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Minimally invasive open pyeloplasty in children: Long-term follow-up

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ABSTRACT

Objective: Our aim was to report the long-term follow-up for minimally invasive open pyeloplasty in children.

Material and methods: A total of 213 children with a mean age 16.33 months underwent miniature open pyeloplasty for ureteropelvic junction obstruction between January 2010 and May 2016. Anderson–Hynes dismembered pyeloplasty was performed through a subcostal miniature incision. The intraoperative and postoperative parameters including surgical operative time, incision size, intraoperative blood loss volume, postoperative analgesic use, hospital stay, complications, and success rate were documented.

Results: The mean surgery time was 65 min (50–85 min), and incision size was 16.99 mm (12–36 mm). None of the patients required blood transfusion or narcotic analgesics in the postoperative period. The mean hospital stay was 21.97 h (10–48 h). Minor side effects included urinary tract infection (3.8%) and urinary leakage in one case (0.004%). Major complications were not observed. The mean antero-posterior pelvic diameter before and after surgery was 28.69 ± 11.54 mm and 15.89 ± 9.29 mm, respectively with a mean difference of 12.78 mm, which shows a significant decrease (P value = 0.001). The success rate was 98.1% with a mean follow-up of 21.43 months (3–56 months). Two of the recurrences occurred in the first postoperative year, another one after 1.5 years, and the last one after 4 years.

Conclusion: Our study confirms minimally invasive open pyeloplasty in children as a safe and efficient procedure with the least complication and hospital stay rate in comparison with other minimally invasive techniques. Moreover, long-term follow-up is a requirement in pyeloplasty surgery.

Keywords: Children; minimally invasive; pyeloplasty.

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Introduction

Ureteropelvic junction obstruction (UPJO) is defined as an obstruction of the flow of urine from the renal pelvis to the proximal ureter. Recently, with the use of screening prenatal ultrasonography, the detection rate of UPJO in infants has increased. Infants with moderate to severe functional renal impairment due to urinary obstruction and persistent grade 4 hydronephrosis with no response to furosemide injection on diuretic renogram (preferably Tc 99m-MAG3) are candidates for surgical treatment.[1,2]

Dismembered open pyeloplasty, which was originally described by Anderson and Hynes in 1949,[3] has been presented as the standard treatment for UPJO with success rates of over 94%.[4,5] Postoperative pain due to the muscle-cutting incision, long hospital stay, and unpleasant scars have resulted in increasing interest in minimally invasive techniques such as laparoscopic pyeloplasty (LP) and robotic pyeloplasty (robot-assisted laparoscopic pyeloplasty, RALP).[6,7] In 1995, Peters et al.[8] presented transperitoneal laparascopic pyeloplasties in pediatric patients, which was advanced with robotic assistance in 2000. However, these minimally invasive techniques have some limiting factors in infants such as limited working space, more difficult techniques, longer learning curve, and the need for expensive equipment.[9] In addition, some articles do not recommend LP in patients younger than six months.[10,11] Therefore, the comparison of minimally invasive techniques with open surgery in the pediatric population is challenging.[12] In 2006, Chacko et al.[13] described a mini-

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mally invasive open pyeloplasty in children. Subsequently, other authors presented similar open techniques with acceptable outcomes over laparoscopic surgery.[10,14,15] In this regard, we present our long-term follow-up for minimally invasive open pyeloplasty in children.

Material and methods

All children who presented with a UPJO diagnosis between January 2010 and May 2016 to our center were enrolled. No child had previously undergone renal surgery. Diagnostic evaluation included serum biochemical analysis, urine analysis and culture, renal ultrasonography, voiding cystourethrogram for ruling out vesicoureteral reflux, and isotope diuretic renogram.

Indications for surgery included severe hydronephrosis with or without parenchymal atrophy (Society for Fetal Urology grade III or IV), frequent urinary tract infections (UTIs), abdominal bulging, delayed wash out of the radionuclide substance from the collecting system (T1/2>20 min) or decreasing differential renal function (<40%) on follow-up isotope scans, and signs of obstruction including recurrent abdominal and flank pain with or without vomiting.

Exclusion criteria included history of previous renal surgery, concomitant ureterovesical junction obstruction, and finding of crossing lower pole renal vessels as the cause of obstruction. Patients underwent surgery by one surgeon (FA). Informed consent was obtained from parents before surgery.

