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Ureterocalicostomy in children: 12 years experience in a single centre

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What's known on the subject? and What does the study add?
Since 1947 ureterocalicostomy has been a recognised option in the treatment of obstructive systems either as a primary or salvage procedure, however few series specific to the paediatric patient exist. This 12 year review of 13 cases at one tertiary centre demonstrates ureterocalicostomy to be a versatile, reliable means of relieving obstruction for a variety of indications; horseshoe kidney, recurrent PUJ obstruction and gross PUJ obstruction with unfavourable anatomy.

OBJECTIVE

- To document the outcome of ureterocalicostomy in children.

PATIENTS AND METHODS

- The outcomes of 13 children who had undergone ureterocalicostomy consecutively under the care of two paediatric urologists between 1997 and 2009 were evaluated retrospectively.
- Ureterocalicostomy was performed as the primary procedure in four children with horseshoe kidney and four children presenting with gross pelvi-ureteric junction (PUJ) obstruction.
- In the remaining five children, it was performed as a secondary procedure for recurrent PUJ obstruction after previous pyeloplasty.
- An open approach was employed in 12 patients, whereas, in one patient, it was performed by a laparoscopically-assisted technique.

RESULTS

- Mean age at operation was 9.3 years and the mean (range) duration of follow-up was 2.6 (0.3–7.0) years. Twelve children (92%) experienced a good functional outcome following ureterocalicostomy, as defined by reduced dilatation and improved drainage on postoperative ultrasonography and/or isotope imaging.
- However one child (8%) developed symptomatic anastomotic obstruction 5 months after primary ureterocalicostomy for obstruction in a horseshoe kidney. Surgical revision was successful, with good drainage, preservation of differential function and relief of symptoms on further follow-up to 3 years.

CONCLUSIONS

- Ureterocalicostomy provides a versatile and reliable means of relieving obstruction for a variety of indications, including horseshoe kidney, recurrent PUJ obstruction and gross PUJ obstruction with unfavourable anatomy.
- Approximation of ureteric and caliceal urothelium and excision of renal parenchyma in the proximity to the anastomosis are the key steps for securing a satisfactory outcome.

KEYWORDS

ureterocalicostomy, children, pelvi-ureteric junction obstruction, pyeloplasty

INTRODUCTION

Although the Anderson–Hynes pyeloplasty is widely regarded as the operation of choice for the routine management of PUJ obstruction [1], there are occasional situations when it may be necessary to consider alternative techniques to achieve reliable drainage. Examples include recurrent PUJ obstruction [2,3] and PUJ obstruction associated with anatomical anomalies, notably horseshoe kidney [4] and traumatic damage to the PUJ or proximal ureter [2].

The use of ureterocalicostomy (anastomosis between the ureter and a dependent calyx) was first described in 1947 and attributed by Kay [5] to Neuwirt, although it was initially slow to gain acceptance because of a high stenosis rate. Subsequent to technical modification, however, it acquired a role in adult urological practice that is now well documented in the literature [6]. By contrast, there have been relatively few reports on the use of ureterocalicostomy in the paediatric age group. The present study aimed to evaluate the outcome of ureterocalicostomy as both a primary and salvage procedure within a single centre over a 12-year period. It was considered that the results obtained in the present study would support the use of such a procedure in carefully selected paediatric cases.

PATIENTS AND METHODS

The study comprised a detailed retrospective review of the clinical notes, radiology and laboratory investigations of all children who had had undergone ureterocalicostomy in our

