Transperitoneal laparoscopic pyeloplasty in children and adolescents: long-term results

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Background **Open pyeloplasty has been the gold standard for the treatment of ureteropelvic junction obstruction (UPJO) in children and young adolescents. However, the use of laparoscopy for the treatment of pyeloplasty is increasing as it has the potential to provide a better and more desirable cosmetic outcome in addition to less postoperative pain and decreased recovery time. The aim of this study was to evaluate the long-term outcome of transperitoneal laparoscopic pyeloplasty (TLP) for the treatment of UPJO in children and young adolescents.**

Patients and methods **Twenty-nine patients with UPJO with 32 renal units were subjected to TLP at Al-Azhar University Hospitals, Egypt, during the period from May 2008 to December 2012. The outcome measurements of this study included operative time, internal stent placement, hospital stay, intraoperative complications, and success rates. Success is defined as both symptomatic relief and radiographic resolution of hydronephrosis at the last follow-up. Patients were followed up with intravenous urography and diethylene triamine penta-acetic acid scan at 3, 6, and 12 months regularly for both functional and morphological outcomes.**

Results **The study included 29 patients (12 male and 17 female) with 32 obstructed renal units. The mean age was 4.23 ± 2.1 years (range 3–16 years). All procedures were completed laparoscopically without conversion. The mean operative time was 143.41 ± 23 min (range 110–220 min). The mean postoperative hospital stay was 4.1 days (range 3–8 days). All patients achieved full recovery without any complications. The mean follow-up period of the patients was 36.34 ± 5.18 months (range 22–60 months). Success rate was 96.9%. Only one case developed recurrent UPJO and was treated with retrograde endopyelotomy and stenting.**

Conclusion **TLP has the advantages of less postoperative pain, short hospital stay, and rapid recovery, with excellent functional and cosmetic outcomes. However, it requires advanced skill level for intracorporeal suturing and knot tying.** ***Ann Pediatr Surg*** **11:231–238 © 2015 Annals of Pediatric Surgery.**

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Keywords: children, laparoscopy, long-term results, pyeloplasty, ureteropelvic junction obstruction

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Introduction

Ureteropelvic junction obstruction (UPJO) is the most common cause of pediatric hydronephrosis, occurring in one per 1000–2000 newborns. The widespread use of antenatal ultrasonography and the advent of modern imaging techniques have resulted in earlier and more common diagnosis of hydronephrosis [1].

Open pyeloplasty originally described by Andersen and Hynes remains the gold standard treatment for UPJO. Over the last two decades, many new approaches for the treatment of UPJO have been evolved, from open pyeloplasty to various minimally invasive procedures such as endopyelotomy, acucise catheter incision, balloon dilatation laparoscopic and robotic pyeloplasty. These minimally invasive options were reported to be less successful compared with open pyeloplasty [2]. The first study on transperitoneal laparoscopic pyeloplasty (TLP) was conducted by Shoma *et al.* [3]. Laparoscopic pyeloplasty is the first minimally invasive option to match the success rate of open pyeloplasty.

Laparoscopic pyeloplasty can be performed using either retroperitoneal or transperitoneal approach. The transperitoneal approach offers familiar anatomic landmarks and wide working space, but more bowel manipulation, and therefore higher likelihood of ileus. Conversely, the retroperitoneal approach offers the advantage of less potential postoperative ileus, but it has the disadvantage of limited working space. Choice of anatomic approach is dictated by surgeon experience and training [4].

The laparoscopic approach has the advantages of having less postoperative pain, shorter hospital stay, and more rapid recovery, with better cosmetic results compared with open pyeloplasty. Moreover, laparoscopy allows for excision of the structured segment, reduction pyeloplasty, transposition of the ureteropelvic junction (UPJ) over crossing vessels, and even extraction of concomitant renal calculi [5].

There is much debate about the outcomes of TLP concerning the functional recovery of renal units after repair. Although some authors reported significant functional improvement after TLP [2,5–7], others found no or slight improvement after TLP [8–10]. The aim of this study was to evaluate the long-term outcome of TLP for the treatment of UPJO in children and young adolescents.

