Prospective clinical trial to compare standard colon-reflecting with transmesocolic laparoscopic pyeloplasty

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Study Type – Therapy (case series)
Level of Evidence 4

OBJECTIVE

• To compare the efficacy and safety of colon-reflecting (CR) and transmesocolic (TM) laparoscopic pyeloplasty approaches in a prospective randomized non-selective setting.

PATIENTS AND METHODS

• Excluding only those patients with a history of abdominal surgery, all consenting patients scheduled for laparoscopic pyeloplasty of left-sided pelvi-ureteric junction (PUJ) obstruction between December 2004 and November 2007 were randomized into one of two groups: laparoscopic pyeloplasty using the standard CR approach or laparoscopic pyeloplasty through the TM aperture.
• All patients underwent dismembered repair by a single expert and were followed by diuretic renogram and urography at 4 months postoperatively and by annual diuretic renogram thereafter.

What’s known on the subject? and What does the study add?
Laparoscopic pyeloplasty has replaced open pyeloplasty as the new standard of care and we, among others, have even proven its applicability to redo surgery. The focus is now on limiting morbidity. One technical modification to this end is transmesocolic (TM) exposure of the PUJ.

This randomized study pinpoints the objective benefits of TM exposure of the PUJ compared with standard colon reflection, and its results showed a 23% conservation in operating time.

• Four discrete task phases were timed for comparison: trochar to PUJ, dismembering and spatulation, stenting and anastomosis.

RESULTS

• Sixty-four patients were randomized into two groups, TM or CR, with 32 patients in each.
• The groups were similar, with no significant difference in sex, age, initial renal function or body mass index.
Forty-seven patients were ≤15 years old.
• The mean (SD) operating time was 23% shorter in the TM group, owing mostly to the much shorter trochar to PUJ phase (5.0 [3.2] min in the TM group vs 35.8 [10.3] in the CR group; P < 0.001). The mean hospitalization time was shorter in the TM group than in the CR group (2.9 vs 3.6 days; P < 0.001).
• Thirty-one of 32 patients in each group (96.9%) achieved a durable cure.

CONCLUSION

• Transmesocolic exposure of left-sided PUJ obstruction is superior to standard CR exposure, in that it saves anaesthesia time, hospitalization time and has lower morbidity with no compromise in efficiency, and could be considered as the new standard approach.

KEYWORDS
laparoscopy, pyeloplasty, Anderson Hynes, dismembered, transmesocolic

INTRODUCTION
Schuessler et al. [1] are generally credited for the first report on laparoscopic pyeloplasty in 1993. The procedure has since gained widespread popularity because of its high success rate and low morbidity, replacing open surgery in many institutions [2–4]. PUJ obstruction is almost twice as prevalent on the left side [5]. Standard transperitoneal laparoscopic pyeloplasty for left-sided PUJ obstruction involves reflection and medialization of the descending colon to expose the renal hilum, as it would otherwise be concealed by the splenic flexure.

Transmesocolic (TM) exposure has been suggested as an alternative method of accessing the area in cases where the renal pelvis is obviously bulged on inspection and the colon mesentery is translucent [6–8]. We developed this approach independently at our centre in 2003 and observed its usefulness for easy access to the PUJ, saving...
operating time and apparently leading to more rapid recovery. The present study was designed in 2004 to put our observations to the test and compare the results of the TM approach with the classic colon-reflecting (CR) procedure.

PATIENTS AND METHODS

Between December 2004 and November 2007, all patients with proven significant left-sided PUJ obstruction without history of abdominal surgery, who consented to laparoscopic repair, were consecutively randomized into one of two study groups. Institutional ethics and review board approval was obtained. Delayed visualization and evacuation with parenchymal changes on urography, and delayed 50% evacuation beyond 40 min on DTPA diuretic renogram curve and compromised function were considered indications for surgical intervention. All procedures were conducted by one expert laparoscopic surgeon (P.S.), who performed dismembered pyeloplasty in an adjustable way, to be very helpful in obese patients.

Our standard position for transperitoneal laparoscopy is modified left lateral decubitus with the patient fixed at 45°. The table tilt function allows an additional 30° in either direction. One 10-mm umbilical port for the telescope and passing needles, and two 5-mm ports (epigastric and left midclavicular) usually suffice, but we find a zero-silk anchoring suture on a straight needle, inserted directly through the left upper quadrant to suspend the upper edge of the TM aperture in an adjustable way, to be very helpful in obese patients.

In the present study, in patients randomized to standard CR exposure, the procedure began by incising Toldt’s line, dissecting the left colon from Gerota’s fascia and reflecting it medially to visualize the renal hilum and PUJ phase 1 in the CR group [Fig. 1].

