Title Page

Outcomes of reintervention for laparoscopic transperitoneal pyeloplasty in children

Running Title

Outcomes of reintervention for pyeloplasty

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Abstract

Background: There is no consensus for the management of failed laparoscopic pyeloplasty in paediatric surgical patients and only limited publications are available. We evaluate the clinical outcomes of reintervention for failed laparoscopic transperitoneal pyeloplasty in infants and children.

Methods: Retrospective review of all children who have undergone laparoscopic transperitoneal dismembered Anderson-Hyndes pyeloplasty for ureteropelvic junction obstruction from 2002 to 2013 was performed. Patients' demographics, indications, operative details and outcomes for primary operation as well as reintervention were studied.

Results: There were forty-two patients with median age of 20 months (range 3 - 192 months) and median body weight of 12 kg (range 6 - 56 kg) undergoing a total of 46 laparoscopic transperitoneal pyeloplasty during the study period. The median operative time and blood loss were 193 minutes (range 115 - 480 minutes) and trace amount (range trace amount - 400 ml) respectively. No conversion was reported. Ten (22%) required reintervention. No statistically significant risk factor for failed pyeloplasty was identified. Indications for reintervention included deterioration of differential renal function (n = 6), progressive hydronephrosis (n = 1), urinary ascites (n = 2) and urosepsis (n = 1). Median time of reintervention was 6.5 ± 38 months post-pyeloplasty. Reintervention was categorized into redo-pyeloplasty group (n = 6) and urinary diversion group (n = 4) (insertion of Double-J® ureteral stent or endopyelotomy) with success rates of 50% and 25% respectively. Among the redo-pyeloplasty group, 3 patients underwent

redo-laparoscopic pyeloplasty and all of them had drainage restored with a median improvement in differential renal function of 11%. The mean follow up duration was 77 ± 38 months.

Conclusions: Laparoscopic transperitoneal pyeloplasty is safe and feasible in children. Redo-pyeloplasty is a more favourable reintervention when compared to urinary diversion in our series. Redo-laparoscopic pyeloplasty has been shown to improve differential renal function.

Article

Introduction

Pyeloplasty has been demonstrated to have a high success rate of 90% regardless of the technique used. [1-7] Few studies on the treatment of failed pyeloplasty were published, including use of endourologic procedures or redo-pyeloplasty. There is no consensus for the management of failed laparoscopic pyeloplasty in paediatric surgical patients and the optimal reintervention was yet to be determined. [8-16] Here, we evaluated the clinical outcomes of reintervention for failed laparoscopic transperitoneal pyeloplasty in infants and children.

Method

A retrospective review of all children who have undergone laparoscopic transperitoneal dismembered Anderson-Hyndes pyeloplasty for uretero-pelvic junction obstruction from 2002 to 2013 was performed. Patients' demographics, indications for pyeloplasty, operative details and outcomes for primary operation, type(s) of reintervention, indication for reintervention, resolution of obstruction, change in differential renal function, and duration of follow-up were studied. Patients with obstruction of distal urinary tract or with other non-mechanical causes of renal impairment were excluded.

Operative technique

The patient was positioned supine with left or right side arched up and a Foley catheter was inserted. A subumbilical incision was made and peritoneum was entered. Splenic flexure was taken down with bipolar diathermy and renal pelvis was exposed. A 4/0 Prolene (Ethicon Inc., Johnson & Johnson, United States) was passed percutaneously to anchor the renal pelvis. The most dependent position of the renal pelvis is identified and opened. The proximal ureter was spatulated across the obstruction, 5/0 Vicryl (Ethicon Inc., Johnson & Johnson, United States) was used for pelvic ureteric anastomosis in continuous fashion. After anastomosing the posterior wall, a Double-J® ureteral stent (Boston Scientific, United States) was inserted depending on patient's body size. Position of Double-J® ureteral stent was confirmed with methylene blue refluxing from catheter. Postoperatively, position of Double-J® ureteral stent was confirmed by plain X-ray. The Foley catheter is removed on post-operative day 5 and patient was discharged on day 5.

