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PREDICTORS OF SURGICAL OUTCOME FOLLOWING PYELOPLASTY IN CHILDREN WITH URETEROPELVIC JUNCTION OBSTRUCTION: A CASE SERIES

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ABSTRACT:
Background: Ureteropelvic junction obstruction (UPJO) is a common cause of upper urinary tract obstruction in children and may present with antenatally detected hydronephrosis, urinary tract infection, abdominal symptoms, or impaired renal function. Pyeloplasty remains an established surgical treatment for relieving obstruction and preserving renal function.
Case Series: This case series describes the clinical experience of a tertiary-care centre in managing 11 children with UPJO who underwent pyeloplasty. The individual cases demonstrated a varied spectrum of presentation and anatomical findings, including antenatal detection, unilateral hydronephrosis, severe renal pelvic dilatation, cortical thinning, reduced differential renal function, lower-polar crossing vessels, and duplex renal anatomy with lower-moiety obstruction. Laparoscopic Anderson–Hynes dismembered pyeloplasty was the predominant surgical procedure, while open pyeloplasty was performed in selected cases. Postoperative clinical and radiological follow-up was undertaken to assess resolution of obstruction and identify complications or recurrence. Most children had an uncomplicated postoperative course and satisfactory follow-up findings. One child developed recurrent obstruction following primary pyeloplasty and subsequently underwent redo pyeloplasty with repeat stenting.
Conclusion: This case series reflects the varied clinical and anatomical presentations of paediatric UPJO encountered in a tertiary-care setting. Pyeloplasty provided satisfactory outcomes in the majority of cases. Careful preoperative assessment, appropriate selection of surgical technique, recognition of anatomical variations, and structured postoperative follow-up are important for successful management of children with UPJO.

KEYWORDS: Ureteropelvic junction obstruction; Pyeloplasty; Children; Hydronephrosis; Renal function.

INTRODUCTION

DUreteropelvic junction obstruction (UPJO) is one of the most important causes of upper urinary tract obstruction and hydronephrosis in children and represents the most common cause of prenatally diagnosed hydronephrosis. The condition results from impaired drainage of urine from the renal pelvis into the proximal ureter and may arise from intrinsic narrowing at the ureteropelvic junction, abnormal peristalsis, or extrinsic compression by crossing vessels [1]. The clinical spectrum is broad, ranging from asymptomatic antenatally detected hydronephrosis to urinary tract infection, abdominal or flank pain, palpable abdominal mass, progressive hydronephrosis, and deterioration of renal function. The natural history is variable, with some children demonstrating spontaneous improvement or resolution, whereas others develop progressive obstruction and renal functional impairment, making appropriate evaluation and follow-up essential [2].
The increasing use of antenatal ultrasonography has resulted in the identification of many children with UPJO before the development of symptoms. Postnatal ultrasonography is central to the initial assessment and provides information regarding the degree of hydronephrosis, renal pelvic anteroposterior diameter, renal parenchymal thickness, and associated urinary tract abnormalities. When clinically indicated, diuretic renography provides functional information regarding differential renal function and urinary drainage and is particularly useful when the severity or functional significance of obstruction remains uncertain [3]. Management therefore requires an individualized assessment incorporating the severity and progression of hydronephrosis, renal morphology, differential renal function, symptoms, urinary tract infections, and serial imaging findings rather than relying on a single parameter [4].
Pyeloplasty is the established surgical treatment for clinically significant UPJO and aims to remove the obstructed segment and establish unobstructed drainage while preserving renal function. The Anderson–Hynes dismembered pyeloplasty is widely used because it permits excision of the abnormal ureteropelvic junction and re-anastomosis of the ureter to the renal pelvis. With advances in minimally invasive surgery, laparoscopic pyeloplasty has become an important alternative to open surgery in children, offering comparable effectiveness with the advantages associated with

minimally invasive approaches [5]. Comparative evidence has demonstrated that laparoscopic and open pyeloplasty have similar surgical success, while laparoscopic surgery may be associated with a shorter hospital stay [6].

