

Transumbilical laparoendoscopic single-site pyeloplasty in infants and children: initial experience and short-term outcome

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Abstract

Background Scar-free abdominal wall surgery is a research hotspot in recent years. This study presented surgical skills of transumbilical laparoendoscopic single-site pyeloplasty (LESS-P) for pediatric patients with ureteropelvic junction obstruction (UPJO) and its clinical application.

Methods Twenty-four pediatric patients with UPJO had transumbilical LESS-P performed by the same surgeon from June to December 2010. Among them, 16 were males and 8 females aged from 2 to 62 months with average of 14 months. Eighteen patients had obstruction on the left ureteropelvic junction and six on the right. The renal pelvis and ureter were anastomosed using 5-0 absorbable sutures and a double-J ureteric stent was placed through the anastomotic stoma.

Results All operations were successful. None was converted to open surgery and no additional sheath tube or incision besides umbilicus was needed. No intraoperative complications occurred. Ectopic blood vessels were found

in two cases during surgery. The mean operative time was 145 min, and the average blood loss about 10 ml. Abdominal drainage tubes were remained for 2–9 days after surgery. The mean postoperative hospital time was 7 days. Two patients had postoperative urinary fistula, which naturally disappeared at 4 and 7 days of postoperation, respectively. Ultrasound and diuretic renal scintigraphy in follow-up found 23 patients had significantly decreased renal pelvis diameter. Although the other one showed no obvious change, but diuretic renography showed significantly improved excretion as indicated by increased glomerular filtration rate from 29 ml/min before surgery to 46 ml/min 6 months after surgery.

Conclusion Pediatric transumbilical LESS-P is not only safe and effective but also can well meet patient's aesthetic desire for scar-free abdominal wall.

Keywords Ureteropelvic junction obstruction · Laparoendoscopic single-site · Pyeloplasty · Infants and children

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Introduction

With comfortable level increasing in laparoscopic environment, there have been continuing attempts to further decrease access-related morbidity [1]. These include the incorporation of natural orifice transluminal endoscopic surgery (NOTES) and laparoendoscopic single-site surgery (LESS) [2]. Because NOTES has higher technical difficulty and requires more advanced equipments and instruments, it currently cannot meet the clinical requirement, thus was only performed in animals [3, 4]. LESS utilizes the existing laparoscopic equipment to perform intraperitoneal surgery, by which not only decreasing the operational difficulty but

also greatly reducing scars in abdominal wall, thus is currently used as a replacement for NOTES in clinic. In recent 3 years, LESS-P has advanced rapidly in adult urology; its clinical outcome and operative time have approached to or achieved those of standard laparoscopy in destructive surgery. In addition, it is also performed in some highly difficult reconstructive surgery and obtains good outcomes [2, 5]. However, limited by equipments and surgical skills, its operative time is longer compared to that of the standard laparoscopy [6, 7]. Here we report our experiences on LESS-P in 24 pediatric patients with ureteropelvic junction obstruction (UPJO). To our knowledge, this is the youngest patient group.

Materials and methods

All operations were approved by the Hospital Ethics Committee. Written consents were obtained from the patients' parents.

Clinical data

Twenty-four consecutive patients, 16 males and 8 females, aged from 2 to 62 months with average of 14 were enrolled in the study. Eighteen of them had left UPJO and six had right UPJO diagnosed by renal ultrasonography, diuretic renal scans, magnetic resonance urography, or/and intravenous urography (IVU) and retrograde pyelography. Eleven patients had symptoms. Among them, three had mild to moderate flank or abdominal pain, three had urinary tract infection, and five had abdominal masses. The other 13 patients had no symptoms. Among them, nine were found to have hydronephrosis in prenatal examination, and four were diagnosed with renal ultrasonography in health examination. Diuretic renography found three patients younger than 6 months had renal glomerular filtration rate (GFR) ≤ 40 ml/min. All patients had extrarenal pelvis and never accepted renal surgery previously. Before the operation, all patients had hydronephrosis with a dilated extrarenal pelvis (5 were moderate and 19 severe). Patients with urinary tract infection received antibiotic therapy until their urine was sterile. Preoperative preparations were performed according to the standard procedure.

Operation

All patients were treated with LESS-P. The first four surgeries were performed with R-Port (Advanced Surgical Concepts, Dublin, Ireland), while the other 20 cases were performed with Port (Huida Medical Equipment Inc. Ltd., Hangzhou, China) (Fig. 1). A 5-mm rigid 30° video-laparoscope (EndoEye, Olympus Medical, Tokyo, Japan) was

used in the first 19 cases and a high-definition laparoscope (Karl Storz, Tuttlingen, Germany) was used in the other 5 cases.