The Double-J® ureteral stent was removed in 6 weeks, all patients then underwent ultrasound of the urinary system and diuretic scintigraphy using Technetium-99m Mercaptoacetyltriglycine (MAG3) in 12 weeks. Subsequent follow up in paediatric urology clinic was arranged. For those with persistent hydronephrosis, ultrasound of urinary system was arranged at 3 months interval. Diuretic scintigraphy was arranged if progressive hydronephrosis was present. Failed pyeloplasty was defined as reduced renal differential function of less than 40%, progressive hydronephrosis or presence of symptoms caused by pelvic-ureteric junction obstruction. Reinterventions included cystoscopy with Double-J® ureteral stent insertion, endopyelotomy, open / laparoscopoic assisted / laparoscopic / robotic redo pyeloplasty, were chosen according to preferences of individual surgeon or parents. Success of reintervention was defined as drainage evidenced by diuretic scintigraphy of the involved kidney.

Unpaired t test and Pearson's chi-square were used for comparative analysis and univariate analysis was done with one-way ANOVA test using SPSS® (version 17.0). Statistical significance was defined as $p < 0.05$.

Results

Forty-three patients were identified. One patient was excluded due to diagnosis of vesico-ureteric junction obstruction post-pyeloplasty. Thus, forty-two patients underwent a total of 46 laparoscopic transperitoneal pyeloplasty during the study period. The median age was 20 months (range 3 - 192 months) and median body weight was 12 kg (range 6 - 56 kg). The median operative time and blood loss were 193 minutes (range 115 - 480 minutes) and trace amount (range trace amount - 400 ml) respectively. No conversion was reported.

Ten (22%) patients required reintervention. The demographics of patients, indication and modality of reintervention were shown in table 1, the patients were numbered in chronological order. No statistically significant risk factors for failed pyeloplasty were identified. Indications for reintervention included deterioration of differential renal function (n = 6), progressive hydronephrosis (n = 1), urinary ascites (n = 2) and urosepsis (n = 1). Median time of reintervention was 6.5 ± 38 months post-pyeloplasty. No crossing vessel was present in any patient. The mean follow up duration was 77 ± 38 months.

The outcomes of patients were summarized in figure 1. Reintervention was categorized into redo-pyeloplasty group (n = 6) and urinary diversion group, either by insertion of Double-J® ureteral stent or endopyelotomy (n = 4). The success rates of redo-pyeloplasty group and urinary diversion group were 50% and 25% respectively, demonstrated in table 2. Among the redo-pyeloplasty group, success was observed in three patients undergoing redo-laparoscopic pyeloplasty. All of them had drainage restored with a median improvement in differential renal function of 11%. Drainage was also observed in one patient who had redo-laparoscopic assisted pyeloplasty. Two patients with unsuccessful outcomes had redo pyeloplasty twice. One patient had open redo pyeloplasty and subsequent redo robotic pyeloplasty, whereas the other patient underwent open redo pyeloplasty twice. The urinary diversion group had less promising outcome, only one patient with endopyelotomy achieved drainage.

Complications

Complications occurred in three reintervention patients. Patient 3 was complicated by anastomotic leakage from pyeloplasty site and displacement of right JJ stent on day 1. He developed oliguria, urinary ascites and acute renal failure. Laparoscopic converted to open redo pyeloplasty was done. Three months post-operatively, he was found to have complete obstruction of right uretero-pelvic junction obstruction and a second open redo-pyeloplasty was done. Post operative MAG3 showed obstruction with renal differential function of 18%. Redo-pyeloplasty was offered to parents.

In patient 4, open redo pyeloplasty was performed 7 months after the failed pyeloplasty, extensive fibrosis was noticed intra-operatively. It was complicated with perinephric abscess, which was treated by intravenous antibiotics. He defaulted reassessment imaging post-operatively and subsequently underwent robotic pyeloplasty 32 weeks later in view of persistent obstruction and a ballotable kidney. Intra-operative findings included large amount of adhesions around the previous anastomosis, a dilated renal pelvis up to 15cm, containing more than 500ml urine.

Patient 7 developed severe urinary ascites resulting from malposition of the Double-J® ureteral stent. She required paediatric intensive care unit admission for treatment of hyponatremia and seizure. She underwent cystoscopy on post-operative day 4, the ureteric stent was found to have migrated into the dilated renal pelvis. Upon laparotomy, the anastomosis was intact and patent, there was moderate ureteric narrowing at pelvic brim level. Open pyelotomy was done and a new ureteric stent was inserted, a pigtail nephrostomy was placed temporarily. Cystoscopy and retrograde pyelogram showed a persistently dilated renal pelvis and Double-J® ureteral stent was exchanged. Diuretic scintigraphy after removal of Double-J® ureteral stent showed gross hydronephrotic right kidney with differential function of 49% and persistent obstruction with prolonged post lasix t ½ of 173 minutes. Reinsertion of Double-J® ureteral stent was performed.

