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Original article

Morphological and functional outcome of dismembered pyeloplasty in children with unilateral ureteropelvic junction obstruction

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KEYWORDS
Children;
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Split renal function

Abstract

Objective: To evaluate the morphological and functional outcome of dismembered pyeloplasty in children with unilateral ureteropelvic junction obstruction (UPJO).

Patients and methods: We retrospectively reviewed the medical records of all children subjected to dismembered pyeloplasty in the department of urology at Al-Azhar University hospitals between January 2004 and December 2011. The preoperative data included the personal history and imaging. Furthermore, the details of surgery and the postoperative course were evaluated. Only children with primary unilateral UPJO were included in this study. Preoperative radiological assessment included renal ultrasonography, magnetic resonance urography (MRU) and diuretic renography for all patients. All cases showed hydronephrosis with an obstructive renal pattern. Dismembered pyeloplasty (Andersen-Hynes) was performed via an open or laparoscopic approach. All cases were followed up clinically and radiologically at regular intervals for the assessment of both morphological and functional outcome. Success was defined as both symptomatic relief and radiographic resolution of obstruction at the last follow-up visit.

Results: During the study period, 83 children were subjected to dismembered pyeloplasty for the treatment of UPJO. Two thirds of the cases were boys. The median age was 4 years (range: 2 months to 17 years). Mean follow-up was 53 (range 14–96) months. The overall success rate was 94% with success being defined as stability or improvement of split renal function (SRF) with no further symptoms. Secondary procedures were needed in 5 patients (6%) showing deterioration of SRF. One patient underwent redo pyeloplasty, whereas endopyelotomy was done in 4 cases. In the remaining 77 patients (94%), radiological follow-up revealed stability or improvement of SRF with no further symptoms. Postoperative diuretic renography showed

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normal drainage in 52 (62.7%) and prolonged drainage in 31 cases (37.3%). Stability or improvement of hydronephrosis was seen in 75 (90.4%) cases.
Conclusion: Dismembered pyeloplasty is a safe and effective treatment of UPJO in children, not only relieving obstruction but also improving renal function.

Introduction

Ureteropelvic junction obstruction (UPJO) is one of the most common pathologies in pediatric urology. It is the most common cause of hydronephrosis in children. Anderson-Hynes dismembered pyeloplasty is the standard procedure performed for management of UPJO, either via an open or laparoscopic approach [1]. The advance of antenatal ultrasonography has resulted in earlier and more frequent diagnosis of hydronephrosis [2]. Diuretic renography providing information on split renal function (SRF) and renal drainage is of great importance for the diagnosis and follow-up of UPJO [3].

In the present study, we evaluated the morphological and functional outcomes of dismembered pyeloplasty for the management of unilateral UPJO in children over a period of 8 years.

Patients and methods

We retrospectively reviewed the clinical charts of all patients subjected to dismembered pyeloplasty in the department of urology at Al-Azhar University hospitals between January 2004 and December 2011. The data evaluated were the age at presentation, the gender, the presenting symptoms, the affected side, the results of preoperative imaging, the surgical details and the postoperative course. Ethical approval was obtained from the urology department ethical committee.

Only cases of primary unilateral UPJO were included in this study. We excluded cases of UPJO in a solitary kidney, cases with bilateral UPJO and recurrent cases. Preoperative radiological assessment included renal ultrasound, magnetic resonance urography (MRU) and diuretic renography for all patients.

Diethylene triaminepentaacetic acid (DTPA) scans were performed preoperatively and 6 months after pyeloplasty to evaluate renal drainage and function. Drainage was classified as good if T1/2 was <20 min; fair if T1/2 was >20 min and the drainage curve was descending; or poor if T1/2 could not be counted and there was an increasing drainage curve [4].

Kidney function was classified as good when SRF was ≥40%, or poor when it was <40%. A reduction of SRF of more than 5% of the previous value was considered as deterioration, an increase of more than 5% was defined as improvement, and changes within 5% were considered as preservation [5].

