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Evaluation of the clinical value of retroperitoneal laparoscopic pyeloplasty in the treatment of ureteropelvic junction obstruction in infants

A single-center experience involving 22 consecutive patients

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Abstract

Retroperitoneal laparoscopic pyeloplasty (RLP) is 1 method for treating ureteropelvic junction obstruction (UPJO) in children, but reports are more common in children than in infants younger than 2 years old. The purpose of this study was to evaluate the clinical value of RLP for infants with UPJO.

From January 2015 to December 2017, a retrospective analysis of 22 infants aged 2 to 24 (11.95 ± 6.00) months with UPJO who were treated with RLP in our hospital was performed. During the same period, 14 infants who underwent conventional transperitoneal laparoscopic pyeloplasty (TLP) were compared with those who underwent RLP. Postoperative recovery and complications, including bleeding, infection, urinary leakage and anastomotic stenosis, postoperative resumption of oral feeding, postoperative hospitalization time and surgical success rate were evaluated. Drainage and function were assessed with isotope scan at 6 months and later during the yearly follow-up and by intravenous urography (IVU) and mercaptoacetyltriglycine (MAG3) renography.

Both groups underwent successful surgery. The operative time in the RLP group was 88 to 205 (120.59 ± 24.59) min, and there was no significant difference compared with the TLP group ($P = .767$). The estimated intraoperative blood loss was 2 to 10 (3.75 ± 1.59) ml, which was not significantly different between the 2 groups ($P = .386$). In the RLP group, the mean postoperative resumption of oral feeding was faster than that in the TLP group (3.55 ± 0.74 vs 5.50 ± 0.85 hour, $P < .001$), and the postoperative hospitalization time was shorter in the TLP group than in the RLP group (6.59 ± 0.50 vs 7.07 ± 0.47 day, $P = .007 < .05$). Follow-up lasted from 6 months to 3 years, and there was a significant reduction in postoperative hydronephrosis in both groups ($P < .05$, respectively).

RLP is a safe procedure for infants. This procedure is associated with relatively little trauma, a quick recovery and good cosmetic effects. RLP also has the advantages of relatively little interference with the abdominal cavity and sufficient operating space; thus, this technique is worth promoting.

Abbreviations: AHP = Anderson-Hynes pyeloplasty, DTPA = diethylene triamine pentaacetic acid, IVU = Intravenous urography, LEP = laser endopyelotomy, MAG3 = mercaptoacetyltriglycine, MRU = magnetic resonance hydrography, PUVs = posterior urethral valves, RLP = retroperitoneal laparoscopic pyeloplasty, RSCs = renal sinus cysts, TLP= transperitoneal laparoscopic pyeloplasty, UPJO = ureteropelvic junction obstruction, VUJ = vesicoureteric junction obstruction, VUR = vesicoureteric reflux.

Keywords: infants, pyeloplasty, retroperitoneal laparoscopy, UPJO

1. Introduction

Congenital hydronephrosis is the most common antenatally detected urinary tract abnormality and is also a common disease in pediatric urology.[1] With the advent of fetal ultrasonography, pediatricians, and urologists have been confronted by an increasing number of babies and children with asymptomatic dilation of the upper urinary tract.[2] Hydronephrosis is the most common presentation of ureteropelvic junction obstruction (UPJO), which causes a reduction in urine flow from the renal pelvis into the ureter and is the most common cause of congenital hydronephrosis.[3,4] The other main causes of hydronephrosis include vesicoureteric junction obstruction (VUJ), posterior urethral valves (PUVs), and vesicoureteric reflux (VUR).[5] The treatment is dependent upon the cause and the severity of hydronephrosis; however, infants with mild UPJO may not need any surgical intervention but must undergo monitoring on a regular basis. In contrast, children with severe hydronephrosis secondary to UPJO may need surgery to alleviate the pressure of

