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Role of Renal Parenchymal Thickness and Renal Isotope Scan in Predicting Outcome After Pyeloplasty in Children with Ureteropelvic Junction Obstruction (UPJO)

Mohamed Shawkey El-Desoukey, Salem Ahmed Khalil, Emad Abdelhamid Salem, Mohamed Mahmoud Seleem
Department of Urology, Faculty of Medicine, Zagazig University, Sharkia, Egypt
***Corresponding author:** Mohamed Shawkey El-Desoukey, **Mobile:** (+20)01141314881, **Email:** mohcoldzero11@gmail.com

ABSTRACT

Background: Pelviureteric junction obstruction (PUJO) is the most common cause of pediatric hydronephrosis.
Objective: To find the relation of renal parenchymal thickness & isotope scan preoperatively & postoperatively in predicting outcome after pyeloplasty.
Patients and Methods: This prospective study included, 30 children ≤ 18 years, with 1ry unilateral UPJO from September 2018 to September 2019 were included in the study. Ultrasound abdomen was done on all patients to look at the size of the kidney, parenchymal thickness & renal echogenicity. DTPA scan was done to measure the GFR, t½ and split function of each kidney & all patients underwent open pyeloplasty. Patients were followed up after the operation at 1, 3, and 6 months respectively. At each follow-up visit, U/S was performed & renal isotope was done at the 6th month. The preoperative parameters were compared with the same parameters after surgical repair of the UPJO at 3rd & 6th months.
Results: In our study, there was an improvement in (83.3%) with a significant change in all parameters at 6th months postoperatively ($P < 0.01$) as T ½ significantly decreased while parenchymal thickness, GFR of the affected kidney & split renal function were significantly increased postoperatively.
Conclusions: This study showed that parenchymal thickness and renal isotope are good predictors for pyeloplasty outcome.
Keywords: Pelviureteric junction obstruction, Renal parenchymal thickness, Renal isotope scan.

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is the commonest cause of pediatric hydronephrosis occurring in 1 in 1000-2000 live births [1].

UPJO is defined as an obstruction to the flow of urine from the kidney to the proximal ureter that results in renal damage and symptoms [2]. The Gold standard surgical treatment for UPJO is Anderson Hynes (AH) dismembered pyeloplasty with or without surgical reduction of the renal pelvis. However, and regardless of the employed technique, the pyeloplasty should results in a dependent, tension-free, anastomosis with meticulous attention to the vascularity, which relieves the obstruction and is also expected to help in functional improvement [3].

There are certain parameters to assess the postoperative outcomes of pyeloplasty. The ultrasound parameters are the reduction in the AP diameter of the pelvis and an increase in parenchymal thickness in a growing kidney. The definitive evidence of improved function is by doing an isotope renogram in the follow-up period, objectively to look for the improvement in GFR (glomerular filtration rate) and also the radiotracer clearance from the PCS (pelvicalyceal system) [4].

This study aimed to find the relation of renal parenchymal thickness and isotope scan preoperatively & postoperatively in predicting outcome after pyeloplasty.

PATIENTS AND METHODS

A prospective study was conducted in the Department of Urology, Outpatient Clinic, Zagazig University Hospital from September 2018 to September 2019 including a total of 30 children ≤ 18 years with 1ry unilateral UPJO.

Ethical Considerations:

Written informed consent was obtained from the patient caregivers to participate in the study. **The approval for the study was obtained from the Urology Departments of Zagazig University Hospitals after the approval of the Institutional Review Board (IRB).** The work was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria were: Children ≤ 18 years who did a pyeloplasty for unilateral 1ry pelviureteric junction obstruction (UPJO) in which the diagnosis of UPJO was made using US parameters & renal isotope scan.

Exclusion criteria were: Children with renal anomalies associated with UPJO, ureteral anomalies associated with UPJO, bilateral UPJO, redo pyeloplasty, 2ry cause of UPJO, renal impairment (GFR ≤ 10 ml/min), single Kidney, patients who were lost to follow up.

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All patients were assessed by a history taking and full physical examination, complete blood picture, coagulation profile, renal function tests, liver function tests, midstream urine analysis with culture and sensitivity to ensure that the patients had sterile urine before the procedure. Patient evaluation and examination with an ultrasound abdomen were done at the first visit to specifically look at the size of the kidney, parenchymal thickness, renal echogenicity, content in the pelvis, and the presence of scars. A DTPA scan was done to confirm the diagnosis and also to measure the GFR, t½ and split function of each kidney. DTPA was performed using a standard protocol.