In this study, we classified the degree of hydronephrosis according to the classification of the Society for Fetal Urology (SFU), with grade (0) indicating a normal kidney with an intact renal sinus, grade (1) indicating a slightly dilated renal pelvis without caliectasis, grade (2) indicating a moderately dilated renal pelvis with mild caliectasis, grade (3) indicating a large renal pelvis and dilated calices, and grade (4) indicating a large renal pelvis with large dilated calices. An improvement of hydronephrosis was defined as a reduction by at least 1 SFU grade [6].

All patients showed hydronephrosis of the affected side on both ultrasound and MRU or intravenous urography (IVU). In addition, all patients had an obstructive renal pattern on DTPA scans.

Anderson-Hynes dismembered pyeloplasty was performed via an open or a laparoscopic approach. The transperitoneal approach was only used for the laparoscopic procedure. An internal stent was placed. A perinephric drain and a Foley catheter were placed in all patients. The Foley catheter was removed on post-operative day 3 or 4. The perinephric drain was removed on the following day, provided the drain output remained low. The internal stent was removed cystoscopically under general anesthesia 4–6 weeks after surgery.

The patients were followed up clinically and radiologically at regular intervals. Follow-up examinations included serial ultrasound, diuretic renography and MRU for the assessment of both the morphological and functional outcome. Success was defined as both symptomatic relief and radiographic resolution of obstruction at the last follow-up visit.

The data were collected and processed using SPSS, version 19 (SPSS Inc., Chicago, IL, USA). Univariate analysis was used to assess the possible prognostic factors for the success of pyeloplasty by Chi-square test. Values of $P < 0.05$ were considered as statistically significant.

Results

During the study period, 83 children were surgically treated for UPJO in our institution. Two thirds of the cases were boys. All our patients were submitted to dismembered pyeloplasty (Andersen-Hynes). Their median age at the time of surgery was 4 years (range: 2 months to 17 years). The patients' characteristics are summarized in Table 1.

A perioperative complication in the form of persistent leakage occurred in one case due to slippage of the stent and was managed by DJ stenting.

Mean follow-up was 53 (range 14–96) months.

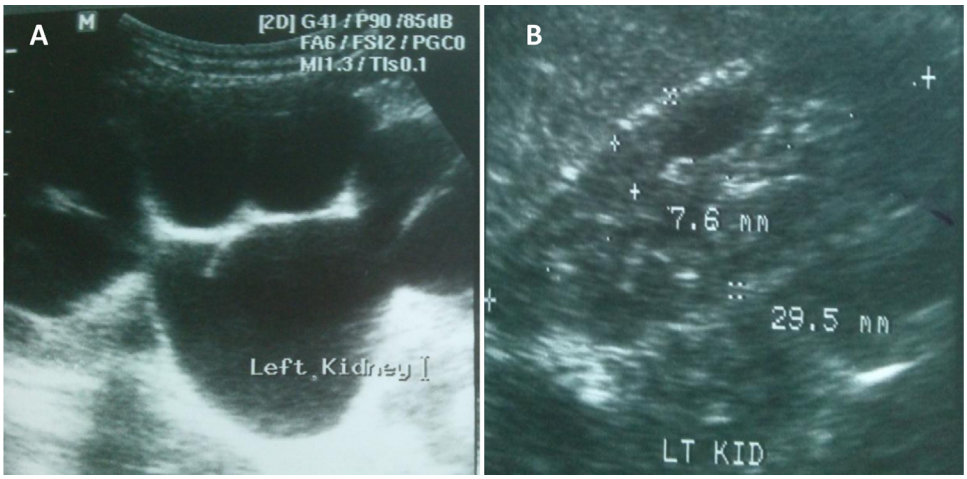

Figure 1 (A) Preoperative U.S. of Left kidney of male child 3 years old showing a grade 5 hydronephrosis. (B) Post operative U.S. with grade 2 hydronephrosis.

