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Research Article

Can pyeloplasty restore normal renal function in patients with severe unilateral ureteropelvic junction obstruction and DRF<35%

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ABSTRACT

Purpose: To assess the outcome of successful pyeloplasty in infants with ureteropelvic junction obstruction and Differential Renal Function (DRF)<35% to determine whether they can attain normal postoperative renal function or not.

Methods: All children diagnosed with antenatal hydronephrosis due to UPJO presented to our institutions were prospectively followed up. Pyeloplasty was performed based on predefined indications such as initial DRF ≤ 40%, progression of hydronephrosis, and recurrent UTI. A total of 173 children who had successful surgical intervention due to impaired DFR, were divided according to their pre intervention DRF value as follows: DRF<35% (group I) and DRF 35-40% (group II). The renal morphology and function changes were recorded and used for comparison between both groups.

Results: Group I comprised 79 patients, and group II included 94 patients. Pyeloplasty achieved significant improvement in the anatomical and functional indices in both groups (p-value<0.001). The degree of improvement in APD and cortical thickness was comparable in both groups (P-value, 0.64 and 0.44 respectively). While the improvement in the DRF was significantly higher in group I (16.06 ± 6.6) than in group II (6.25 ± 2.66), (P-value<0.001). Despite that, a significantly higher percentage of infants in group II (61.7%) achieved normal final DRF compared with only (10.1%) in group I (P-value<0.001).

Conclusion: Even in badly affected renal function (<35%) pyeloplasty can recover a significant part of lost renal function, however, most of those patients do not achieve normal postoperative renal function.

Keywords: Antenatal hydronephrosis, Ureteropelvic junction obstruction, Differential renal function, Pyeloplasty, Surgical intervention

Abbreviations: ANH: Antenatal Hydronephrosis; APD: Anteroposterior Diameter; DFR: Differential Renal Function; DTPA: Diethylenetriamine Pentaacetate; SFUG: Society for Fetal Urology Grade; UTI: Urinary Tract Infection; UPJO: Uretero Pelvic Junction Obstruction; VUR: Vesico Ureteral Reflux

INTRODUCTION

With the widespread use of antenatal routine ultrasound examinations, Antenatal Hydronephrosis (AHN) has become a common problem, affecting about 5% of pregnancies [1]. Ureteropelvic Junction Obstruction (UPJO) is by far the most common cause of neonatal hydronephrosis [2]. Several lines of management exist for prenatally diagnosed hydronephrosis due to UPJO [3]. In mild cases, conservative management is usually sufficient [4,5].

Indications for surgical intervention included initial low (<40%) Differential Renal Function (DRF), deterioration of DRF by more than 5 or 10%, or progressive increase in the degree of hydronephrosis during conservative follow up [6-9]. Pyeloplasty is considered the gold standard procedure for the management of pelvic ureteric junction obstruction, however in those patients who had badly affected renal function (DRF <35%) achieving normal postoperative renal function may be questioned, so in our study, we have evaluated the value of pyeloplasty in those patients [10].

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MATERIALS AND METHODS

All infants born with antenatal hydronephrosis due to UPJO presented to our institutions (Sohag university hospitals and Abu El Reesh Japanese children's hospital) between January 2018 and January 2022 were followed prospectively. The initial evaluation of those patients included ultrasonography at the end of the first week of life to confirm the diagnosis, and the results were graded according to the SFUG, then radionuclide evaluation with 99 mTc-DTPA at 6-8 weeks postnatal. All patients who required surgical intervention due to impaired DFR either early (after the initial evaluation) or later on after a period of follow up were included in the study. Patients who had bilateral disease, solitary functioning kidney, associated high grade VUR, or any other urological anomalies were excluded. Patients who had failed intervention requiring reoperation (5 patients) were also excluded from the study.

The age, sex, and side of the affected kidney were recorded. Those who had initial DRF ≤ 40% or clinical complications e.g., febrile UTI were managed by early pyeloplasty after the initial evaluation, and those who had initial DRF>40% were followed prospectively. Ultrasonography was performed every month. Radionuclide was repeated with a progressive increase in APD on two consecutive examinations during follow-up of conservatively treated patients. For those who had initial nonoperative management, conservation was terminated when there was either; progressive worsening in the degree of hydronephrosis on 2 consecutive examinations, a decline in DRF by ≥ 10%, or development of complications like recurrent UTI. Prophylactic antibiotic (amoxicillin) was prescribed for patients with high grade hydronephrosis (SFUG 3-4) till the age of 1 year or till the time of pyeloplasty if indicated.

All patients who required intervention (n=214) received standard dismembered pyeloplasty at our institutions by our paediatric urology team, and then underwent repeated evaluations, including ultrasonography at 3 and 6 months following surgery and DTPA diuretic renography at 6 months postoperatively as routine follow up after pyeloplasty [11]. Success was defined as; improved renal morphology on ultrasonography along with stable renal function and patent drainage on follow up diuretic renography [12].