Operative technique:

The procedure was performed under general anesthesia. A prophylactic antibiotic was given with induction of anesthesia and 12 h after the procedure and continued for the next 7 days. All children underwent an open Anderson Hynes pyeloplasty. A dependent, tensionless anastomosis was performed between the ureter and the pelvis by giving meticulous importance to the vascularity of both ends. A drain was placed. All procedures were done by a single experienced pediatric urologist.

Postoperative Assessment:

All patients were evaluated with ultrasound at 3, 6 months postoperatively for assessment of US parameters. A DTPA renogram was done at 6 months after pyeloplasty. All Patients were followed up after the operation at 1, 3, and 6 months respectively. The procedure was accepted as successful when radiological parameters were: ultrasound showed an improved degree of hydronephrosis or improve AP diameter and renal isotope parameter showed GFR improved or stable, excretion curve was improved and t½ was improved. Failure was defined as the presence of obstructive urinary tract symptoms, an ultrasound showed a worse degree of hydronephrosis or working AP diameter and renal isotope parameter showed decreased GFR, excretion curve wasn't improved and t½ wasn't improved or the need for any post-operative intervention.

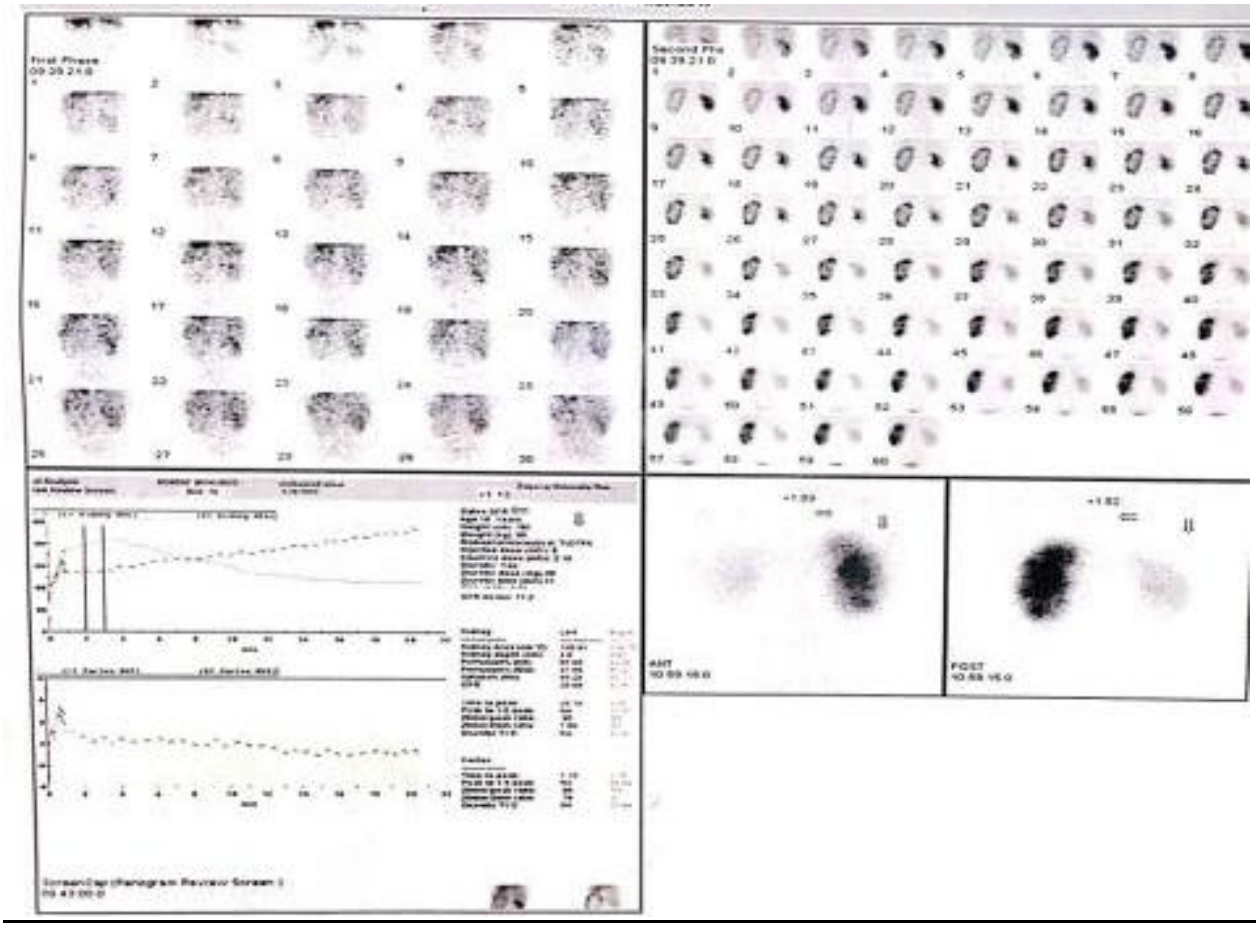

Fig. (1): Pre-operative renal isotope of case 1

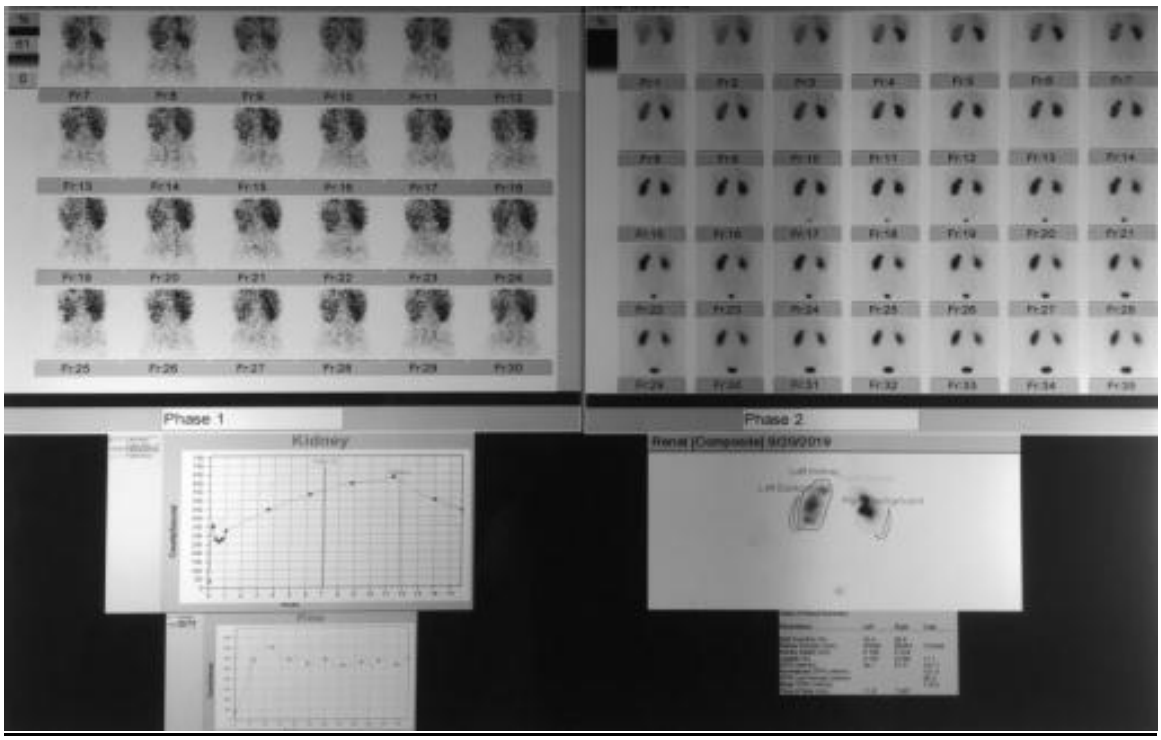

Fig. (2): Post-operative renal isotope of case 1

Statistical analysis

Data collected throughout history, basic clinical examination, laboratory investigations, and outcome measures coded, entered, and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis.

RESULTS

Table 1 showed the demographic data distribution among the studied group, age was distributed as 8.85±4.9 and regarding sex, males were 60% and females reached 40%.

That graph showed the improvement distribution among the studied group, 83.3% had satisfactory improvement and 16.7% hadn't improved,**Figure (3).**

Table 2 showed the change assessment among the studied group, all parameters significantly changed as Pelvic APD and T ½ significantly decreased but Parenchymal Thickness, GFR, and Split Function were significantly increased throughout the study.

