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ORIGINAL RESEARCH

Primary laparoscopic ureterocalicostomy as an option in selected cases of ureteropelvic junction obstruction

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Abstract

Purpose To evaluate the outcome of primary laparoscopic ureterocalicostomy in nine children.

Methods All children who underwent laparoscopic ureterocalicostomy (LUC) as the primary procedure were included in the study. The surgery was performed by two pediatric urologists from two different institutions during the study period (2016–2022). The technique of ureterocalicostomy employed was similar in all children and consisted of identification of the most dependent portion of the lower pole calyx and anastomosis with the ureter with or without dismembering the ureteropelvic junction (UPJ). Double J stent was placed in all children for a period of 6–8 weeks; three children had an additional nephrostomy which was removed after 1 week.

Results We had a total of nine children (five boys, four girls). The median age at operation was 5 years (2 months–14 years), and the mean duration of follow-up was 3 years. The indications for LUC included horseshoe kidney (4), giant hydronephrosis (1), and malrotated kidney (4). All children experienced a good outcome, as defined by reduced dilatation on post-operative ultrasonography. No children developed any complications. The mean operating time was 120 min.

Conclusion Our study shows that primary laparoscopic ureterocalicostomy is a feasible and safe option for UPJ obstruction in children with a high insertion ureter and a posteriorly malrotated kidney where the lower calyx is most dependent and accessible.

Keywords Laparoscopic ureterocalicostomy · Ureteropelvicjunction obstruction

Introduction

Anderson–Hynes pyeloplasty is widely regarded as the operation of choice for the routine management of ureteropelvic junction obstruction (UPJO). In selected cases like giant intra-renal pelvis or UPJO associated with horseshoe kidney or malrotated kidney, ureterocalicostomy (UC) has been described as an alternative technique to Anderson–Hynes dismembered pyeloplasty [1–4]. The principle of ureterocalicostomy is excision of the hydronephrotic thinned lower pole parenchyma and anastomosis of the dismembered ureter directly to the lower pole calyx to provide effective drainage [5, 6]. At the beginning, an open approach was preferentially adopted to perform UC due to the complexity of this technique, especially in recurrent UPJO [6]. However, an open approach was associated with longer operative time and higher morbidity rates due to larger surgical incisions, a longer length of stay, and increased analgesic therapy [7–9].

In recent years, minimally invasive approaches have become effective alternatives to open techniques, providing excellent results [10]. As this procedure is infrequently performed, there is a paucity of literature regarding laparoscopic ureterocalicostomy (LUC) in the pediatric population. The present retrospective study was aimed at evaluating the outcome of LUC as a primary procedure in nine children.

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Methods

All children who underwent LUC as the primary procedure were included in the study. The surgery was performed by two pediatric urologists from two different institutions during the study period (2016–2022). Pre-operative work-up included ultrasonography (US) for antero-posterior diameter (APD) and a diuretic renal scan for split renal function (SRF) and drainage. A magnetic resonance urogram (MRU) or a computed tomography (CT) urogram was performed in cases with complex anatomy when there was doubt about the site and location of the pelvis. LUC was done via a transperitoneal approach with a three-port technique, using 5-mm instruments in older children and 3-mm instruments in toddlers. Intraoperatively, cystoscopy/retrograde pyelography (RGP) was performed in all children, and a ureteric catheter was placed for identification of the ureter.

The decision to perform primary LUC was made intraoperatively in the following situations: (1) posteriorly malrotated kidney with high insertion of the ureter, where standard dismembered pyeloplasty would be technically challenging; (2) horseshoe kidney with non-dependent, intra-renal pelvis; (3) giant hydronephrosis with a small intra-renal pelvis, where the lower calyx was the most dependent part. Figure 1 illustrates pre-operative imaging in some of these cases.

The technique included disconnection of the ureter from the renal pelvis and identification of the most dependent part of the lower pole calyx. However, in three cases, the UPJ was not dismantled and a side to side anastomosis was performed (Fig. 2). The renal parenchyma was excised to expose a sizeable area of the lower pole calyx.