Patients and methods

This study was conducted at the Department of Urology and Pediatric Surgery, Al-Azhar University Hospitals, Egypt, between May 2008 and December 2012. A total

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of 29 patients with 32 renal units were subjected to TLP. All patients were evaluated by means of full history taking, thorough clinical examination, routine laboratory investigations (complete blood count, bleeding time, clotting time, random blood sugar, and liver and renal profile), and imaging workup, which included renal ultrasound, magnetic resonance urography, intravenous urography (IVU), and diuretic renography. Diethylene triamine penta-acetic acid scan was performed to evaluate drainage, glomerular filtration rate (GFR), and split renal function.

Inclusion criteria included patients with pelvi-ureteric junction obstruction, whereas exclusion criteria included untreated coagulopathy, active urinary tract infection, intrarenal pelvis, previous pyeloplasty, or previous endopyelotomy. Ethical committee of our hospitals approved the study protocol, and written informed parental consent was obtained.

All patients were admitted in the early morning on the day of surgery and a prophylactic intravenous antibiotic in the form of third-generation cephalosporin at a dose of 50 mg/kg body weight was given 1 h before the procedure. After induction of general anesthesia and fixation of nasogastric tube and Foley's urethral catheter, the patient was placed in the lateral kidney position, whereas patients with ectopic kidneys were placed in the supine position. The surgeon and the cameraman were on the contralateral side with the TV monitor in front of them. A 5-mm port was inserted through the umbilicus using open Hasson's technique and creation of pneumoperitoneum to a pressure of 12–15 mmHg was accomplished. A 5-mm telescope with 30° was used. Two 5-mm working ports, one subcostal in the midclavicular line and the other just anterior to the anterior superior iliac spine under vision. The colon was reflected medially, and the dilated renal pelvis and upper ureter were identified and dissected free from the surrounding tissues. The crossing vessel was identified and, if present, adequate care was taken to separate it safely from the renal pelvis for transposition.

Laparoscopic dismembered pyeloplasty was performed for all cases. The ureter was cut at UPJ; the narrow segment was excised with spatulation of the upper ureter. (Figs 1 and 2) To minimize operative time, redundant renal pelvis was transcutaneously fixed to the anterior abdominal wall with prolene 2/0 for retraction and sparing a trocar.

Extraction of multiple concomitant calyceal stones from ectopic kidney was carried out by introduction of the ureteroscope from the operating trocar sheath.

The anastomosis was performed with continuous intracorporeal suture using 4-0 vicryl suture. The first suture was placed at the apex of the spatulated ureter from outside in, and then taken through the most distal part of the pelvis. The posterior anastomosis was completed running up the length of the spatulated ureter and pelvis. A double-J stent (4.8 Fr, 18 cm) was mounted on the guidewire and passed through the proximal ureter into the bladder. The upper coil of the double-J stent was left within the renal pelvis. In cases of aberrant vessels the anastomosis was brought anterior to the vessels. Drain was inserted adjacent to the site of repair (Figs 3 and 4).

Foley's catheter was removed after 24 h and the tube drain was removed when it ceased output. Internal stent was removed by means of cystoscopy after 6 weeks.

Patients were followed up with IVU, magnetic resonance urography, and diethylene triamine penta-acetic acid scan, for both functional and morphological outcome at 3, 6, and 12 months. Success was defined as both symptomatic relief and radiographic resolution of obstruction at last follow-up.

Statistics analysis

Data were collected and processed using SPSS, version 18 (SPSS Inc., Chicago, Illinois, USA). *P*-values less than 0.05 were considered statistically significant.

Results

This study included 29 patients with a mean age of 4.23 ± 2.1 years (range 3–16 years). There were 12 male and 17 female patients with 32 obstructed renal units at UPJ (three bilateral). Thirteen patients had right-sided UPJO, 13 had left-sided UPJO, and three had bilateral UPJO. The most common presentation was loin pain (25 cases), whereas two patients presented with hematuria and two patients were accidently discovered. Twenty-six patients had unilateral UPJO (four out of them had a congenital ectopic kidneys).