The overall success rate was 94%. Secondary procedures were needed in 5 patients (6%) who had developed deterioration of SRF. One of them underwent redo pyeloplasty, whereas endopyelotomy was needed in 4 cases. The other 77 (94%) patients showed stability or improvement of SRF with no further symptoms. Postoperative diuretic renography showed normal drainage (T1/2 < 20 min) in 52 (62.7%) and prolonged drainage (T1/2 > 20 min) in 31 (37.3%) cases.

Postoperative renal ultrasonography (Fig. 1) provided information on an improvement of renal parenchymal thickness and the grade of renal hydronephrosis according to the SFU grading system (Table 2). The MRU findings were similar to those of ultrasonography, but MRU was superior in the determination of morphology (Figs. 2 and 3).

Table 1 The patients' characteristics of 83 renal unites.

Variables	No. of renal unites (%)
Gender	
Boys	55
Girls	28
Age	
4 years (range: 2 months until 17 years)	
Affected side	
Left	52 (62.7)
Right	31 (37.3)
Presentation	
Antenatal diagnosis	23 (27.7)
Abdominal pain	25 (30.1)
UTI	14 (16.9)
Palpable abdominal mass	7 (8.4)
Hematuria	1 (1.2)
Accidentally discovered	13 (15.7)
SFU grade of hydronephrosis	
Grade 3	22 (26.5)
Grade 4	61 (73.5)
Split renal function SRF (%)	
32 ± 12.1 (range 7–63)	
Parenchymal thickness (mm)	
Mean 8.2 ± 2.6. Range from 2 to 15 mm	
Operative method	
Open	69 (83.1)
Laparoscopic	14 (16.9)

SFU, the Society for Fetal Urology.

According to the findings on renography, postoperative SRF improved in 53 patients (63.9%), remained stable in 25 (30.1%), and deteriorated in 5 cases (6%). The degree of SRF improvement ranged from 2 to 23%. Postoperative renal drainage improved in 52 patients (62.7%), remained stable in 23 (27.7%) and deteriorated in 8 (9.6%) (Figs. 4 and 5).

The degree of hydronephrosis deteriorated in 8 (9.6%) cases but improved or was preserved in 75 (90.4%) cases. The renal parenchyma deteriorated in 10 (12%) cases (Table 2). The postoperative changes found on renal ultrasound and diuretic renography are presented in Table 2.

When correlating SRF to diuretic obstruction, none of the 52 patients with normal diuretic excretion had a worsened SRF, whereas 19/31 (22.9%) patients with persistent diuretic obstruction (T1/2 > 20 min) had an improved SRF and all patients with deteriorated SRF had persistent diuretic obstruction (Fig. 6).

When studying the effects of the patients' age, the affected side, clinical presentation, ultrasound findings and preoperative SRF on the functional outcome of dismembered pyeloplasty, no statistical significant correlation was found between these factors and the success of pyeloplasty (Table 3).

Discussion

UPJO is the most common cause of pediatric obstructive uropathy. The advance of antenatal and early postnatal sonography has resulted in a marked increase in the diagnosis of UPJO [2].

The surgical treatment for UPJO today includes laparoscopic pyeloplasty, open pyeloplasty, endopyelotomy, endopyeloplasty and robot-assisted laparoscopic pyeloplasty. Open pyeloplasty is the standard procedure for UPJO in infants, while laparoscopic pyeloplasty is the treatment of choice in older children and adults [7].