Patients were assigned into 2 groups according to their preoperative DRF values as follows: DRF<35% (group I) and DRF 35-40% (group II). Patients who had surgical intervention due to causes other than impaired DFR (45 patients) were excluded from the statistical analysis (32 due to progression of hydronephrosis and 13 due to recurrent UTI). The impact of pyeloplasty on preoperative ultrasonographic parameters and DRF was evaluated in both groups. The change (improvement) in APD, cortical thickness, and DRF were estimated 6 months postoperatively and used for comparison between both groups. Finally, patients were assigned into 3 categories according to their final DFR, normal (≥ 45 %), borderline (35-44%), and impaired (<35%) [13,14].

Statistical analysis

Data were shown as the mean ± standard deviation and frequency with percentages. Outcomes were compared using the Wilcoxon test and Mann-Whitney test as data were not normally distributed. All values of $p<0.05$ were accepted as statistically significant. SPSS version 26 was used for statistical analysis.

RESULTS

Our study included 173 infants, assigned into 2 groups: Group I (79 patients), and group II (94 patients). The mean age at pyeloplasty was 3.32 ± 2.07 months in group I and 6.18 ± 4.2 months in group II. The left kidney was involved in 45 children in group I and 58 children in group II, and the right kidney was involved in 34 children in group I and 36 children in group II. Group I included (50 males and 29 females), while group II included (83 males and 11 females). The demographics and clinical characteristics of both groups are summarized in Table 1.

Table 1. Demographic and clinical characteristics of the groups.

Variable	No. of patients (%)		P-value
	Group 1 (n =79)	Group II (n=94)	
Gender			
Male	50 (63.3%)	83 (88.3%)	< 0.001
Female	29 (36.7%)	11 (11.7%)	
Affected side			
Right	34 (43%)	36 (38.3%)	0.173
Left	45 (57%)	58 (61.7%)	
Baseline creatinine (mg/dl)	0.44 ± 0.15	0.46 ± 0.14	0.274
Mean age at pyeloplasty (months)	3.32 ± 2.07	6.18 ± 4.2	<0.001

Significant differences have been observed between the pre and post operative anatomical and functional indices in both groups as summarized in (Tables 2 and 3). No significant difference in the improvement of the APD and cortical thickness after pyeloplasty at the 6 months follow up was observed between groups I and II (p-value 0.64 and 0.44 respectively). While the improvement in DRF was significantly different between both groups (p<0.001). The mean DRF improvement in group I (16.06 ± 6.6) was higher than that of group II (6.25 ± 2.66). All patients had improved postoperative drainage patterns. Results

are summarized in (Table 4).

Table 2. Pre and post operative anatomical and functional criteria for group 1.

	Pre operative	**Post operative**	**P-value**
APD (mm)	40.34 ± 12.11	13.66 ± 5.1	<0.001
Cortical thickness	4.6 ± 1.98	7.73 ± 1.27	<0.001
SFU grade			
SFUG 1	0 (0%)	34 (43)	<0.001
SFUG 2	0 (0%)	40 (50.6%)	
SFUG 3	20 (25.3%)	5 (6.3%)	
SFUG 4	59 (74.7%)	0	
DRF	18.45 ± 9.1	34.51 ± 8.01	<0.001

Table 3. Pre and post operative anatomical and functional criteria for group 2.

	Pre operative	**Post operative**	**P-value**
APD (mm)	37.85 ± 13.4	10.1 ± 4.5	<0.001
Cortical thickness	5.39 ± 1.67	8.1 ± 0.97	<0.001
SFU grade			
SFUG 1	0 (0%)	63 (67%)	<0.001
SFUG 2	0 (0%)	29 (30.9%)	
SFUG 3	41 (43.6%)	2 (2.1%)	
SFUG 4	53 (56.4%)	0 (0%)	
DRF	38.34 ± 1.79	44.59 ± 2.93	<0.001

Table 4. The change in renal morphology and DRF after the operation in both groups.

	Group I	**Group II**	**P-value**
Change in APD after the operation (mm)	26.68 ± 11.48	27.75 ± 10.8	0.64
Change in cortical thickness after the operation (mm)	3.1 ± 2.13	2.76 ± 1.56	0.44
Change in DRF after the operation (%)	16.06 ± 6.6	6.25 ± 2.66	<0.001

The final DRF outcomes of both groups were subdivided into 3 categories: Normal (≥ 45%), borderline (36-44%), and impaired (<35%). According to the final DRF at the 6 months follow up, the improvement of the DRF to normal values occurred in a significantly higher number of patients in group II (61.7%), while only 8 patients (10.1%) improved to normal values in group I (p<0.001). Data are summarized in Table 5 and Figure 1.