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the hydronephrotic kidney. There are many methods for treating UPJO, but surgical treatment is the most reliable, with the purpose of removing the obstruction and protecting renal function.[6] Open Anderson-Hynes pyeloplasty (AHP) has been widely accepted as the surgical treatment of choice for UPJO in children, with a success rate of >90% in most reports.[7,8] With the rapid advent of minimally invasive surgical techniques, transperitoneal laparoscopic pyeloplasty (TLP) through a transperitoneal route has been described in both adults and children.[9] Retroperitoneal laparoscopic pyeloplasty (RLP) for UPJO is an advanced method for the treatment of children. However, reports of this technique are more common in children than in infants younger than 2 years old because some authors think that the operating space is too narrow and the operation is too difficult in infants.[10] However, in practice, we have found that as long as there is a certain basis of laparoscopy and skill, RLP can be successfully performed in infants. Compared with TLP, RLP has many advantages, such as decreased interference with the abdominal cavity and quick postoperative recovery. From January 2014 to December 2017, we used this method to treat 22 consecutive infants with UPJO and found that the curative effect was satisfactory, as reported below.

2. Patients and methods

The data range is from January 2014 to December 2017. All of the children were diagnosed with moderate to severe hydronephrosis caused by congenital UPJO by b-ultrasonography, CT, intravenous urography (IVU), and micturating cystourethrography. Other causes of hydronephrosis (bladder and ureteral reflux, ureteral end stenosis, urinary calculi and tumor, etc) were excluded. Twenty-two infants were treated with RLP, while fourteen infants who underwent TLP performed during the same period were selected as the control group. Written informed consent was obtained from all of the infants' parents before surgery. The protocol was approved by the Ethics Committee of Foshan Maternal and Children's Hospital of Southern Medical University. The authors can access the information of a single participant during the collection, and the information cannot be directly identified by the authors after the collection through coding.

2.1. Surgical technique

The patients had an indwelling catheter placed after inducted general anesthesia. They were positioned from the lateral decubitus position, and the surgical site was marked (Fig. 1). A longitudinal incision approximately 1.5 cm in length was made under the junction of the 12th rib and posterior axillary line. To reach the vessels, forceps were used to bluntly separate the waist muscles and lumbodorsal fascia to reach the perirenal fascia. The perirenal space was separated with the little finger and the peritoneum was pushed forward. Then, a homemade air bag was placed, inflated to 80 to 150 ml and removed after 3 to 5 minutes. The positions of the 3 puncture trocars are shown in Figure 1. In brief, 1 puncture was made under the 12th rib along the posterior axillary line, one at the 11th rib at the tip of the axillary front, and another at approximately 1 cm above the intersection of the midaxillary line and the iliac ridge. A carbon dioxide retroperitoneal insufflation at a pressure of 8 mmHg was created via gas passage through 1 trocar. To prevent peritoneal injury, the renal fascia near the dorsal psoas was separated first. The pyeloplasty method used is based on the AHP, which has been

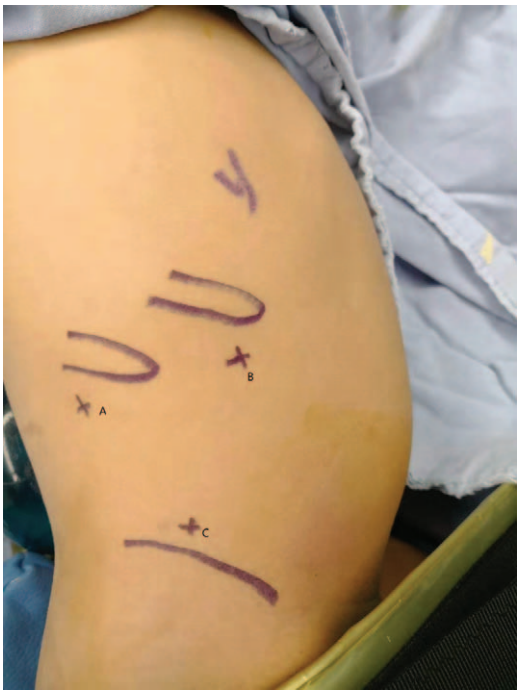

Figure 1. Preoperative skin markers in a 5-month-old boy with severe right hydronephrosis undergoing transperitoneal laparoscopic pyeloplasty: A, B, and C were the trocar puncture points, respectively, the scope was placed through the trocar of point C, and the laparoscopic forceps were placed through the trocar of points A and B, respectively.

