

A Review of Pediatric Laparoscopic Pyeloplasty

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Accepted for Publication on December 16, 2008

INTRODUCTION

Open pyeloplasty has been the standard treatment for congenital or acquired ureteropelvic junction (UPJ) obstruction in adults and children, with overall success rates of 90% to 100% [1-3]. Open pyeloplasty has a high success rate done through either a flank, dorsal lumbotomy, or anterior muscle splitting incision. Proponents of open pyeloplasty have shown that this procedure can be done without placement of an indwelling ureteral stent and along with simple percutaneous drainage by either a nephrostomy tube or a single Penrose drain [1,2].

Although endopyelotomy [4] and retrograde dilation [5] are alternative approaches in children [6], the success of these 2 procedures is inferior to that reported for conventional dismembered pyeloplasty [7]. In the initial reports, the operative time ranged from 3 to 7 hours, but the procedure has gradually gained in popularity and acceptance, with a reported success rate of over 95% [8-10].

DIAGNOSIS

Approximately 1% of prenatal ultrasounds detect hydronephrosis in the fetus. In 50% of these cases, UPJ obstruction is the etiology, being more common in males, affecting the left kidney more often than the right, and with 10–30% of cases occurring in both kidneys (bilaterally) [11]. Neonates suspected to have this condition are evaluated for the obstruction using renal ultrasound and diuretic renography. Magnetic resonance urography has become part of the armamentarium as well. Debate continues as to whether or not a voiding cystourethrogram (VCUG) might be utilized to rule out vesicoureteral reflux as a cause of the hydronephrosis or as a concomitant finding. Symptoms of UPJ obstruction are typically seen in older children but can be seen in infants and include any combination of back or flank pain, hematuria, failure to thrive, flank mass, or pyelonephritis.

INDICATIONS

The indications for laparoscopic pyeloplasty are similar to those for an open pyeloplasty, such as increasing hydronephrosis, progressive deterioration of renal function, recurrent urinary tract infection (UTI), and persistent pain. Refinement of instrumentation and experience with intracorporeal suturing allows reconstructive laparoscopy to be implemented in the pediatric population (Figure 1 and Figure 2), and multiple techniques have already been described in the literature [12]. One of the earliest descriptions of the transperitoneal Anderson-Hynes laparoscopic pyeloplasty in pediatric patients by Tan *et al.* [13] recommended that it should not be performed in children less than 6 months of age. The advent of improved 3 mm instrumentation and laparoscopic telescopes has allowed better suture manipulation and visualization making it feasible even in infants less than 6 months old [14]. The key point to performing a laparoscopic pyeloplasty in the infant is based on the geometry of the patient's body in relation to trocar placement. A triangle is formed with the umbilicus as the apex and the remaining points being lateral to the ipsilateral rectus muscle subcostally and at the level of the anterior superior iliac spine.

Yeung *et al.* [15] reported their initial experience with retroperitoneal laparoscopic pyeloplasty in 13 children, 1 of whom required open conversion. The mean operative time was 143 min (range = 103-235 min). El-Ghoneimi [16] reported their experience with 50 retroperitoneal cases in children aged between 22 months and 15 years. Conversion to open surgery was necessary in 4 cases due to technical difficulties during suturing. Mean hospital stay was 2 days, and return to full activities occurred within 5 days of surgery. The longer time needed for the retroperitoneal approach is almost certainly related to the limited working space that renders suturing more difficult.

Whereas open pyeloplasty has long been described, laparoscopic pyeloplasty has only recently been reported, and

long-term outcome data are still being evaluated. There seems to be promise of a multicenter prospective study comparing open, laparoscopic, and robotic techniques with a treatment algorithm that will be common among the institutions evaluating the techniques.