Table 5. Post operative DFR categories.

	Group I	**Group II**	**P-value**
Normal (≥ 45%)	8 (10.1%)	58 (61.7%)	<0.001
Borderline (35-44%)	33 (41.8)	36 (38.3%)	
Impaired (<35%)	38 (48.1%)	0	

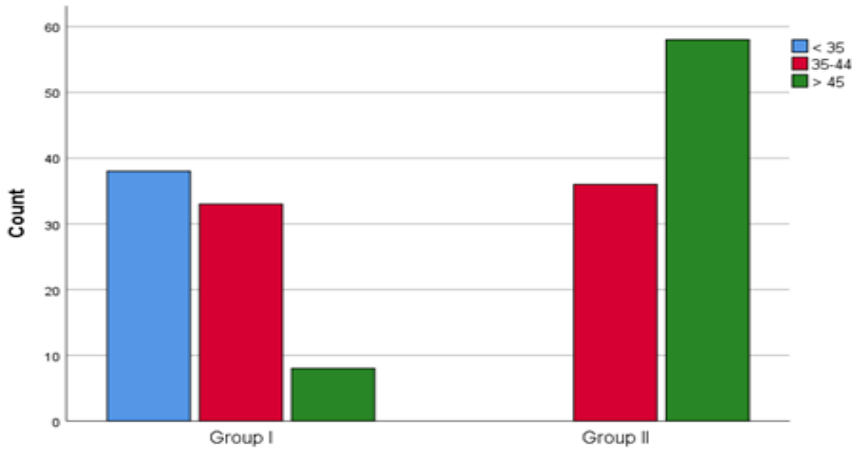

Figure 1. DFR categories.

DISCUSSION

Anderson-Hynes dismembered pyeloplasty is considered the gold standard procedure for the management of UPJO with a success rate of about 95% [15,16]. However, infants with severely impaired initial DFR had a minor probability of achieving a normal postoperative function. As we are studying the effect of the successful intervention on renal function recoverability, we have excluded failed cases (5 patients) from the analysis as we have mentioned before.

Most of our interventions were done early, the mean age at pyeloplasty was 3.32 ± 2.07 months in group I and 6.18 ± 4.2 months in group II. Both groups have shown significant improvement in the morphologic and functional indices at 6 months postoperatively. Kim, et al. also supported this and reported that early pyeloplasty can significantly recover the affected renal parenchymal thickness. Also, Chandrasekharam, stated that infants who had early pyeloplasty (at age<1 year) with functional affection due to asymptomatic unilateral UPJO had functional improvement and a better prognosis [17].

In our study, the improvement of the APD and cortical thickness after pyeloplasty at the 6 months follow up was comparable in both groups, with no statistically significant difference between them (p-value 0.64 and 0.44 respectively). While the improvement in DRF was significantly higher in group I than in group II ($p<0.001$). Our explanation for this difference is that the preoperative DRF (18.45 ± 9.1) was lower in group I, which allowed for greater improvement in those patients with marked recovery when an obstruction was corrected by pyeloplasty. However, in group II, the preoperative DRF (38.34 ± 1.79) was higher, which did not permit much improvement. Therefore, in group II, pyeloplasty has led to minor functional recovery, but it prevented further deterioration in the renal function. Our results were consistent with what was reported who compared patients with DRF values of (30-35%) and from (35 to 40%). In addition, reported similar findings among patients who had DRF values of below 30% and from 30 to 40% [18].

A DRF value of ≥ 45% has been defined as “normal” by many authors. In our series, we have assigned patients according to their final DRF into 3 categories: Normal, borderline, and impaired. We have found that significantly more patients ($p <0.01$) achieved normal function in group II (61.7%) than in group I (10.1%) at 6 months after pyeloplasty, as also reported. The ability of the kidney to achieve normal postoperative function was largely dependent on its initial function. Severe preoperative impairment may decrease the likelihood of renal function recovery to normal values. In this study, one interesting observation was that, after pyeloplasty, patients with an initial DRF below 35% showed rapid improvement in renal function, so pyeloplasty is still a valuable option for them.

As most of the studies discussing this topic were retrospective, the strengths of our study included the prospective nature of the study that allowed for a standardized single follow up protocol for all patients. On the other hand, our main limitation was the short duration of follow up as our results are based on 6 months of postoperative evaluation.

CONCLUSION

Even in badly affected renal function (DFR<35%) pyeloplasty can recover a significant part of lost renal function, however, most of those patients do not achieve normal postoperative renal function and parents should be counseled about that before intervention.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest regarding the publication of this paper.

ETHICAL APPROVAL

The work was approved by our faculty of medicine ethics committee.

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