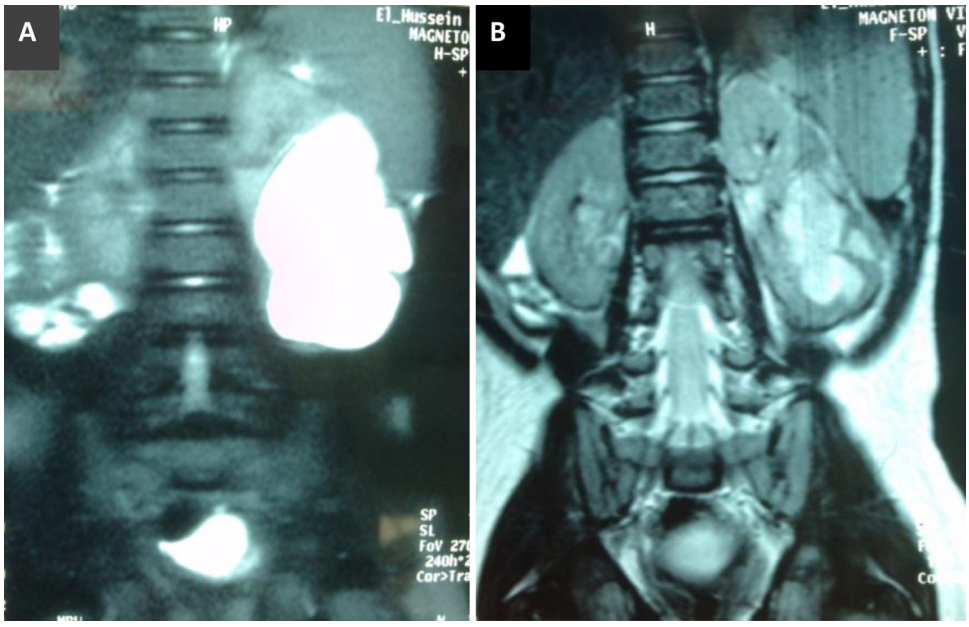

Figure 2 (A) Preoperative MRU coronal image in male 5 years old showing marked hydronephrosis of the left kidney with huge renal Pelvis. (B) Postoperative MRU coronal image showing a significant reduction in hydronephrosis, with preserved renal parenchyma 1 year after pyeloplasty.

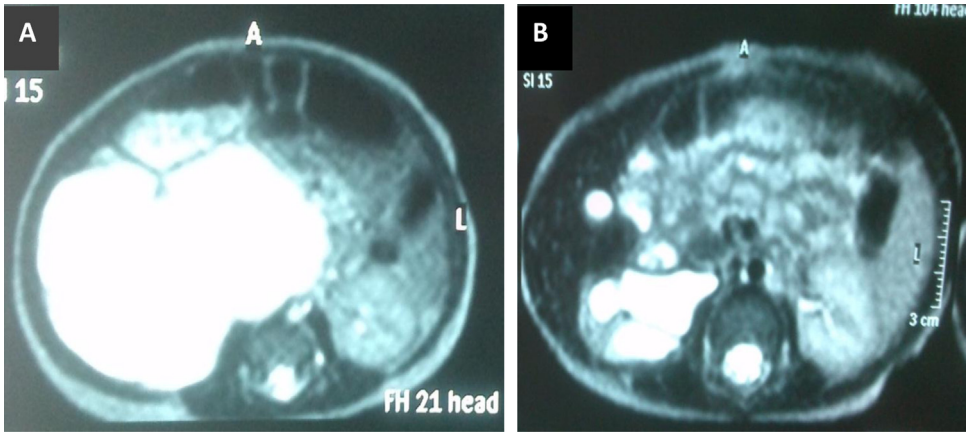

Figure 3 (A) Preoperative MRU axial image in male child 2 month old showing marked hydronephrosis of the right kidney with huge renal pelvis occupying most of the abdomen and crossing the vertebral column. (B) Postoperative MRU axial image showing a significant reduction in the hydronephrosis, 9 months after pyeloplasty.

The aim of surgical treatment is to improve urinary drainage from the dilated collecting system [8], but also to prevent deterioration of renal function and to relieve the pain [9].

In our study, the patients were classified into two age groups to verify the effect of age on the outcome of surgery. Group (A) included children aged below one year and group (B) children aged one year and above. No significant differences in the outcome of surgery were found between the two age groups ($P = 0.08$).

Most studies analyzing the effect of age at surgery on final SRF showed that age does not affect the eventual functional outcome for both prenatal and postnatal hydronephrosis [5,10–15]. Only Chandrasekharam et al. in their study reported that symptomatic patients

Table 2 Postoperative changes in renal US and diuretic renography of 83 renal unites.