OUTCOMES

The evolution of surgical therapies continuously challenges open and endoscopic interventions with data emerging from laparoscopic pyeloplasty series [11-19]. Debate concerning which approach to choose (i.e. transperitoneal or retroperitoneal) is based more on philosophy than true evidence-based medicine. It has been stated that the gold standard of pediatric open renal surgery is the retroperitoneal approach and that minimally invasive surgery should follow the same rules [20]. Typically, surgeons who have started with retroperitoneal extirpative laparoscopic procedures perform pyeloplasties in a retroperitoneal fashion. However, this is not for everyone because of the longer time needed for the retroperitoneum related to the limited working space, which makes suturing more difficult early in the learning curve [20]. However, there are no data to show that a transperitoneal approach has any increased complication rate or decreased success rate. The approaches appear to be equal, and overall laparoscopic pyeloplasty in children has been demonstrated to be feasible and to have satisfactory results approaching that of open pyeloplasty [13,15,16,20,21].

When comparing the gold standard open approach to the laparoscopic approach [20], the mean operative time was significantly shorter in the open surgery group (96 min, range = 50-150 min) versus the laparoscopy group (219 min, range = 140-310 min) ($P < 0.0001$). On the other hand, the mean postoperative use of analgesics and hospital stay were less in the laparoscopy group. The major disadvantage of the laparoscopic approach is that it is clearly technically challenging, leading to increased surgical times because of the high proficiency required for intracorporeal suturing. Although automated devices that facilitate suturing are available [22], accurate suture placement and unavailability of a small size for pediatric application limit their use [23]. Development of novel alternatives to suturing, such as fibrin glue and laser welding, may enhance the utilization of the laparoscopic approach; however, the results with these methods alone have not yet matched the success of conventional sutures in providing adequate tensile strength of the anastomosis [24]. Therefore, surgeons interested in this approach can help decrease the operative times in pediatric laparoscopy through suturing practice and training in an inanimate model [17].

COMPLICATIONS

In the adult population, the total rate of laparoscopic complications is approximately 4 to 6 per 1000 [25-27], and the mortality is approximately 3 per 100,000 [26]. The complication rate is significantly associated with the complexity of the

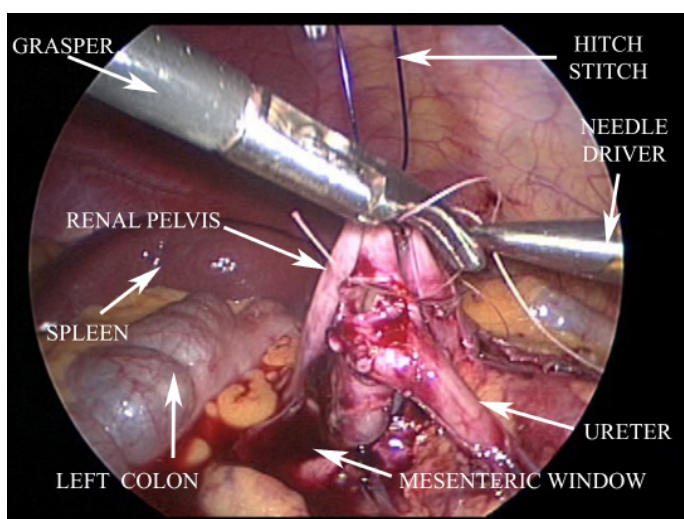


Figure 1. Laparoscopic view of the "crotch stitch" for a left transmesenteric pyeloplasty
doi:10.3834/uij.1944-5784.2008.12.09.f1

