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Laparoscopic dismembered pyeloplasty for ureteropelvic junction obstruction in children

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Objectives: To present our initial experience with laparoscopic pyeloplasty and to evaluate the safety and short-term outcome of this technique in children.

Methods: Thirteen kidney units in twelve children underwent laparoscopic dismembered pyeloplasty for the management of ureteropelvic junction obstruction (UPJO) at our institution between 2005 and 2008. Patient age at surgery was 18–177 months (mean 89.8 months). There were six boys and six girls. Ten had unilateral UPJO with a normal contralateral kidney, one had bilateral UPJO and one had UPJO of a solitary kidney. We used 3- and 5-mm instruments for grasping, blunt dissection, incising and suturing to facilitate safe and precise surgery. The outcome was measured by the operative time and resolution of obstruction and symptoms.

Results: Median operative time was 275 min (range 154–420). There was a slight relationship between age and operative time. No major perioperative complications occurred in any cases. Median renal pelvic anterior–posterior diameter at ultrasonography significantly decreased from 8.6 cm (range 3.8–22.0) preoperatively to 3.9 cm (1.0–8.9) postoperatively (P < 0.05). The median pre- and postoperative split renal function on diuretic renography in unilateral cases was 37.3% (range 29.7–46.4) and 39.5% (27.8–48.0), respectively. Overall, successful resolution of UPJO was observed in 12 of 13 kidneys (92.3%).

Conclusions: Laparoscopic pyeloplasty represents a safe and effective option in the surgical treatment of children with UPJO.

Key words: children, laparoscopy, pyeloplasty, ureteropelvic junction obstruction.

Introduction

Ureteropelvic junction obstruction (UPJO), which is defined as the restricted flow of urine from the renal pelvis to the ureter, remains the most common obstructive uropathy in children. Although various surgical procedures have been described for repairing UPJO, open pyeloplasty is still the gold standard with a success rate exceeding 90%. Recently, laparoscopic pyeloplasty has gradually gained acceptance as a feasible and reliable treatment associated with minimal morbidity in the pediatric population of Western countries since its first report for children in 1995. A recent report obtained from the pediatric health information system in the USA showed that 6.2% of procedures were performed laparoscopically from 2002 to 2007.

The low risk of complications demonstrated in the large series confirms that pediatric laparoscopic procedures are safe, although there possibly remains a risk of significant injury. Although various laparoscopic techniques through transperitoneal and retroperitoneal approaches have been reported, laparoscopic pyeloplasty for children has not been accepted yet in Japan and there are very few reports.

In this study, we present our initial experience of laparoscopic pyeloplasty for children at our institution and evaluate the safety and short-term outcome of this technique.

Methods

Thirteen kidneys of 12 children underwent laparoscopic dismembered pyeloplasty for the management of UPJO at our institution between 2005 and 2008. Patient age at surgery was 18–177 months (mean 89.8 months), and there were 6 boys and 6 girls. Ten had unilateral UPJO with a normal contralateral kidney, one had bilateral UPJO and one had UPJO of a solitary kidney; 11 were on the left and two on the right. Nine children had symptomatic UPJO. All children underwent preoperative radiological imaging, including ultrasonography and diuretic renography, for the diagnosis of UPJO. The indications of surgery included an increasing degree of hydronephrosis, a low split renal function (<40%) and/or an obstructive pattern on diuretic renography and/or symptoms such as pain, urinary tract infection or constipation. Three patients had undergone percutaneous nephrostomy before surgery because of acute renal failure, abdominal pain and large hydronephrosis.

Laparoscopic dismembered pyeloplasty was carried out in the lateral position under general anesthesia. Cystoscopy and retrograde pyelography were performed at the beginning of the procedure to identify the UPJO and other anomalies of the urinary tract system. A small skin incision was made at a level just cephalad to the umbilicus, and the peritoneum was dissected under direct vision. A 5-mm trocar was inserted into the peritoneal cavity and pneumoperitoneum was conducted at 8 to 10 mmHg to observe the inside of the abdominal cavity clearly using a 5-mm, 30-degree scope. Two additional trocars (3 mm and 5 mm) were inserted (Fig. 1). Occasionally, an extra 3-mm trocar was placed for retraction purposes. We used 3- and 5-mm curved dissectors for grasping and blunt dissection, 3-mm curve scissors for incising and a 3-mm needle driver for suturing and tissue anastomosis to facilitate safe and precise surgery.