Discussion

Despite high success rate of pyeloplasty in treating uretero-pelvic junction obstruction in children, there was a small proportion of patients with persistent obstruction. Early study by Persky et al [17] found scarring and peripelvic fibrosis in patients with failed initial pyeloplasty, which might lead to urinary extravasations and urosepsis. Other studies had identified anatomical findings such as ureteral kink, redundancy of renal pelvis and long ureteral stricture in failed pyeloplasties. [9, 10] Lim et al [9] suggested that prolonged urinary drainage and younger patient age (less than 6 months) might be risk factors for persistent obstruction. In our series, no statistically significant risk factor was identified.

Reinterventions for patient with failed pyeloplasty can be classified into endourologic approach via pyelotomy or Double-J® ureteral stent insertion, and redo-pyeloplasty. Pyelotomy can be done in an antegrade or retrograde fashion using electrocautery, a cold knife, or a holmium-laser. Faerber et al [8] performed 4 successful percutaneous antegrade cold knife endopyelotomy on 5 patients who failed open pyeloplasty. The failed patient eventually underwent a successful ureterocalicostomy. The authors concluded endopyelotomy was a minimally invasive alternative to conventional repeat open pyeloplasty. Veenboer et al [14] reported less successful outcome with endopyelotomy. Ten endopyelotomies using electrocautery was performed on patients with failed open/laparoscopic pyeloplasty or ureterocalicostomy. In 10 patients, endopyelotomy was done percutaneously, and in 1 patient it was done in a retrograde fashion. The procedure was successful in 70% of the patients. In 4 patients, reintervention had to be considered. One re-pyeloplasty was performed. The authors concluded endopyelotomy could not be considered as a gold standard. Braga et al [11] also reported a lower success rate of retrograde endopyelotomy than redo pyeloplasty in 32 patients with failed pyeloplasty. Retrograde endopyelotomy technique consisted of holmium laser in 10 patients and cautery/balloon dilation in 8. Retrograde endopyelotomy was successful in 39% of the patients, while redo open / laparoscopic pyeloplasty had a 100% success rate ($p = 0.002$). Only 1 of 8 children (13%) had a successful retrograde endopyelotomy using cautery followed by balloon dilation. A more recent study by Kim et al [18] reported a 94% successful rate of endopyelotomy in 35 patients with failed pyeloplasty at a median 5-year follow up. Perinephric hematoma/urinoma developed in 2 patients and postoperative ileus occurred in one, all resolved under conservative management.

Published studies on open redo pyeloplasty had reported success rates of 75% to 100%. [9-11, 13] Lim et al [9] reported a salvage rate of 75% by repeat open pyeloplasty on 10 patients. Six patients who had recurrent uretero-pelvic junction obstruction were younger than 6 months at the time of the original pyeloplasty. A strong association between a crossing vessel and ultimate failure was observed. A 100% success rate by redo open pyeloplasty had been reported in Braga's comparative analysis. [11] Thomas et al [10] also reported favourable outcome with redo open pyeloplasty, six failed cases had a 100% success rate with little postoperative morbidity. Only 1 patient underwent endopyelotomy after a failed balloon dilation, who eventually failed and had to be redone with a pyeloplasty. Helmy et al [13] also shared their experience on redo open pyeloplasty in 14 patients with a salvage rate of 89% and excellent functional results.

There was limited published data on laparoscopic redo pyeloplasty in the paediatric population. Success rates reported in adults ranged from 75 to 92%. [19-21] Piaggio et al [12] compared laparoscopic to open redo pyeloplasty in 10 patients and reported an 80% success rate in each group.

The newer technique of robotic surgery facilitated dissection, intracorporeal suturing and knot tying. Lindgren et al [15] performed redo robotic-assisted laparoscopy in 13 patients and redo robotic-assisted laparoscopic ureterocalycostomy in 3. The mean age of patients was 6 years. Thirteen of the 16 patients had history of other interventions after the initial failed pyeloplasty, including endopyelotomy with stent placement, percutaneous nephrostomy and stent placement with or without balloon dilation. Improved radiological findings were seen in 88%. One patient underwent transfusion and conversion to an open procedure due to bleeding. Hemal et al [22] reported successful robotic-assisted laparoscopic redo pyeloplasty in 9 adolescents and young adults.