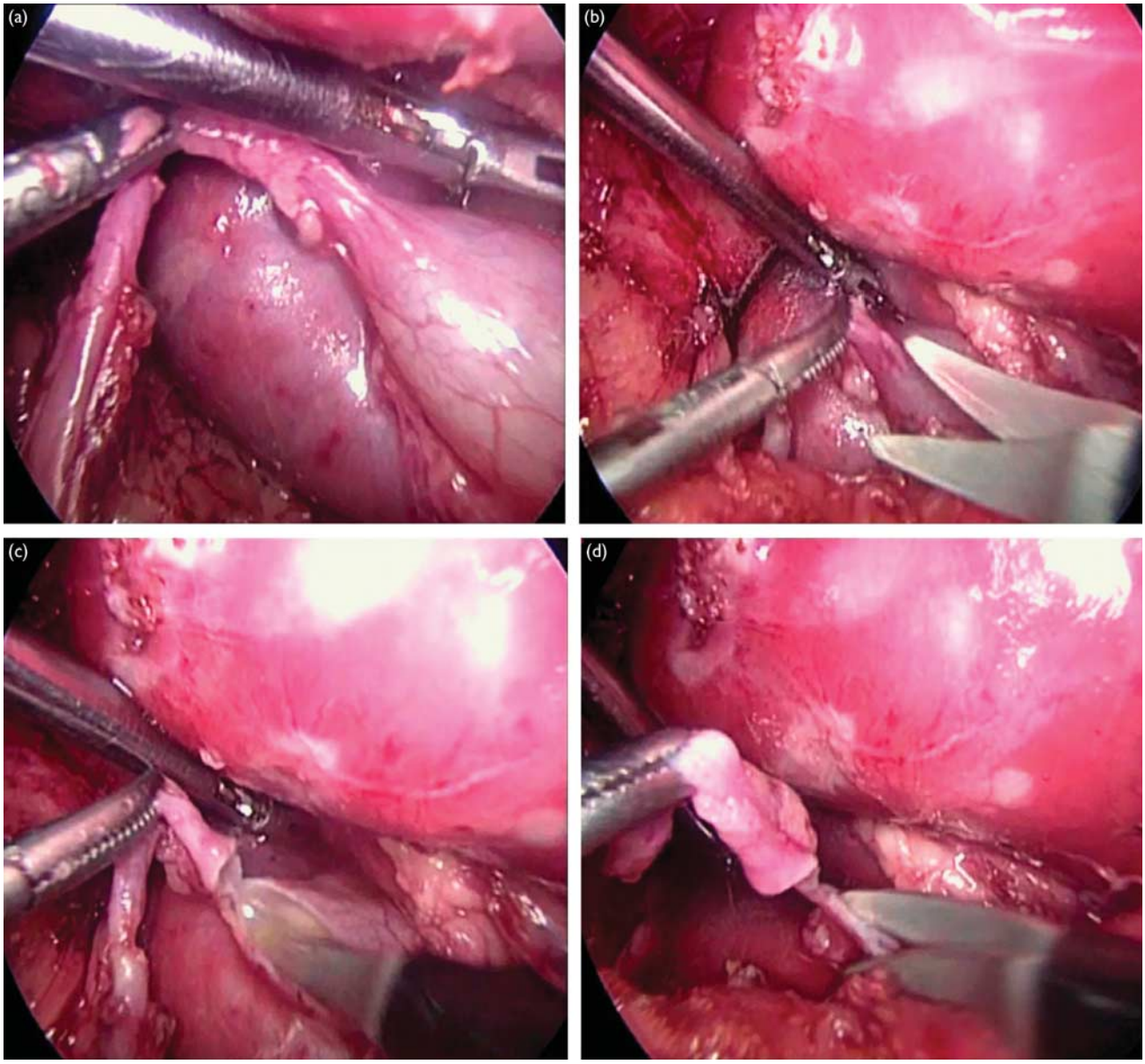
All cases were completed laparoscopically without any conversion. Aberrant vessels were detected in six patients. Concomitant multiple renal stones were found in one case. The mean operative time was 143.9 ± 22.6 (range 110–210) (Table 1).

All patients were given diclofenac sodium to control postoperative pain. The mean postoperative hospital stay was 4.1 ± 1.5 days (range 3–8 days). Tube drains were removed on the third postoperative day when drainage had stopped, with a mean of 3.4 ± 1.2 days (range 2–8 days). One patient developed postoperative fever and was managed conservatively with proper antibiotics. The mean duration of stenting was 5.8 ± 2.11 weeks (range 6–10 weeks). The mean follow-up of the patients was 36.34 ± 5.18 months (range 22–60 months). There was one case of recurrence UPJO giving a success rate of 96.9%.

