A Retrospective study to Analyze the Outcomes of Paediatric Pyeloplasty in Poorly Functioning Kidneys

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Abstract

Introduction: Pyeloplasty has success rate of up to 98%. We believe that paediatric pyeloplasty even in poorly functioning kidney, will result in maximum salvage of renal function. The aim of our study was to evaluate the outcome of pyeloplasty in poorly functioning kidneys with PUJO in the paediatric population.

Methods: The children with PUJO with a GFR < 30 ml / min or < 30% differential function on DTPA, who underwent pyeloplasty in NU hospitals, Bengaluru over a period of 11 years 2 months, were included in our retrospective study. Anteroposterior diameters (APD) and parenchymal thickness (PT) were assessed at three months. After one year of surgery, they underwent DTPA. Outcomes analyzed were febrile UTI, the need for secondary procedures, structural and functional outcomes in operated kidneys till one year of follow-up.

Results: A total of 30 patients with a mean age of four years ± 4 SD (standard deviation) with poor function on DTPA renogram (< 30%) were included in the study. 10 patients (33.33%) had a differential renal function (DRF) of 15% or less. Pre - operative mean PT was 4.7mm, mean APD was 38.5 mm, mean DRF was 19.3% and mean GFR was 17.7 ml / min. PT was increased to 6.4mm (± 2.4SD) and APD reduced to a 16.7 mm (± 10 SD) at the end of three months ($p < 0.001$). Increment in DRF percentage was 33.2 (± 9.4 SD) and GFR was 33.9 (± 12.5 SD) at the end of one year ($p < 0.001$). 13.3% of the patients had UTI, none of the study subjects required re-intervention within one year.

Conclusions: The pyeloplasty for pediatric PUJO significantly improved the functional outcomes even in poorly functioning kidney, hence we recommend the pyeloplasty for selected pediatric cases of poorly functioning kidney with PUJO.

INTRODUCTION

Pelviureteric junction obstruction (PUJO) is the most common form of urological obstruction in children.[1] It is reported to occur in 1:500 to 1:1250 live births.[2] Boys are more commonly affected than girls (65% : 35%). In 60% of cases, left side predilection is seen. The bilateral involvement is seen in 10%. The response to urine flow impairment is renal atrophy due to programmed cell death called apoptosis. It may lead to significant and long standing histological and functional damage to the renal parenchyma.[3]

The indication for pyeloplasty versus nephrectomy is mainly based on the results of repeated renal ultrasonography (US) and DTPA renogram with % DRF, GFR and drainage pattern. Nephrectomy is usually recommended if DRF is less than 10%. However, recent studies with long-term follow-up indicate that even with an initial DRF of less than 10%, a significant improvement of DRF may be seen when pyeloplasty is performed so that nephrectomy may not be justified.[4]

The management of poorly functioning kidneys with ureteropelvic junction obstruction (UPJO) is controversial, with some recommending direct nephrectomy and others direct pyeloplasty, and others temporary diversion. The aim of the study was to determine outcomes of pyeloplasty in poorly functioning kidneys.

METHODS

The paediatric patients (Defined by Indian Academy

of Paediatrics - Age group of 18 or less) who had poor renal function and underwent pyeloplasty at our hospital were included in the study.[5] It was a bidirectional cohort study. The subjects of retrospective chohort were operated between May 2008 and April 2018, and that of prospective arm were between May 2018 and June 2019. The poor renal function was defined for the purpose of the study as GFR less than 30 ml / min or DRF less than 30%. The patients under the age of 18 years with pelvi-ureteric junction block undergoing pyeloplasty with affected kidney GFR of less than 30 ml / min or a differential renal function of less than 30% were included in the study. The children with pyonephrosis, renal failure, solitary kidney, who had already undergone one attempt of pyeloplasty, whose parents / guardians refused to participate in the study or who lost to follow up were excluded from the study.

The demographic parameters, the mode of presentation, clinical and laboratory parameters, pre-operative renal parameters including parenchymal thickness, renal AP diameters were recorded by ultrasound of abdomen. The GFR, split renal function and drainage (O'Reilly curves) were recorded by DTPA renogram. Anderson Hynes pyeloplasty and stenting was performed for all the patients via an open or laparoscopic approach, depending upon surgeon's preference. As per our hospital protocol, follow up ultrasound was done at three months to assess renal pelvis AP diameters and maximum renal parenchymal thickness. The renal size was measured for all the patients' pre and post operatively but not included as an outcome parameter in our study. Ultrasound abdomen was done even at one year as well but ultrasound parameters were looked at three months only as per protocol. After one year of surgery, all patients underwent DTPA renogram at radio diagnostic centre to measure split renal function of the operated kidney and GFR and drainage pattern. DTPA renogram was decided as it was available and to maintain similar standard pre - and post - operatively. The total injected dose was determined by subtracting the post count from the pre count. The region of interest (ROI) was manually drawn on the frame of the kidney, and a semi lunar background was placed around the lower, outer renal margin. After the patient's weight and height were entered into an online computer, the GFR was automatically calculated by commercially available software according to the Gate's algorithm. Though it's not a standardized method of GFR calculation and also various pitfalls with DTPA renogram, we have calculated GFR based on DTPA as per protocol. The drainage patterns were also recorded by using O'Reilly curves.

