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ORIGINAL RESEARCH

Modified retroperitoneal laparoscopic dismembered pyeloplasty for children

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Abstract

Aim We describe our modified retroperitoneal laparoscopic pyeloplasty (MRLP) and assess the incidence of anastomotic stricture and torsion of the ureter in the mid-term.

Methods We reviewed 12 patients with ureteropelvic junction obstruction (UPJO) we treated with MRLP between 2013 and 2018. MRLP involves: identifying the lowest point of the renal pelvis and the lateral aspect of the ureter to ensure correct orientation of the anastomosis; placing the first suture between the lower edge of the incised pelvis and the distal end of the spatulated ureter to avoid crushing tissue that will be anastomosed; and complete excision of the narrow segment.

Results All MRLP were completed successfully without conversion. UPJO was resolved completely, both clinically and radiologically, in all cases. Mean age at surgery was 6.8 years (range: 1.7–8.8 years); mean operative time was 212.1 min (range: 170–333 min); mean estimated blood loss was 4.2 mL (range: 2–8 mL); mean follow-up was 36.7 months (range: 6–65 months); mean post-operative differential renal function on the affected side was 53.1 ± 13.7% (range: 37.0–87.2%), increased from 44.9 ± 16.0% (range: 27.0–84.3%), pre-operatively ($p = 0.02$). All remain completely cured after mean follow-up of 36.7 ± 19.7 months (range: 6–65).

Conclusions Our MRLP is safe and effective despite limited retroperitoneal space.

Keywords Ureteropelvic junction obstruction · Pyeloplasty · Retroperitoneal laparoscopy · Children

Introduction

Ureteropelvic junction obstruction (UPJO) is the most common congenital cause of upper urinary tract obstruction, and it causes progressive dilatation of the renal collecting system. Dismembered pyeloplasty has been the gold standard for treating UPJO with an overall success rate greater than 90% [1–3]. As with most procedures, advancements in laparoscopic instruments and refinement of laparoscopic techniques have enabled more complex procedures to be performed using minimally invasive techniques and laparoscopic dismembered pyeloplasty through a transperitoneal or retroperitoneal approach that is being performed more frequently by pediatric surgeons [4]. In fact, laparoscopic pyeloplasty (LP) is quickly becoming the method of choice for the surgical correction of UPJO in the past two decades because its success rate is equivalent to that of the open procedure and has advantages of minimal morbidity and significant reduction in cost. However, the procedure demands extremely advanced laparoscopic surgical skills, especially during suturing and knot tying. In addition, a ureter and renal pelvis are often crushed by instruments during suturing, so suturing is time consuming. LP requires mastery of many skills and its success is unfortunately limited by a steep learning curve.

To overcome technical issues that complicate LP, we trialed a series of modifications and developed a modified retroperitoneal laparoscopic pyeloplasty (MRLP). Herein, we present our experience of using MRLP to treat UPJO, evaluated its safety, and summarize peri-operative and short-term outcomes.

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Materials and methods

Twelve patients with unilateral UPJO (2 right-sided; 10 left-sided) and intermittent flank pain ($n=3$) and decreasing unilateral renal function ($n=9$) were the subjects of this study. Mean age at surgery was 6.8 years (range: 1.7–8.8 years). Eight patients were male and 4 were female. Pre-operative differential renal function, operative time, post-operative complications, and renal function were compared.

Successful treatment was defined as relief from symptoms with either stable or improved renal function or improved washout shown on diuretic renogram or excretory urography; i.e., better post-operative renal function than pre-operative.

Surgical technique

After induction of general endotracheal anesthesia, the patient is placed in the lateral decubitus position with the affected side up. To maximize exposure between the 12th rib and the iliac crest, the torso is overextended and the ipsilateral leg is straightened. A Foley catheter is inserted to decompress the bladder. The surgeon, assistant, and nurse stand on the side of the patient's back and the monitor is placed on the opposite side of the operating table.