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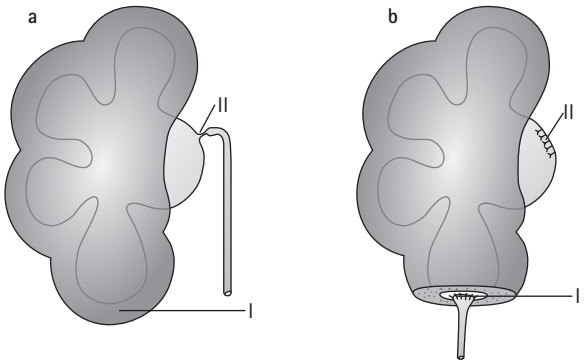
FIG. 1. ***a,*** *Anatomical features favouring ureterocalicostomy in preference to pyeloplasty. I Thinned cortex overlying dilated lower pole calyx. II: High insertion of PUJ or recurrent PUJ obstruction. Difficulty in ensuring reliable dependent drainage by conventional pyeloplasty.* ***b,*** *Key features of ureterocalicostomy. I: Exposure of lower pole calyx and excision of cortical tissue adjacent to the site of anastomosis. Tension-free anastomosis ensuring continuity of calyceal and ureteric urothelium. II: Closure of renal pelvis at the site of the original PUJ.*



centre during an arbitrary 12-year period (1997–2009). Particular attention was paid to the surgical indications, technical aspects of the procedure and clinical outcomes. Thirteen consecutive patients (five male, eight female) underwent ureterocalicostomy under the care of two consultant paediatric urologists at a mean (range) age of 9.3 (2.5–17.0) years.

Eight children presented symptomatically: two with recurrent urinary tract infections, three with flank/abdominal pain and three with a combination of pain and infection. In two children, the presence of obstruction came to light incidentally during CT scanning for haematuria after minor trauma and obstruction was identified incidentally in one child during the course of investigation of voiding dysfunction. In two children, asymptomatic recurrent PUJ obstruction was detected during the course of routine postoperative follow-up after previous pyeloplasty.

In eight of the 13 children (61%), ureterocalicostomy was performed as a primary procedure. In total, four children underwent ureterocalicostomy for PUJ obstruction in horseshoe kidneys and, in four children, it was performed as a primary procedure for PUJ obstruction associated with gross dilatation and unfavourable anatomy. This consisted of an intrarenal pelvis in all four children. In two cases, this was further complicated by high insertion of the ureter and, in a third case, by the presence of crossing vessels. In these four children, it was judged that a conventional pyeloplasty anastomosis at the level of the renal pelvis could not be relied upon to secure adequate dependent drainage. In five children (38%), ureterocalicostomy was performed as a secondary or 'salvage' procedure for recurrent PUJ obstruction following previous pyeloplasty. Two of these cases were referred to the senior authors after having previously undergone unsuccessful pyeloplasty performed by other surgeons.

The technique of ureterocalicostomy employed by both the senior authors was similar and comprised disconnection of the ureter from the renal pelvis and identification of the most dependent part of the lower pole calyx by instrumentation within the collecting system. The risk of fibrotic stenosis was minimized by ensuring that renal parenchyma was generously excised to expose a sizeable area of the lower pole calyx. A tension free anastomosis between the spatulated proximal ureter and opened calyx was then created using a 6-0 polydioxanone suture, with care being taken to ensure continuity between the two urothelial surfaces. A simplified illustration of this procedure is provided in Fig. 1.

In 12 children, ureterocalicostomy was performed as an open procedure via either a loin incision or, in the cases of horseshoe kidneys, by a limited transperitoneal approach, with reflection of the hepatic or splenic flexure. In one child, ureterocalicostomy was performed using a retroperitoneal laparoscopically-assisted technique with an operation duration of 170 min. Mean (range) operation duration for the 12 open procedures was 151 (80–240) min. In 11 patients, postoperative drainage consisted of indwelling JJ stents, which were introduced at the time of operation and removed endoscopically after a mean (range) interval of 6 (4–16) weeks. In two patients who had required percutaneous nephrostomy preoperatively, this form of drainage was maintained postoperatively in conjunction with a transanastomotic stent. The mean (range) duration of hospital admission was 5 (3–7) days; this value is skewed by four patients having problems with epidural analgesia and the need for postoperative i.v. antibiotics requiring monitoring.

RESULTS

No intra-operative complications were encountered and no children required additional early interventions, other than scheduled endoscopic removal of JJ stents.