All operations were performed under general endotracheal anesthesia. Patients were placed in supine position with a 45°–60° inclination. The healthy side of patients was arranged as close as possible to the edge of the operating table. Surgeon stood facing the patients' abdomen. His left hand was used to handle bending devices and his right hand was used to operate Harmonic Scalpel, standard laparoscopic straight scissors and needle holder. A 1.5-cm long incision was made at the center of umbilicus and used to place laparoscopic system at the center.

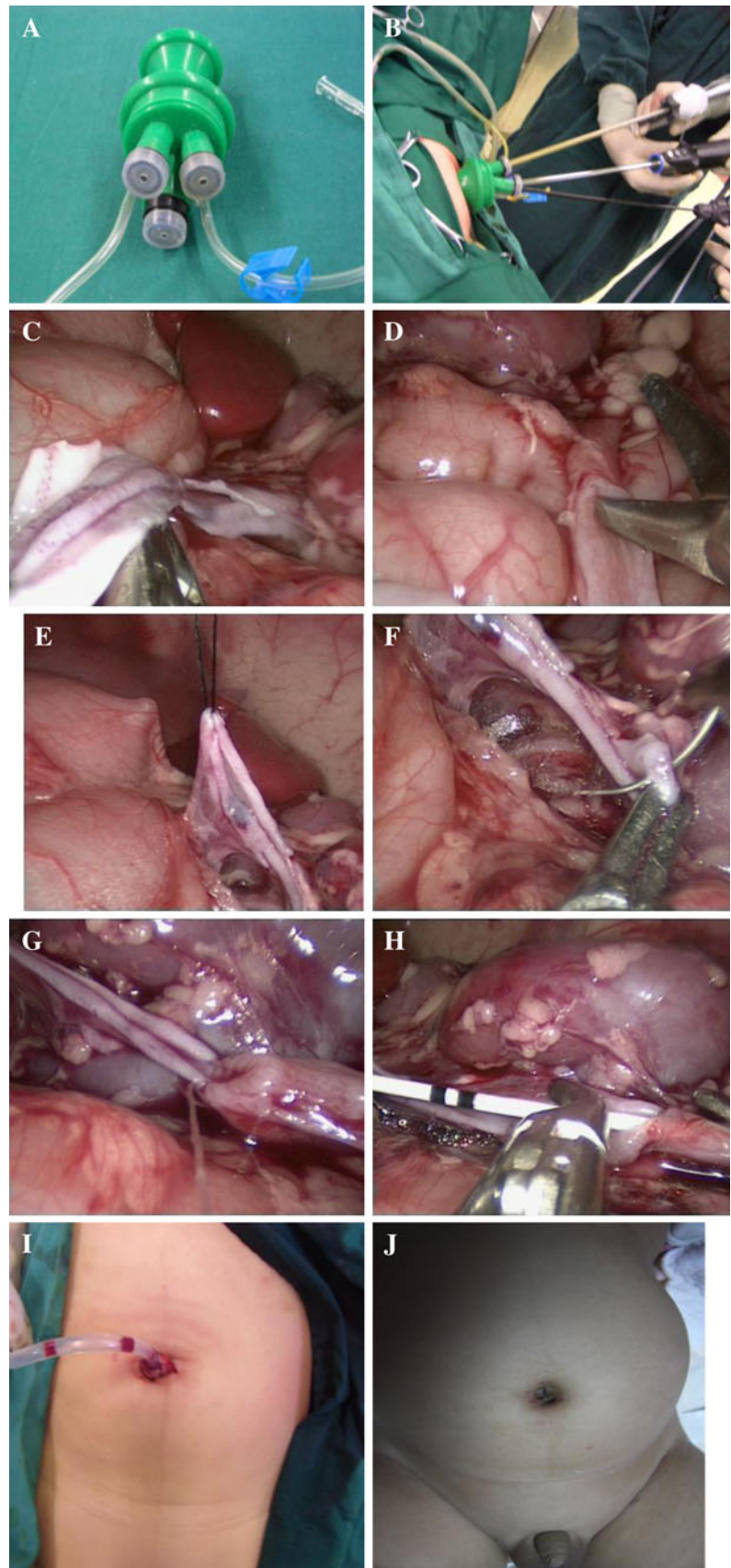
During the operation, the lateral peritoneum of colon was incised using Harmonic Scalpel to free colon inwardly. Gerota's fascia and perirenal fat tissue were dissected along lateral gonadal vessel to fully free the expanded renal pelvis and the upper ureter from inferior pole of kidney. An arc incision was made at the expanded renal pelvis. The narrow ureter segment was removed and a 2-cm incision was then made longitudinally along the lateral ureter. A traction line was passed through the abdominal wall to tract the upper corner of the incised renal pelvis. For the two cases with ectopic vessels, ureteropelvic junction was placed on the anterior wall of the ectopic blood vessels, and ureteropelvic anastomosis was then carried out. The lower corner of pelvic lobe was sutured to the lowest point of ureter incision point-to-point using 5-0 absorbable sutures. After the posterior layer of anastomotic junction was continuously sutured, a trans-anastomotic double-J stent was placed and the anterior layer of the pelvic-ureteric anastomotic junction and extra openings of pelvic lobe were sutured. After washing the wound with physiological saline, lateral peritoneum was closed using 5-0 absorbable sutures. Then a peritoneal drainage tube was placed under direct vision and umbilical incision was closed layer-by-layer.