The incidence of febrile urinary tract infection and the need for secondary procedures till the end of one year were noted. At the end of one year, the data was analyzed to evaluate structural and functional outcomes in the form of APD, Parenchymal thickness and GFR, DRF in the operated kidney respectively. All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean ± SD (standard deviation) were used. Chi square test, paired t-test, bivariate correlation analysis was used to analyze and interpret the data in appropriate settings using SPSS statistical analysis software (version 23.0). The p-value of < 0.05 was considered to be statistically significant.

RESULTS

Out of 30 patients, 14 were aged between one to five years, seven were between six to ten years and so on (Table 1). The mean age for pyeloplasty was four years ± 4 SD. There was no difference in age at presentation and age at the pyeloplasty because all children had undergone pyeloplasty shortly after the first consultation. The majority of the participants were males (80%).

Table 1: Patient Characteristics

Characteristic		Number of subjects (in % of total subjects)
Age	< 1 year	6 (20)
	1 - 5 years	14 (46.7)
	6 - 10 years	7 (23.3)
	10 years	3 (10)
Sex	Male	24 (80)
	Female	6 (20)

The range of stenting days were from 14 - 22 days (Mean = 16.7). The mean decrease of APD diameter postoperatively was 16.7 mm with SD of 10.0. (p value = < 0.001). The mean increased parenchymal thickness was up to 6.4 mm with SD of 2.4. (p value = < 0.001). Postoperatively, the mean increment in GFR was 33.9 ml / min with SD of 12.5 (p value = < 0.001). The mean increase in the %DRF postoperatively was from 19.3% to 33.2% with SD of 9.4. (Table 2, Figures1 and 2)

Table 2 : Determinants of outcome

Parameter	Pre operative	Post operative	p value
Mean APD in mm	38.5	16.7	< 0.001
Mean parenchymal thickness in mm	4.7	6.4	< 0.001
GFR ml/min	17.7	33.9	< 0.001
of DRF ipsilater- % al kidney	19.3	33.2	< 0.001

Post operatively, the %DRF was increased more than 20 in 20% of the patients, between 10 and 20 in 50% patients, between five to ten in 20% and less than five in 6.7% patients. One child showed worsening of DRF from 29.5% to 15% (Figure 1). Pre operatively, all the patients had type-2 curve whereas post operatively all patients had type-3A pattern, one patient showed type-3B pattern in DTPA (Figure 2).

Figure 1: Distribution of change in DRF compared to pre-operative values

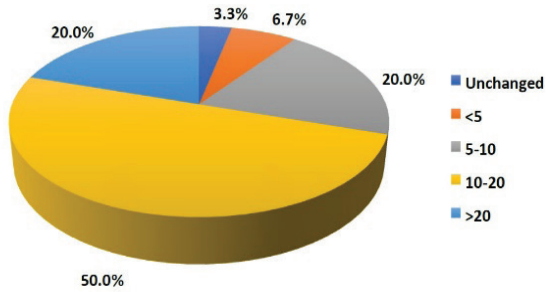
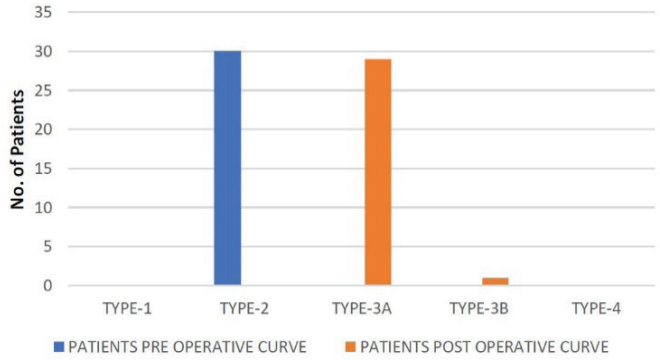


Figure 2 : Pattern of O'Reilly drainage (Pre / post operative)



DISCUSSION

PUJO is defined as an obstruction to the flow of urine from the renal pelvis to the proximal ureter. As a result of back pressure within the renal pelvis, progressive renal damage and deterioration sets in. The widespread use of ultrasonography and the advent of modern imaging techniques have resulted in earlier diagnosis of PUJO. The condition is more frequently encountered in males and on the left side, as noted in the present study.

The renal function reserve is the difference between pre-operative and postoperative GFR measurements at one year. This reserve is preserved in children with hydronephrosis, which ultimately contributes to the improvement in renal function after surgery. The goals of management of PUJO are to improve urine flow, to prevent further parenchymal damage and to alleviate symptoms.

In the literature there are number of studies both in favor and against preservation of poorly functioning kidneys.