The mean (range) duration of follow-up was 32 (3–84) months. Postoperative imaging with ultrasonography was routinely undertaken in all 13 children initially at a mean (range) of 7 (2–24) months and the findings on the most recently undertaken scans were evaluated for the purposes of the present study. The mean (range) time to the most recent scan was 42 (6–83) months. In 11 (85%) of the 13 patients, ultrasonography documented a reduction in anteroposterior renal pelvic diameter in the range 6–62 mm. In one patient, the renal pelvic anteroposterior diameter was not formally measured postoperatively but the overall ultrasonography appearances were improved. In the remaining child, postoperative ultrasonography showed increasing dilatation, which was accompanied by further symptoms of pain and infection related to anastomotic obstruction at the ureterocalicostomy.

Functional imaging with MAG3 was not undertaken routinely if clear evidence of substantially reduced dilatation was seen on postoperative ultrasonography. Thus, dynamic renography was not performed in four children with sonographic evidence of resolution or marked improvement in dilatation denoting successful relief of obstruction. However, function and drainage were assessed postoperatively by MAG3 studies in nine children at a mean (range) of 32 (6–83) months. In four of these children,

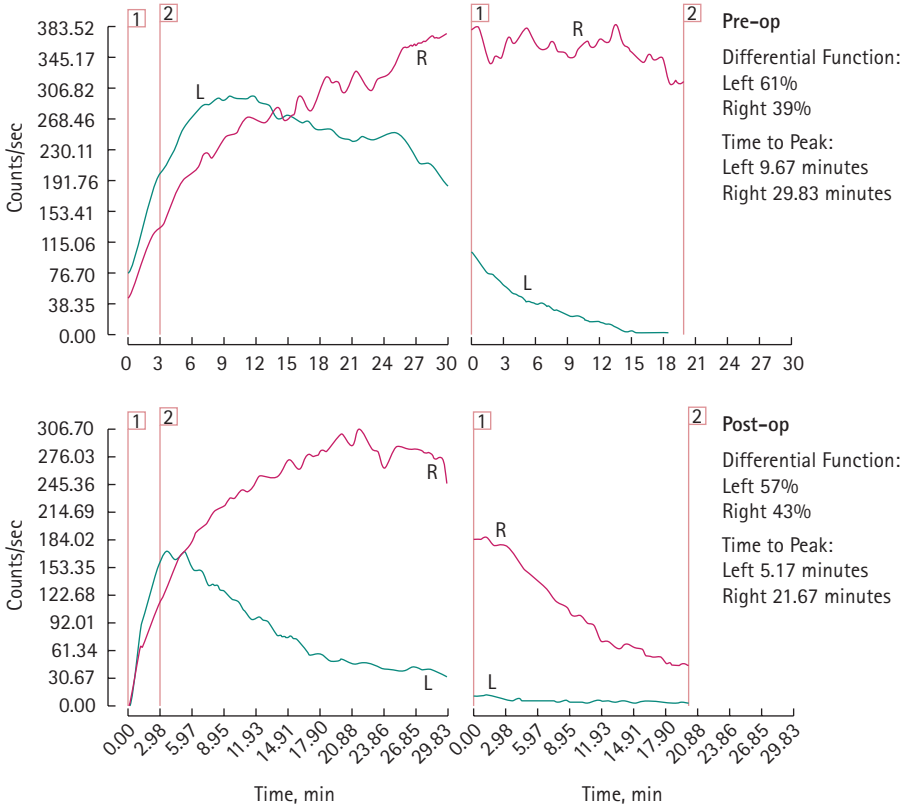
this was prompted by the presence of residual pelvic or caliceal dilatation. In addition, isotope renography was routinely performed as a precautionary measure in all five children who had undergone ureterocalicostomy for recurrent PUJ obstruction.

Evidence of improved drainage following ureterocalicostomy was observed in eight of the nine children who underwent postoperative imaging with MAG3 renography. In four of these eight patients, the improvement in drainage was associated with stable differential function in the affected kidney, whereas, in four patients, the improvement in drainage was also accompanied by a modest postoperative increase in differential function in the range 6–10% (Fig. 2).

Overall, 12 children (92%) experienced a good symptomatic and functional outcome following ureterocalicostomy with ultrasonography and/or isotope imaging, confirming satisfactory drainage and relief of obstruction.