Two (6.9%) patients had persistent urine leakage after TLP and were managed conservatively and the leakage stopped after 2 weeks (Table 2). One of them improved without further intervention, whereas the other patient developed recurrent UPJO, which was managed with double-J fixation first and then with retrograde endopyelotomy after 1 year.

Postoperative evaluation was carried out with abdominal ultrasound; IVU and renal scan were performed 3–8 months later. In all patients there was significant improvement in UPJO with improved renal functions and reduction in the size of renal pelvis (Figs 3 and 4). Comparative analysis of preoperative and postoperative

Fig. 1



Identification of the dilated renal pelvis and the upper ureter (a). Excision of the dilated renal pelvis with the atretic ureteral segment (b–d).

IVU revealed statistically significant differences between preoperative and postoperative results as regards the degree of hydronephrosis ($P = 0.016$) (Table 3).

Discussion

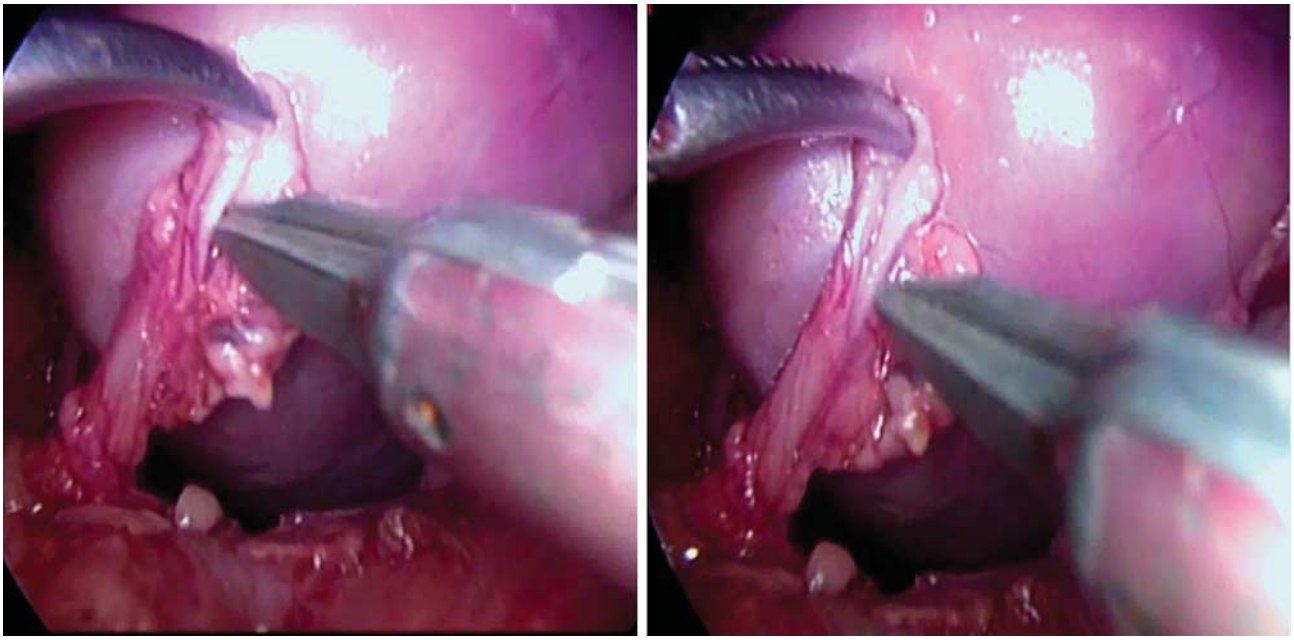
Laparoscopic pyeloplasty is a first-line option for the management of UPJO. It has a greater success rate than that of endopyelotomy and is associated with a shorter and less intense convalescence compared with open pyeloplasty. The technique is well established and reproducible, although it is more difficult in certain situations, such as after a previous pyeloplasty and intrarenal pelvis [11].

The transperitoneal approach is more familiar to most surgeons and offers the following advantages: much wider workspace that would allow easier addition of techniques, such as transposition of polar vessels or remodeling of the pelvis and resolution of secondary lithiasis, and the anatomical landmarks allow better guidance and more easily reproduce the steps of open surgery [12].