This study showed a difference between improved and not improved groups. The pelvic APD and T½ postoperatively were significantly lower among the improved cases while parenchymal thickness, GFR, and split function postoperatively were significantly higher among the improved cases, **Table (3).**

Table (1): Demographic distribution among the studied groups

		Age / Years	
Mean± SD		**8.85±4.9**	
Median (Range)		**9.5 (0.5-18)**	
		N	**%**
Sex	**Female**	**12**	**40.0**
	Male	**18**	**60.0**
	Total	**30**	**100.0**

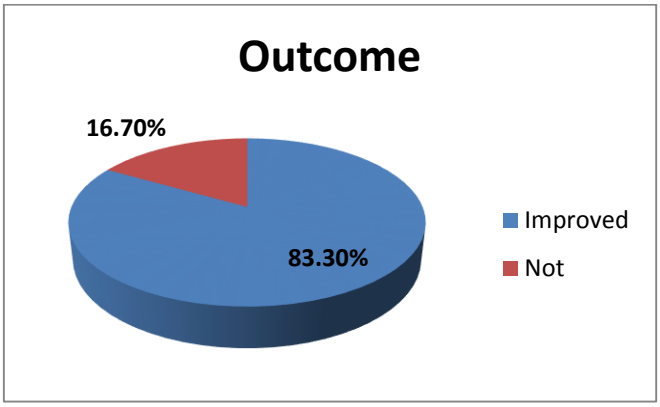

Figure (3): Improvement distribution among the studied group

Table (2): Change assessment among the studied group

	Mean ± StD	Paired t-test	P-value
Pelvic APD Pre-Operative	39.2833 ± 9.29654	18.742	0.001**
Pelvic APD Post-Operative at 3rd month	16.0633 ± 4.41511		
Pelvic APD Pre-Operative	39.2833 ± 9.29654	22.475	0.001**
Pelvic APD Post-Operative at 6th month	12.3000 ± 4.39278		
Parenchymal Thickness Pre-Operative	9.8700 ± 3.25063	-10.498	0.001**
Parenchymal Thickness Post-Op at 3rd month	15.6567 ± 5.12315		
Parenchymal Thickness Pre-Operative	9.8700 ± 3.25063	-14.293	0.001**
Parenchymal Thickness Post-Op at 6thmonth	24.6533 ± 5.73674		
Total GFR Pre-Operative	91.7000 ± 6.55034	-14.636	0.001**
Total GFR Post-Operative at 6th month	108.5667 ± 10.15291		
Affected Unit GFR Pre-Operative	34.3667 ± 3.55725	-11.445-	0.001**
Affected Unit GFR Post-Op at 6th month	47.6700 ± 7.44623		
Split Function Pre-Operative	37.5823 ± 3.99802	-9.367-	0.001**
Split Function Post- Op at 6th month	44.0033 ± 4.44574		
Pre-Operative T ½	25.2113 ± 2.68795	10.702	0.001**
Post-Operative T ½ at 6th month	17.6800 ± 4.16441		

Table (3): Comparison between the improved and not improved groups

	Improved	Not Improved	t-test	P-value
Pelvic APD Pre-Operative	36.38±6.6	53.8±6.9	-5.339	0.001**
Pelvic APD Post-Operative at 3rd month	13.23±4.3	30.2±10.03	-6.268	0.001**
Pelvic APD Post-Operative at 6th month	10.79±2.6	19.84±3.4	-6.612	0.001**
Parenchymal Thickness Pre-Operative	10.24±3.56	8.0±2.2	0.869	0.392
Parenchymal Thickness Post-Op at 3rd month	16.5±5.1	11.4±1.51	2.160	0.039*
Parenchymal Thickness Post-Op at 6th month	26.34±4.45	16.18±3.45	4.800	0.00**
Total GFR Pre-Operative	92.68±6.04	86.8±7.46	1.915	0.066
Total GFR Post-Operative at 6th month	111.64±6.12	93.2±12.94	5.023	0.00**
Affected Unit GFR Pre-Operative	34.72±3.12	32.6±5.31	1.227	0.230
Affected Unit GFR Post-Op at 6th month	50.48±3.18	33.6±6.65	8.897	0.001**
Split Function Pre-Operative	37.62±4.23	37.39±2.86	0.113	0.911
Split Function Post- Op at 6th month	45.28±2.81	37.59±5.84	4.594	0.00**
Pre-Operative T ½	25.0±2.52	26.24±3.52	-0.941	0.355
Post-Operative T ½ at 6th month	16.37±2.3	24.22±5.2	-5.415	0.001**

DISCUSSION

In the current study, we measured preoperative ultrasound parameters of the hydronephrotic kidneys including APd and parenchymal thickness, and compared them with the same parameters after surgical repair of the UPJO at the 3rd & 6th months post-operatively in a trial to correlate between them and the surgical outcomes.