As already noted, one child presented acutely with flank pain 5 months after undergoing primary ureterocalicostomy for horseshoe kidney. Imaging at this time showed increased renal pelvic and calyceal dilatation on ultrasonography coupled with evidence of obstructed drainage and functional deterioration on renography. Re-exploration identified an anastomotic stricture that was considered to be attributable to inadequate excision of parenchymal tissue adjacent to the anastomosis at the time of the original surgery. A more extensive clearance of lower pole parenchymal tissue was performed, the stricture was excised and the anastomosis was refashioned in a dependent position. Following re-exploration, this patient has remained asymptomatic during an additional 36 months of follow-up. The most recent ultrasonograph shows minimal residual dilatation and a renal pelvic anteroposterior diameter of 10 mm. Satisfactory drainage was subsequently confirmed by isotope renography, with a postoperative increase in differential function from 7% to 21%.

FIG. 2. Upper image: preoperative MAG3 in a 5-year-old girl presenting with gross right hydronephrosis. Obstructive drainage pattern with no washout after furosemide (differential function 39%). Lower image: postoperative MAG3, 8 months after primary ureterocalicostomy. Prompt washout after furosemide. Improvement in differential function (43%).



DISCUSSION

Kay [5] attributes the first published report in of ureterocalicostomy in 1947 to Neuwirt, who reportedly employed the technique in a grossly hydronephrotic kidney with thinned cortex. Subsequent efforts by other surgeons to reproduce Neuwirt's outcome met with varying success. For example, Jameson *et al.* [7] reported their experience of ureterocalicostomy in one patient with an intrarenal pelvis who developed recurrent obstruction as a result of a stricture within the lower pole tissue that had been left *in situ* at the time of the original operation. Hawthorne *et al.* [8] reported three patients of whom one required re-operation after developing intrarenal obstruction at the site of the anastomosis. In the light of their experience, Hawthorne *et al.* [8] modified their technique to excise the lower pole parenchyma, achieving good results using this modification in a further two patients. Mollard and Braun [4] described the successful use of ureterocalicostomy as a primary procedure in 14 children, of whom seven had horseshoe kidneys.

Kelalis [9] was subsequently instrumental in popularizing the procedure and highlighting the key technical aspects of success, namely extensive excision of lower pole tissue to expose the calyx and a stented non-circumferential anastomosis, with care being taken to ensure continuity between the urothelial lining of the ureteric lumen and the luminal surface of the opened calyx. Mesrobian and Kelalis [9] reported the use of ureterocalicostomy for a range of indications in a series of 21 children ranging in age from 6 months to 17 years. Nineteen of these patients had a decrease or elimination of hydronephrosis. There were, however, two patients with postoperative complications requiring further surgical intervention: one requiring stent insertion for prolonged urinary drainage with anastomostic leakage and the other requiring treatment of a Candida perinephric abscess causing ureterovesical junction obstruction on the ipsilateral side to the ureterocalicostomy.

Sarhan *et al.* [2] recently reported their experience in ten children, with an overall success rate (as evident on isotope renography) of 80% at a mean follow-up of 18 months. Two patients in their series (20%) required nephrectomy for recurrent obstruction and loss of function.

In the series of 13 children in the present study, obstruction was successfully relieved by ureterocalicostomy in 12, with one child requiring re-operation (i.e. a success rate of 92%). The child who underwent a second ureterocalicostomy subsequently experienced a successful outcome with good preservation of renal function. The findings at operation at the time of redo ureterocalicostomy (circumferential extrinsic compression by fibrosed parenchymal tissue) highlight the importance of achieving adequate excision of surrounding lower pole tissue before anastomosis. No child in the present series required nephrectomy.

Ureterocalicostomy can be considered the operation of choice for the management of most cases of recurrent PUJ obstruction as a result of scarring and stenosis at the site of a previous pyeloplasty. In the series reported by Mesrobian and Kelalis [9], recurrent PUJ obstruction was the indication for ureterocalicostomy in ten (48%) of their 21 paediatric cases. Although the series with recurrent PUJ obstruction reported by Selli *et al.* [3] consisted mainly of adults, it did include one child who experienced a successful outcome following ureterocalicostomy. Rohrmann *et al.* [10] reported the use of ureterocalicostomy for recurrent PUJ obstruction in three children, with the same number being reported by Thomas *et al.* [11]. In our series, recurrent PUJ obstruction accounted for five patients (38%), all of whom experienced a satisfactory outcome, with resolution or improvement in dilatation and improved drainage in those patients in whom renography was performed.