performed for over 6 decades and has etched its name in the annals of urology.[11] However, there is no need for excessive dissection around the kidney and ureter or for excessive clipping of the enlarged renal pelvis, which can only be fully exposed to achieve tension-free anastomosis (Fig. 2). A tube drain was placed through the 5-mm port near the iliac crest and removed after 1 to 2 days depending on the drain output. The double-J stent was removed with a cystoscope for children (Olymbus, 5.6 F) 6 to 8 weeks postoperatively.

2.2. Follow-up

Long-term follow-up of all patients was performed in an outpatient clinic. Urinalysis was checked every 2 to 4 weeks in a proportion of the subjects who had an indwelling double-J tube. Urinalysis and renal ultrasound examinations were performed at a clinic at 1, 2, 4, 6, and 12 months after the stent was removed (Fig. 3). Immediate and long-term postoperative complications were recorded using the Clavien-Dindo grading system. After the removal of the double-J stent, patients were followed-up with urinalysis and renal ultrasonography at 1, 2, 4, 6, and 12 months thereafter. IVU and a diethylene triamine pentaacetic acid (DTPA) scan were performed if necessary, such as in cases of increased postoperative hydronephrosis. The patients were then followed up with an ultrasound every 6 months for more than 5 years.

2.3. Statistical analysis

All statistical analyses were performed using SPSS version 19.0 (IBM, New York, NY). Measurement data are expressed as the mean ± standard deviation ($x \pm s$). Parameters of the 2 groups