The peritoneum overlying the kidney was incised to expose the UPJO with medial mobilization of the colon. A percutaneous hitch stitch was placed in the pelvis to facilitate exposure. The stenotic segment was excised and the ureter spatulated (Fig. 2). The lower corner of the ureter was sutured to the lower edge of the pelvis with an everting 5-0 Vicryl suture. A 4.7 Fr double-J catheter was inserted in an antegrade fashion over a guidewire. Ureteropelvic anastomosis was
basically performed with interrupted 5-0 Vicryl sutures. The renal pelvis was then closed with a running 5-0 Vicryl suture. Modest reduction of the renal pelvis is routinely performed. An intra-abdominal Penrose drain was left in all patients through a port site.

The double-J catheter was removed after six to eight weeks under general anesthesia. Postoperative ultrasonography was performed monthly, and a diuretic renogram was performed at 6 and 12 months, and annually thereafter. The criteria for short-term success were a marked reduction of hydronephrosis on ultrasonography, preservation of split renal function and improvement in the drainage curve on diuretic renography, and symptom resolution at 6 months.

The correlation between patient age and the operation time was evaluated with Pearson correlation tests using StatView 4.5 software (Abacus Concept, Inc., Cary, NC, USA). The significance of differences in the renal pelvic anterior–posterior diameter on ultrasonography and split renal function on diuretic renography between pre- and post-operation was determined by the unpaired t-test using the same software. Significance was defined as $P < 0.05$.

**Results**

All operations were completed by laparoscopic dismembered pyeloplasty following the principles of the open Anderson-Hynes procedure. One child with bilateral UPJO underwent right laparoscopic pyeloplasty 6 months after left laparoscopic pyeloplasty.

Median operative time was 275 min (range 154–420). There was a slight relationship between age and operative time (Fig. 3a; $r = 0.43$). The time required for exposure of UPJ was recorded at a median of 78.7 min (range 40–140), which had a slight relationship with age (Fig. 3b; $r = 0.40$). The time required for ureteropelvic anastomosis was recorded at a median of 156.9 min (range 84–260), including the time needed for placement of the Double-J catheter (Fig. 3c; $r = 0.26$). One girl had a huge pelvis of 3 L capacity, requiring an extensive reduction, which would have extended the operative time. There was no difference in the operating time between right- and left-sided procedures. No aberrant crossing vessel was observed in any cases. No patient required open conversion. In principle, a liquid diet was started 6 h after opera-
and was rapidly increased if tolerated by the patients. Feeding began after a mean of 1.5 (0–3) days. The urethral catheter was removed after a mean of 3.6 (3–7) days. Children passed stools after a mean of 2.1 (1–5) days. No major perioperative complications occurred in any cases. One patient had postoperative urine leakage and subileus, which resolved spontaneously after a short period. No patients required perioperative percutaneous nephrostomy. Postoperative pain management was optimal using only nonsteroidal anti-inflammatory drugs for a few days.

No patient required treatment for urinary tract infection with oral antibiotics while the Double-J catheter was indwelling.

Median follow-up months were 16.4 months (range 6–40). Median renal pelvic anterior–posterior diameter on ultrasonography was statistically significantly decreased from 8.6 cm (range 3.8–22.0) preoperatively by 3.9 cm (1.0–10.2) postoperatively (Fig. 4a; \( P < 0.05 \)). The median pre- and postoperative split renal function on diuretic renography in unilateral cases was 37.3% (range 29.7–46.4) and 39.5% (27.8–48.0), respectively (Fig. 4b). One patient underwent repeat laparoscopic pyeloplasty after 11 months due to persistent hydronephrosis and decreasing split renal function. The child improved after the second operation. Ultimately, successful resolution of UPJO was observed in 12 of 13 kidneys (92.3%). The wound was smaller than 5 mm in all and the cosmetic appearance of wounds after the operation was good in all cases (Fig. 5).