Under general anesthesia, the patient was positioned in a flank position. Surgical access was gained through a subcostal miniature incision. The size of the incision was proportional to the patient's age and body size, i.e., the smallest size that provided access to the retroperitoneum and renal pelvis. A muscle-splitting dissection followed by Gerota's fascia exploration for exposure of the UPJ retroperitoneally was performed. After detecting the renal pelvis, a 4-0 chromic traction suture was placed on it, and the renal pelvis was pulled out of the incision. This was facilitated by drawing some urine from the severely dilated renal pelvis. The ureter was then identified, taken by another traction suture, separated from the pelvis and spatulated down to the point, where a normal caliber lumen was observed. Before re-anastomosing the spatulated ureter to the renal pelvis, we inserted a 'home-made' pyeloureteral stent as has been described by Kajbafzadeh et al.[10] This was made by cutting the very distal end of a 6 F feeding tube, inserting the close end of a 3 Fr double pigtail stent into it, and fixing the two by a through-and-through 5-0 Nylon suture. Since passing antegrade stents from the ureter to the bladder harbors a small but important risk of ureterovesical junction damage and secondary obstruction (UVJO), we made a modification to this technique by cutting the distal part of the DJ stent and leaving it in the distal ureter (Figure 1).

Anderson–Hynes dismembered pyeloplasty was then performed extracorporaly, using 6-0 Vicryl continuous sutures. At the conclusion of the operation, a Penrose drain was inserted through the same stab incision through which the pyeloureteral stent exited. We did not fix a Foley catheter postoperatively.

Main Points:

- Dismembered open pyeloplasty has been presented as the standard treatment for UPJO with success rates of over 94%.
- Minimally invasive techniques such as laparoscopic and robotic pyeloplasty were introduced due to lesser operative and postoperative complications.
- Minimally invasive techniques are challenging in the pediatric population; therefore, minimally invasive open pyeloplasty was considered.
- Compared with previous studies, minimally invasive open pyeloplasty in children is a safe and efficient procedure with the least complication and hospital stay rate.

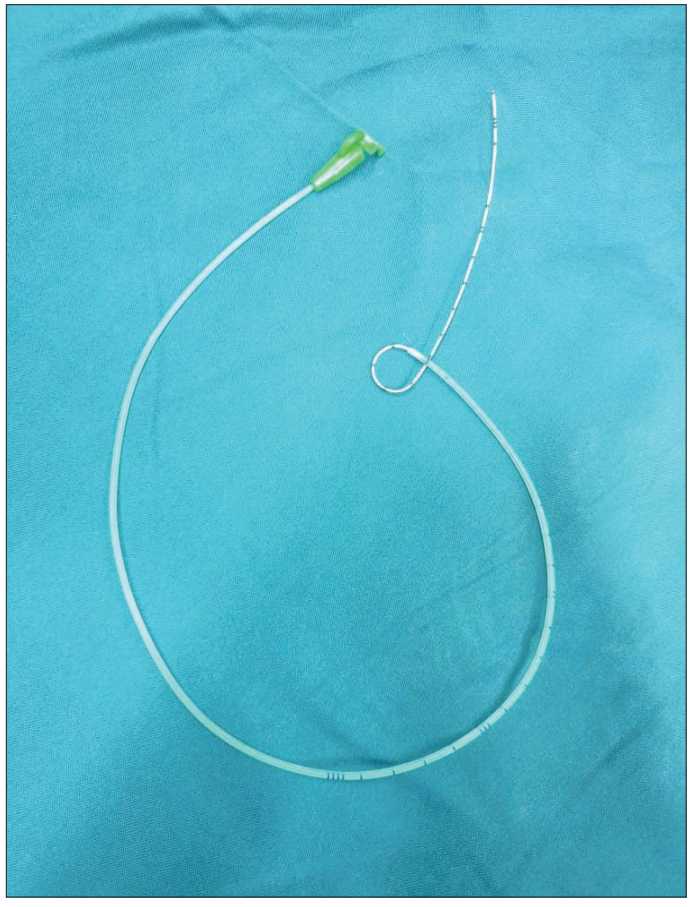

Figure 1. Home-made pyeloureteral stent

After one week, the drain was removed and the proximal end of the feeding tube was detached from the urine bag, clamped, and put under the wound dressing. The parents were instructed to reconnect the feeding tube to a urine bag in case of fever development or flank pain and irritability. The pyeloureteral stent was removed in the office after one month. In the meantime, we performed a urine culture in the presence of fever and/or storage lower urinary tract symptoms.