In our study, as well as in other studies [3,5,13], the incidence of intraoperative blood loss was minimal and the requirement for blood transfusion was rare. The estimated blood loss in our study was less than 50 ml in 86.2% of patients and between 50 and 100 ml in 13.8%. None required blood transfusion. Inagaki *et al.* [14] found that the mean blood loss was 158 ml. Such results are comparable to blood loss reported in open pyeloplasty.

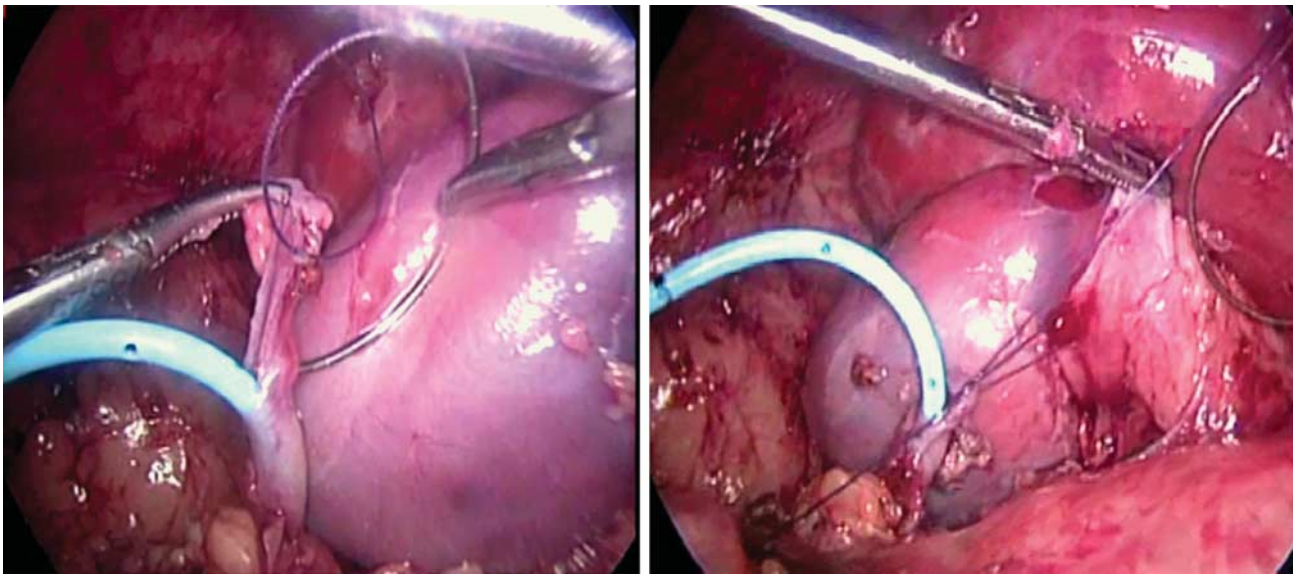
The mean operative time in the present study was 143.9 min (range 110–220 min), which is nearly similar to that reported by other researchers [5,15,16]. In the work of Mandahani *et al.* [15], the mean operative time was 246 min (range 100–480 min). Recently, Juliano and

Fig. 2



Spatulaion of the upper ureter.