Although pyeloplasty generally produces favourable outcomes, individual children may present with complex anatomical and functional abnormalities that influence management. Crossing lower-polar vessels may produce extrinsic compression of the ureteropelvic junction and are an important intraoperative finding that can influence the reconstructive approach. Crossing vessels are not restricted to older children and may also be encountered in infants and young children, emphasizing the importance of careful intraoperative assessment [7]. Similarly, UPJO may occasionally occur in association with anatomical variations such as duplex collecting systems, in which obstruction may involve a particular renal moiety and require individualized surgical reconstruction [8].

Renal functional status is another important consideration in children with UPJO. Reduced differential renal function may reflect longstanding obstruction, but impaired function does not necessarily imply irreversible renal damage. Evidence suggests that a proportion of poorly functioning kidneys can demonstrate functional recovery following relief of obstruction, supporting renal-preserving surgery in appropriately selected children [9].

Despite the availability of extensive outcome data, individual case presentations remain valuable because paediatric UPJO encompasses a heterogeneous group of patients with different ages at presentation, anatomical variations, degrees of hydronephrosis, renal functional impairment, and operative findings. The present case series therefore describes the experience of managing children with UPJO who underwent pyeloplasty, highlighting their individual clinical presentations, radiological characteristics, operative findings, postoperative courses, and follow-up outcomes.

2.Case series

Patient 1

A 7-year-old male child presented with progressive enlargement of the renal pelvis detected on antenatal and subsequent imaging follow-up. He had no documented urinary tract infection and no palpable renal mass. The child was clinically evaluated for progressive renal pelvic dilatation. Ultrasonography of the abdomen demonstrated dilatation of the left renal pelvis, measuring approximately 3.3 cm, compared with 1.4 cm on the right side. The renal cortical thickness was reported as normal. Preoperative ultrasonographic evaluation supported the diagnosis of left-sided ureteropelvic junction obstruction (UPJO).

The child underwent an open left Anderson–Hynes dismembered pyeloplasty with placement of a left DJ stent. No intraoperative complication or crossing vessel was documented. The postoperative course was uneventful, and the child remained hospitalized for 4 days. The DJ stent was subsequently removed, and follow-up was planned at 1 month, 6 months, and 1 year. Postoperative imaging was performed and did not demonstrate a documented postoperative complication. The child did not require reintervention. The case represents a successfully managed left-sided UPJO in an older child with preserved renal cortical thickness.

Patient 2

A 1-year-old male child presented with progressive enlargement of the right renal pelvis following antenatal detection of the abnormality. The child had a history of urinary tract infection and examination revealed a palpable right kidney. Preoperative evaluation was performed with an EC scan, which demonstrated right-sided UPJO with differential renal function of 60% in the right kidney and 40% in the left kidney. The right renal pelvic anteroposterior diameter was approximately 1.5 cm, while the renal cortical thickness was reported as normal.

The child underwent diagnostic cystoscopy and retrograde pyelography followed by laparoscopic right Anderson–Hynes dismembered pyeloplasty with right DJ stenting. No intraoperative complication or crossing vessel was documented. The postoperative hospital stay was 7 days. The DJ stent was subsequently removed, with follow-up planned at 1 month, 6 months, and 1 year. Postoperative imaging was performed and no postoperative complication or recurrent obstruction was documented. The child did not require reintervention. This case demonstrates successful laparoscopic management of right-sided UPJO in a young child with preserved differential renal function despite a history of urinary tract infection.

Patient 3

A 3-month-old female infant presented with progressive enlargement of the renal pelvis following antenatal detection of left-sided UPJO. There was no documented urinary tract infection. Clinical examination revealed a palpable left kidney. Preoperative EC scan demonstrated left-sided UPJO, with differential renal function of 42% in the left kidney and 58% in the right kidney. The left renal pelvic anteroposterior diameter was approximately 2.4 cm, while renal cortical thickness was reported as normal.

The infant underwent open left Anderson–Hynes dismembered pyeloplasty with placement of a left DJ stent. No crossing vessel or intraoperative complication was documented. The postoperative hospital stay was 6 days. The DJ stent was subsequently removed, and follow-up was planned at 1 month, 6 months, and 1 year. Postoperative imaging was performed without documentation of recurrent obstruction or other postoperative complication. No reintervention was required. The case highlights successful open pyeloplasty in a young infant with antenatally detected left UPJO and preserved differential renal function.