In those patients randomized to TM exposure, the procedure began by incising the mesocolon lateral to Treitz’ ligament and medial to the inferior mesenteric vein (phase 1 in the TM group). The vein’s blue hue was always clearly visible in that vicinity, regardless of how prolific the adipose layers may be. The anatomical landmarks that we have described in Fig. 2, and standardized for approaching the PUJ through a TM aperture are safely and repeatably discernable. Even in the obese patient, in whom the prolific fatty tissues in the retroperitoneum conceal most anatomical features, Treitz ligament is always evident by following the duodenum to its exit point. Momentarily retracting the transverse colon cephalad in turn, using a non-traumatic instrument in the left hand, places the inferior mesenteric vein into tension. This makes the overlying peritoneum stand out as an unmistakable fold. The incision is then placed and developed in the gutter between the duodenum and the vein. It is necessary simply to keep aiming at the psoas muscle to avoid inadvertently dissecting into the overlying mesenteric planes containing the mesenteric vessels and lymphatics (Figs 2,3). Blunt, cold dissection aiming at the bulge of the lower left renal pole should rapidly bring the gonadal vein, upper ureter and ureteropelvic junction into view in succession.

After visualizing the PUJ, and dissecting a few cm distally to search for extrinsic obstructing elements; phase 2 began by incising the PUJ for dismemberment with/without reduction, and ended in adequate spatulation of the proximal ureter. In phase 3, a JJ stent was inserted antegrade by guiding the closed tip via the ureter into the bladder, then the guidewire was removed and the proximal coil was placed into the renal pelvis. Finally, phase 4 involved pelvi-ureteric anastomosis in the manner described by Anderson Hynes using 5/0 polyglactin sutures over the indwelling stent. According to our routine procedure, we placed three interrupted sutures at the corner of the anastomosis, then placed anterior and posterior continuous suture lines carried cephalad.

All the time spent on repositioning the anatomical elements to make these manoeuvres possible were included in each phase, to accurately reflect how effectively each exposure method allowed for these critical phases to be carried out. The entire operation was video recorded in real time to avoid the inconvenience and irregularities associated with timing individual phases of the procedure during the actual surgery. Precise timing on the recorded timeline thus became a much easier task for the reviewing team, who simply extracted the exact time spent on each procedural milestone.

Patients left the operating room with a Foley catheter fixed and one closed tube gravity drain placed through the lateral port site. The catheter was removed once there was no leak for 24 h, and the drain was then removed after it was dry for a further 12 h. The stent was kept for 6 weeks, and all patients received regular clinical follow-up and underwent diuretic renogram and urography at 4 months after surgery, with an annual diuretic renogram thereafter. Radiographic follow-up was done annually for 4 years, unless longer follow-up was required because of suspicion of progressive changes or symptoms. The operation was considered successful when obstruction was resolved on diuretic renogram and the patient’s symptoms were relieved.
Biometric and demographic data, procedural timings, anatomical findings during laparoscopy, bleeding estimates, postoperative findings, including any complications, and follow-up findings were recorded and analysed with SPSS software.

Complications, and follow-up findings were postoperative findings, including any laparoscopy, bleeding estimates, timings, anatomical findings during laparoscopy, and analgesics were requested less frequently in the postoperative period by patients in the TM group ($P=0.005$).

The mean (range) follow-up period was 33 (17–54) months in the CR group, and 32 (17–53) months in the TM group. Both groups had a 96.9% (31/32) success rate as defined above; with only one re-intervention required in each group. One patient in the CR group complained of re-emergent dull flank pain at 4 months after surgery, with significant unresolved obstruction on the images and was re-operated by open surgery to remove an apparently fibrotic 5-mm segment of the proximal ureter.

Asymptomatic refractory partial obstruction was found on the 12-month diuretic renogram in one patient in the TM group, which has remained cured for 3 years after an initial ureteroscopic intervention for balloon dilation of a membranous epithelial bridge at the anastomotic site upon diagnosis.

**RESULTS**

Between December 2004 and November 2007, 64 patients with left-sided PUJ obstruction were randomized into one of two groups (32 on each); Table 1 shows the major findings in these two study groups. There was no significant difference between the two groups in age, gender composition, body mass index (BMI), serum creatinine concentration, the left kidney’s share of split renal function, or associated findings. All procedures were carried to completion without any instance of converting to open surgery. Sixteen patients in the TM group and 17 in the CR group were found to have crossing vessels. All these patients underwent routine dismembered pyeloplasty.

The mean (SD; range) operating times were 150.4 (23.3; 121–205) min for the CR group, and 115.5 (18.5; 92–168) min for the TM group; therefore the TM procedure was ~23% shorter in duration ($P<0.001$).