	Improvement, *n* (%)	Preservation, *n* (%)	Deterioration, *n* (%)
Parenchymal thickness	39 (47)	34 (41)	10 (12)
Degree of hydronephrosis	47 (56.6)	28 (33.8)	8 (9.6)
Split renal function SRF	53 (63.9)	25 (30.1)	5 (6)
Renal drainage	52 (62.7)	23 (27.7)	8 (9.6)

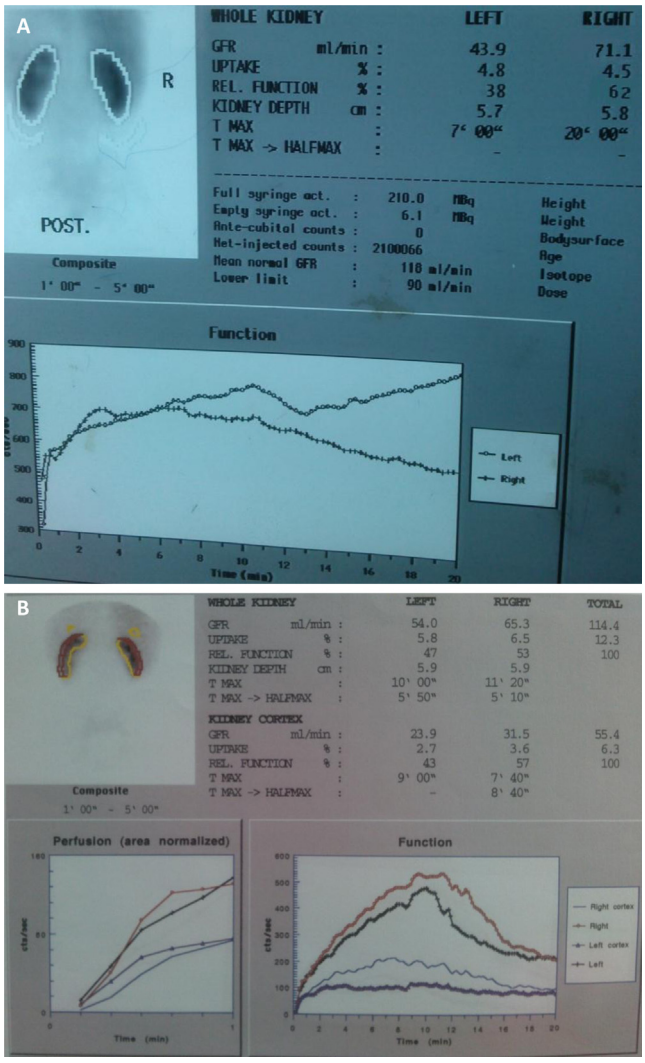

Figure 4 (A) Preoperative diuretic renography of male child 5 years old showing impaired excretion and an obstructed curve of the left kidney. (B) Postoperative diuretic renography showing a reduction in kidney size and improved SRF with nonobstructed drainage.