Patient 4

A 1-year-old male child with antenatally detected right-sided UPJO presented with progressive enlargement of the right renal pelvis. There was no documented urinary tract infection, and no palpable renal mass was noted on clinical examination. Preoperative EC scan demonstrated right-sided obstruction, with differential renal function of 45% in the

right kidney and 55% in the left kidney. The right renal pelvic anteroposterior diameter measured approximately 3.0 cm. Renal cortical dimensions were documented as 6.2 × 5.6 × 6.2 mm.
The child underwent laparoscopic right Anderson–Hynes dismembered pyeloplasty with right DJ stenting. No crossing vessel or intraoperative complication was documented. The child had an uncomplicated postoperative course and remained hospitalized for 6 days. The DJ stent was subsequently removed, and follow-up was planned at 1 month, 5 months, and 1 year. Postoperative imaging did not demonstrate a documented complication, and no reintervention was required. This case represents successful laparoscopic correction of right UPJO in a young child with preserved differential renal function.

Patient 5
A 5-month-old male infant with antenatally detected right-sided UPJO presented with progressive enlargement of the renal pelvis. There was no documented urinary tract infection, although a palpable right kidney was noted clinically. Preoperative EC scan demonstrated a right renal pelvic anteroposterior diameter of approximately 2.0 cm, compared with 0.8 cm on the left. Renal cortical thickness was reported as normal. Differential renal function was 47% in the right kidney and 53% in the left kidney.
The child underwent laparoscopic right Anderson–Hynes dismembered pyeloplasty with right DJ stenting. A lower-polar crossing vessel was identified intraoperatively and was documented as the principal intraoperative finding. No other intraoperative complication was reported. The postoperative hospital stay was 8 days. The DJ stent was subsequently removed, with follow-up planned at 1 month, 6 months, and 1 year. Postoperative imaging was performed and no postoperative complication or recurrent obstruction was documented. The child did not require reintervention. This case illustrates successful laparoscopic pyeloplasty in an infant with UPJO associated with a lower-polar crossing vessel.

Patient 6
A 3-year-old female child with antenatally detected right-sided UPJO presented with progressive enlargement of the right renal pelvis. There was no documented urinary tract infection and no palpable renal mass. Preoperative EC scan demonstrated right-sided UPJO, with differential renal function of 45% in the right kidney and 55% in the left kidney. The right renal pelvic anteroposterior diameter was approximately 2.3 cm, and renal cortical thickness was reported as normal.
The child underwent laparoscopic right Anderson–Hynes dismembered pyeloplasty with right DJ stenting. An associated right inguinal hernia was identified intraoperatively. No crossing vessel was documented. The postoperative course was satisfactory, with a hospital stay of 5 days. The DJ stent was subsequently removed, and follow-up was planned at 1 month, 6 months, and 1 year. Postoperative imaging was performed without documented recurrent obstruction or other postoperative complication. No reintervention was required. This case demonstrates successful laparoscopic management of right UPJO in a preschool-aged child with an associated inguinal hernia identified during surgery.

Patient 7
A 5-year-old male child presented with abdominal pain and was subsequently evaluated for left-sided UPJO. Unlike most of the other children in the series, the condition was not detected antenatally. There was no documented urinary tract infection. Examination revealed a palpable left kidney. Preoperative EC scan demonstrated marked left renal pelvic dilatation measuring approximately 4.3 cm, with a markedly reduced differential renal function of 16% in the left kidney compared with 84% in the right kidney. The renal cortex at the mid-pole was reported to be approximately 3 mm in thickness, indicating significant cortical thinning.
The child underwent laparoscopic left Anderson–Hynes pyeloplasty with left DJ stenting. A lower-polar crossing vessel was identified intraoperatively. The postoperative hospital stay was 10 days. The DJ stent was subsequently removed, and follow-up was planned at 1 and 6 months. Postoperative imaging was performed and no postoperative complication or recurrent obstruction was documented. No reintervention was required. This case is notable for delayed symptomatic presentation with marked pelvic dilatation and substantially reduced differential renal function, yet a satisfactory postoperative outcome following laparoscopic pyeloplasty.