The patients were evaluated with ultrasonography at 1, 3, 6, 9, 12, 18, and 24 months and then every year postoperatively. If the first postoperative ultrasound showed a less that 30% reduction in the antero-posterior (AP) renal pelvis diameter, the second ultrasound was done after one month instead of three months. In the presence of a persistently dilated renal pelvis, a Lasix renogram was requested. A diuretic renogram was also performed in patients with severely diminished renal function (<30% of differential renal function) on the initial scan after one year and in any patient with sudden increase in AP diameter of renal pelvis. We did not do a nephrostography in any of our patients. Radionuclide renal scan was also omitted in patients with persistently decreasing AP renal pelvis diameter.

The intraoperative and postoperative parameters including surgical incision size, operative time (from the initial incision to the final suture), intraoperative blood loss volume, postoperative analgesic use, hospital stay, complications, and success rate were documented.

Statistical analysis

Data were entered into the Statistical Packag for the Social Science software (IBM SPSS Corp.; Armonk, NY, USA), version 22. Chi-square, Fisher's exact test, Mann-Whitney U test, t-test and Wilcoxon's test were used for analyzing the data. P-value of 0.05 was considered statistically significant.

Results

A total of 213 children underwent miniature open pyeloplasty for UPJO. UPJO was bilateral in five patients. On the other hand, five patients were excluded from the study: three with a crossing vessel that was managed with vascular hitch and two with undiagnosed concomitant UPJO and UVJO, who underwent initial pyeloplasty plus distal loop ureterostomy and later, ureteroneocystostomy. In these two patients, the ureter was unusually dilated after a stenotic UPJ. We tried to pass a ureteral catheter into the bladder that was impossible. After completion of pyeloplasty, a cystoscopy was performed that confirmed the stenotic UVJ. There were 137 boys (64.3%) and 76 girls (35.7%). Their mean age was 16.33 months (1 month to 12 years). The most common clinical manifestations were antenatal hydronephrosis (61.0%; Table 1). The mean surgery time was 65 min (50–85 min) and incision size was 16.99 mm (12–36 mm); it was <1.5 cm in all patients below 1 year of age, and <2 cm in all cases below 2 years of age. Crossing lower pole renal vessels were observed in four patients; Anderson–Hynes dismembered pyeloplasty was applied to one of them and vascular hitch to the rest. None of the patients required blood transfusion or narcotic analgesics in the postoperative period.

Four patients had concomitant calyceal stones that were washed out after pelvis incision. They were not the cause of stenosis but perhaps the consequence of it. Minor side effects included urinary tract infection in eight patients (3.8%) and urinary leakage in one (0.004%).

Major complications were not observed. Mean hospital stay was 21.97 h (10–48 h). The mean AP pelvic diameter before surgery was 28.69±11.54 mm and postoperative diameter was 15.89 ± 9.29 mm with a mean difference of 12.78 mm, which shows a significant decrease (p=0.001).

The surgery was successful in 98.1% of renal urinary units with a mean follow-up of 21.43 months (3–56 months). All but two of the recurrences occurred in the first postoperative year, another one after 1.5 years and the last one after four years.

Discussion

In this study, we achieved a success rate of more than 98% by a miniature incision in long-term follow-up. This finding is compatible with previous studies. Sharifiaghdas et al.[15] recently presented 109 children with a mean age of two years and eight months who underwent miniature incision open pyeloplasty. Their mean surgery time was 52 min with a success rate of 98.2 % in a three-year follow-up. In another similar study, Kajbafzadeh et al.[10]

Table 1. Common clinical manifestations of patients in the study

Presentation	(%)
Antenatal hydronephrosis	130 (61)
Flank pain	13 (6.1)
UTI	12 (5.6)
Irritability	12 (5.6)
Abdominal pain	8 (3.8)
Accidental	8 (3.8)
Enuresis	4 (1.9)
Abdominal trauma	3 (1.4)
Vomiting	2 (0.9)
Others	21 (9.8)