Fig. 3



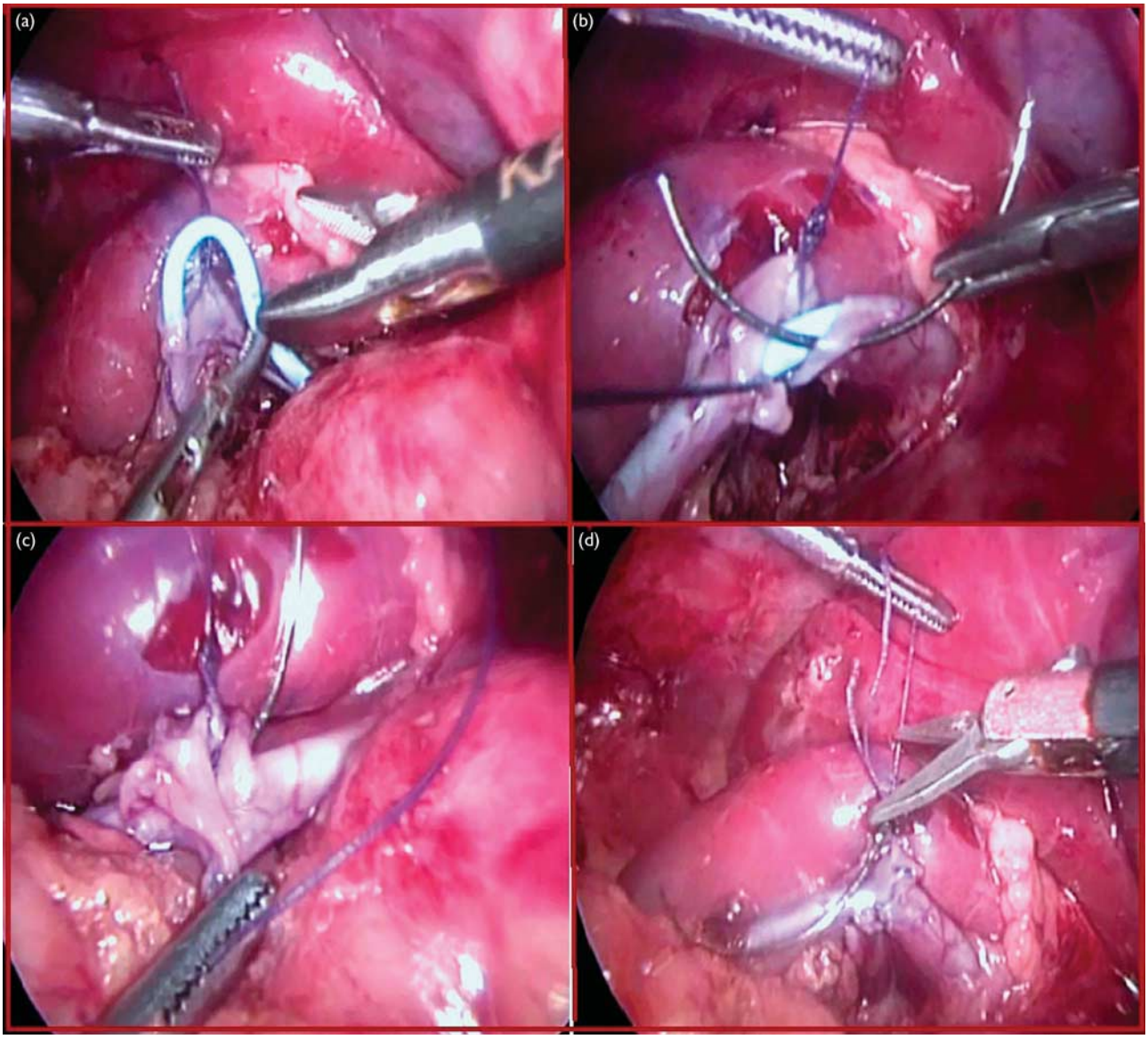
Insertion of double-J into the upper ureter and starting ureteropelvic anastomosis.

colleagues reported a mean operative time of 127 min (range 45–370 min). The significant difference in the operative time found in several studies may be attributed to the presence of different surgeons with different experiences. The technique of suturing, the methods used for knot tying, the inclusion of recurrent UPJO, and the occurrence of intraoperative complications are important factors related to operative time [7].

The type of TLP is another factor in determining the mean operative time. Szydełko and colleagues found that patients who underwent nondismembered Y-V plasty had significantly shorter operative time while maintaining similar postoperative outcomes. The shorter operative time in the Y-V plasty group was explained by the fact that fewer anastomotic sutures were needed in this procedure, which made it technically easier and more feasible [17].

Many urologists prefer to perform retrograde urography before proceeding with TLP, to more precisely define the length and location of the strictured segment and to rule out distal obstruction and then insert double-J stent retrogradely before completion of the anastomosis. However, such technique adds to the increased operative

Fig. 4



Completion of the posterior layer and coil of the double-J stent left within the renal pelvis (a).