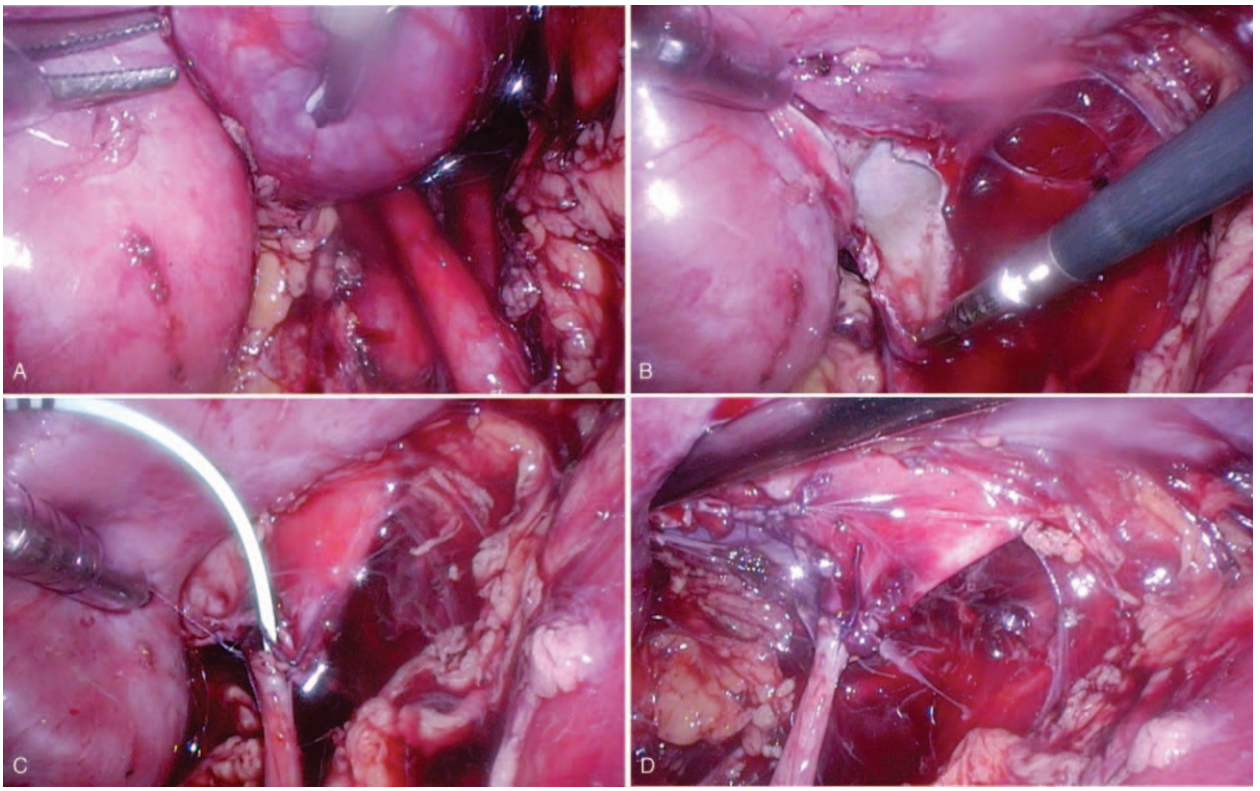

Figure 2. Images of a 6-month-old child undergoing transperitoneal laparoscopic pyeloplasty. A: the show of UPJO; B: incision of the renal pelvis; C: dorsal ureteropelvic anastomosis and double J tube implantation were completed; D: ureteropelvic anastomosis was completed.

were compared using the unpaired t test and X^2 test. A value less than 0.05 was considered statistically significant.

3. Results

The RLP group included 10 males and 12 females, aged from 2 to 24 (11.95 ± 6.00) months. Nine patients had left UPJO, 12 had right UPJO, and 1 had bilateral UPJO, but only the side with severe hydronephrosis was treated. Of the 22 patients, 18 had hydronephrosis during the fetal period, and 2 had been treated with renal puncture and drainage. Preoperative ultrasonography in all patients showed moderate to severe hydronephrosis (7 cases of Grignon grade 4 and 15 of grade 5). IVU, magnetic resonance hydrography (MRU) and cystography confirmed UPJO. One patient had mild VUR. All 22 patients in the RLP group and those in the TLP group underwent successful surgery, none required conversion to open surgery, and none experienced intraoperative complications. The average operative time in the RLP group was

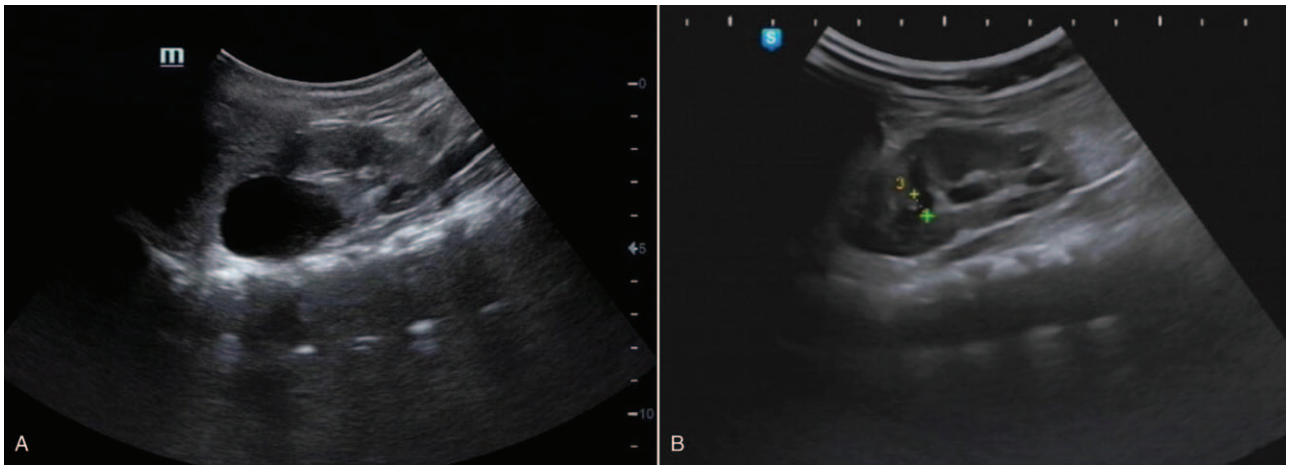

Figure 3. Ultrasound images of a 4-month-old patient with congenital hydronephrosis before (A) and over 6 months after transperitoneal laparoscopic pyeloplasty (B).