All retroperitoneal procedures are performed in the lateral decubitus position. The retroperitoneal space is accessed using a closed technique to avoid air leakage and subcutaneous emphysema, according to a technique described previously elsewhere [5]. Briefly, the initial access point is the costovertebral angle at the lateral border of the sacrospinalis muscle. A 5 mm bladeless optical trocar (Xcel™, Ethicon Endo-Surgery, Cincinnati, OH) allows the operator to have complete visual control of orientation and can be advanced directly into the retroperitoneal space under direct vision. After passing through the lumbodorsal fascia, the presence of fat is a characteristic of the retroperitoneal space. Insufflation with CO_2 at 8–12 mmHg is commenced. The tip of a scope is used to further dissect the retroperitoneal space, taking great care to prevent injury to the retroperitoneum. Two additional trocars are placed under direct vision. The retroperitoneal space is created just over the fascia of psoas parallel to the ureter. After dissecting the dilated renal pelvis and the proximal ureter, the site and length of obstruction are identified. Dissection to determine the cause of UPJO is also performed, thus, identifying the lower and middle poles of the kidney on the affected side. Adequate dissection of the renal pelvis facilitates later reconstruction. The ureteropelvic junction (UPJ) is examined for aberrant vasculature. Orientation is confirmed by ascertaining that the lateral aspect of the upper ureter is medial to the vascular pedicle of the distal ureter. We retract the proximal ureter toward the surgeon's side using a 5/0 stay suture, which improves exposure of the lateral wall of the ureter.

The initial step of MRLP involves incising the pelvis and ureter. The incision begins at the lateral side of the pelvis, which is close to the surgeon in the retroperitoneal space, and is extended to the stenotic segment (Fig. 1). The incision is extended further from the anterolateral side of the ureteropelvic junction to 2 cm distal to the ureter. The renal pelvis is retracted maintaining the relationship between the inferior–posterior part of the pelvis and the superior–posterior

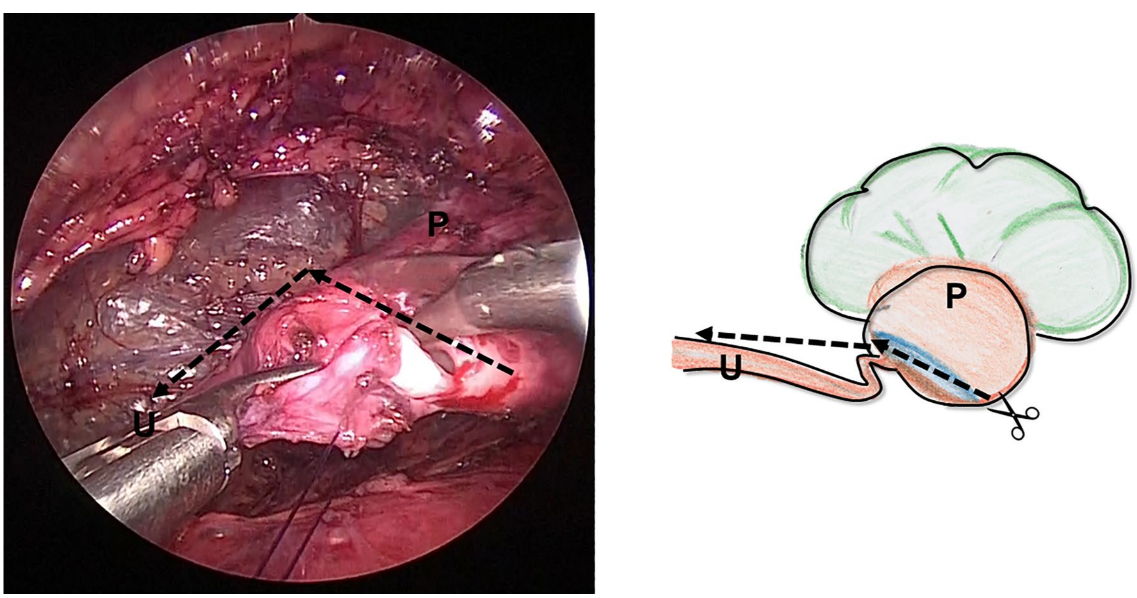

Fig. 1 The incision (dots line) begins at the lateral side of the pelvis (P), which is close to the surgeon in the retroperitoneal space, and is extended to the stenotic segment. *U* ureter

