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# Feasibility, safety and effectiveness of laparoscopic transperitoneal pyeloplasty in children: Ain Shams University early experience

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## Abstract

**Background/purpose:** Laparoscopic pyeloplasty (LP) is now widely recognized as a minimally invasive alternative for the surgical repair of ureteropelvic junction obstruction (UPJO) in paediatrics. In this work, we aim to evaluate the feasibility, safety and effectiveness of LP in our early experience.

**Patients and methods:** Between April 2019 and April 2020, patients presented with indication for surgical repair of UPJO were offered laparoscopic transperitoneal Anderson-Hynes pyeloplasty. Demographic data, preoperative investigations, operative data and intra- or postoperative complications, as well as short and mid-term follow-ups were recorded.

**Results:** During the specified period, 13 patients underwent LP (8 girls and 5 boys) with a median age of 12 months (range from 5 to 150 months). There was no conversion to open approach with operative time ranging from 120 to 240 min (mean =  $175 \pm 34$  min). No intra- or postoperative complications were encountered. One to 2 years postoperative follow-up was performed (median = 18 months) in 11 patients. One patient discontinued follow-up after 1 month and another after 6 months. Follow-up PAUS showed a reduction in the anteroposterior diameter of the renal pelvis in all cases. Postoperative diuretic renal scans (DTPA renography) were done for three patients with a persistent anteroposterior diameter of the renal pelvis greater than 20 mm which showed improvement in the washout. All patients had a good cosmetic outcome.

**Conclusion:** In our early experience in LP, we found the procedure a safe, feasible and effective technique in managing UPJO in children and infants with good cosmetic outcome.

**Level of evidence:** This is a case series study (level IV evidence).

**Keywords:** Laparoscopic pyeloplasty, Ureteropelvic junction obstruction, Anderson-Hynes pyeloplasty

## Introduction

The ureteropelvic junction obstruction (UPJO) is one of the most prevalent genitourinary abnormalities in children. The incidence of congenital hydronephrosis

due to UPJO is one in 2000 children, where the ratio of affected boys to girls is 2–3:1. A UPJO occurs more frequently on the left side, and bilateral hydronephrosis occurs in 20–39% of affected patients [1, 2]. The main issue with this obstructive disorder is the progressive deterioration in kidney function, which can lead to renal unit loss. There are many techniques for PUJO repair, but the dismembered Anderson-Hynes

