

OUTCOME OF PEDIATRIC PYELOPLASTY IN RENAL UNITS WITH SPLIT RENAL FUNCTION LESS THAN 20%

By

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ABSTRACT

Background: Prenatally diagnosed, hydronephrosis does not mean presence of decompensated obstruction and spontaneously improvement or resolution can occur postnatally. If obstruction persists, the split renal function (SRF) of the diseased kidney will dramatically decrease, and surgical intervention will be necessary.

Objective: Evaluation of outcome of pyeloplasty in children with ureteropelvic junction obstruction (UPJO) in renal unit with split function less than 20% and to asses renal function recoverability.

Patients and Methods: Cohort (historical and concurrent) study included 88 patients with UPJO with split renal function (SRF) < 20%. Preoperative patient was investigated by abdominopelvic ultrasound, magnetic resonance urography (MRU) or computerized tomography and renal isotope scan. Split renal function and T 1/2 .Preoperative and postoperative were compared. Results of the procedure were evaluated by clinical examination, abdomino-pelvic ultrasound after one month. Urine analysis with culture and sensitivity and renal isotope scan after 6 months.

Results: Our study included 88 patients divided into two groups according to SRF (group 1, SRF >20% and group 2, SRF < 20%). Mean preoperative SRF was $31.34 \pm 15.27\%$ in all cases, $41.79 \pm 7.03\%$ in group 1 and $13.06 \pm 4.90\%$ in group 2, which increased postoperatively to $38.35 \pm 15.61\%$, $46.86 \pm 8.43\%$ and $20.81 \pm 7.67\%$ respectively and this improvement was highly significant. Group 2 included 9 patient with SRF < 10%, mean preoperative SRF was $6.21 \pm 2.26\%$ which increased preoperatively to $15.04 \pm 7.09\%$, also in the remaining 23 cases, mean preoperative SRF was $15.74 \pm 2.30\%$ increased postoperatively to $23.07 \pm 6.75\%$.

Conclusion: Poorly functioning renal unit with SRF < 20%, can show functional improvement and recoverability, so in these renal units, we should not have to rush to nephrectomy and instead of that we can proceed to pyeloplasty.

Key words: Ureteropelvic junction obstruction; Pyeloplasty; split renal function, Pediatric.

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is considered one of the most common causes of hydronephrosis in pediatric (*Kim et al., 2010*). Indications for intervention in kidney with UPJO include the following Split renal function (SRF) < 40%, Deterioration of split renal

function of > 10% in serial studies, impaired drainage after the injection of laxis, increased anteroposterior diameter on serial ultrasound and Grade III and IV dilatation according to the Society for Fetal Urology (*Radmayr et al., 2019*). The intervention for poorly functioning kidneys has no clear protocol which can be used as a guideline. The traditional

intervention is nephrectomy but recently, there were studies which recommend pyeloplasty even with SRF < 10% as these kidneys shows significant improvement (Lone *et al.*, 2017).

The present work aimed to evaluate pyeloplasty outcome in children with pelvi-ureteric junction obstruction in renal unit with split renal function less than 20% and assessment of renal function recoverability.

PATIENTS AND METHODS

Cohort (historical and concurrent) study was carried out at Al-Azhar university hospitals after approval of study protocol by local ethical committee. Prospective cases included 20 patients and retrospective cases including patients who underwent pyeloplasty from 2011 to 2017. Patients were divided into 2 groups according to Split Function:

Group 1: SF > 20 %.

Group 2: SF from 0% to 20%.

Inclusion criteria:

Our study included pediatric patients with unilateral, single-system hydronephrosis due to UPJO and a normal contralateral kidney.

Exclusion criteria:

Bilateral UPJO, Recurrent cases and associated anomalies (vesicoureteral reflux (VUR), solitary kidney, posterior urethral valve) were excluded from the study.

Preoperative evaluation include the following: History, clinical examination, Laboratory investigation: Routine preoperative investigation including: (Complete Blood Count, Bleeding profile

including prothrombin time, prothrombin concentration, and Fasting blood glucose level, liver function tests, serum Creatinine and urine analysis) and Imaging studies in form of Pelvi abdominal US. Magnetic resonance urography (MRU) or computerized tomography and renal isotope scan: looking for split renal function and T $\frac{1}{2}$. 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 (Fernbach *et al.*, 1993). Renal isotope scan was done using 99m Diethylenetriaminepentaacetic acid (DTPA). Adequate hydration either oral or parenteral is very important prior to study. SRF was measured by the calculation of accumulated tracer in each kidney between 1 and 3 minutes after radionuclide injection. Renal and background regions of interest (ROIs) should be drawn on all acquisition data; background (ROIs) included the upper, outer and lower aspects of the kidney. Background activity was subtracted and the net counts within each kidney were expressed as a percent of total renal counts. Kidney function was classified as good when SRF was $\geq 40\%$ impaired when it was < 40% and poor when it was < 20%. Intravenous laxis was injected 20 minutes after radionuclide injection; dose of furosemide is 0.5 mg/kg for infants during the first year of life, and for older

