

Original Research Article

The evaluation of safety and efficacy of percutaneous nephrostomy in young adult patients with severe hydronephrosis due to ureteropelvic junction obstructions

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ABSTRACT

Background: Majority of poorly functioning kidney (PFK) due to primary ureteropelvic junction obstructions (UPJO) in young adult have potential to recover after an attempted percutaneous nephrostomy (PCN). The split renal function measured by nuclear renal scan may not be sufficient enough to predict recovery of such kidney. Therefore, this study was undertaken to determine the functional recovery and potential salvageability of PFK due UPJO. Objective of the study was to evaluate safety and efficacy of PCN in adult patients with severe hydronephrosis due to PUJO.

Methods: A total of 25 (10 male and 15 female) young adult patients of severe hydronephrosis due to PUJO and SRF<20% underwent PCN procedures. Only, those who had significant improvement in their SRF $\geq 10\%$ and developed PCN output ≥ 400 ml/day underwent Anderson-Hyenas pyeloplasty and rest underwent nephrectomy.

Results: Both male and female young patients had significantly improvement after 6 weeks of PCN, their mean pre-PCN SRF changed from 16.30% and 12.27% to became $28.10 \pm 08.41\%$ and $18.53 \pm 09.89\%$, respectively. Those with age <30 years improved most with $\geq 10\%$ increase in the mean SRF and in 72% patients average PCN output increased from 279.80 ± 93.90 ml/day to 445.20 ± 160.341 ml/day at 6 weeks period. Overall, the patients with average PCN output ≥ 400 ml/day had a mean improvement of $10.33 \pm 05.48\%$ in SRF. However, 5(20%) developed haematuria, 8% fever, 16% displaced PCN tip with no major puncture site bleed.

Conclusions: The trial of PCN before definite surgery in young adult patients with poorly functioning kidney due to UPJO not only predicts renal renal function recovery but also prevent unwarranted renal loss.

Keywords: Adult, Complications, PCN, SRF, UPJO

INTRODUCTION

The ureteropelvic junction obstruction (UPJO) is a common cause of hydronephrosis (HDN), which may eventually lead to renal parenchymal atrophy and

impaired function.¹ If symptomatic, it may present with present nausea, vomiting, flank pain, intermittent diuresis and renal mass. The single renal unit function i.e. split renal function (SRF) estimated by radionuclide scan is commonly used for diagnosis, assess renal function,

prognosis and for follow up of UPJO patients.^{2,3} The nephrectomy of poorly functioning kidney (PFK) due PUJO with SRF \leq 20%, deprive patients of his potential recovery and nuclear renal scan are not sufficient enough to predict function of such kidney, thus this treatment is debatable.⁴ With first description of percutaneous nephrostomy (PCN) by Goodwin et al as an emergency procedure to relieve urinary obstruction, its role has further expanded in UPJO, pyonephrosis, acute renal failure. PCN is simple, easy and like saving procedure which can be done under local anesthesia.^{5,6} The majority of such PFK on radionuclide scan due UPJO in young adult may recover their function after attempted PCN, and kidney may become salvageable.⁴ Therefore, the objective this study was to evaluate the safety and efficacy of PCN in young adult patients with severe hydronephrosis due to UPJO and to determine the salvageability of such PFK. Objective of the study was to evaluate the safety, efficacy of percutaneous nephrostomy in young adult patients with severe hydronephrosis due to PUJO and to compare improvement in SRF and renal cortical thickness.

METHODS

This prospective study was conducted between 1st November 2016 to 31st March 2019. A total of 25 patients aged between 18-40 year (10 male;15 female) with severe hydronephrosis due to primary UPJO with SRF $<$ 20% underwent PCN procedures after standard urological evaluation. All patients with bilateral HDN or secondary PUJO were excluded from this study. After PCN, the renal nuclear for split renal function was repeated at 6 weeks. If repeat scan showed an improved SRF \geq 10% and average clear PCN output \geq 400 ml/day, then patients underwent standard pyeloplasty, and those who failed to improve underwent nephrectomy. All patients of pyeloplasty were regularly followed up with physical examination, blood pressure measurement, BUN/Serum Creatinine, urine analysis and culture. The ultrasonography or IVP or renal radionuclide scan was repeated as per standard protocol at 3, 6 months.