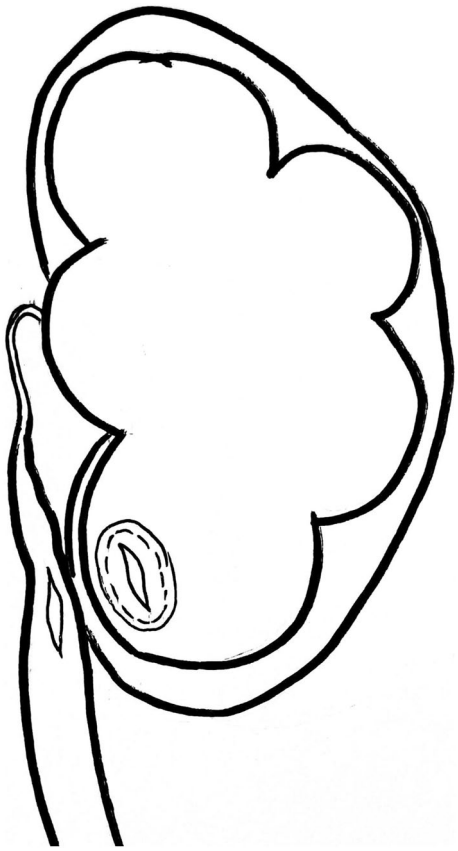

Fig. 2 Illustration shows the technique of side to side ureterocalicostomy. The high riding UPJ and intra-renal pelvis may be left undisturbed

A tension-free anastomosis was carried out between the spatulated proximal ureter and opened calyx using a 5–0 Vicryl suture. In some cases, a perinephric drain was

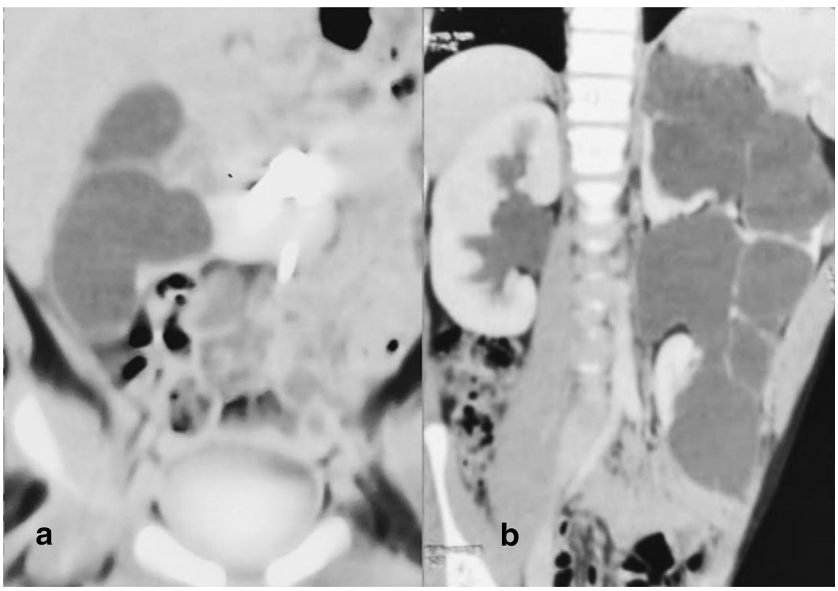

Fig. 1 Situations for primary ureterocalicostomy **a** right UPJO in horseshoe kidney—CT urogram showing non-dependent pelvis **b** left giant hydronephrosis with intra-renal pelvis—CT urogram shows lower calyx more dependent

placed and removed before discharge. Three children had an additional nephrostomy. A double J stent was placed in all children for a period of 8 weeks. An ultrasonogram and a diuretic renal scan were performed as post-operative follow-up scans at 3 and 6 months, respectively.

Results

We had a total of nine children (five boys and four girls) who underwent LUC. The median age at operation was 5 years (2 months–14 years). Seven of the children presented symptomatically: four with recurrent urinary tract infections, two with abdominal pain, and one with hypertension. It was asymptomatic in two children who were detected antenatally with hydronephrosis.

For all nine children, LUC was performed as a primary procedure. In total, four children underwent LUC for UPJO in horseshoe kidneys; in four children, it was performed as a primary procedure for UPJO associated with a posteriorly malrotated kidney, and in one, the indication was for a giant hydronephrosis with more intra-renal calyceal dilatation.

In all children, ureterocalicostomy was achieved laparoscopically with no open conversion and without any major intra- or post-operative complications. The mean operating time was 120 min (excluding the cystoscopy and RGP), and the mean duration of follow-up was 3 years. All nine children had a good outcome, as defined by reduced dilatation on post-operative ultrasonography or improved function on renogram. Preoperatively, all nine had grade 4 hydronephrosis on US, and it reduced to grade 2 at post-operative follow-up in all except the one with giant hydronephrosis (case 3; Table 1). All patients were evaluated with a post-operative diuretic renogram, which showed significant improvement in drainage in six children (Fig. 3); and improvement in function in eight; the only patient with giant hydronephrosis had static renal function with no deterioration post-op (case 3; Table 1). Patient details are summarized in Table 1.

Discussion

To our knowledge, this is the largest series of primary LUC reported till date. This series included two infants, 2 months and 6 months old, implying that LUC could be performed safely and successfully in small infants as well. Ureterocalicostomy was first described by Neuwrit in 1947 [6]. Hawthorne et al. modified their technique to excise the lower pole parenchyma, achieving good results using this modification in a further two patients [11].