In a recently published series on 27 failed pyeloplasties by Romao et al [16], therapeutic procedures were offered at the discretion of the attending surgeon, which included cystoscopy with Double-J® ureteral stent insertion, endoscopic endopyelotomy, open or laparoscopic redo pyeloplasty, and ureterocalicostomy. The authors found that more invasive and definitive techniques, such as redo pyeloplasty and ureterocalicostomy, were more successful than minimally invasive ones.

Our series also demonstrated redo-pyeloplasty to be more favourable compared to urinary diversion. One of the limitations of our study was that reintervention procedure was chosen according to preferences of individual surgeon or parents. In our urinary diversion group, patient 9 and 10 had Double-J® ureteral stent insertion in view of equivocal drainage post initial pyeloplasty. Both had regular ultrasound reassessments and Double-J® ureteral stent was changed at six to eight week intervals. In patient 1, open redo pyeloplasety was unsuccessful due to dense fibrosis and thus endopyelotomy was performed. Management of patient 7 had been discussed in detail previously in the results section. The unsuccessful outcome of open and robotic pyeloplasty in patients 3 and 4 could be explained by the complications mentioned earlier. Another limitation of our study was the small number and heterogeneity of the reintervention group.

Our series, when compared to the very few published on laparoscopic redo pyeloplasty in children [12], had demonstrated reasonably satisfactory outcome. Possible explanation might include an increased laparoscopic experience resulting from the larger number of laparoscopic pyeloplasty in our centre compared to other techniques. Our study did not demonstrate benefit of earlier reintervention as the interval to reintervention was the longest in our laparoscopic subgroup, compared to other modalities.

We would like to make the following recommendations from our experience on laparoscopic pyeloplasty. A suitable size of Double-J® ureteral stent was first prepared according to the body measurements made before the operation started. A Double-J® ureteral stent with inadequate length might lead to the detrimental consequence of migration and coiling inside the dilated renal pelvis, whereas an excessively long catheter would lead to easy slipping via the urethra. We found that it was easier to identify a dilated renal pelvis and thus insertion of Double-J® ureteral stent was usually performed during anastomosis after mobilization. A correctly placed Double-J® ureteral stent was essential to facilitate post-operative drainage and prevent complication of leakage, methylene blue was injected via foley catheter and furthermore, fluoroscopy was utilized intra-operatively to confirm the position of the two ends of the catheter. Plain X-ray was performed post-operatively to ascertain the position of Double-J® ureteral stent after removal of foley catheter, before discharge of the patients.

Conclusion

Laparoscopic transperitoneal pyeloplasty is safe and feasible in children. Redo-pyeloplasty is a more favourable reintervention when compared to urinary diversion in our series. Redo-laparoscopic pyeloplasty has been shown to improve differential renal function.

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Nil

Disclosure Statement

The authors declare that they have no conflict of interest and no competing financial interests exist.

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Table 1

Demographics of patients requiring reintervention, indication and modality of reintervention

Patient	Age at pyeloplasty (months)	Body weight (kg)	Laterality	Indication for reintervention	Interval for reintervention (months)	Modalities of reintervention	Pre-intervention differential renal function (%)	Post-intervention differential renal function (%)
1	4	6	Right	Urosepsis	4	Attempted open redo Endopyelotomy	48	45
2	108	56	Left	Reduced function	96	Laparoscopic pyeloplasty	23	27
3	5	7	Right	Urinary ascites	1 day 9	Open right pyeloplasty 2nd Redo right open Pyeloplasty	48	18
4	8	11	Left	Reduced function	7 32	Open pyeloplasty Robotic pyeloplasty	28	22
5	10	8	Right	Reduced function	3	Laparoscopic pyeloplasty	27	4
6	6	8	Left	Progressive hydronephrosis	36	Laparoscopic pyeloplasty	50	52
7	9	8	Right	Urinary ascites	5	Cystoscopy with Double-J® ureteral stent insertion	39	49
8	8	9	Right	Reduced function	8	Laparoscopic pyeloplasty	36	40
9	20	12	Right	Reduced function	6	Cystoscopy with Double-J® ureteral stent insertion	43	0
10	12	9	Right	Reduced function	7	Cystoscopy with Double-J® ureteral stent insertion	38	30

Table 2

Outcome of subgroup (Redo-pyeloplasty and urinary diversion)

	Success (number/%)	Median improvement in differential renal function (%)	Median follow up period (months)
Redo-pyeloplasty (N=6)	3 (50%)	11 (range 4 - 17)	82 (range 37 - 111)
Urinary diversion (N=4)	1 (25%)	0	46 (range 13 -117)