Table 1

Comparison of the main indexes of infants in the RLP and TLP groups.

IG	NC	Age (month)	OT (minute)	EBL (ml)	PC (Clavien-Dindo)	IDT (days)	PHT (days)	PDT (hours)	RDT (cm)		
									Preoperative	Postoperative	*P* values
RLP	22	11.95 ± 6.00	120.59 ± 24.59	3.75 ± 1.59	0.55 ± 0.51	1.09 ± 0.29	6.59 ± 0.50	3.55 ± 0.74	3.12 ± 0.72	0.83 ± 0.66	<.001
TLP	14	11.35 ± 5.62	123.21 ± 15.26	4.43 ± 2.17	0.50 ± 0.65	1.21 ± 0.43	7.07 ± 0.47	5.50 ± 0.85	3.32 ± 0.74	0.90 ± 0.62	<.001
P values		.767	.731	.386	.816	.310	.007	<.001	.440	.758	

EBL = estimated intraoperative blood loss, IDT = indwelling drainage tube time, IG = items and groups, NC = number of cases, OT = operative time, PC = postoperative complications, PDT = postoperative recovery diet time, PHT = postoperative hospitalization time, RDT = renal pelvis anteroposterior diameter on ultrasonography, RLP = retroperitoneal laparoscopic pyeloplasty, TLP = transperitoneal laparoscopic pyeloplasty.

121 (120.59 ± 24.59) min, the average drainage tube removal time was 1.1 (1.09 ± 0.29) days, and the average intraoperative blood loss was estimated to be 3.75 (3.75 ± 1.59) ml; all of these findings were not significantly different from those in the TLP group. The postoperative recovery time in the RLP group was 3.6 hours on average, which was faster than the recovery time in the TLP group (3.55 ± 0.74 vs 5.50 ± 0.85 hours, $P < .001$). The mean postoperative hospitalization time was shorter in the RLP group than in the TLP group (6.59 ± 0.50 vs 7.07 ± 0.47 days, $P = .007 < .05$). Six months after surgery, ultrasonography showed that the anteroposterior diameter of the renal pelvis on the affected side was significantly reduced in both groups ($P < .05$). The patients were followed up for 6 to 36 months, and only the Clavien-Dindo grade I complication rate was 36.4% (8/22). Some of the main indexes of the infants in the RLP and TLP groups are shown in Table 1.

4. Discussion

Open surgery or laparoscopic AHP, as conventional operative techniques, seems to be widely used in patients with UPJO.[12] Pediatric laparoscopic pyeloplasty was reported for the first time in 1995 by Peters[13]; this technique is widely used due to its advantages of minimal pain and trauma, a quick recovery, good cosmetic effects and a high success rate, especially with the recent rise of robot-assisted laparoscopic pyeloplasty.[14] There are 2 methods for laparoscopic AHP, namely, transperitoneal, and retroperitoneal approaches.[15] The transabdominal approach provides a larger space for surgery and clearer visualization, but this approach may interfere with the organs intraoperatively, and if the leakage of urine occurs, the consequences are more serious. However, there is no such concern after retroperitoneal surgery. However, in the early days, the visual field during the Anderson-Hynes operation with retroperitoneoscope was considered to be not as clear as that with the abdominal approach: the space was small, the operation was difficult, and this technique was not recommended.[10] Whether the transperitoneal approach is better than the retroperitoneal approach is still debated. A long learning curve is needed, especially for suturing and knotting.[4] In recent years, with the development of endoscopic technology, more experts have recognized the advantages of retroperitoneoscopic pyeloplasty, and more reports have been published; thus, this technique has gradually become one of the advanced methods for treatment.[16] However, the reports that have been published have mostly involved children older than 2 years, and less have been reported involving infants younger than 2 years. Here, we report on 22 infants who underwent retroperitoneal laparoscopic Anderson-Hynes dismembered pyeloplasty. The youngest infant was 2 months. The postoperative recovery time was faster, and food intake was earlier in the RLP group than in the TLP group, indicating that RLP required less interference with the abdominal cavity. There was no significant difference between the 2 groups in terms of the operative time, intraoperative bleeding and postoperative hydronephrosis. Therefore, our research shows that RLP can be performed well in infants and provides sufficient space, such as decreased peritoneal interference and peritoneal absorption of urine, even if urine leakage occurs.