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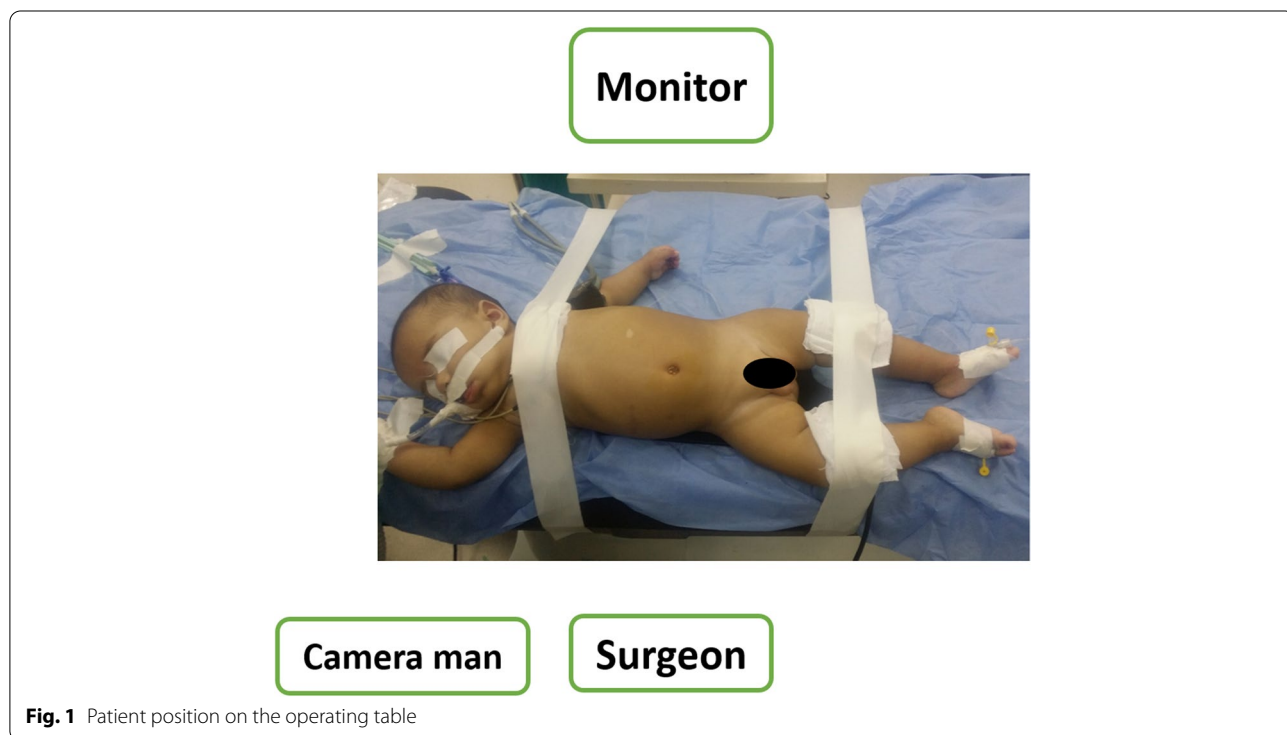
pyeloplasty remains the gold standard for surgical reconstruction [3]. Laparoscopic Anderson-Hynes pyeloplasty has become the gold standard in many paediatric centres; it was first reported by Peters and his colleagues in 1995 [4]. The lengthy learning curve of intracorporeal suturing as well as anastomosis has slowed the widespread acceptance of laparoscopic pyeloplasty (LP). The small incision required for open pyeloplasty (OP) and faster recovery time compared to adults resulted in slower acceptance of LP in paediatrics [5]. However, in the past decade, an increasing trend to minimally invasive pyeloplasties from 0.34 to 11.7% has been reported [6]. Many studies have been done showing that LP has comparable outcome with OP with shorter hospital stay and better cosmetic outcome; however, it has longer operative time [7–9]. LP for UPJO can be performed through both the transperitoneal and retroperitoneal approaches, and either approach is associated with a high success rate and a low complication rate. Transperitoneal approach has a wider working space that provides a shorter operative time and lower conversion rate, while retroperitoneal approach has rapid recovery of intestinal movement and early resumption of oral feeding [10, 11]. The aim of our study is to assess the feasibility, safety and short- and mid-term outcomes of laparoscopic transperitoneal pyeloplasty in children with UPJO at our centre.

**Materials and methods**

This prospective case series study was conducted in Ain Shams university hospitals between April 2019 and April 2020. Cases with established diagnosis of PUJO with an indication of surgical repair were offered to participate in this study for laparoscopic repair. Children with primary UPJO older than 6 months or weighted more than 6kg were included. Patients with solitary functioning kidney, associated renal anomalies, associated stones, or recurrent UPJO were excluded. The following data were recorded preoperatively: gender, age at presentation, age at operation, antenatal diagnosis, symptoms, previous history of urinary tract infection, kidney functions, pelvi-abdominal ultrasound with kidney measurements including anteroposterior diameter of the pelvis and DTPA scan. An informed consent was taken from the parents. The study was approved by the ethical committee of Pediatric Surgery Department, Ain Shams University (IRB no.00006379).

**Operative technique (trans-peritoneal laparoscopic pyeloplasty)**

The patient was placed supine on the edge of the table. The affected side was slightly elevated by towels to about 15° (Fig. 1). During the procedure, if we need more elevation, we can tilt the table itself by elevating the affected side. The patient was prepared with exposed surgical field from the costal margin above till mid-thigh below