part of the ureter (Fig. 2). By partially opening the pelvis and ureter, the stenotic segment at the ureteropelvic junction is better visualized. Before the ureter and pelvis are dismembered, the lower edge of the incised pelvis is sutured to the distal end of the spatulated lateral part of the ureter (Fig. 3). After the second and third sutures are placed 2 mm away from the first suture, the dilated posterior part of the renal pelvis and the stenotic segment are excised. The posterior pelvic–ureteric anastomosis is completed with interrupted 5/0 absorbable sutures. The redundant part of the ureter and pelvis is retracted by the 5 mm instrument used in the surgeon's left hand to avoid tissue injury during suturing. Once the posterior wall anastomosis is completed, a double J stent (4.7 Fr) is placed in an anterograde fashion transcutaneously

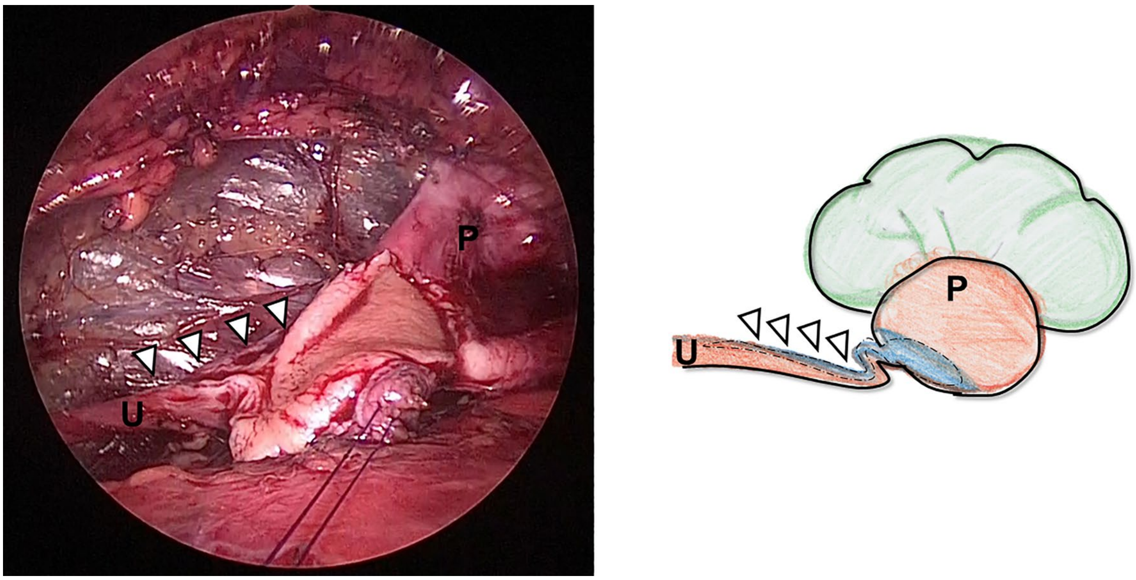

Fig. 2 The incision (arrow heads) is extended further from the anterolateral side of the ureteropelvic junction to 2 cm distal to the ureter (U). The renal pelvis (P) is retracted maintaining the relationship between the inferior–posterior part of the pelvis and the superior–posterior part of the ureter