A comparison of the timings for the four phases of the surgical procedure, as described above, is shown in Fig. 4. The mean (SD) duration of phase 1, trochar to PUJ, was 35.8 (10.3) in the CR group and 5.0 (3.2) min in the TM group ($P<0.001$ significantly favouring TM). For phase 2, dismembering, reduction and spatulation, it was 1.6 (1.0) min for the CR group and 2.4 (1.8) min for the TM group. Although significantly different ($P=0.033$) this element could not negate the stark benefit obtained in phase 1. The mean (SD) duration of Phase 3, stent insertion, was similar for the CR and TM groups: 1.2 (0.5) min and 1.3 (1.1) min, respectively ($P=0.554$). Phase 4, anastomosis, was again significantly shorter in the TM group, with a mean (SD) duration of 84.6 (14.7) min in the CR group vs 68.2 (20.5) min for the TM group ($P<0.001$).

The mean postoperative hospitalization time was 3.6 days in the CR group, and 2.9 days in the TM group. This difference significantly favoured the TM group ($P=0.001$), and was related to the two cases of ileus beyond 24 h that occurred in patients in the CR group. The anaesthetist’s estimate of blood loss was less than 50 mL in both groups, and analgesics were requested less frequently in the postoperative period by patients in the TM group ($P=0.005$).

**DISCUSSION**

Pelvi-ureteric junction obstruction is the most common cause of hydronephrosis in neonates and children; however its presentation may be delayed until later years of life [9]. The left kidney is much more commonly affected [5]. Open pyeloplasty, using a dismembering technique, is considered to be the ‘gold standard’ treatment for PUJ obstruction [10]. Schuessler et al. [1] first reported the laparoscopic pyeloplasty technique in 1993 and, with the improvement in laparoscopic...
techniques, laparoscopic pyeloplasty has gained wide acceptance and become the standard approach in many centres. Several studies have reported that laparoscopic pyeloplasty has a success rate similar to the open procedure and also provides advantages, such as reduction of bleeding and pain, magnification and improvement of vision, and better cosmetic appearance owing to minimal access [2–4]. Laparoscopic pyeloplasty is performed via a transperitoneal or retroperitoneal approach, with similar success rates and particular advantages and disadvantages [11,12]. The transperitoneal approach provides a larger working space with familiar anatomical landmarks, and allows the more precise detection and transposing of aberrant vessels. The retroperitoneal approach limits the operating field and takes more time, but it also avoids entry to the abdominal space, minimizing the risk of abdominal organ injury and limiting probable urine leakage to the retroperitoneal space.

The classic transperitoneal laparoscopic approach to left PUJ obstruction needs medial mobilization of the descending colon and its mesentery. This phase is time-consuming and involves colon manipulation with its adherent consequences [8]. Regarding the anatomic position of the splenic flexure, which is located more cranially than colon flexure on the right side and overlies left kidney parenchyma, colon mesentery is placed on the left renal pelvis and allows TM access to the PUJ [13]. Andreoni et al. [6] and Cisek et al. [7] published the first cases of TM laparoscopic pyeloplasty in 2004. Later, Romero et al. [8] reported on 18 patients, selected for a TM approach at the surgeon’s discretion, and compared the results with 170 patients who underwent the standard CR procedure. The TM approach resulted in a 22.5% and 19.2% reduction in operating time and hospital stay, respectively. The minimal manipulation of the bowel and the direct approach to the PUJ were considered to contribute to these reductions. Another study by Sedlăček et al. [13], compared TM left-sided laparoscopic pyeloplasty with a right-sided standard approach, and concluded that the TM approach was performed with a shorter operating time and similar success and complication rates. The theoretical concern about injury to mesenteric vessels was encountered in none of the studies [14].

Although BMI was thought to affect the adipose tissue content of the colon mesentery and thus the feasibility of the TM approach in the first series, this was not confirmed by later studies [8,14]. Porpiglia et al. [14] compared the results of the TM approach between patients with BMIs of <25 kg/m² and ≥25 kg/m². Their results showed no significant difference in operating time, hospital stay or success and complication rates.

To our knowledge, the present study is the first to compare left-sided TM laparoscopic pyeloplasty with the CR approach on the same side in a randomized prospective fashion. Making the comparison on the same side and with a randomized prospective design obviates some possible concerns about the precision of the study. Moreover, using the recorded video of the operations, the present study design was particularly focused on recording the duration of each phase to provide precise evidence about the procedure timing. Our findings showed a significant decrease in operating time by 23%. This reduction was mainly attributable to the first (trocar to PUJ) and fourth (anastomosis) phases of the operation. The present results confirm that avoiding colon mobilization may facilitate anastomosis by reducing adjacent visera displacement to the operative field. As was shown by Porpiglia et al. [14], the TM approach was feasible in all randomized patients regardless of their BMI. Hospital stay was also shortened significantly. Prolonged ileus beyond 24 h was encountered only in the CR group. Success rate and complications were not different between the TM and CR groups.

In conclusion, left-sided TM laparoscopic pyeloplasty is a safe and effective approach with several advantages over the CR approach, including reduced operating time and hospital stay.

CONFLICT OF INTEREST

None of the contributing authors have any conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript, and there has been no specific funding for this study.

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Abbreviations: CR, colon-reflecting; TM, transmesocolic; BMI, body mass index.