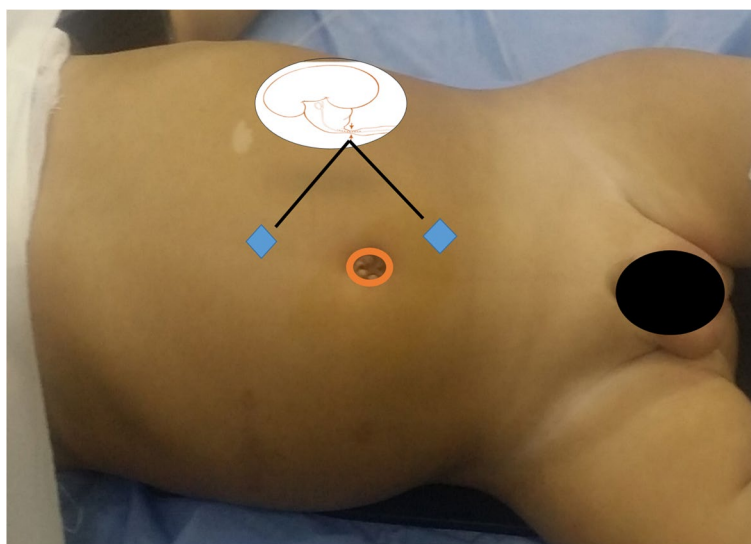
**Fig. 1** Patient position on the operating table

which permits the use of cystoscopy when needed. The surgeon and assistant (camera man) stand at the normal side while placing the monitor at the affected kidney site (Fig. 1). Intraperitoneal access was obtained with open placement of a 5-mm umbilical port. Two 3- or 5-mm instruments (according to the patient's age) were placed, one of which was in the mid-epigastrium and the other in the lower abdomen in the midclavicular line ipsilateral to the affected kidney (Fig. 2). For left-sided procedures, the ureteropelvic junction (UPJ) was accessed via a transmesenteric approach. While on the right side, the retrocolic approach is preferable because of the short mesentery. The retrocolic was accessed by mobilizing the colon to the level of the hepatic flexure. The renal pelvis was mobilized from the surrounding tissues, anteriorly, medially and posteriorly. The ureter was carefully dissected free of attachments to avoid affecting its vascularity. Before the renal pelvis was sectioned, three polypropylene 2-0 sutures (hitch stitches) were placed percutaneously. The first stitch was placed through the abdominal wall just below the costal margin and then passed through the upper pole of the renal pelvis, passed back through the abdominal wall, and was secured by a haemostat. The second one was placed in the ipsilateral iliac fossa, passing through the lower pole. The last one was passed through the UPJ. Incision of the renal pelvis was done at the dependant point where an anastomosis with the ureter should be placed. Immediate suction of the urine should be done to avoid the potential risk of urinary peritonitis. The ureter was partially incised by a small transverse cut just below the UPJ to open its lumen then spatulated with straight scissors on its lateral aspect