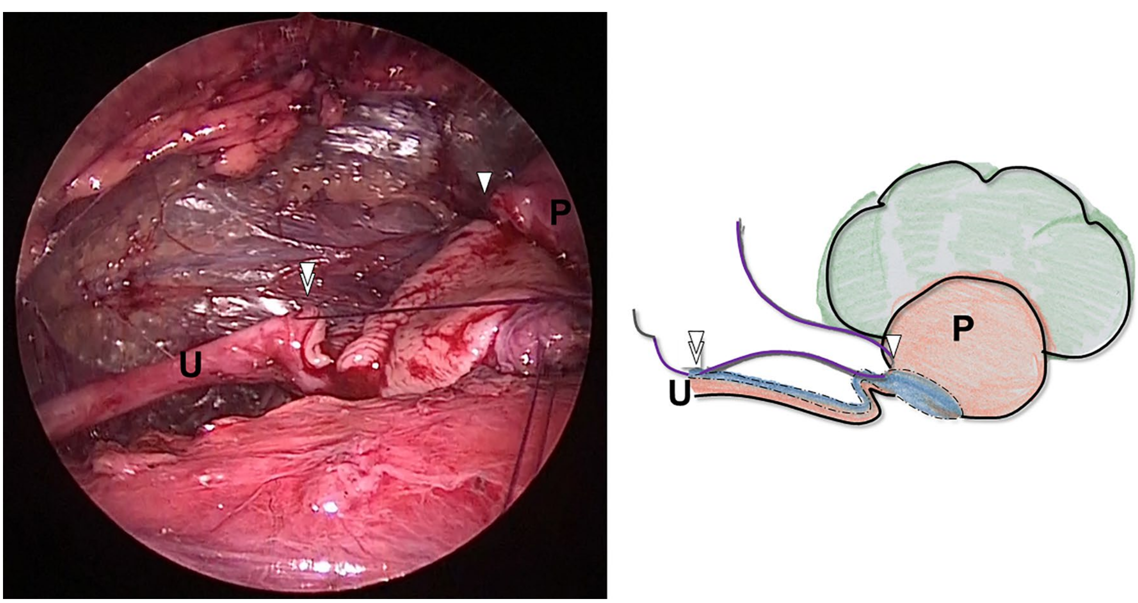

Fig. 3 By partially opening the pelvis (P) and the ureter (U), the stenotic segment at the ureteropelvic junction is better visualized. Before the ureter and pelvis are dismembered, the lower edge of the incised pelvis (arrow head) is sutured to the distal end of the spatulated lateral part of the ureter (arrows head)

by using a guide wire; ureter end first, then the renal pelvis end. The anterior wall is closed using the same suturing technique. The redundant renal pelvis and the stenotic segment of the UPJ are then removed, and the pelvis is closed with interrupted sutures. Hemostasis is confirmed especially after the pneumoretroperitoneum insufflation pressure is lowered. A closed suction drain is placed in the incision for detection and consequence of prolonged drainage in case with leakage at the anastomosis. The Foley catheter is removed 2 or 3 days post-operatively. The retroperitoneal drain is subsequently removed once output decreases to less than 10 mL per day. The stent is removed in 4–6 weeks.

Results

All cases were treated successfully using MRLP. There were no aberrant arteries in any case and no intra-operative complications. Urine leakage from anastomosis between ureter and pelvis occurred in one case post-operatively and was successfully treated by conservative management. Mean operative time was 212.1 min (range: 170–333 min). Mean estimated blood loss was 4.2 mL (range: 2–8 mL), and mean post-operative hospital stay was 5.7 days (range: 3–13 days). Mean follow-up was 36.7 ± 19.7 months (range: 6–65 months).

All cases had improvement in symptoms, and post-operative nuclear scans showed non-obstructive drainage. Mean pre- and post-operative split renal function on diuretic renography was 44.9 ± 16.0% (range: 27.0–84.3%) and 53.1 ± 13.7% (range: 37.0%–87.2%), respectively ($p = 0.02$). Additionally, there was significant improvement in T1/2 time post-operatively compared with pre-operatively ($p = 0.01$).