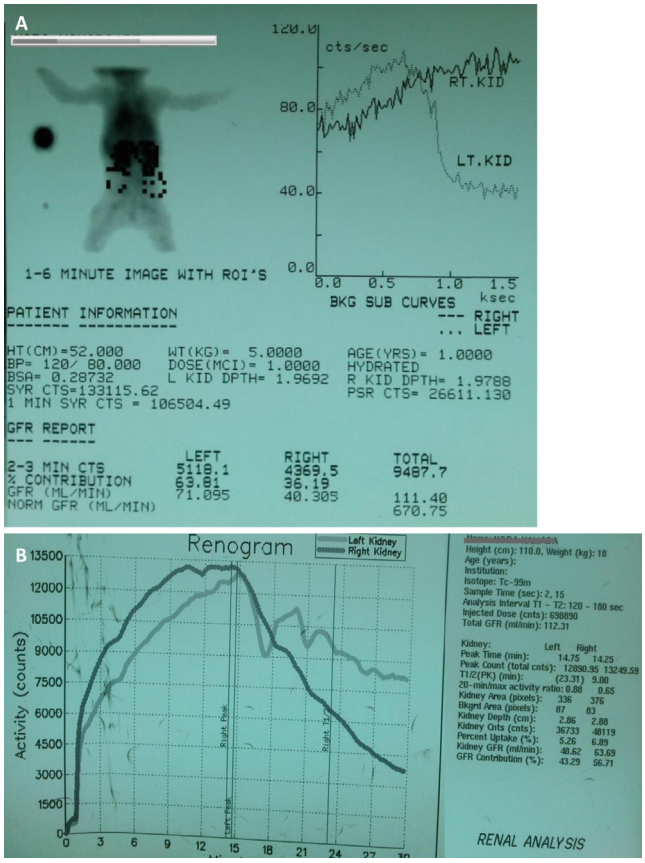

Figure 5 (A) Preoperative diuretic renography of female child 4 months old showing impaired excretion and an obstructed curve of the right kidney. (B) Postoperative diuretic renography of the same patient after 4 years showing improved SRF with better function than other kidney with nonobstructed drainage.

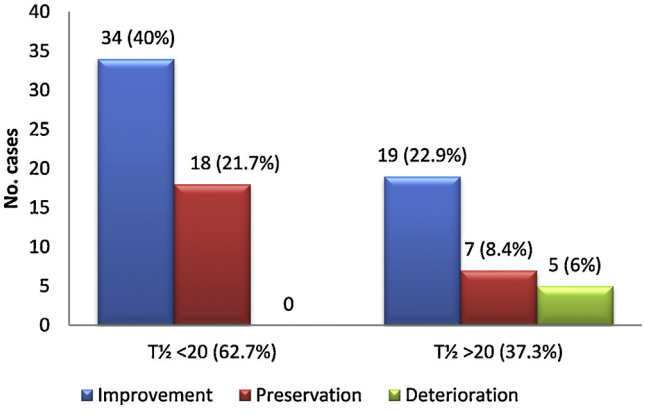

Figure 6 Changes in split renal function according to urinary drainage after 6 months.

who underwent surgery before 1 year of age had significantly better final average SRF (45%) than those operated on at the age of 1–5 years (38%) and those above 5 years (31%) [16].

Regarding the effect of presenting symptoms on the outcome of surgery, our study revealed that the outcome of surgery was not affected by presenting symptoms ($P = 0.30$). In one report, there was a significantly higher frequency of functional improvement in symptomatic patients, but the clinical presentation was not a significant predictor [5]. Others confirmed the lack of correlation between presenting symptoms and the functional outcome [17]. Among symptomatic patients, a significant improvement was found in patients presenting with a mass [16], while Calisti et al. found a more significant improvement in patients with crossing vessels. Those patients had a better improvement, but had the same final SRF as the asymptomatic cases [18].

We found that the outcome of surgery in our study was not affected by the degree of preoperative hydronephrosis ($P = 0.96$). Neither the anteroposterior pelvic diameter [10,14] nor the parenchymal thickness [14] or the degree of dilatation according to the SFU classification [13,15,19] were predictors of functional outcome. Konda et al. showed that the grade of hydronephrosis correlated with the severity of renal cortical damage measured on DMSA scan, but not with postoperative SRF [20].

Table 3 Univariate analysis of preoperative factors in relation to the functional outcome of 83 renal unites.

	Deterioration of SRF		*P*-value
	Yes	No	
Age group			
<1 year	1	25	0.084
≥1 year	4	53	
Affected site			
Left side	3	49	0.408
Right side	2	29	
Presentation			
Antenatal diagnosis	1	22	0.300
Abdominal pain	2	23	
UTI	1	13	
Palpable abdominal mass	1	6	
Hematuria	0	1	
Accidentally discovered	0	13	
SFU grade of hydronephrosis			
Grade 3	1	21	0.963
Grade 4	4	57	
Parenchymal thickness (mm)			
<5	2	15	0.103
≥5	3	63	
Pre-operative SRF (%)			
<30	2	35	0.873
≥30	3	43	

We found that preoperative SRF is not a predictor of functional outcome ($P = 0.873$). Similarly, Capolicchio et al. and McAleer and Kaplan found that preoperative SRF was no predictor of functional outcome, regardless of the prenatal or postnatal diagnosis. They reported a similar degree of recovery in patients with an initial SRF of >40% or <40% [17,21]. However, others claim that preoperative SRF is the only predictor of renal function after surgery [5,13].