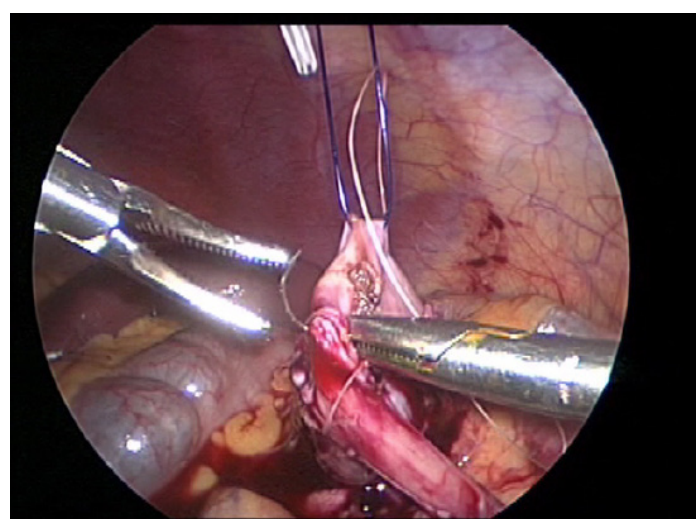


Figure 2. Same view as in photo 1 showing the anterior anastomosis being completed
doi:10.3834/uij.1944-5784.2008.12.09.f2

procedure, as seen in 2 large adult studies [25,26]. The true danger lies in the fact that complications can often be overlooked during laparoscopic surgery. The postoperative rather than intraoperative recognition of these injuries increases the severity of the sequelae [25]. In Chapron's series [26], 1 in 4 complications were diagnosed subsequent to surgery because of consequences of the complication. Diligent inspection of the viscera at the end of every procedure may help identify an injury. Postoperatively, a patient should continue to improve hourly in the immediate postoperative period and then dramatically day by day over the first week. If this sequence does not occur, then one must be wary of a missed injury, and acting quickly to solve it should minimize adverse outcomes.

Potential complications with pyeloplasty:

1. Bleeding requiring transfusion (1 per 5000)
2. Trocar or insufflation needle damage to viscera or vessels (1 per 3000)
3. Thermal damage to tissues or organs (1 per 2500)
4. Hernia at the port site and/or internally (< 1%)
5. Wound infection (< 1%)
6. Persistent leakage of urine (< 1%)
7. Stent migration (< 1%)
8. Re-obstruction (transient (5-10%) and persistent (1-3%))
9. UTI with stent in place (5%)

CONCLUSIONS

Transperitoneal and retroperitoneal approaches are reported to have comparable outcomes. In our experience, the retroperitoneal approach has been difficult in the following

scenarios: (1) children under 15 kg with extremely large renal pelvises, and (2) previous violations of the retroperitoneal space. For a relatively long obstructed UPJ segment associated with a hydronephrotic extrarenal pelvis, several flap pyeloplasty techniques, such as a Culp-Deweerd spiral, Scardino-Prince vertical flap, and a dismembered tubularized renal pelvic wall flap, have been performed, as described by Gill *et al.* [24].

Reports on the retroperitoneal approach in laparoscopic pyeloplasty are less common despite wide use of this approach in laparoscopic nephrectomy. The level of difficulty of manipulation certainly increases in the retroperitoneal space. We believe that difficulty of manipulation in the retroperitoneal space can be overcome with improvement in operative skill, especially in ambidextrous suturing technique. This approach has some advantages. First, it can avoid dissemination of urine into the peritoneal cavity under retroperitoneoscopic procedures when the renal pelvis is transected. Second, it can minimize the risk of injury to intraperitoneal organs, such as the colon and small bowel, but this is still not established with current experiences. Some speculate that the transperitoneal approach poses less risk to abdominal organs because they are always kept in the field of view.

The success rate of laparoscopic pyeloplasty is equal to that of conventional open pyeloplasty. Transperitoneal and retroperitoneal approaches are reported to have comparable outcomes [16]. We believe that laparoscopic dismembered pyeloplasty for UPJ obstruction in infants is technically possible. We also believe the use of an indwelling stent is helpful, but not mandatory.

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- TO CITE THIS ARTICLE: Casale P. A Review of Pediatric Laparoscopic Pyeloplasty. *UIJ.* 2009 Feb;2(1). doi:10.3834/uij.1944-5784.2008.12.09