21	25	46
abdominal pain, n (%)	9 (42.9%)	8 (32%)	17 (37%)
pyelonephritis, n (%)	8 (38.1%)	5 (20%)	13 (28.3%)
hydronephrosis, n (%)	4 (19%)	3 (12%)	7 (15.2%)
prenatal diagnosis, n (%)	0	2 (8%)	2 (4.3%)
incidental finding, n (%)	0	1 (4%)	1 (2.2%)
positive urine culture, n (%)	0	6 (24%)	6 (13%)

in 21 and 25 patients with UPJO respectively. The reasons of referral in these patients were abdominal pain, pyelonephritis, positive urine culture, hydronephrosis, prenatal diagnosis, and incidental findings (Table 1).

The mean age was 27.5 years in the LP group and 17.7 years in the OP group. Male-to-female ratio was 13/8 in the LP group and 15/10 in the OP group. No significant differences were seen in mean age ($p = 0.07$) and gender ($p = 0.895$) between the 2 groups (Table 2).

The mean operating room time in the LP group (280 ± 95 minutes) was significantly ($p = 0.003$) higher than the OP group (204 ± 59 minutes). In the LP group (26.25 ± 35.79 mg), the mean dosage of postoperative analgesic was lower than the OP group (38.33 ± 55.45 mg), but this difference was not significant ($p = 0.744$). No significant differences were seen in the mean indwelling duration of drain (LP: 2.5 ± 1.56 days; OP: 2.1 ± 1.14 days; $p = 0.31$) and the mean postoperative hospital stay (LP: 4.6 ± 1.76 days; OP: 4.3 ± 1.55 days; $p = 0.934$) between the 2 groups (Table 2)

All operations were performed successfully and no failure occurred in the laparoscopic and open procedures. No conversion to OP occurred in patients with LP and no mortality was reported in the 2 groups. The complication rate in the LP group (23.8%) was lower than the OP group (36%), but this difference was not significant ($p = 0.791$). Fever (n = 5; 23.8%) was the only complication of the laparoscopic pyeloplasty group and no patients in this group required blood transfusions. In the open pyeloplasty group, 7 patients (28%) experienced fever and 2 patients (8%) required a blood transfusion. In the LP group (3.9 ± 1.26 days), the mean duration of a return to normal activity after discharge was significantly ($p = 0.002$) shorter than the OP group (5.2 ± 1.32 days) (Table 2).

Despite better results from the last cases compared to the first cases, we reported our general results because of our small sample size of the groups. Significant improvement or complete resolution of symptoms occurred in the symptomatic patients after operation. Diuretic renograghy and IVU were done in all patients 3 months after operation and there was no evidence of obstruction.

DISCUSSION

In addition to open pyeloplasty as the gold standard procedure, various minimally invasive procedures such as laparoscopic pyeloplasty have been used for the surgical treatment of UPJ obstruction during the last 2 decades [5]. Laparoscopic pyeloplasty is a technically difficult procedure that requires advanced laparoscopic skill. Multiple parameters have been used for the comparison of laparoscopic pyeloplasty and open pyeloplasty in recent years [2,5,11,17-19,20,22-30].

Operative Time

In our study, the mean operating room time in laparoscopic pyeloplasty (280 minutes) was significantly longer than open pyeloplasty (204 minutes). Similar results were obtained by Bansal et al. (LP: 244.2 minutes; OP: 122.4 minutes; $p < 0.01$) [5], Tong et al. (LP: 102.6 minutes; OP: 95.4 minutes; $p < 0.05$) [26], Simforoosh et al. (LP: 3.2 hours; OP: 2.2 hours; $p = 0.00$) [18], Calvert et al. (LP: 159 minutes; OP: 95 minutes; $p < 0.001$) [22], Piaggio et al. (LP: 278 minutes; OP: 144 minutes; $p < 0.001$) [30], and Bonnard et al. (LP: 218.6 minutes; OP: 95.6 minutes; $p < 0.0001$) [21]. Piaggio et al. reported a significant ($p < 0.001$) negative correlation between operative time and the experience of LP [30], but no difference was seen in the mean operating time between LP and OP in research published by Baldwin et al. [29] and Soulié et al. (LP: 165 minutes; OP: 145 minutes; $p > 0.05$) [6].

Furthermore, in Zhang et al., retroperitoneal dismembered LP (80 minutes) had a significantly ($p < 0.001$) shorter median operative time than OP (120 minutes) [23]. Our prolonged operating room time in LP may be due to laparoscopic technical

Table 2. Demographic data and surgical outcomes in LP and OP groups.
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Parameter	LP	OP	p Value
mean age (year)	27.5	17.7	0.07
male/female ratio, n (%)	13 (61.9%)/8 (38.1%)	15 (60%)/10 (40%	0.895
mean operating room time (min)	280 ± 95	204 ± 59	0.003
mean dosage of analgesic (mg)	26.25	38.33	0.744
mean indwelling duration of drainage (day)	2.5 ± 1.56	2.1 ± 1.14	0.31
mean postoperative hospital stay (day)	4.6 ± 1.76	4.3 ± 1.55	0.934
mean duration of a return to normal activity after discharge (day)	3.9	5.2	0.002
complication, n (%)	5 (23.8%)	9 (36%)	0.791
fever, n (%)	5 (23.8%)	7 (28%)	-
transfusion, n (%)	0	2 (8%)	-

difficulty, anesthesia, and recovery times. Also, the experience and the learning curve of the surgeon can affect on operative time (Table 3).