Of course, to complete RLP, some basis of laparoscopy is needed, and there is a learning curve, but there are also some key points for reference. First, when establishing the posterior abdominal space, the incision should not be more than 1.5 cm in length under the 12th rib along the posterior axillary line, and the action of making the incision should be performed gently. Because the effective distance between the adjacent trocar is approximately 2 cm, a 3-mm or 5-mm trocar is recommended. Second, the placement of the ventral trocar under laparoscopic monitoring is recommended to prevent peritoneal injury. For infants, if peritoneal injury and leakage occurs, the subsequent surgery is difficult to complete due to the narrow retroperitoneal space. The intraoperative retroperitoneal insufflation pressure was maintained at approximately 8 mmHg. The retroperitoneal anatomy is easily visualized and clear because of the relatively little fat, loose tissue and bleeding. However, there is no need for excessive dissection around the kidney; only exposure of the pyeloureter and tension-free anastomosis are needed. Likewise, there is no need to remove much out of the enlarged pelvis; for instance, we have records of patients with a large renal pelvis that was not resected enough to recover well; however, the amount of the renal pelvis to resect is a matter of debate. Finally, the pelvis and ureter should be repaired with tension-free anastomosis, avoiding ureteral deformation. Double-J tubes were placed postoperatively. Although there is controversy over whether to leave the stent in place postoperatively, most scholars advocate that placement of an antegrade double-J ureteric stent is an important component of pyeloplasty,[17] but some authors believe that there is no statistically significant difference in the postoperative outcome.[18] There are also authors who believe that the use of an external stent provides a viable alternative while avoiding the need for an additional anesthetic procedure.[19,20] However, our experience is that routine placement of indwelling double-J tubes in infants after surgery is more conducive to reducing postoperative complications and reducing the difficulty of nursing care. Excessive manipulation should be avoided during the placement of the double-J tube, as stimulation of the ureter in infants makes the ureter prone to edema and leads to placement failure.

In terms of surgical safety, anesthesia is a primary consideration in infant surgery, although weight does not appear to be a

limitation.[21] The effect of retroperitoneal insufflation on the diaphragmatic muscles is relatively small compared to that during laparoscopy, but we still recommend that the patient be monitored on the first postoperative day, paying attention to the management of the respiratory tract. Twenty-two patients in the RLP group had no serious complications, no leakage of urine, no intraoperative bleeding, rapid resumption of oral feeding and obvious relief of hydronephrosis postoperatively; thus, this surgery is safe and effective.

Of course, RLP is just 1 minimally invasive method for hydronephrosis, and there are still some less invasive methods that could be considered for future applications. Laser endopyelotomy (LEP) is considered an option for the treatment of pelviureteric junction obstruction.[22] Some authors have reported long-term multicenter experience with retrograde intrarenal holmium-laser incision for the management of symptomatic renal sinus cysts (RSCs) and proved it to be a safe and effective treatment for symptomatic RSCs.[23] The endoscopic use of laser for a pelviureteric junction obstruction is also conceivable.[24]

In conclusion, RLP for infants with UPJO has many advantages, such as a high success rate, low complication rate, relatively little trauma, and quick recovery. RLP with appropriate laparoscopic technology is recommended as a routine treatment for UPJO in infants. Of course, due to the limited number of cases, the details and methods of this surgical technique require further exploration.

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