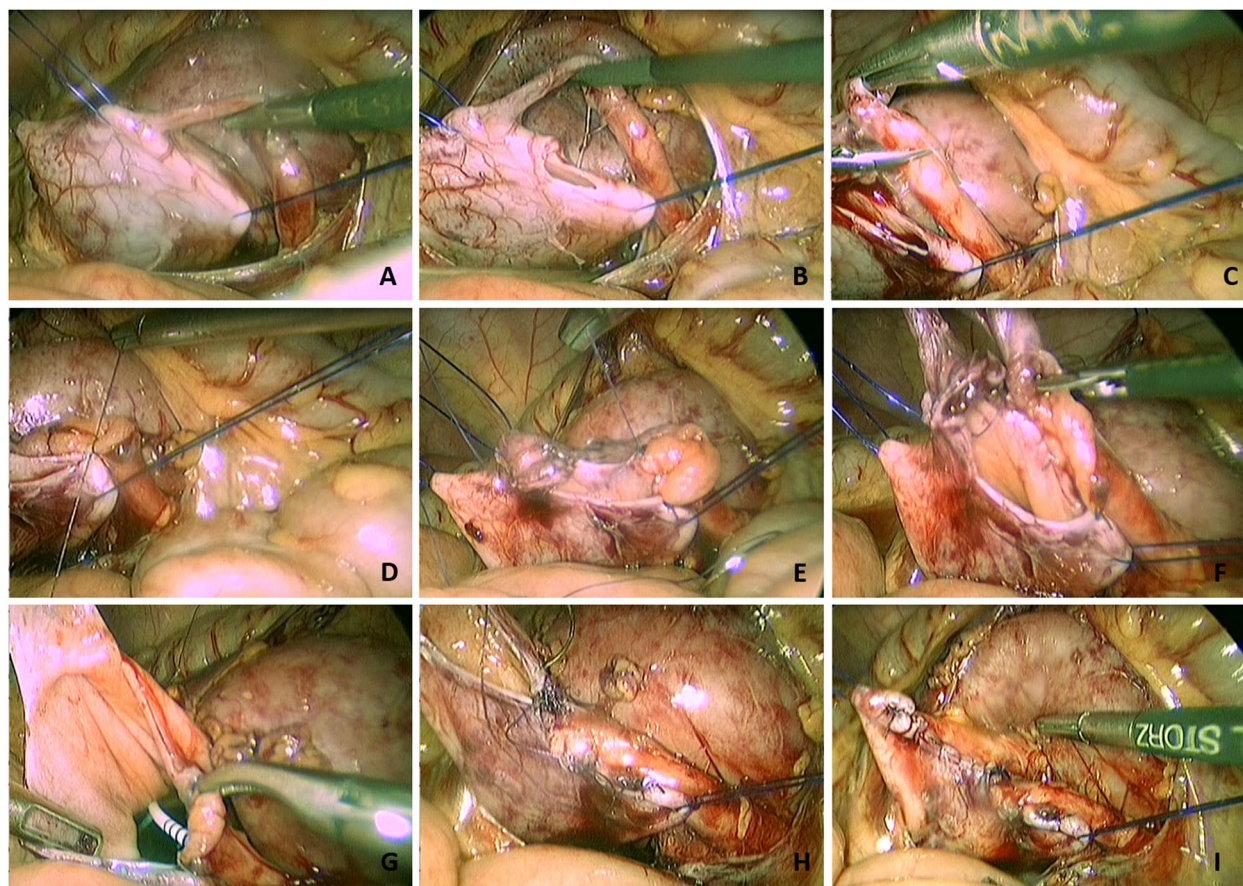
till we could have a good calibre of the ureter (that can accommodate the insertion of a closed laparoscopic instrument inside the lumen). The anastomosis began at the vertex of the spatulated ureter with the most dependent part of the renal pelvis. The posterior aspect of the ureteral-pelvic anastomosis was initiated with two to three interrupted sutures (5/0 vicryl), which can be then completed by running sutures. After completion of the posterior wall, the double J catheter was inserted then the anterior portion of ureteral-pelvic anastomosis was completed in a manner similar to the posterior wall over the double J catheter. We used 3-Fr double J catheter in infants and size of 4 Fr. in older children. Redundant pelvis was resected if the pelvis was greatly dilated. Thereafter, the pelvis was closed with running sutures (Fig. 3). A Nelaton catheter was left as perinephric drain at the site of the anastomosis that emerged from the lower port site.

#### Double j insertion

At the beginning of applying LP in our centre, the double J catheter was inserted percutaneously (the abdominal wall was punctured with a wide venous cannula, through which the guidewire was pushed through the anastomosis down to the urinary bladder), and then the catheter was advanced on the guide wire in an antegrade manner. The passage of the catheter into the bladder was confirmed by appearance of methylene blue dye through the proximal pores of the double J catheter (methylene blue was injected into the bladder preoperatively through a urethral catheter). We encountered some difficulties with this technique as the guide wire failed to pass the ureterovesical junction in three cases. Moreover, we changed



**Fig. 2** Port sites for laparoscopic transperitoneal pyeloplasty



**Fig. 3** Operative steps of laparoscopic transperitoneal dismembered Anderson-Hynes pyeloplasty. **A** Transmesocolic exposure of UPJ for left sided UPJO. Three polypropylene stay sutures were taken (upper pole, UPJ, lower pole) that emerged from a corresponding points at the anterior abdominal wall. **B** Opening of the lower pole of the renal pelvis at a dependent site. **C** Opening and spatulation of the ureter. **D** The first stitch between the apex of the renal pelvis and the spatulated ureter. **E** Beginning of the posterior wall anastomosis. **F** Completion of the posterior wall anastomosis followed by dismembering the UPJ. **G** Insertion of the double J catheter. **H** Fashioning of the anterior wall of the uretero-pelvic anastomosis over the double J catheter. **I** Closure of the remaining renal pelvis edge to edge

our approach by inserting it in a retrograde manner using cystoscopy. Before insertion of the umbilical port, cystoscopic insertion of the guide wire was done and left in place until completion of the posterior wall anastomosis, and then we advanced the double J catheter over the guide wire in a retrograde manner before starting to suture anterior ureteropelvic anastomosis.