Patient 8
A 2-month-old male infant with antenatally detected left-sided UPJO presented with progressive enlargement of the renal pelvis. The child had urinary tract infection at presentation and a palpable left kidney. Preoperative EC scan demonstrated severe left renal pelvic dilatation measuring approximately 5.4 cm, the largest recorded renal pelvic diameter in the series. The renal cortex was reported as thinned out. Differential renal function was markedly reduced, with 28% contribution from the left kidney compared with 72% from the right kidney.
The infant underwent laparoscopic left Anderson–Hynes pyeloplasty with left DJ stenting. No crossing vessel or intraoperative complication was documented during the primary procedure. The initial postoperative hospital stay was 9 days. During follow-up, postoperative imaging demonstrated recurrent obstruction. Because of the recurrent obstruction, the child underwent diagnostic laparoscopy followed by redo left pyeloplasty with repeat left DJ stenting. Subsequent follow-up documented postoperative imaging, and no further reintervention was recorded in the available master chart. This was the only case in the series to develop recurrent obstruction requiring secondary surgical intervention. The case highlights the clinical importance of severe preoperative pelvic dilatation, cortical thinning, urinary tract infection, and reduced differential renal function in a very young infant.

Patient 9
A 2-year-2-month-old male child presented with abdominal distension and was diagnosed with left-sided UPJO. The condition was not documented as antenatally detected. There was no urinary tract infection and no palpable renal mass. Preoperative EC scan demonstrated left renal pelvic dilatation measuring approximately 1.5 cm. The renal cortex was reported as thinned out. Differential renal function was 44% in the left kidney and 56% in the right kidney.
The child underwent laparoscopic left Anderson–Hynes dismembered pyeloplasty with left DJ stenting. No crossing vessel or intraoperative complication was documented. The postoperative hospital stay was 5 days. The DJ stent was subsequently removed, with follow-up planned at 1 and 6 months. Postoperative imaging was performed and no postoperative complication or recurrent obstruction was documented. No reintervention was required. This case demonstrates successful laparoscopic correction of left UPJO in a child presenting beyond infancy with abdominal distension and relatively preserved differential renal function.

Patient 10
A 2-month-old male infant with a left duplex renal system and ureteropelvic junction obstruction involving the lower moiety was identified following antenatal detection of progressive renal pelvic enlargement. There was no documented urinary tract infection and no palpable renal mass. Preoperative EC scan demonstrated differential renal function of 40% in the left kidney and 60% in the right kidney. Within the left kidney, the upper moiety contributed 68% and the lower moiety 32% of the left renal function. The left renal pelvic anteroposterior diameter was approximately 2.3 cm, and the renal cortex was reported as thinned out.
The child underwent diagnostic cystoscopy and retrograde pyelography followed by laparoscopic left lower-moiety pyeloplasty with left DJ stenting. Intraoperatively, a duplex left kidney was identified with narrowing involving the lower moiety, while the upper moiety was reported to be normal. No crossing vessel was documented. The postoperative hospital stay was 5 days. The DJ stent was subsequently removed, and follow-up imaging was planned at 1 month. Postoperative imaging did not demonstrate a documented complication, and no reintervention was required. This case highlights the importance of recognising associated duplex renal anatomy and appropriately addressing obstruction involving the affected moiety.

Patient 11
A 1-year-1-month-old male child with antenatally detected left-sided UPJO presented with urinary tract infection. Preoperative EC scan demonstrated left renal pelvic dilatation measuring approximately 2.0 cm. The renal cortex was reported as thinned out. Differential renal function showed 37% contribution from the left kidney and 63% from the right kidney. No palpable renal mass or crossing vessel was documented.
The child underwent laparoscopic left Anderson–Hynes dismembered pyeloplasty with left DJ stenting. No intraoperative complication was documented. The postoperative course was uncomplicated, and the child remained hospitalized for 4 days. The DJ stent was subsequently removed, and follow-up was planned at 1 and 6 months. Postoperative imaging was performed, with no documented recurrent obstruction or other postoperative complication. No reintervention was required. This case represents successful laparoscopic management of left-sided UPJO in a young child presenting with urinary tract infection and reduced differential renal function.