In the current study, the ultrasound parameters were significantly improved reflecting the improved kidney function. Regarding the change in APd, we could demonstrate a significant reduction in the post-operative APd at 0, 3 & 6 months. The early reduction

because we used to do a moderate reduction of the renal pelvis during the procedure. However, we noticed a progressive reduction during the follow-up period at the 3rd and 6th month which is similar to **Sarhan *et al.*** [5] which in their study confirmed the improvement in the AP diameter of the renal pelvis as indicators for successful pyeloplasty. Similarly, **Rickard *et al.*** [6] expanded on the work by **Romao *et al.*** [4] in using percentage improvement of the renal pelvis APd as a predictor of surgical success and proposed an algorithm for post-pyeloplasty monitoring.

Our results revealed that the parenchymal thickness increased along with the serial follow-up with a statistically highly significant difference between pre and post-operative values at the 3rd month and the 6th month post-operative respectively which is like the study done by **Kis *et al.*** [7] **and Kim *et al.*** [8], who observed that the parenchymal size and thickness increased, representing an improvement in renal tissue quality.

On the other hand, **Prasanna *et al.*** [9] reported that APd correlates better than the parenchymal thickness in predicting the change in renal function 1 year following pyeloplasty, that may be due to that cases in their study were relatively had poorly parenchymal thickness with mean pre-operative parenchymal thickness was 4.072mm which is lower than ours which was (9.87 ± 3.25 mm). Also, this study was a retrospective on 45 children & they did the renal scans after 1 year of operation.

In the present study, the renal isotope parameters [including the total GFR, the affected unit GFR, and the renal split function] were increased along with the serial follow-up & the T½ was decreased with a statistically highly significant difference between pre and post-operative values.

Similar to us, **Harraz *et al.*** [10] showed a significant improvement in differential renal function (DRF) in their retrospective study on 196 children with follow up over 12 months. Also, **Matsumoto *et al.*** [11] reported improvement in 14 cases (23%) and a decrease in 9 cases (15%) in DRF in the early postoperative period, in a population of 60 pediatric patients after dismembered pyeloplasty. Equally, **Salem *et al.*** [12] observed that only kidneys with impaired preoperative renal function improved after pyeloplasty by about 77%.

In our study, the cases not improved are the cases with the lowest renal function preoperatively (16.7%). On the other side, **Niemczyk *et al.*** [13] reported that patients with renal function greater than 35% demonstrated functional improvement after surgery and that none of the patients with renal function less than 30% showed postoperative functional improvement. **Niemczyk *et al.*** [13] report comprised only adults with an age range of 19–67 years but the other discussed reports included pediatric subjects, and therefore this discordance may be due to different improvement rates in children and adults.

In contrast, **McAleer and Kaplan** [14] showed that renal function did not improve after pyeloplasty regardless of the initial level of renal function who did a retrospective study on 79 children from 1990-1997.

In our study, the improved group showed that all parameters are significantly changed pre- and post-operatively but in the not improved group, all renal isotope parameters were not significantly changed. The cases not improved in our study were due to a mild increase in the echogenicity from the start from repeated UTI who the lowest renal functions were preoperatively.

In our study, we could demonstrate improvement after surgical repair for 25 patients (83.3%) which is similar to the improvement rate for pyeloplasty in the cases reported by **Ortapamuk *et al.*** [15] which indicated that pyeloplasty improved the function by 40% of patients and provide stability or prevent deterioration of renal function in (87.5%).

Otherwise, **Clark and Malek** [16] found 95% success in the resolution of clinical symptoms and 91% success in decompression of pelvicalyceal system on urography after dismembered pyeloplasty, who had a retrospective study involving 111 patients with UPJO over a 15-year-period & 95 (86%) of patients underwent surgical repair. **O'Reilly** [17] found that open Anderson-Hynes dismembered pyeloplasty arrests functional deterioration in almost every case and improves function significantly in the majority in 26 consecutive patients with UPJO as he based on the split-function analysis from preoperative and postoperative renal scans.

On the other hand, **Kis *et al.*** [7] investigated that the stability or improvement is 76% after pyeloplasty which did the study on 267 infants.

CONCLUSION

Renal parenchymal thickness & renal isotope scan can be used as a good indicator of the success of operation & improvement of renal function postoperatively.

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