Patients were followed up with ultrasound after 1, 3, 6, and 12 months. DTPA scan was done in some cases where there was a persistent anteroposterior diameter of more than 20 mm upon follow-up U/S.

## Results

From April 2019 to April 2020, thirteen UPJ units in 13 patients underwent LP. Seven units were right sided, and six units were left sided. All laparoscopic procedures were completed with no need for conversion to the open technique. Eight girls and five boys, whose age ranged

from 5 months to 12.5 years old (median = 12 months) (IQR = 8–66). Their weight at time of surgery ranges from 6 to 55 kg (median 10 kg) (IQR = 7.5–20). Six patients were diagnosed antenatally, three patients were presented with urinary tract infection, three patients were presented by flank pain and one patient was accidentally discovered by U/S done for another cause. Pre-operative AP diameter of the renal pelvis ranged from 23 mm to 120 mm. The indication for surgery was the presence of symptoms (UTI or flank pain) in 6 patients and a progressive increase in AP diameter of renal pelvis or diminished kidney function divided on isotope scan in 7 patients. Patient's characteristics were summarized in Table 1.

The mean operative time was  $175 \pm 34$  min (range from 120 to 240 min). The mean operative time in the first ten cases and the last three cases were 187 and 137 min respectively. Aberrant vessels were found in 2

**Table 1** Preoperative patients characteristics

Case no.	Age at presentation	Age at surgery	Weight at surgery (kg)	Affected side	Preoperative AP diameter of the pelvis	Indication for surgical repair
1	5.5 years	6 years	20	Rt (aberrant vessel)	24 mm	Loin pain
2	3 years	4 years	20	Lt	46 mm	↑↑ AP diameter and ↓ split kid function
3	2 months	5 months	7	Rt	41 mm	↑↑ AP diameter and ↓ split kid function
4	4.5 years	5 years	20	Lt	42 mm	Recurrent UTI and ↓ split kid function
5	12 years	12.5 years	55	Lt (aberrant vessel)	95 mm	Loin pain and ↓ split kid function
6	5.8/12 years	6 years	22	Lt	30 mm	Loin pain and UTI and ↓ split kid function
7	2 months	1 year	10	Lt	23 mm	↑↑ AP diameter and ↓ split kid function
8	6 months	10 months	10	Rt	40 mm	↑↑ AP diameter and ↓ split kid function
9	1 month	10 months	8	Rt	24 mm	↑↑ AP diameter and ↓ split kid function
10	1 years	2 years	10	Rt	130 mm	↑↑ AP diameter and ↓ split kid function
11	4 months	1 year	9	Lt	30 mm	↑↑ AP diameter and ↓ parenchymal thickness
12	Antenatal	6 months	7	Lt	34 mm	↓ parenchymal thickness and recurrent UTI
13	1.5 months	6 months	6	Lt	45 mm	↑↑ AP diameter

patients. Two of the patients had previously undergone open pyeloplasty on the contralateral side. No intraoperative complications were encountered in this series. No postoperative urinary leakage occurred and drains were removed 24h postoperatively in all cases. Feeding was started on the same day of surgery in all cases after auscultation of bowel sounds. The bladder catheter was removed after 24h. All patients were discharged after 2 days.

Double J stents were inserted by antegrade manner in 7 patients and failed to be inserted in 3 patients where an open percutaneous pyelostomy tube and a closed ureteric stent were used instead. And in the last 3 cases, we inserted the double J catheter by the retrograde approach. The double J catheters were removed by cystoscopy after 4–6 weeks. Those with pyelostomy tube had a nephrostogram study performed 2 weeks postoperatively. Two patients showed free passage of contrast with the urinary bladder (and the tube was removed after intermittent clamping). The third case showed arrest of contrast at the uretero-vesical junction (Fig. 4). Therefore, the diagnosis of concomitant obstructive megaureter was established, after which ureteric reimplantation was performed prior to the removal of the pyelostomy tube.