Mollard and Braun described the successful use of ureterocalicostomy as a primary procedure in 14 children [12]. The post-operative course was complicated by urine leakage

Table 1 Summary of all cases

Case no.	Age	Symptoms	Indications	Pre-op APD	Post-op APD at 3 months	Pre-op SRF	Post-op SRF at 6 months	Follow up	Remarks	Op.time
1	6 m/F	AN	Horseshoe	25 mm	12 mm	38%	40%	1 y	Side to side anastomosis	130
2	10 y/M	Hypertension	Horseshoe	23 mm	11 mm	35%	38%	6 m	Side to side anastomosis	100
3	14 y/M	Pain,UTI	Giant HN	35 mm	30 mm	18%	17%	2 y	Side to side anastomosis	140
4	2 m/M	AN	Posterior malrotation	30 mm	12 mm	30%	38%	3 y	End to side anastomosis	90
5	3 y/F	UTI	Posterior malrotation	21 mm	13 mm	28%	37%	3 y	End to side anastomosis	120
6	5 y/F	UTI	Posterior malrotation	24 mm	12 mm	31%	38%	6 y	End to side anastomosis	140
7	6 y/F	Pain	Posterior Malrotation	25 mm	11 mm	36%	40%	5 y	End to side anastomosis	150
8	7 y/M	Pain, UTI	Horseshoe	22 mm	10 mm	32%	40%	4 y	End to side anastomosis	120
9	5 y/M	UTI	Horseshoe	25 mm	14 mm	35%	40%	5 y	End to side anastomosis	100

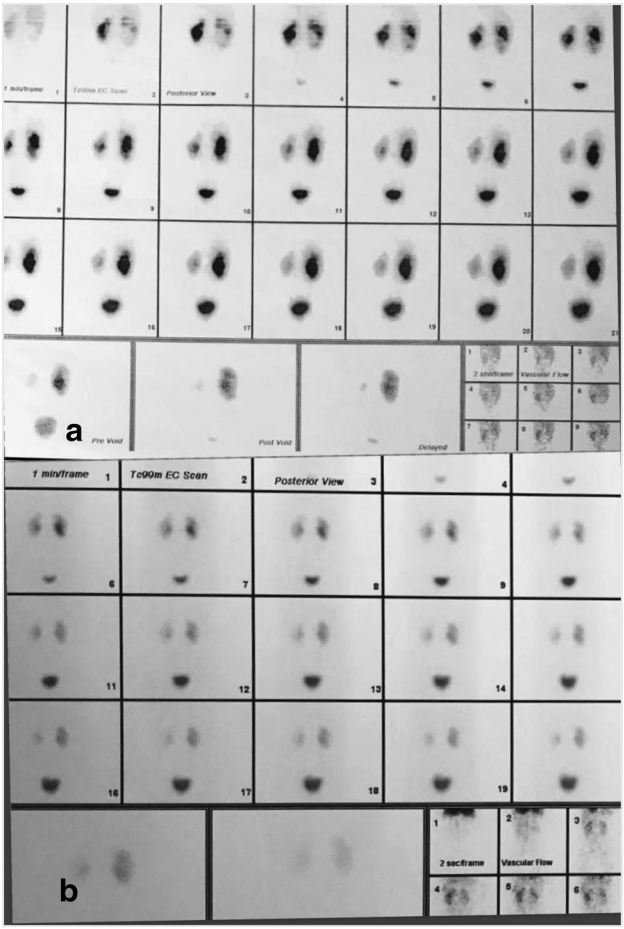

Fig. 3 Pre- and post-op renogram showing good improvement post UC

in three patients, of whom one ended up with a nephrectomy 1 month later because of urinary sepsis. Transient hematuria and one episode of hypertension were noted in two patients, respectively. Mesrobian and Kelalis [13], in their series of 21 children ranging in age from 6 months to 17 years, reported the use of ureterocalicostomy for various indications. Good outcomes were observed in 19 patients. There were, however, two patients with post-operative complications requiring further surgical intervention: one requiring stent insertion for prolonged urinary drainage with anastomotic leakage, and the other requiring treatment of a *Candida* perinephric abscess causing ureterovesical junction obstruction on the same side of the ureterocalicostomy. In the present series, there was no urine leakage post-operatively, probably because of the use of the DJ stent. Furthermore, nephrostomies were performed in three cases to provide additional protection against urine leaks.