In addition to its role as a salvage procedure, ureterocalicostomy may offer distinct advantages over conventional Anderson–Hynes pyeloplasty for the primary surgical management of PUJ obstruction, notably for obstruction secondary to complicating anatomical anomalies of the kidney, such as horseshoe kidney. In this anomaly, the aberrant vasculature and the interconnecting isthmus of parenchyma may make it difficult to create an anastomosis capable of ensuring dependent drainage. Other anatomical barriers to adequate drainage include an intrarenal pelvis and upper ureteric stenosis, for which ureterocalicostomy has been successfully employed in the management of these rare causes of upper tract obstruction, as reported in small numbers by Jameson *et al.* [7] and Duckett and Pfister [12]. The study by Mesrobian and Kelalis [9] of 21 patients included ten patients who underwent ureterocalicostomy for anatomical limitations of the renal unit. Of these, three patients had an intrarenal pelvis and one had stenosis of the proximal ureter, whereas one had infundibulopelvic stenosis. On the basis of their experience, however, Mesrobian and Kelalis [9] cautioned against the use of ureterocalicostomy for infundibular stenosis. The remaining five patients had anomalies of fusion or ascent, including horseshoe systems.

Ureterocalicostomy is a versatile operation and, in addition to the indications described above, its use has also been reported for the management of renal avulsion as a result of trauma by Hawthorne *et al.* [8] and by Moloney [13]. Other reported indications include renal transplant salvage [14] and renal sparing surgery in transitional cell carcinoma [3]. The series recently reported by Sarhan *et al.* [2] includes the use of ureterocalicostomy in four children who had either sustained iatrogenic injury to the proximal ureter or iatrogenic avulsion of the ureter.

Although initially introduced into adult urological practice, laparoscopic and robotic pyeloplasty is now becoming firmly established within paediatric urological practice. It is likely that the minimally invasive techniques being developed for the management of recurrent obstruction and anatomical variants in adults will also be adapted for use in children. Gill *et al.* [15] reported two cases of recurrent PUJ obstruction in adults that were successfully managed by minimally invasive ureterocalicostomy. Casale *et al.* [16] published a series of nine children managed by transperitoneal robotic ureterocalicostomy. Six of these patients underwent ureterocalicostomy as a secondary procedure post failed pyeloplasty, two of which were found to have initially missed crossing vessels as a cause for obstruction. A primary procedure was performed in three children who all had an exaggerated intrarenal collecting system preventing conventional surgery. Ultrasonographic assessment of all nine patients was performed at 3 months after stent removal and showed persistent severe dilatation. However, diuretic renography performed 12 months postoperatively showed no significant deterioration in function. The present series included one child (aged 5 years) in whom uretercalicostomy was successfully performed using a retroperitoneoscopically assisted technique in which the retroperitoneal space was created and the PUJ and lower pole mobilized endoscopically. The ureter was divided from within, and the anastomosis was performed externally by extending the incision.

In conclusion, the experience reported in the present study endorses the role of ureterocalicostomy as a versatile and reliable means of relieving obstruction for a variety of indications in children, including horseshoe kidney, recurrent PUJ obstruction and gross PUJ obstruction with unfavourable anatomy. Approximation of ureteric and caliceal urothelium and excision of renal parenchyma in the proximity to the anastomosis are the key steps for securing a satisfactory outcome. With increasing experience of laparoscopic renal surgery in children, it is likely that, in future, ureterocalicostomy will be increasingly performed by a minimally invasive technique.

CONFLICT OF INTEREST

None declared.

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Abbreviations: **PUJ**, pelvi-ureteric junction; **CT**, computed tomography; **MAG3**, mercapto acetyl triglycine.