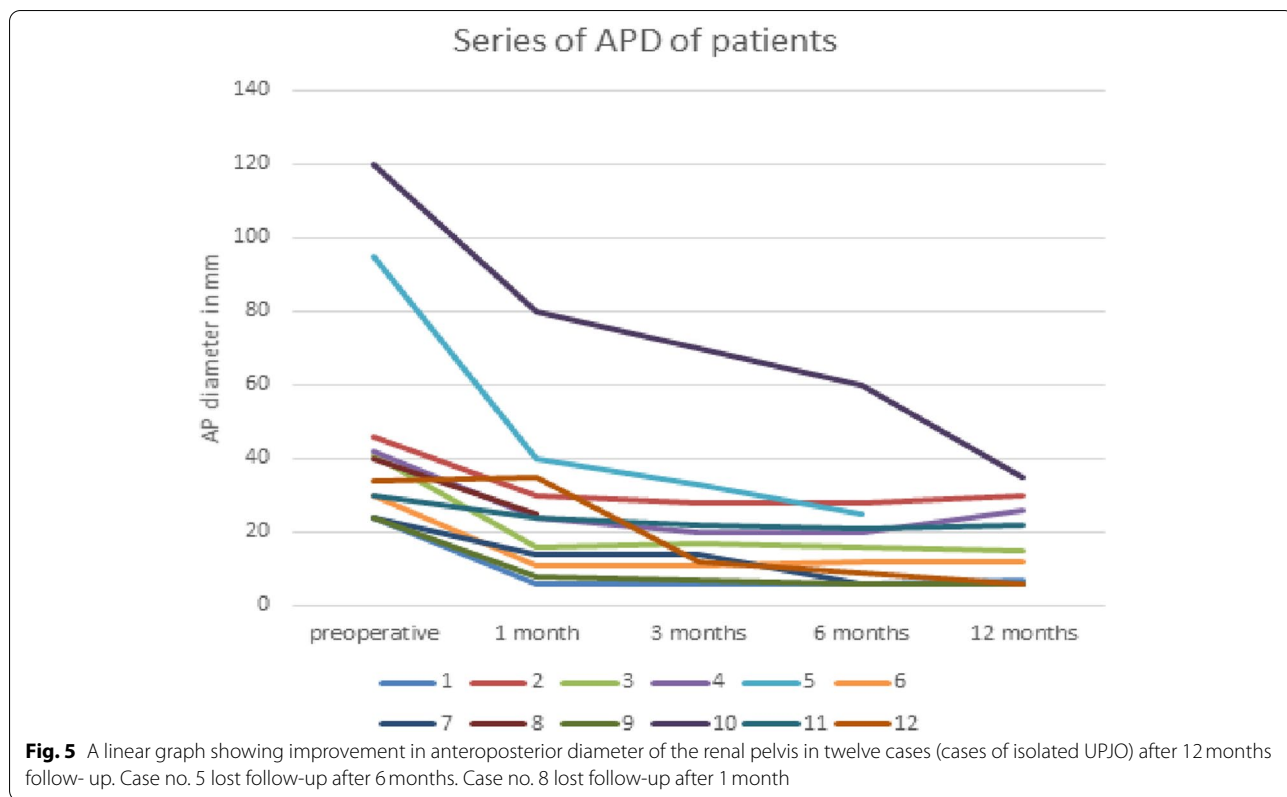
A postoperative follow-up was done for at least 1 year in 11 patients (1 patient discontinued follow-up after 1 month and another case after 6 months), and the PAUS showed a decrease in anteroposterior diameter of the renal pelvis in all cases (Fig. 5).

Postoperative diuretic renal scans were not routinely performed. Three patients of the early cases with a persistent anteroposterior diameter greater than 20 mm



**Fig. 4** Nephrostogram showing free passage of the contrast through UPJ after LP; however, there is arrest of the contrast at uretero-vesical junction indicating the presence of concomitant distal obstructive megaureter

underwent the isotope scan that showed an increase in split kidney function with improvement in the washout in the DTPA renography. These cases (cases no. 2, 4 and 5) had a preoperative AP diameter of 46, 42 and 95 mm



that reduced postoperatively at 6 months follow-up to 30, 26 and 25 mm respectively. Their split renal function improved from 47%, 42.5%, 35% to 58%, 54% and 40% respectively.

The cosmetic results were very satisfactory for the parents. This was more evident in the patient who had bilateral UPJO repair, in which the first site was previously operated with open technique and then approached to the contralateral side by LP (Fig. 6).