3.DISCUSSION
Ureteropelvic junction obstruction (UPJO) is an important cause of obstructive uropathy in children, and Anderson–Hynes dismembered pyeloplasty remains the standard reconstructive treatment for clinically significant obstruction. The present tertiary-care case series included 11 children with UPJO who underwent primary pyeloplasty. The cohort demonstrated a male predominance, with 9 males (81.8%) and 2 females (18.2%), while 7 children (63.6%) had left-sided and 4 (36.4%) had right-sided disease. Antenatal detection was documented in 9 children. The mean preoperative anteroposterior renal pelvic diameter (APD) was 2.73 ± 1.21 cm, and the mean affected-side differential renal function (DRF) was 40.4 ± 11.8%. Nine children underwent laparoscopic Anderson–Hynes pyeloplasty and two underwent an open approach. Overall, 10 children (90.9%) achieved a successful composite surgical outcome, whereas one child (9.1%) developed recurrent obstruction requiring redo pyeloplasty.
The favourable outcome observed in the present series is consistent with the findings of Salem et al., [10] evaluated 100 pyeloplasties in 98 children aged 5 days to 16 years. In their study, drainage half-times improved in 98% of patients, and only 1 patient required reoperation. Renal function improved by more than 5% in approximately one-third of patients in each age group, remained stable in 68% of kidneys, and decreased in only one kidney. Among kidneys showing functional improvement, 77% had impaired preoperative renal function of 40% or less. Importantly, regression analysis identified preoperative DRF as the only statistically significant predictor of postoperative renal functional improvement. These observations are relevant to our case series because the only child with an unfavourable outcome had a relatively reduced preoperative DRF of 28%. However, unlike Salem et al., our sample was too small to establish DRF as an independent predictor.
Our predominance of laparoscopic surgery is comparable with the experience of Maheshwari et al., [11] reported 82 paediatric patients undergoing laparoscopic pyeloplasty. Their mean age was 7.12 years, with an age range of 4 months to 15 years and a male-to-female ratio of 4.3:1. Dismembered pyeloplasty was performed in 70 patients, while Foley Y-V plasty was performed in 12. The mean operative time was 151 minutes, mean blood loss was 88.01 mL, and mean hospital stay was 5.05 days (range 2–11 days). Conversion to open surgery was required in 4 patients (4.87%). Follow-up renograms were available for 74 patients; drainage improved in 69 (93.2%), while 5 demonstrated an obstructed

pattern. Two patients underwent redo pyeloplasty, and the overall success rate at a mean follow-up of 41.58 months was 91.89%. The success rate of 90.9% in our series is therefore very similar to the 91.89% reported by Maheshwari et al., despite the much smaller number of patients in our series. Our mean hospital stay of 6.3 ± 2.0 days was also broadly comparable with their reported 5.05 days.

The results of Sweeney et al. [12] further support the high effectiveness of laparoscopic pyeloplasty in children. Their retrospective study included 112 children who underwent transperitoneal laparoscopic pyeloplasty between November 2001 and June 2009. The mean age was 9.4 years, with a range of 0.2–20.5 years, and mean follow-up was 15.3 months. There was one conversion to open surgery. The mean operative time was 254 minutes, and one minor intraoperative complication (0.8%) was reported. Twelve patients (10.8%) developed postoperative complications, most of which were minor and resolved without long-term sequelae. Postoperative ultrasonography was available for 102 patients, of whom 99 (97%) demonstrated improvement. Three patients (3%) had persistent symptomatic or radiographic obstruction requiring adjunctive procedures, including laser endopyelotomy in two and redo open pyeloplasty in one. The overall success rate among completed laparoscopic procedures was 97.2%. The slightly lower success rate in our series, 90.9%, may reflect the very small sample size and the presence of one particularly severe infant case.