Table 1 Perioperative parameters in 32 transperitoneal laparoscopic pyeloplasty procedures

Parameters	Minimum	Maximum	Mean ± SD
Mean age (years)	3	16	4.23 ± 21
Operative time (min)	110	210	143.9 ± 22.6
Mean postoperative hospital stay (days)	3	8	4.1 ± 1.5
Mean duration of stenting (weeks)	6	10	5.8 ± 2.11
Mean follow-up (months)	22	60	36.34 ± 5.18

time [1,18,19]. Others performed double-J placement in an antegrade manner just preoperatively. In this study, double-J stent was inserted in all cases antegradely during the operation. Two steps may have a role in diminishing the mean operative time in this study: the first step was the fixation of redundant renal pelvis to anterior abdominal wall using vicryl 2/0 as a sling, which acts as retraction, and sparing one trocar; and the second step was the insertion of double-J stent over the guidewire passed through puncture needle after spatulation of the ureter [20–22].

A double-J stenting is a standard of care to drain pyeloplasty in many centers (25). It may have an advantage of lessened nursing care and reduced morbidity after pyeloplasty. Egan and colleagues have shown that double-J stenting may result in more rapid resolution of hydronephrosis after pyeloplasty. The double-J ureteral stent is often placed after ureteral spatulation and before beginning the anterior wall of the anastomosis to minimize the risk for undue traction or compromise to the reanastomosis [23]. However, stent malpositioning has been reported with blind antegrade stenting. Malpositioning of the lower end of the double-J stent is usually associated with difficulties in negotiating the ureterovesical junction [20].

Most surgeons perform the anastomosis in a running manner. Lapra-Ty clips may be used to minimize knot tying, and

Table 2 Early postoperative complications in 32 units of 29 cases after transperitoneal laparoscopic pyeloplastyUPJO, ureteropelvic junction obstruction

Complications	Number of cases	Clavien classification	%
Blood loss (ml)			
<50	25	Grade 1	86.2
50–100	4	Grade 1	13.8
Urine leakage>100 ml	1	Grade 1	6.9
	1	Grade 3 as the case treated by double J	
Recurrent UPJO	1	Grade 3	3.4
Total	32		100

Table 3 Results of preoperative and postoperative intravenous urography

IVU	Preoperative [*n* (%)]	Postoperative [*n* (%)]
Normal	0 (0.0)	12 (37.5)
Unilateral mild hydronephrosis	8 (25)	15 (46.9)
Unilateral moderate hydronephrosis	15 (46.9)	4 (12.5)
Unilateral marked hydronephrosis	6 (18.7)	1 (3.1)
Bilateral moderate hydronephrosis	3 (9.4)	0 (0.0)
Total	32 (100)	32 (100)
χ^2-Test		
χ^2	29.315	
P-value	0.016	

Postoperative GFR also showed significant improvement compared with preoperative GFR (Tables 4 and 5).
GFR, glomerular filtration rate; IVU, intravenous urography.

Table 4 Results of preoperative and postoperative glomerular filtration rate after 6 monthsGFR, glomerular filtration rate

GFR values	Preoperative [*n* (%)]	Postoperative [*n* (%)]
Rt kidney		
<20	0 (0)	0 (0)
20–40	6 (18.75)	0 (0)
>40	10 (31.25)	16 (50)
Lt kidney		
<20	2 (6.25)	0 (0)
20–40	8 (25)	1 (3.1)
>40	6 (18.75)	15 (46.9)
Total	32 (100)	32 (100)

Table 5 Results of preoperative and postoperative glomerular filtration rate and split renal functionsGFR, glomerular filtration rate

			Paired *t*-test	
Results	Range (ml/min)	Mean ± SD	*t*	*P*-value
GFR				
Rt				
Preoperative	30.0–50.0	46.312 ± 13.350		
Postoperative	40.9–65.8	58.213 ± 13.416	−3.011	0.006*
Lt				
Preoperative	10.0–48.4	42.357 ± 12.516		
Postoperative	20.1–66.6	53.716 ± 13.210	−5.301	<0.001*
Split functions				
Rt				
Preoperative	31.0–49.0	55.223 ± 12.342		
Postoperative	38.0–68.0	47.677 ± 10.739	1.560	0.134
Lt				
Preoperative	12.0–53.0	44.230 ± 11.567		
Postoperative	36.0–68.0	52.429 ± 10.867	−1.732	0.099

**P*-value <0.001 means significant.

specialized instruments such as the endostitch device may facilitate suturing. Important principles include the creation of a tension-free watertight anastomosis with preservation of the periureteral blood supply [24]. In this study, we performed the anastomosis in a continuous running vicryl suture. The authors started TLP after gaining a good experience in different laparoscopic procedures and mastering intracorporeal suturing and knot tying.