UTI: urinary tract infection

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Table 2. Comparison of recent studies with minimally invasive open pyeloplasty

Authors	Chacko et al.[13]	Ruiz et al.[14]	Kajbafzadeh et al.[10]	Sharifiaghdas et al.[15]	Our study
No. of patients	74	45	373	109	213
Mean age	4.6 years	11.2 months	4 months	2 years and 8 months	16.33 months
Incision size	20–35 mm	25–35 mm	11–15 mm (13 mm)	18–28 mm	16.99 mm
Mean operative time	120 min (109–134 min)	92 min (60–150 min)	53 min (43–75 min)	52 min (47–60 min)	65 min (50–85 min)
Mean Hospitalization	<23 h	11.5 h (6–35 h)	18 h (14-21)	3 days (2–8 days)	21.97 h (10-48h)
Success rate	95%	89%	100%	98.2%	95.8%
Follow up		47.5 months (4–103 months)	25 months (8–55 months)	36 months	21.43 months

reported 373 infants with a mean age of four months who were treated with this technique and 100% success rate in median 25 months of follow-up. In their study, Chacko et al.[13] first reported their five-year experience with minimally invasive open pyeloplasy with 74 patients from <1 year to >10 years with a 95% success rate. These studies finding are presented in Table 2.

Open dismembered pyeloplasty has been considered the treatment of choice in UPJO[16]; however, minimally invasive techniques such as laparoscopic and robotic pyeloplasty were introduced by the time due to the significant dissatisfaction with the previous technique.[7] Different criteria have been considered in comparing minimally invasive pyeloplasty procedures such as success rate, incision size, operative time, hospitality stay, and postoperative complications. In comparison with laparoscopic, and robotic surgery, the presented method had an acceptable success rate of more than 95% and shorter operation time. Our study had the longest follow-up between similar studies. After 65 months of follow-up, we observed four failed cases and interestingly, the last one was four years after operation, which highlighted the importance of long-term follow-up after pyeloplasty. The incision size was between 12 and 36 mm, depending on the patient's age. In patients under two years of age, it could be comparable or even less than the total sum of the incisions in LP.

One of the main drawbacks of laparascopic and robotic surgeries is the longer operative time in comparison with the suggested miniature pyeloplasy. In the laparoscopic technique, the mean surgical times were 102 min, 219 min, and 188 min by Tong et al.,[17] Bonnard et al.,[18] and Piaggio et al.,[19] respectively. With regard to the robotic assisted laparoscopic technique, Lee et al.[20] reported an operative time of approximately 219 min. As it is shown in Table 2, the mean operative time in miniature pyeloplasty is 66 min, which is approximately one-third to one-half of the other minimally invasive techniques.

On the other hand, the hospital stay was reported to be longer in open surgery. Recently, Bonnard et al.[18] found that the main benefit of LP over open pyeloplasty was the shorter hospital stay (2.4 days vs. 5 days, p=0.05). In Kutikov et al.[21] study, this was reduced to 1.2 days in patients younger than 6 months. In addition, Lee et al. described a shorter hospital stay in robotic assisted LP (2.3 days vs. 3.5 days, p=0.001).[20] In the recent miniature pyeloplasty studies, the mean hospital stay was decreased significantly related to previous classic open surgeries so this defect can be neglected.

Overall, minimally invasive and open procedures had the same efficacy and complication rates, but patients undergoing LP or RALP had a shorter hospitalization period and less narcotics consumption for pain control.[22] However, we believe that these two advantages of laparoscopic and robotically assisted laparoscopic approaches were challenged by our technique.[10] Hence, the advantages of minimally invasive techniques combined with short operative time represent this approach as a potential rival for LP and RALP, especially in infants and younger children and when small size laparoscopic equipment are not available.

Our finding approved previous studies that represent minimally invasive open pyeloplasty in children as a safe and efficient procedure with the least complication and hospital stay rate in comparison with other minimally invasive techniques such as laparoscopic and robotic pyeloplasty.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Isfahan University of Medical Science (IR.MUI.REC.1395.2.142).

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

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lection and/or Processing – S.H., B.S.; Analysis and/or Interpretation – S.H., B.S.; Literature Search – S.H., B.S.; Writing Manuscript – S.H., B.S.; Critical Review – F.A., S.H.

Conflict of Interest: The authors have no conflicts of interest to declare.

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