After surgery, abdominal drainage tube was remained for 2–9 days till 2 days after no liquid drainage was observed. The urinary catheter was retained for another 6–7 days, and double-J stent was removed 3–4 weeks after surgery through cystoscopy.

Results

All 24 surgeries were successful. None was converted to open surgery and no additional sheath tube or incision besides umbilicus was needed. No intestinal, visceral and vascular injuries, hypercapnia and other complications occurred during the operation. One ectopic blood vessel was found in each of two cases during surgery. Intraoperative clamping the ectopic blood vessel found that the color of the

Fig. 1 **a** Single-port laparoscopic channel from Huida Medical Equipment Inc. Ltd., Hangzhou, China, **b** appearance of instrument cooperation during the surgery, **c** the excessive renal pelvis was cut in arc shape and removed, **d** 2 cm of ureter was longitudinally incised through the narrow segment, **e** the upper corner of the incised renal pelvis was towed using a traction line from abdominal wall, **f** the lower corner of pelvic lobe was sutured to the lowest point of ureter incision point-to-point using 5-0 absorbable sutures, **g** the posterior layer of anastomotic junction was continuously sutured, overhanding once every two sutures, **h** a trans-anastomotic double-J stent was placed, **i** the appearance of the incision after surgery, **j** no scar was seen on abdomen wall in follow-up 2 months after the surgery



lower kidney became dark. The ectopic blood vessel was retained and was placed on the opposite of the ureter. The mean operative time was 145 (70–300) min and blood loss was 10 (5–20) ml. Intestinal ventilation recovered 1–2 days postoperation. Patients had no more intestinal obstruction. Abdominal drainage tubes were placed in patients for 2–9 days. The mean postoperative hospital stay was 7 (6–10) days. Postoperative fistula was found in two patients and disappeared naturally 4 and 7 days after surgery, respectively. Double-J stents were removed 3–4 weeks of postoperation under bladder endoscope. Umbilical incisions recovered well showing no wound infection and bleeding. Abdominal surgical scar was not obvious.

All patients were followed up for 3–12 months with average of 6 months. Their abdominal symptoms disappeared, ultrasound at 3 months of postoperation and renal scintigraphy at 6 months of postoperation prompted that 23 patients had significantly decreased renal pelvis diameter, the other one patient showed no obvious decrease in renal pelvis diameter (Fig. 2), but his diuretic renogram showed significantly improved renal excretion as indicated by increased glomerular filtration rate from 29 ml/min before surgery to 46 ml/min 6 months after surgery, and no anastomotic restenosis.

Discussion

Laparoscopic pyeloplasty has been the first option in UPJO treatment [7, 8]. LESS-P has the features of both the standard laparoscopy and NOTES, thus is considered as the transitional technology in the development of NOTES.

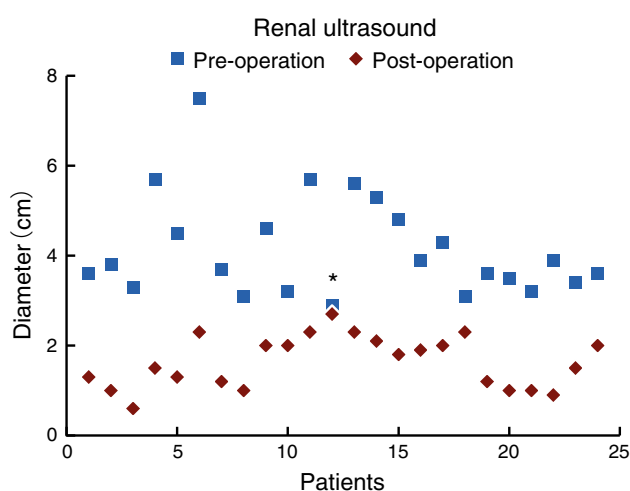


Fig. 2 Renal pelvis anteroposterior diameters of patients before and after operation. *Asterisk* indicates that there was no obvious decrease in renal pelvis anteroposterior diameter (from 2.9 to 2.7 cm) in one patient