Sarhan et al. [14] reported their experience with ten children, with an overall success rate of 80% at a mean follow-up of 18 months. However, two children in their series (20%) required nephrectomy for recurrent obstruction and loss of function. Radford et al. [15] reported on the outcomes of 13 children who had undergone ureterocalicostomies consecutively. Ureterocalicostomy was performed as the primary procedure in four children with horseshoe kidneys and four children presenting with gross UPJO. In the remaining five children, it was performed as a secondary procedure for recurrent UPJO after previous pyeloplasty. Following ureterocalicostomy, 12 children (92%) had a good functional outcome. However, one child (8%) developed symptomatic anastomotic obstruction 5 months after a primary ureterocalicostomy for obstruction in a horseshoe kidney. The surgical revision was successful, with good drainage, preservation of differential function, and relief of symptoms on further follow-up up to 3 years.

No child in the current series developed re-obstruction after a 3-year average follow-up. Two factors may have prevented re-obstruction in our series: our practice of leaving the DJ stent in situ for 8 weeks (instead of the standard 4–6 weeks for standard pyeloplasty) and the practice of excision of a disc of renal parenchyma from the lower pole to prevent stricture of the anastomosis. In this respect, it may be important to choose only those kidneys with a thinned-out lower pole parenchyma for LUC.

In our series, all cases were found to have a significant reduction in hydronephrosis except one child, as shown in the table. This child had a poorly functioning kidney, giant hydronephrosis, and disproportionate calyceal dilatation in comparison to the pelvis. The post-operative diuretic scan showed static function with sluggish drainage. In six of nine cases, end-to-end anastomosis was done after dismantling the UPJ. However, in three cases where there was an intrarenal pelvis with high insertion of ureter, UPJ was not dismembered, and the anastomosis was performed side by side between the dependent calyx and the ureter (Table 2).

Laparoscopic (minimally invasive) pyeloplasty has been considered the standard of care for pediatric UPJO in many centers around the world. However, certain conditions prevail, wherein alternative options such as ureterocalicostomy need to be the choice of intervention. Nerli et al. [16] described primary ureterocalicostomy as an option in eight of the children in their study. Three out of eight children required conversion to open surgery due to difficult dissection. In our series, there was no open conversion, probably because all cases were operated on by two senior pediatric urologists with extensive experience in laparoscopic pyeloplasty. The mean operative time of 134 min reported by Nerli et al. is comparable to the mean operative time for LUC in our series. Adamic et al. [17] recently performed robotic-assisted LUC on four patients ranging in age from 11 months to 14 years. The mean operating time in their series was 208 min, probably because of the additional time taken to dock the robot.

Table 2 Comparison of outcomes with other studies

Author, year	No of patients	Technique	Indications	complications
Mollard et al., 1980 [12]	14	Open UC	Recurrent PUJO, horseshoe	Stenosis (2)
Mesrobian and Kelalis, 1989 [13]	21	Open UC	Recurrent PUJO,	Perinephric abscess (1) Anastomotic leakage (1)
Radford et al., 2010 [15]	13	Open UC Lap UC (1)	Recurrent PUJO, Horseshoe, giant HN	Stenosis(1)
Nerli et al., 2017 [16]	8	Lap UC	Recurrent PUJO, horseshoe, giant HN, malrotation	Conversion (3) Prolonged ileus (1)
Adamic et al., 2020 [17]	4	Robotic-assisted lap UC	High insertion, redo, malrotation	–
Our series	9	Lap UC	Horseshoe, giant HN, malrotation	–

Ciro et al. [10], compared the results of pyeloplasty with ureterocalicostomy operated by minimally invasive approach. In 7/15 (46.7%) patients who underwent laparoscopic ureterocalicostomy, it was performed as the primary procedure for UPJO associated with unfavorable anatomy. This included intra-renal hydronephrosis with minimal or no evident extra-renal pelvis for reconstruction and malrotation. In 8/15 (53.3%) patients, LUC/ robotic-assisted LUC was performed as a "salvage" procedure for recurrent UPJO after a prior failed open Anderson–Hynes dismembered pyeloplasty. Of the 15 patients who underwent laparoscopic ureterocalicostomy, 9 developed Calvin-II complications but did not require any intervention. When compared to other studies; it can be seen that our series compares favorably to both open and robot-assisted ureterocalicostomy. One of the theoretical limitations of UC is that it will only drain the lower pole calyx; however, when the child ambulates, gravity will allow it to drain the middle calyx as well. The other concern is risk of bleeding from the cortex; but this can be prevented by prompt coagulation of edges of excised disk of cortex. While LUC can be technically demanding for beginners, robotic approach may make UC much easier to be adopted more widely.

Conclusion

In children with UPJO and difficult anatomy precluding successful pyeloplasty, we found that primary LUC is a safe and successful procedure in expert hands. In our experience, LUC provided reliable drainage and was associated with a low complication rate.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s42804-023-00182-z.

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Declarations

Conflict of interest No conflict of interest.

Ethical approval Retrospective study on patients managed with clinical protocols.

Consent to publish Obtained.

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