The comparative effectiveness of laparoscopic and open pyeloplasty was evaluated by Mei et al. [13] in a systematic review and meta-analysis. Their review identified 1,403 studies, of which one randomized controlled trial, two prospective comparative studies and six retrospective observational studies met the eligibility criteria. The pooled analysis included 694 laparoscopic cases and 7,334 open cases. Open pyeloplasty had a significantly shorter operative time than laparoscopic pyeloplasty, with a weighted mean difference of 59.00 minutes (95% CI 41.15–76.85; $P < 0.00001$). Open surgery also had a higher stent-placement rate (OR 5.97, 95% CI 3.17–11.26; $P < 0.00001$). In contrast, laparoscopic pyeloplasty was associated with a shorter hospital stay (WMD −0.40 days, 95% CI −0.77 to −0.03; $P = 0.03$). No significant difference was found in postoperative complications (OR 0.78, 95% CI 0.46–1.34; $P = 0.37$) or surgical success (OR 1.76, 95% CI 0.71–4.36; $P = 0.22$). In our series, both open and laparoscopic approaches were successfully used, although the small sample does not permit meaningful comparison between approaches.

Renal functional recovery after pyeloplasty was specifically investigated by Li et al., [14] prospectively enrolled 95 children with unilateral UPJO treated between March 2019 and March 2020. Postoperative assessment was performed at 6 months. They defined DRF improvement as an increase of at least 5% when preoperative DRF was below 55%, or a reduction of at least 5% to the normal 45–55% range when preoperative DRF was above 55%, together with improvement in drainage. In their cohort, 28 patients (29.5%) demonstrated improvement in postoperative DRF, whereas 67 patients (70.5%) maintained stable DRF. On univariable analysis, sex, age, baseline DRF, APD, minimum and maximum renal parenchymal thickness, and APD/maximum parenchymal thickness ratio were associated with DRF improvement. On multivariable analysis, maximum parenchymal thickness and APD/maximum parenchymal thickness ratio were independent predictors of improvement in postoperative DRF. This finding is particularly relevant to our series because the only failure case had marked pelvic dilatation of 5.4 cm, cortical thinning and DRF of 28%. In our cohort, the failure case had a larger APD than the successful cases (5.4 cm vs 2.3 cm median) and lower DRF (28% vs 44% median).

The importance of crossing vessels is highlighted by Zhao et al., [15] retrospectively evaluated 747 children undergoing primary surgery for UPJO. They identified 90 cases of crossing vessels. The overall crossing-vessel detection rate was significantly higher with laparoscopic surgery than with open surgery: 78/457 (17.1%) versus 12/290 (4.1%), $P < 0.001$. Among children aged ≤3 years, crossing vessels were identified in 27/144 (18.8%) laparoscopic cases compared with 11/274 (4.0%) open cases ($P < 0.001$). Within the laparoscopic group, the detection rate was similar between children ≤3 years (18.8%) and those >3 years (16.3%), indicating that crossing vessels are not confined to older children. In our series, lower-polar/crossing vessels were documented in 2 of 11 children (18.2%), a proportion remarkably close to the 17.1% laparoscopic detection rate reported by Zhao et al. This supports the importance of careful identification of crossing vessels during laparoscopic pyeloplasty.

The major limitation of this case series was the small sample size of 11 patients, with only one case of recurrence, which limited the ability to draw definitive conclusions regarding independent predictors of surgical failure. In addition, the single-centre observational design and relatively limited follow-up may restrict the generalisability of the findings. Nevertheless, the study was strengthened by its prospective tertiary-care case-series approach with detailed clinical, radiological, operative, and postoperative assessment, providing a comprehensive description of the spectrum of paediatric UPJO encountered in routine clinical practice. Future multicentre studies involving larger patient populations and longer follow-up are warranted to further evaluate the predictive value of preoperative APD, renal cortical thickness, differential renal function, crossing vessels, and clinical presentation for postoperative recurrence and renal functional recovery following pyeloplasty.

CONCLUSION

Pyeloplasty was found to be an effective surgical treatment for children with ureteropelvic junction obstruction in this tertiary-care case series. The majority of children showed satisfactory postoperative outcomes following surgical correction, with laparoscopic Anderson–Hynes dismembered pyeloplasty being the commonly used approach. The cases also demonstrated that paediatric UPJO can present with varied anatomical and functional characteristics, including severe hydronephrosis, cortical thinning, reduced renal function, crossing vessels, and duplex renal anatomy. Careful preoperative assessment and appropriate surgical planning, together with regular postoperative imaging and functional follow-up, are important for identifying recurrent obstruction and ensuring optimal long-term renal outcomes.

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