## Discussion

There are different techniques for surgical repair of UPJO. Open pyeloplasty (OP), laparoscopic pyeloplasty (LP), and robotic pyeloplasty are the main techniques used nowadays. The prevalence of minimally invasive pyeloplasties has increased in the last decade [6]. Nonetheless, OP remains the most prevalent procedure for children with UPJO, and MIS appears to be available mainly in institutions where surgeons have a high level of skill in laparoscopic surgery, such as large paediatric hospitals and teaching hospitals [12]. Many reported series and meta-analysis studies comparing different techniques for managing UPJO revealed that LP has an aesthetic advantage, less pain, fewer overall complications, and shorter hospital stay than OP. And despite the fact that the LP had a longer operative time, the success rate of LP is comparable to that of OP [7, 13, 14].

Laparoscopic pyeloplasty can be done via a transperitoneal approach or retroperitoneal approach. The retroperitoneal approach is characterized by being extraperitoneal with minimal complications for the GIT but, unfortunately, a small working space with longer operative time [15]. We preferred the transperitoneal approach for wider working space and easier anastomosis.

In this study, we presented our early experience. Our mean operative time was 175 min which is similar to other reported LP studies that ranged from 155 to 275 min [8, 9, 14, 16, 17]. Intraoperatively, there were no major complications like organ injury or haemorrhage. No need for conversion to open pyeloplasty. Most of the operative time was consumed by the intracorporeal suturing. LP needs a high level of experience in laparoscopic surgery with good training on intracorporeal suturing.

At the beginning of our work, we encountered some difficulties while inserting the double J catheter in some cases. Silay et al. found that the most common intraoperative complication in LP was due to complicated double J stent insertion [8]. Many techniques have been used to place the double J stent, either antegrade or retrograde. In the antegrade technique, the main problem is the passage of the stent through the vesicoureteric junction, especially in patients under the age of 1 year. We first used a percutaneous wide bore cannula to introduce the stent and Rodriguez technique using methylene blue to ensure entry into the bladder [18]. It is difficult to determine the exact positioning of the distal end as it is a blind approach. Then, we shifted to retrograde approach using cystoscopy, which has an additional advantage of diagnosing the associated distal obstructive ureterovesical junction. Some studies recommended using transrenal stenting than double J stents [19, 20].

At the beginning of LP in paediatrics, many surgeons found it hazardous in infants [21], but over time, the studies have proven that it is safe and feasible to perform in infants [5, 22]. We had 7 cases under the age of 1 year in our study with no intra or post-operative complications.

The definition of successful surgery is not standardized. Accepted one is that successful surgery will meet the following criteria: resolution of symptoms, no reoperation, decreased hydronephrosis and/or improved renographic drainage [9]. Passoni and Peters found that the success rate of LP is 92–99% [23]. Also, Chandrasekharam and Ramesh found a similar success rate of 97.5% [24]. John Gatti has similar success rate as well (94%) [25]. In our study, only one case needed further intervention for associated distal vesicoureteric obstruction.

The main issue in LP is the learning curve; it takes time to become an expert in LP. We noticed improvement in the operative time with progress in cases in our study. Our study is limited by the small cohort size and the absence of comparison with open pyeloplasty series. Another limitation is a relatively short follow-up period which can potentially affect the assessment of late surgery failure. Long-term follow-up with greater number of patients is justified to demonstrate the safety and efficacy of LP.

## Conclusion

Although this is an early experience in performing a LP, we found that the approach is a safe, feasible, and effective procedure in infants and children with UPJO with good cosmetic outcomes. We encourage other centres dealing with UPJO to consider LP for these children; however, it should be performed by surgeon who has a good experience in intracorporeal laparoscopic suturing.

## Abbreviations

UPJO: Ureteropelvic junction obstruction; LP: Laparoscopic pyeloplasty; UPJ: Ureteropelvic junction (UPJ); OP: Open pyeloplasty.

## Authors' contributions

All authors contributed in the design of the work, collection and analysis of data, drafting and revising of the manuscript, and approving the final version for publishing.

## Funding

None.

## Declarations

### Ethics approval and consent to participate

The study was approved by the ethical committee of Pediatric Surgery Department, Ain Shams University (IRB no.00006379).

### Consent for publication

Not applicable.

**Competing interests**

The authors read and approved the final manuscript.

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