Discussion

Laparoscopic pyeloplasty is the choice of treatment for UPJO with a high success rate that is equal to or better than open pyeloplasty [6]. Despite excellent results, laparoscopic dismembered pyeloplasty is hampered by technical difficulties and a steep learning curve [7]. The modifications we developed to overcome technical difficulties encountered during certain steps have some advantages compared with the conventional dismembered technique.

One modification has the advantage of improving exposure of the stenotic segment by partial opening of the pelvis and ureter and placing the stay sutures initially, before complete excision of the stenotic segment and dilated pelvis, thus obviating the need for a fourth trocar. These sutures also become the basic sutures for the anastomosis and are easier to place early. If the anastomosis can be facilitated, MRLP becomes a less demanding laparoscopic surgical procedure. Thus, our MRLP would be far easier compared with conventional laparoscopic surgery.

A second advantage is accurate identification of the lateral aspect of the ureter to minimize anastomosis torsion by observing the blood supply to the ureter to determine the site of spatulation and preserve the vascular pedicle to the ureter. Many techniques have been used to prevent torsion of the anastomosis. In the classic technique of dismembered pyeloplasty [8], a tagging suture was placed on the lateral aspect of the ureter to maintain the orientation of the ureter. Others maintain a strip of pelvis to the ureter to prevent anastomotic torsion [9, 10]. In our technique, the UPJ was completely detached before spatulating the ureter. We placed first sutures between spatulated ureter edge and renal pelvis before cutting the ureter, and these prevented unrecognized rotation of the ureter. It was easy to spatulate the lateral wall of the ureter and greatly reduce the difficulty of intracorporal suturing and knotting.

The third and final advantage of our technique that differs from traditional dismembered pyeloplasty was the suturing technique. Our MRLP was only useful in primary intrinsic stenosis. It is critical to ensure minimize crushing damage to the sutured pelvic and ureter edges, and it has been universally acknowledged that intracorporal suturing is more difficult in children than in adults. In our method, we are using retraction of the reductant part of the ureter and pelvis for assistant suturing, which greatly facilitated, precise and delicate anastomosis and greatly decreased the risk of clamping the anastomotic tissue during the ureteropelvic anastomosis. Although we focused on retroperitoneal laparoscopic pyeloplasty in this series, our maneuver would also be valuable during trans-peritoneal laparoscopic pyeloplasty as well because it enhances visualization, and gives the operating surgeon an opportunity to improve and secure the anastomosis during the ureteropelvic anastomosis. Recently, robot-assisted surgery has gained increasing acceptance in the pediatric field [11, 12]. Although the robot potentially overcame the challenges of intracorporal surgery [12, 13], it relied largely on visual cues in the absence of haptic feedback. Our technique can be used by surgeons with less experience in laparoscopic surgery and robotic laparoscopic surgery without worrying about clamping damages to the pelvic–ureteric tissue.

In the previous studies, the overall complication rate for the laparoscopic dismembered pyeloplasty was between 6 and 23% [14–18], with most complications being related to hematoma formation or urine leakage. Our overall complication rate in this study was 10.0% (1/10) which was relatively low. Only one patient presented minor post-operative complications which were resolved by conservative treatment. This would result from extensive tension of the suture. After the follow-up period of at least 12 months, our success rate was 100% which was similar to the previous experiences.

These results indicate that our innovative techniques are very valuable in ensuring high-quality pelvis–ureter anastomosis, although the number of cases and follow-up are limited. No comparison was carried out in this study between standard Anderson–Hynes technique and our modified technique. A full evaluation of our innovation necessitates more studies to compare the operative time, suturing time, complication rate, success rate, and other peri-operative data between the two procedures. The conversion rate in the literature reported following anastomosis ranges between 0.5 and 5.5% [16].

In conclusion, our modification to the standard retroperitoneoscopic dismembered pyeloplasty is technically ease and safe. Thus, it might be a useful alternative to greatly decrease the difficulty of this procedure.

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