Chiou et al., in their prospective series, reported that only patients with an initial SRF of 35–40% improved significantly after surgery. Hence, in their experience, a SRF < 35% had a 100% sensitivity and positive predictive value for a poorly preserved renal outcome [22].

In our study SRF significantly improved after pyeloplasty. It improved in 63.9% of our patients, remained stable in 30.1% and deteriorated in 6%. We considered the cases with decreased post-operative SRF as failed cases, although a decrease in SRF may be due either to deterioration of the operated kidney or to contralateral compensation [3].

There are many reports that report a significant improvement of renal function after pyeloplasty [23,24]. According to Harraz et al. the improvement of renal function persisted 3–5 years after surgery and even until puberty [25].

Renal obstruction is usually diagnosed by prolonged drainage on the DTPA diuretic renogram. As for postoperative renal drainage, renal T1/2 improved in 62.7% of our patients, while the kidney remained obstructed in 37.3% of the patients. Nevertheless, an impaired renal drainage should not be used as a sign of obstruction in children with unilateral hydronephrosis [26].

In our study, 47% of the renal units showed an improvement, 41% no change and 12% a decrease in parenchymal thickness. The change in parenchymal thickness did not affect the outcome ($P = 0.103$). Baek et al. reported that renal parenchymal thickness did not significantly change in patients with giant or non-giant hydronephrosis after pyeloplasty [27].

In our study, a perioperative complication in the form of post-operative urine leakage due to spontaneous early stent migration developed in one patient only on the 2nd postoperative day, and the patient underwent JJ stent fixation. No late postoperative complications were encountered, however recurrence of UPJO occurred in 5 cases (6%). The failure was proved by progressing hydronephrosis and deterioration of SRF. Four cases underwent endopyelotomy and one case underwent revision of pyeloplasty.

Tal et al. studied 103 cases of dismembered pyeloplasty in children and reported that 31.1% of their patients developed fever and 12.6% had documented urinary tract infection (UTI). Leakage was found in 7.8% of their patients [28]. On the other hand, Sarhan et al., studied 526 cases of primary UPJO subjected to open dismembered pyeloplasty with no reported perioperative complications [4]. Nerli et al. performed 102 laparoscopic pyeloplasties, and postoperative complications including prolonged ileus, prolonged urinary leak, fever, hematuria and recurrent UPJ stenosis occurred in 11.65% of their patients. Recurrent UPJ stenosis occurred in 4.9% of the children, resulting in reoperation [29].

Gupta and Sharma performed 329 open pyeloplasties, and the post-operative complications included slippage of the stent in 11, blockage/non-drainage in 7, difficult retrieval in 4, urine leak in 4, infection in one and urinoma in 3 patients [30].

In our study, Anderson Hynes pyeloplasty, either via the open or laparoscopic approach, resulted in a success rate of 94% which is comparable to most studies in the literature. Eskild-Jensen et al. reported that pyeloplasty was successful in treating symptoms, and an improvement of renal dilatation and the excretion pattern was found in up to 95% of their patients [31]. Calvert et al. reported a 96% success rate of laparoscopic pyeloplasty and a 98% success rate of open pyeloplasty in 100 patients [32]. In other reports, the success rates of laparoscopic dismembered pyeloplasty were 95.2% and 96.2% [33,34].

Conclusion

Dismembered pyeloplasty is a safe and effective treatment of UPJO in the pediatric population, not only providing relief of obstruction but also improvement of renal function. It remains the treatment of choice for this patient group in our department.

Conflict of interest

None.

Acknowledgments

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