The presence of stones is recognized as a complication of the UPJO, and the diagnosis creates dilemmas as regards treatment. Inagaki *et al.* [14] reported the presence of kidney stones in 16% of patients. Rivas *et al.* [12] reported on concomitant kidney stones in 12 of 62 patients (19%) who had undergone transperitoneal TLP. They removed stones in eight cases using a flexible cystoscope and a nitinol N-circle basket, whereas in the remaining four cases the stones were extracted using laparoscopic grasping instruments. In cases of UPJO associated with renal stones, a flexible cystoscope or ureteroscope can be inserted through a laparoscopic port into the pyelotomy before closing the defect for removing the stone from the renal pelvis or calyces using forceps or Dormia basket. The light source and camera can be transferred to the cystoscope or the ureteroscope [11]. In this study, extraction of multiple concomitant calyceal stones from ectopic kidney was carried out by introduction of the ureteroscope from the operating trocar sheath.

In this study, one case developed urine leakage, which stopped spontaneously within 2 weeks. Another case developed recurrent UPJO, which was managed with double-J stent first and with retrograde endopyelotomy after 1 year. Shoma *et al.* [3] reported two cases of postoperative complications: one had mild hematuria, which was managed conservatively, and the second developed urine leakage, which stopped on the ninth postoperative day. Lasmar *et al.* [5] reported a postoperative complication rate of 10.9% in 10 patients in the form of urine leakage (six cases), urinary fistula (one case), and port site infection (three case), and all were managed conservatively. Juliano *et al.* [7] reported 9.6% postoperative complication rate, and urine leakage occurred in eight cases (6.1%); all cases were managed conservatively.

One of the most distressing complications of TLP is conversion to open surgery. This conversion has been reported to be in the range of 0–1.8% [5,7]. In this study, there was no single case of conversion to open surgery and all operations were completed laparoscopically without any complication. This is in agreement with that mentioned by Shoma *et al.* [3], who studied 40 cases of TLP without conversion to open surgery. The success rate of TLP in the current study was 96.9% (31/32), which is compatible with that reported in the literature. The success rate of TLP has been reported to be consistently high, at 87–98% [3,5–7]. In contrast, Metzelder *et al.* [20] reported poor success for laparoscopic nondismembered Y-V pyeloplasty. Moreover, Casale and colleagues reported a success rate of 94% for dismembered pyeloplasty and 43% for nondismembered pyeloplasty in children with UPJO. The difference in outcomes between the two laparoscopic techniques was attributed to the dysplastic tissue found in pelviureteric junction obstructions, which is only rearranged in nondismembered procedures but resected in Anderson-Hynes dismembered pyeloplasty [21].

Fig. 5

Preoperative intravenous urography (IVU) showing bilateral hydronephrosis (a). Post-transperitoneal laparoscopic pyeloplasty (TLP) IVU (b) showing no obstruction, with good configuration of both kidneys.

Despite observed success in relieving obstruction, functional improvement after UPJO repair is less certain. One study showed no improvement after pyeloplasty in patients, with preoperative renal function of less than 20% 18 [8]. In another study, only two of 10 patients with preoperative renal function less than 30% improved after the repair [9]. In the work of Khan *et al.* [10], the majority of patients had persistent hydronephrosis after surgery and the improvement in renal function and T½ was noted in less than 50% of cases. In the present study, there was a statistically significant difference between preoperative and postoperative IVU results as regards the degree of hydronephrosis ($P = 0.016$). Moreover, there was a statistically significant improvement in the postoperative GFR than in the preoperative values after 6 months of follow-up ($P = 0.006$). This can be explained by the fact that 93.8% of renal units we studied had preoperative GFR greater than 20 ml/min/1.73 m^2 and 50% of renal units had GFR greater than 40 ml/min/1.73 m^2.

Our study may be limited by the lack of randomization, the small number of cases, and the heterogeneity of patients studied as regards ages and type of TLP (Tables 4 and 5, Fig. 5).

Conclusion

Laparoscopic pyeloplasty has a minimal level of morbidity, short hospital stay, better cosmesis, and excellent radiological and functional outcomes.

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Conflicts of interest

There are no conflicts of interest.

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