**Discussion**

In this study, we demonstrated the short-term outcome of pediatric laparoscopic pyeloplasty at our institution. The success rate was 92.3%, similar to that of open and laparoscopic pyeloplasty reported previously. No open conversion or perioperative major complication was observed. We documented its efficacy and safety in children in our series, and whether it could become the minimal invasive treatment of choice.

There are several advantages of laparoscopic pyeloplasty in children as well as adults. First, laparoscopic pyeloplasty has an advantage with regard to pain and cosmetic value. Even a 3–5-cm posterior lumbodorsal incision for open pyeloplasty necessitates several weeks before a return to normal activity and a flank incision requires even more time, because significant tissue retraction is needed to expose the field and the muscle incision and damage is often more than that anticipated. On the other hand, laparoscopic surgery needs only a 3–10-mm skin incision and less muscle damage corresponds to the skin incision and can be performed safely with good exposure. Additionally, we used 3- and 5-mm curve dissectors for grasping and blunt dissection, 3-mm curve scissors for incising and a 3-mm needle driver for suturing and tissue anastomosis to facilitate safe and precise surgery.

The second main advantage is that all medical staff, including the surgeon, assistant, anesthesiologist, nurses, residents and medical students, share the same real-time operative view through the monitor. This enables us not only to avoid complications and technical insecurity, but also better educates residents and medical students. At our institute, both pediatric urological specialists and laparoscopic specialists certified by each association in Japan are involved in laparoscopic pyeloplasty for children, especially this year, to avoid perioperative complications.

On the other hand, several disadvantages of laparoscopic pyeloplasty have been pointed out in previous reports. The disadvantage of laparoscopic pyeloplasty is that operative times are significantly higher than open pyeloplasty. In particular, laparoscopic suturing for children is challenging and time-consuming and requires a learning curve; however, it significantly improved, even with pediatric laparoscopic pyeloplasty, with increased experience in previous reports.

Open pyeloplasty is performed through the retroperitoneal approach, which has the advantage of less risk of intraperitoneal organ injury, postoperative ileus, and avoidance of potential deleterious effects of peritoneal exposure to blood and urine. Although adhesions may occur.
with pediatric urological laparoscopic procedures, the incidence appears lower than would be expected with open exploration. Recently, several reports have demonstrated the usefulness of retroperitoneoscopic pyeloplasty for not only adults but also children. Although there are some reports on retroperitoneoscopic pyeloplasty, we used a transperitoneal approach because we find that the working space is not limiting and we are more comfortable with this approach. Canon et al. reported in their comparison study between retroperitoneoscopic and laparoscopic pyeloplasty in children that no major difference exists between the two approaches for correcting UPJO, although the average operative time for the retroperitoneoscopic approach was significantly longer than that for the laparoscopic approach because of the larger working space for suturing, the perceived ease of antegrade stent placement and the subjective improvement in cosmetic outcome. Metzelder et al. concluded that no disadvantage was attributable to the transabdominal approach in children. There have been no large-scale randomized and prospective studies comparing the approaches. Retroperitoneoscopic pyeloplasty remains a technically challenging procedure in children and further studies will be needed.

Laparoscopic dismembered pyeloplasty is an acceptable option for UPJO in infants and younger children. A recent report has demonstrated that laparoscopic dismembered pyeloplasty is technically possible in infants younger than 6 months. Our study included two children under 3 years old. Interestingly, a slight relationship between age and operative time was observed, despite the small series study. In addition, the time required for UPJ exposure had a slight relationship with age. In our impression, as younger children generally have little surrounding fatty tissue, it may be easier to expose the UPJ.

**Conclusion**

In conclusion, laparoscopic pyeloplasty is a safe and effective option in the surgical treatment of children with UPJO. Recently, several reports have shown that robot-assisted pyeloplasty was another safe and effective modality for treating children with UPJO, having improved the surgical manipulation of laparoscopic surgery and provided short-term results similar to those of conventional laparoscopic pyeloplasty in Western countries. Because of the limitations of public medical insurance and cost performance, it is not yet acceptable in Japan. Pediatric laparoscopic pyeloplasty for children will gradually become a more acceptable procedure with the development and improvement of instruments and a better training system in Japan, as in Western countries.

**References**