The earlier trend was to perform nephrectomy for poorly functioning kidneys as the functional improvement with pyeloplasty was questionable.[6] Moreover the complications like recurrent UTI episodes, hypertension, renal dysfunction and re-do surgeries has been reported in the literature for pyeloplasty in those poorly functioning kidneys.[7] However, the trend has been changed over the time due to early detection and modified methods of pyeloplasty. The nephrectomies and subsequent complications related with solitary kidney can be avoided in these poorly functioning kidneys. Also, early pyeloplasty may result in better structural and functional outcomes and maximum salvage of the poorly functioning kidneys.[8] Pyeloplasty is followed by an improvement in the renal dilatation, renal parenchymal thickness, GFR, %DRF and excretion pattern in up to 98% of patients.[9] The nephrectomy can be opted for poorly functioning kidney to prevent long term sequelae.

In 1985, Mcanena OJ et al[10] studied role of nephrectomies in poorly functioning kidneys. In 2012 Datta B et al[6] and Daradka I et al [11] did nephrectomies for poorly functioning kidneys due to recurrent UTI, persistent hypertension and symptomatic PUJ block. On the other side, pyeloplasty in poorly functioning kidney may be associated with immediate and long-term complications. The patient may need redo surgery for recurrent block. The recurrent pain, UTI episodes, chronic hypertension and renal dysfunction were reported in the literature with pyeloplasty.[7,12]

Lee HE et al[7] analyzed 55 patients who were followed up for at least 10 years and follow-up data available were analyzed. Seven (12.7%) patients were diagnosed with hypertension, and 10 (18.2%) with proteinuria. The grade of hydronephrosis decreased, and the differential RF measured by MAG-3 renal scan significantly increased at final analysis ($p = < 0.001$). Presence of preoperative symptoms ($p = 0.034$), and serum creatinine elevation showed correlation with hypertension. The highest incidence of both hypertension and proteinuria was observed between 15 and 20 years postoperatively. Vihma Y et al[13] studied the effect of pyeloplasty in 23 children and followed them with a post-operative renal scan. They observed that hydronephrotic kidneys that had reduced glomerular function preoperatively improved after pyeloplasty. In our series left kidney was affected with PUJO in almost three fourth cases and this is similar to the findings of the literature in which 66% was more common on left side. Males are commonly affected than females with a ratio of 4:1 according to our study and the literature showed a ratio of 2:1.

Wagner M et al[4] studied long-term results of pyeloplasty

in 32 patients (Mean age 33 months) and divided them into three groups (I > 40%, II 10 to 40%, III < 10%). There was significant improvement of split function 12 months after pyeloplasty in children with < 10% split function. In our study, according to diuretic renogram, DRF improved in 29 children (96.7%) and worsened in one postoperatively. The average DRF was19.3% preoperatively and 33.2% post operatively at one year. The improvement was more pronounced in the group of kidneys with severely reduced preoperative glomerular function. Our study showed mean GFR increased to 33.9 (± 12.5 SD) at the end of one year.

Menon P et al[14] studied total 744 patients with UPJO in the study period with 112 had DRF ≤ 20%. Ten with no function underwent nephrectomy. The study included 102 subjects (mean age 4.7 years) with DRF 0 – 9% (n = 40) and 10 – 20% (n = 62). During the follow up period ranging from one to eight years, there was significant improvement in drainage in the remaining 96 patients. The mean DRF and IVU function showed highly significant improvement (p = < .001) in those with clinical signs and symptoms (n = 85), compared to asymptomatic patients in preoperative 0 – 9% and 10 – 20% group. All patients had resolution of initial complaints. Hypertension resolved in two patients with crossing vessels. No patient required re-do pyeloplasty or developed hypertension during follow up. Kumar M et al[15] studied 145 patients after pyeloplasty for structural changes in ultrasonography. There was reduced APD with increased parenchymal thickness in 96.55% patients. In our study, it was100% improvement as APD was reduced and parenchymal thickness was increased for all the children. More recently in 2019, Gnech et al[8] studied the role of nephrectomy vs pyeloplasty in such poorly functioning kidneys. The patients undergoing nephrectomy had significantly lower median pre-operative DRF (p < 0.001) and were significantly more likely to undergo a minimally invasive approach than those undergoing pyeloplasty. No postoperative variable was statistically different between groups. After a mean follow-up of 63 months, no statistically significant difference was found in intra-operative, early, late, and overall complications between pyeloplasty and nephrectomy. Pyeloplasty failed in 3% of cases. Of the patients undergoing successful pyeloplasty, 36 had a pre-operative and a postoperative renogram, and functional recovery of more than 5% was observed in 13 (36%), whereas the DRF remained unchanged in 16 (45%) patients. Only postnatal diagnosis was associated with a significantly higher chance of functional recovery (p = 0.047). Since the number of children in this group was small, it is too early to say that such kidneys may always be taken up for pyeloplasty.

CONCLUSIONS

There was significant improvement in the mean APD, mean parenchymal thickness, GFR, %DRF ipsilateral kidney post pyeloplasty of poorly functioning kidneys. The success of pyeloplasty is determined by the relief of symptoms, improved renal drainage, GFR and differential renal function in follow up diuretic renogram. Hence, we would like to recommend pyeloplasty as a standard of care even in poorly functioning kidneys with PUJO. However, nephrectomy is an option to prevent recurrent UTI, hypertension and renal dysfunction in poorly functioning kidneys.

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