Currently, LESS is applied in almost all organ surgeries of urinary and reproductive system including both destructive and functional reconstructive surgeries [2]. White et al. [9] reported eight LESS-P cases. All operations were successful, and had average operative time of 233 min and no obvious complications. Desai et al. [10] reported their LESS-P experiences of 17 cases. The average operative time was 236 min. One case was converted to standard laparoscopic surgery. All surgeries needed an extra 2 mm Trocar and had no complications and 93.5% cure rate. Tugcu et al. [11] reported 11 pediatric LESS-P cases with 100% success rate. In two right lateral surgeries, they designed a line to tract liver. The mean operative time was 182.5 (160–300) min. Our LESS-P in 24 children had 100% successful rate in follow-ups and average operative time of 135 (70–300) min. The success may be related to that the surgeon is very good at standard laparoscopic surgery, which significantly reduces the surgical learning curve.

Intraoperation interference of operating equipments is the biggest problem in LESS-P. Compared to standard laparoscopic surgery, spatial distance between other laparoscopic devices and laparoscope is too small to obtain a good separation and consistent angle. Thus, collision and interference of devices often occur, which make the surgery relatively difficult. If left hand handles front-end bending devices and right hand operates ultrasonic scalpel, conventional laparoscopic scissors and needle holder, the vision field for integrated laparoscopic endoscope can be significantly improved and operational comfortability can be enhanced. LESS-P has higher requirement for inert hand and need both hands function well. Thus, during the in vitro training, we focused on functional training of both hands, hoping to shorten operative time. In addition, suture knotting under laparoscope is the most important and difficult part in pyeloplasty and requires superb intracorporeal stitching techniques. In order to reduce surgical difficulty, we added a line on the abdominal wall to raise the upper corner of the renal pelvis lobe, which greatly facilitated anastomosis and significantly shortened operative time. Moreover, repeated exploration and coordination of a fixed operating team are very important to shorten learning curve.

In our previous retroperitoneal laparoscopic pyeloplasty, we often incompletely dismember ureter when dissecting renal pelvis and the upper ureter to prevent ureter from distortion [12, 13]. However, in LESS-P, because the operational instruments are parallel to laparoscope and operation angle is limited, it is better to first dismember ureter, then pull up ureter, and last longitudinally make 2 cm opening at laterally ureter, thereby making the operation easier and preventing anastomosis from twisting.

The placement timing of Double-J stent is critical. In our previous retroperitoneal laparoscopic pyeloplasty, double-J stent was placed through the anterior anastomotic wall after completing anastomosis of posterior anastomotic wall and renal pelvis lobe. But in LESS, we found it is better to place double-J stent right after completing anastomosis of posterior wall. Because larger opening of renal pelvis lobe could facilitate the placement of double-J stent, thereby not only reducing both operational difficulty and operative time but also avoiding preoperative placement of double-J stent through cystoscope.

Adept endoscopic suturing and knotting skills are keys for success of reconstructive laparoscopy. Compared to standard laparoscopic pyeloplasty, LESS-P has significantly longer suturing time possibly due to its surgical curve and equipment constraints. We found using left hand to curve suture arc upward and place it above lateral tooth of clamper can make knotting easier and greatly shorten operative time.

The data indicate that that visible scarring in children can reduce self-confidence, impair socialization skills, and lower self-rating of problem-solving ability [14]. LESS-P is implemented via a single incision through umbilicus, therefore should not have psychosocial impact as visible abdominal scarring.

In short, not only is pediatric LESS-P safe and effective, but can meet patient's aesthetic desire for scar-free abdominal wall. Although LESS-P has many technical difficulties and challenges even for an experienced laparoscopic clinicians, it can achieve comparable clinic outcomes with the standard laparoscopy after a relatively short learning curve and improve cosmetic effect. Whether it has more benefits on pain and recovery need to be further investigated using animal experiments and clinical studies. We believe that with the development and improvement of single-port channel system and equipments, LESS-P as a minimally invasive surgery may replace the standard laparoscopic pyeloplasty and become a new option for UPJO treatment.

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