children 1mg /kg, and $t_{1/2} > 20$ min with continuously rising curve was defined as obstructed drainage. All patients in our study underwent Anderson–Hynes dismembered pyeloplasty (except four cases underwent Y-V plasty) under general and caudal anesthesia. Early post-operative evaluation: Including: Vital signs, abdominal tenderness and rigidity, Drain output, Post-operative pain and early post-operative complications e.g. fever, infection and leakage. KUB after 24 hours to ensure that DJ in place. Catheter was removed in 2nd postoperative day if there was no drain output, and then drain removed in 5th day. The postoperative complications were classified according to the Clavien system (*Dindo et al 2008*). Results of the procedure evaluated by: Clinical examination, Abdomino-pelvic ultrasound after one month. Urine analysis with culture and sensitivity and Renal isotopic scan (after 6 months). 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. Criteria for successful outcome: Success was defined on the basis of either improvement in symptoms, improvement in drainage on postoperative Tc-99m DTPA renography, regression of degree of

obstruction and/or improvement or preservation in renal function on renal scan. Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The distribution of quantitative data was tested by Kolmogorov-Smirnov test of normality. So, the quantitative data were presented as mean, standard deviations and ranges when parametric while non-parametric were presented as median with inter-quartile range (IQR). Also, qualitative variables were presented as number and percentages.

The comparison between groups regarding qualitative data was done by using Chi-square test and/or Fisher exact test when the expected count in any cell found less than 5. The comparison between two independent groups with quantitative data and parametric distribution was done by using Independent t-test while with non-parametric distribution was done by using Mann-Whitney test. The comparison between two paired groups with quantitative data and parametric distribution was done by using Paired t-test. The confidence interval was set to 95% and the margin of error accepted was set to 5%. P-value < 0.05 was considered significant.

RESULTS

Our study included 88 patients. Patients divided into two groups: Group 1 included 56 patients and group 2 included 32 patients. Median age was 2.5 years (1 year in group 1 and 6 years in group 2), number of males was 66 (40 in group 1

and 26 in group 2), female patients were 22 (16 in group 1 and 6 in group 2). Left side affection was in 59.1% of cases (34 in group 1 and 18 in group 2). Right side affection was in 40.9% of cases (22 in group 1 and 14 in group 2).

As regard clinical presentation of patient in our study was as follow: 30 cases were diagnosed antenatal (23 in group 1 and 7 in group 2), 18 cases were discovered accidentally (10 in group 1 and 8 in group 2), 31 cases were presented with loin pain (20 in group 1 and 11 in group 2) and 9 cases were presented with abdominal swelling (3 in group 1 and 6 in group 2). As regard preoperative radiological data, degree of obstruction was as follow: 3 cases with mild hydronephrosis (all of them in group 1), 38 cases with moderate hydronephrosis (32 cases in group 1 and 6 cases in group 2) and 47 cases with marked hydronephrosis (21 cases in group 1 and 26 case in group 2). Most of cases in group 2 were presented with marked hydronephrosis. Mean over all

Preoperative SRF% was 31.34 ± 15.27 (41.79 ± 7.03 in group 1 and 13.06 ± 4.90 in group 2).

All cases in our study underwent dismembered pyeloplasty except 4 cases underwent Y-V plasty (all of them in group 2). All cases underwent internal stent fixation which was removed one month later. All over success rate was 95.5 % (98.2% in group 1 and 90.6% in group 2). As regard improvement of SRF, mean postoperative SRF for all cases was 38.35 ± 15.61 (p-value 0.000). In group 1, it was 46.86 ± 8.43 (p-value 0.000) and in group 2 was 20.81 ± 7.67 (p-value 0.000). There was no significant difference in improvement in both groups as regard SRF, T- half and degree of obstruction (Table 1).