Analgesic Use

No significant difference was seen in the mean dosage of narcotic analgesic (meperidine) between the LP (26.25mg) and the OP (38.33mg) groups in our study, although this dosage was lower in the LP group. In research by Piaggio et al., LP and OP had similar (p = not significant) postoperative narcotic (morphine) dosage (LP: 0.28 mg/kg; OP: 0.27 mg/kg), and ketorolac dosage (LP: 0.36 mg/kg; OP: 0.6 mg/kg) [30]. But postoperative analgesic (diclofenac) use in LP was significantly lower than in OP in research by Bansal et al. (LP: 107.14 mg and 1 day; OP: 682.35 mg and 3.41 days; $p < 0.01$) [5] and Zhang et al. (LP: 75 mg; OP: 150 mg; $p < 0.001$) [23]. Similar results were obtained with tramadol and morphine sulfate equivalent in studies by Klingler et al. (LP: 190 mg; OP: 370 mg; p = 0.001) [17] and Baldwin et al. (LP: 27.2 mg; OP: 124.2 mg; p = 0.02) [29], respectively. In a Bonnard et al. report, LP (1.85 days) had a significantly (p = 0.03) lower mean postoperative acetaminophen use than OP (3.22 days). But the mean postoperative nalbuphine use was similar between LP (1.85 days) and OP (1.85 days) [21] (Table 3).

Indwelling Duration of Drain

In our study, the mean indwelling duration of drainage was similar between LP (2.5 days) and OP (2.1 days) groups. In a Piaggio et al. report, the mean indwelling duration of drainage was 2.5 days in LP and 6.3 days in OP [30]. In laparoscopic pyeloplasty, our result (2.5 days) is similar to the result of Piaggio et al. (2.5 days), but in open pyeloplasty, our result (2.1 days) is better than the result of Piaggio et al. (6.3 days) (Table 3).

Hospital Stay

In our study, no significant difference was seen in the mean postoperative hospital stay between LP (4.6 days) and OP (4.3 days) groups. The mean hospital stay was similar between LP and OP in reports by Soulié et al. (LP: 4.5 days; OP: 5.5 days; $p > 0.05$) [6], Simforoosh et al. (LP: 6.2 days; OP: 6.2 days) [18], Calvert et al. (LP: 5.4 days; OP: 5.6 days; p = 0.59) [22], and Piaggio et al. (LP: 2.4 days; OP: 2.5 days; p = 0.63) [30]. There was a significant negative correlation between hospital stay and the surgical experience of LP in the Piaggio et al. study [30], but the mean postoperative hospital stay in LP was shorter than in OP in the report by Bansal et al. (LP: 3.14 days; OP: 8.29 days; $p < 0.01$) [5], Zhang et al. (LP: 7 days; OP: 9 days; $p < 0.001$) [23], Klingler et al. (LP: 5.9 days; OP: 13.4 days) [17], and Tong et al. (LP: 2.5 days; OP: 5 days; $p < 0.01$) [26]. Also, LP produced a significantly shorter hospital stay than OP in Baldwin et al. (LP: 1.4 days; OP: 3.0 days; p = 0.03) [29] and Bonnard et al. (LP: 2.9 days; OP: 5.4 days; $p < 0.001$) [21] (Table 3).

Return to Normal Activity

Table 3. A comparison of laparoscopic pyeloplasty and open pyeloplasty in multiple studies.
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		Bansal et al.	Tong et al.	Simforoosh et al.	Calvert et al.	Piaggio et al.	Bonnard et al.	Baldwin et al.	Zhang et al.	Klingler et al.	Soulie et al.	Falahatkar et al.
Mean operative time (min)	LP	244.2	102.6	3.2 hours	159	278	218.6	no diff with OP	80		165	280
	OP	122.4	95.4	2.2 hours	95	144	95.6	no diff with LP	120		145	204
	P	< 0.01	< 0.05	0	< 0.001	< 0.001	< 0.0001		< 0.001		ns	0.003
Mean dosage of analgesic	LP	107.14 mg (d)				0.258 (mo) 0.36 (k) [mg/kg]	1.85 (a) 1.85 (n) [days]	27.2 mg (mo.eq.)	75 mg (d)	190 mg (t)		26.25 mg (me)
	OP	682.35 mg (d)				0.27 (mo) 0.6 (k) [mg/kg]	3.22 (a) 1.85 (n) [days]	124.2 mg (mo.eq.)	150 mg (d)	370 mg (t)		38.33 mg (me)
	P	< 0.01				m = ns k = ns	a = 0.03 n = ns	0.02	< 0.001	0.001		0.744
Mean indwelling duration of drain (day)	LP					2.5						2.5
	OP					6.3						2.1
	P											0.31
Mean hospital stay (day)	LP	3.14 postop	2.5 postop	6.2	5.4	2.4	2.9	1.4	7 postop	5.9	4.5	4.6 postop
	OP	8.29 postop	5 postop	6.2	5.6	2.5	5.4	3	9 postop	13.4	5.5	4.3 postop
	P	< 0.01	< 0.01		0.59	0.63	< 0.001	0.03	< 0.001		ns	0.934
Return to normal activity	LP										90% at 15 days[1] (postop) 88% at 1 month	mean: 3.9 days after discharge
	OP										70% at 15 days[1] (postop) 75% at 1 month	mean: 5.2 days after discharge
	P										0.14	0.002
Complication rate	LP		13% postop	24% postop	20% early	36% postop			3.6%		11.5% postop	23.8%
	OP		14.3% postop	6.2% postop	24% early	35% postop			7.5%		14.3% postop	36%
	P		0.33	< 0.05	0.116	0.06			0.729		ns	0.791