Table (1): Comparison between group 1 and group 2 regarding postoperative data

Parameters		Groups		P-value
		Group 1 No. = 56	Group 2 No. = 32	
Degree of obstruction	No HN	2 (3.6%)	0 (0.0%)	0.220
	Mild HN	39 (69.6%)	23 (71.9%)	
	Moderate HN	12 (21.4%)	4 (12.5%)	
	Marked HN	3 (5.4%)	5 (15.6%)	
T ½(min)	Mean±SD	13.53 ± 5.06	11.06 ± 5.85	0.041
	Range	5 – 30	4 – 30	
increase in SRF%	Median(IQR)	7 (1.5 – 11)	8 (3.5 – 13)	0.358
	Range	-7 – 15	-8 – 12.7	

Group 2 included 9 patient with SRF < 10%. They showed significant improvement of SRF. Also the remaining

23 cases showed significant improvement without significant difference between them (Tables 2 and 3).

Table (2): Improvement of SRF in group 2 in cases above and below initial SRF<10%

Parameters		Preoperative	Postoperative	P-value
Cases with SRF<10%				
T1/2 min	Mean±SD	19.33 ± 4.53	9.56 ± 5.50	0.000
	Range	15 – 24	4 – 18	
SRF %	Mean±SD	6.21 ± 2.26	15.04 ± 7.09	0.012
	Range	3 – 9.9	0 – 18.7	
Parameters		Preoperative	Postoperative	P-value
Cases with SRF10-20%				
SRF %	Mean±SD	15.74 ± 2.30	23.07 ± 6.75	0.000
	Range	11 – 19	10 – 33	

Table (3): Improvement of SRF in cases above and below 10%

Split %	0 – 10%	11 – 20%	P-value
	No. = 9	No. = 23	
Increase in SRF			0.355
Median (IQR)	12.7 (4 – 14)	6 (2 – 13)	
Range	-8 – 17	-6 – 17	

In our study, we observed that only preoperative variable to have effect on improvement of SRF was mode of presentations. Symptomatic cases were shown more increase in SRF than asymptomatic one. This occurred either in all cases or in group 1 and group 2 (Table 4).

Table (4): Comparison of presentation versus improvement of SRF% and T1/2 in all cases

Cases		Asymptomatic	Symptomatic	P-value
Improvement		No. = 48	No. = 40	
increase in SRF%	Median(IQR)	4 (0 – 6.5)	13 (10 – 16)	0.000
Group 1		Asymptomatic	Symptomatic	P-value
Improvement		No. = 33	No. = 23	
increase in SRF%	Median(IQR)	3 (0 – 6)	11 (10 – 14)	0.001
Group 2		Asymptomatic	Symptomatic	P-value
Improvement		No. = 15	No. = 17	
increase in SRF%	Median(IQR)	4 (2 – 7)	13 (9 – 16)	0.018

Among symptomatic cases, most of them improved by ≥ 5%. This was in all cases and in group 1 and group 2 separately (Table 5).

Table (5): Relation between mode of presentation and degree of improvement of SRF%

Cases		< 5%		≥ 5%		P-value
Improvement		No.	%	No.	%	
All cases	Asymptomatic	25	89.3%	22	39.3%	0.001
	Symptomatic	3	10.7%	34	60.7%	
Group 1	Asymptomatic	17	94.4%	16	43.2%	0.000
	Symptomatic	1	5.6%	21	56.8%	
Group 2	Asymptomatic	8	80.0%	6	31.6%	0.013
	Symptomatic	2	20.0%	13	68.4%	

Among symptomatic cases in group 2, the mean improvement in SRF was highly significant in cases presented with an abdominal swelling, while for cases presented with loin pain and antenatal

diagnosed cases was significant, for accidentally discovered cases, improvement was not significant (Table 6).

Table (6): Improvement of SRF in different mode of presentation in group 2

Clinical presentation \ SRF%	Preoperative	Postoperative	p-value
Antenatal	9.32 ± 5.45	14.96 ± 3.25	0.014
Loin pain	14.4 ± 3.18	22.96 ± 9.96	0.011
Accidentally discovered	16.79 ± 2.04	20.03 ± 4.83	0.084
Abdominal swelling	9.98 ± 5.48	24.76 ± 6.56	0.000

DISCUSSION

The traditional intervention for poorly functioning renal unit was nephrectomy but recently, there were studies which recommend pyeloplasty even with SRF<10% as these kidneys shows significant improvement (*Lone et al., 2017*). The definition of Poorly functioning kidneys show wide variability as we will discuss later on, we considered kidney is poorly functioning if SRF ≤ 20%. We included in our study not only the data for kidneys with less than 20% SRF but also included the group with SRF >20% to see how renal units with SF close to the poorly functioning range behave.

In a study of *Singh et al. (2013)*, percutaneous nephrostomy (PCN) tube used preoperatively in all patient in their study to detect chance of renal recovery, while in our study, PCN not used in any case, as the policy in our center to use PCN only in case of emergency such as pyonephrosis, single kidney or bilateral obstruction with elevated serum Creatinine, this point of view is in agree with *Lone et al. (2017)* in their study. Also PCN fixation in pediatric patient done

under general anesthesia which represents an extra risk for patient, this point of view is in agree with *Gnech et al. (2019)* in their study.

In study by *Bansal et al. (2012)*, they studied 39 patient with SRF< 30% and divided them into two groups: group I (10-30%) and Group II (<10%). Mean preoperative renal function in group I was 24.7% (increased to 38.9% with mean increase was 14.2% and in group II was 5.1% (increased to 19% with mean increase was 13.9%). Also in our study there were 9 cases with SRF <10%, mean preoperative SRF was 6.21 ± 2.26% increased to 15.04 ± 7.09 with median increase was 12.7%. Another study done by *Lone et al. (2017)*, they studied 24 patients with SRF ≤15%, divide them into two groups: group A (15%-11%) and group B (≤ 10%). The overall preoperative mean SRF was 10.61 ± 5.23% increased in postoperative follow up to 18.08 ± 7.3%, 18.17 ± 8.63% and 18.42 ± 8.42% at 3 months, 9 months and 18 months respectively. Preoperative mean SRF in group A was 14.4 ± 1.01% increased in postoperative follow up to 19.6±6.1% (p-value 0.29) and in group B was 5.3±3.7%

increased to $16.7 \pm 8.8\%$ (p-value 0.03), so they concluded that in spite both group shows improvement, it was significant in group B and overall but not in group A, while in our study all cases in group 2 either with SRF 20-10% or with SRF < 10% showed significant improvement (from $15.74 \pm 2.30\%$ to 23.07 ± 6.75 , p-value 0.000) and (from 6.21 ± 2.26 to 15.04 ± 7.09 p-value 0.012) respectively .

Nayyar et al. (2016) studied 32 cases with split renal function $\leq 20\%$. Thirteen patients (40.6%) showed significant improvement in renal function, and in all, except 1 (3.1%) case there was no further deterioration of function. Another study was done by *Singh et al. (2013)* showed Functional improvement in 24.1%, no improvement in 44.8%, deterioration in 31% of cases. Our study showed improvement in 63.6%, preservation in 31.8% and deterioration in 4.6% of cases.

In a retrospective study done by *Gnech et al. (2019)*, one case showed a postoperative SRF 47%, starting from a 19% pre-operative SRF otherwise, the mean increase in the DRF was $3.5 \pm 9.8\%$. Improvement > 5% was observed in 13 (36%) cases, SRF remained unchanged in 16 (45%) and 7 patients (19%) showed deterioration in the SRF greater than 5% compared with preoperative values. They compared the cases showed functional improvement greater than 5% with the others; only a postnatal presentation was associated with a better improvement. When we saw the presentation of cases in this study, we observed that no cases discovered accidentally, so we can say all postnatal cases were presented by clinical signs and symptoms, so we can say that symptomatic cases in this study showed

better improvement which is similar to observation in our study. Also in this study there is no significant difference in median age between improved and none improved group which is also similar to our study. In retrospective study done by *Harraz et al. (2013)*, postoperative SRF had improved by greater than 5% in 49% of cases, while it was static at around 5% in 23% of cases and deteriorated more than 5% in 28.1% of cases. Mean SRF significantly improved after pyeloplasty, increasing from $35.8 \pm 10\%$ to $38.7 \pm 11\%$ and . As stratified by baseline SRF, baseline SRF in the poor and intermediate groups improved, while in the good group SRF was static postoperatively .

In prospective study done by *Menon et al. (2016)*, they studied 122 patients with UPJO and SRF < 20%, ten patients underwent nephrectomy so the final number of patient was 102. They divided patients into group with SRF 0-9% and group with SRF 10-20% then subdivided both group into patient with clinical signs and symptoms and patient with asymptomatic presentation (antenatal diagnosis and incidentally discovered). They observed that highly significant mean increase in DRF was seen from 3.16 ± 2.87 to $18.46 \pm 14.17\%$ in the preoperative 0-9% . and from 14.84 ± 3.39 to $23.71 \pm 10.48\%$ in the 10-20% group , our result was nearly similar to this result, in patient with initial SRF 20-10%, SRF increased from $15.74 \pm 2.30\%$ to 23.07 ± 6.75 ,(p-value 0.000) which is highly significant and in patient with initial SRF < 10%, SRF increased from 6.21 ± 2.26 to 15.04 ± 7.09 . which is significant. As regard relation between clinical presentation and improvement of SRF,