LP: laparoscopic pyeloplasty; OP: open pyeloplasty; P: p value; diff: difference; ns: not significant; d: dicolofenae; mo: morphine; k: ketorolac; a: acetaminophen; n: nalbuphine; mo.eq.: morphine sulphate equivalent; t: tramadol; me: meperidine; postop: postoperative; 1: in younger than 40-year-old patients

In our study, the mean duration of a return to normal activity after discharge was 3.9 days in the LP group and 5.2 days in the OP group, and this difference was significant. In Soulié et al., 88% of patients with LP and 75% of patients with OP returned to normal activity 1 month after operation. All asymptomatic patients returned to full activity 3 months after operation. In patients younger than 40 years old, 90% of patients with LP and 70% of patients with OP returned to normal activity without sports 15 days after operation, but this difference was not significant (p = 0.14) [6] (Table 3).

Complications

In our study, mortality and failure were not seen in 2 groups. No conversion to OP occurred in the LP group. Bansal et al. [5] and Zhang et al. [23] reported no mortality in LP and OP groups. In Zhang et al., no failure occurred in the LP group [23]. No conversion to OP was seen in patients with LP in Simforoosh et al. [18], Zhang et al. [23], and Piaggio et al. [30], but Bansal et al. (n = 1; due to disability in the removal of an associated stone) [5], Calvert et al. (n = 4; due to bleeding and lost vision in 3 patients and fibrosis and failure in 1 patient) [22], and Soulié et al. (n = 1; due to adhesion formation following pyelonephritis) [6] reported conversion to OP in the LP group.

In our study, the complication rate was 23.8 and 36% in the LP and the OP groups, respectively. This difference was not significant. No significant difference was seen in complication rates in Soulié et al. (LP: 11.5%; OP: 14.3%; p = 0.729) [6], Zhang et al. (LP: 3.6%; OP: 7.5%; p = 0.729) [23], Tong et al. (LP: 13.0%; OP: 14.3%; p = 0.33) [26], Calvert et al. (LP: 20%; OP: 24%; p = 0.16) [22], and Piaggio et al. (LP: 36%; OP: 35%; p = 0.06) [30], but LP (24%) had a significantly (p < 0.05) higher postoperative complication rate than OP (6.2%) in Simforoosh et al. [18].

In Bansal et al. [5] and Soulié et al. [6], no patients required blood transfusions in the LP and OP groups. One patient with LP (3.5%) experienced prolonged drainage of urine in Bansal et al. [5]. In Soulié et al., postoperative complications consisted of pyelonephritis (n = 1, 4%), anemia following parietal hematoma (n = 1, 4%), migration of a pigtail stent below the UPJ anastomosis (n = 1) in the LP group, and pyelonephritis (n = 2, 7.1%) and wound infection (n = 2, 7.1%) in the OP group [6]. In Piaggio et al., intraoperative bleeding without the need for a blood transfusion occurred in 2 patients (5.4%) with LP and 1 patient (2.4%) with OP [30]. In our study, the only complication of the LP group was fever (23.8%). No patients with laparoscopic pyeloplasty required a blood transfusion. In the open pyeloplasty group, fever and transfusion rates were 28 and 8%, respectively (Table 3).

Although the results of the last cases were better than the first cases, we reported our results due to a small sample size of the groups. These comparisons reveal that even in primary experiences, laparoscopic pyeloplasty is a safe and effective minimally invasive procedure with shorter or similar postoperative analgesic use and hospitalization, similar complication rate, and quicker returns to normal activity in comparison to open pyeloplasty. But LP has a prolonged operating time. This duration can be decreased with an increase in the experience of the surgeon and without calculating the stent placement and related anesthesia times.

CONCLUSION

Although OP has a shorter operating room time, laparoscopic pyeloplasty is a gold substitute for open pyeloplasty even in primary experiences due to cosmetic advantages, an earlier return to normal activity, and comparable results. Laparoscopic pyeloplasty can be the gold standard treatment for UPJ obstruction if LP is performed by experienced and skillful surgeons.

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