they found that symptomatic patients improved better than asymptomatic patients, from 9.81 ± 6.78 to 22.25 ± 11.42 , and (from $13.24 \pm 4.18\%$ to $21 \pm 12.7\%$, respectively, which is also similar to our study. In their study patient presented with palpable mass and pain showed a highly significant . mean increase in DRF was seen from $8.14 \pm 6.49\%$ to $24.12 \pm 1.94\%$ and $11.45 \pm 7.04\%$ to $19.54 \pm 10.48\%$ respectively, which is also similar to our study mean increase of SRF for patients presented with abdominal swelling and loin pain in group 2 was from $9.98 \pm 5.48\%$ to 24.76 ± 6.56 . and from 14.4 ± 3.18 to 22.96 ± 9.96 respectively.

Another prospective study done by *Abdelaziz et al. (2018)*, the median preoperative SRF was 5% increased to 21% and 20% after six months and one year respectively. They observed that mean improvement in SRF was high in cases presented with a palpable mass, median increased from 2% to 21% , which is similar to our study, mean increase of SRF for patients presented with abdominal swelling in group 2 was from $9.98 \pm 5.48\%$ to 24.76 ± 6.56 (.

CONCLUSION

From previously mentioned data, we can conclude that poorly functioning renal unit with SRF < 20%, can show functional improvement and recoverability, and these renal units behaves similarly to that one with SRF > 20%. So in these renal units, we should not have to rush to nephrectomy and instead of that we can proceed to pyeloplasty.

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نتائج تجميل حوض الكلى فى الأطفال فى الوحدات الكلوية ذات الوظيفة الجزئية الأقل من 20%

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خلفية البحث: تضخم الكلى المشخص قبل الولادة لايعنى وجود انسداد غير معوض، وقد يحدث التحسن التلقائى أو اختفاؤه نهائياً بعد الولادة. واستمرار الإنسداد قد يؤدي إلى نقص شديد فى الوظيفة الكلوية الجزئية للكلى المريضة ويصبح التدخل الجراحى ضرورياً.

الهدف من البحث: تقييم نتائج تجميل حوض الكلى فى الأطفال الذين يعانون من ضيق حوض الكلى فى الوحدة الكلوية ذات الوظيفة الجزئية الأقل من 20% وتقييم إسترداد الوظيفة الكلوية.

المرضى وطرق البحث: إشملت الدراسة الحالية على 88 مريض يعانون من ضيق حوض الكلى بوظيفة كلوية جزئية أقل من 20% قبل الجراحة. وقد تم فحص المرضى بالموجات فوق الصوتية على البطن والحوض والرنين المغناطيسى على المسالك البولية والأشعة المقطعية المحوسبة والمسح الذرى على الكلى لمعرفة الوظيفة الجزئية للكلى وزمن النصف. وقد تم تقييم نتيجة الجراحة عن طريق الفحص الإكلينيكي والموجات الصوتية على البطن والحوض بعد شهر من الجراحة وعن طريق المسح الذرى على الكلى بعد ستة أشهر.

النتائج: اشتملت الدراسة على 88 مريض تم تقسيمهم على حسب الوظيفة الكلوية الجزئية الى مجموعة ذات وظيفة كلوية جزئية اكبر من 20% ومجموعة ذات وظيفة كلوية جزئية اقل من 20%. وكان متوسط الوظيفة الكلوية الجزئية قبل الجراحة $31.34 \pm 15.27\%$ فى كل الحالات و $41 \pm 7.03\%$ فى المجموعة الأولى و $13.06 \pm 4.90\%$ فى المجموعة الثانية والتى زادت بعد الجراحة الى $38.35 \pm 15.61\%$ فى كل الحالات و $46.86 \pm 8.43\%$ فى المجموعة الأولى و

7.67±20.81 % فى المجموعة الثانية. وقد اشتملت المجموعة الثانية على 9 مرضى بوظيفة كلوية جزئية أقل من 10% وكانت متوسط الوظيفة الكلوية الجزئية المبدئية 2.26±6.21% والتي زادت بعد الجراحة الى 7.09±15.04% و كذلك فى الحالات الثلاثة والعشرين المتبقية كانت الوظيفة الكلوية الجزئية المبدئية 6.75±23.07% والتي زادت بعد الجراحة الى 15.74±74%.

الإستنتاج: الوحدة الكلوية ذات الوظيفة الجزئية الفقيرة الأقل من 20% تظهر تحسنا واسترداداً للوظيفة.