The statistical analysis was done using appropriate statistical test. The percentage of kidney function assessed on nuclear scan was expressed as mean and the quantitative data was expressed as mean, mean \pm SD or median. For comparisons of different groups, t-Test and Chi-Square test was used. The P-value less than 0.05 was taken as statistically significant. The data analysis was done using SPS version 17.0 (SPSS INC. Chicago, IL).

Table 2: Mean post-PCN split renal function in different age-groups.

Split renal function	Age Group	N	Mean SRF (%)	Std. Deviation (%)	P value
Pre- PCN SRF	\geq 30 years	16	12.13	4.674	0.012
	$<$ 30 years	9	17.00	3.354	
Post-PCN SRF	\geq 30 years	16	19.06	9.678	0.030
	$<$ 30 years	9	28.22	9.148	

RESULTS

Out of 25 patients of primary UPJO with severe hydronephrosis who underwent PCN, the 10 patients were male and 15 female with mean age of 31.60 \pm 7.168 years (S.D-7.168) and 30.47 \pm 8.667 years (S.D-8.667), respectively. Overall, 10 (40%) patients underwent right-side PCN and 15 (60%) left-side and 10 (66.7%) female had left-side PCN compared to 5 (50%) male patient which was statistically not significant (P-value $<$ 0.405). However, the male patient had equal frequency of right and left side PCN. The mean pre-PCN SRF was 13.88 (SD-4.807) with mean of 16.30 (S.D-03.498) in male & 12.27 (S.D-04.978) in female patients, respectively.

Pre and post-PCN mean split renal function

In our study, mean pre-PCN split renal function (SRF) in male patients was 16.30 \pm 03.49% (SD-03.498) compared to 12.27 \pm 04.97% (SD-04.978) in female patients and difference between two was statistically significant (P-value $<$ 0.037). After PCN procedure, the mean post-PCN SRF in males was 28.10 \pm 08.41% (SD-08.412) compared to 18.53 \pm 09.89% (SD-09.899) in females patients at 6 weeks and improvement was statistically significant (P-value $<$ 0.020) (Table 1).

Table 1: Pre and post-PCN split renal function.

Nuclear Renal scan	N	Mean SRF (%)	Std. Deviation	P value
Pre-PCN	Male	10	16.30	0.037
	Female	15	12.27	
Post-PCN	Male	10	28.10	0.020
	Female	15	18.53	

Mean post-PCN SRF improvement in different age-groups

Out of twenty-five patients, 16 (64%) had age \geq 30 years and 9 (36%) age $<$ 30 years. Before PCN procedure, mean SRF (split renal function) in patients age \geq 30 years was 12.13 \pm 4.67% compared to mean SRF of 17 \pm 3.35% in patients age $<$ 30 years and relation between two age groups was statistically significant (P-value $<$ 0.012). However, post-PCN, the patients with age \geq 30 years had mean SRF of 19.06 \pm 09.67% compared to 28.22 \pm 09.14% in patients with age $<$ 30 years, the relation between two was statistically significant (P-value $<$ 0.030) (Table 2).

Mean post-PCN SRF improvement in different age-groups with time

In our study, 16(64%) patients had age ≥ 30 years and 9(36%) had age < 30 years. In patients, with age ≥ 30 years, the mean post-PCN SRF change at 6 weeks was $6.94 \pm 05.80\%$, whereas in patients with age < 30 years, the mean post-PCN SRF change at 6 weeks was $11.22 \pm 07.03\%$. Although, the change in mean post-PCN SRF after PCN was more in patients of age < 30 years but difference between two variables was not significant (P-value < 0.989) (Table 3).

Table 3: Mean post-PCN SRF improvement in different age-groups.

Age (years)	N	Mean change in SRF %	Std. Deviation (%)	P value
≥ 30	16	06.94	05.802	0.989
< 30	9	11.22	07.032	

Frequency of overall improvement in different SRF-groups

In this study, the patient had different value of improvement in SRF at 6 weeks of PCN. Out of 25 patients, 20% (5) patients had $< 5\%$ improvement in SRF after PCN, 32% (8) had improvement between 5-9% and 48% (12) had improvement $\geq 10\%$ SRF after PCN procedure. Interestingly, out of twenty patients, 8% (2) patients had decreased in SRF after procedure, the first

patient had 3% decreased and second 5% decrease in SRF (Figure 1).

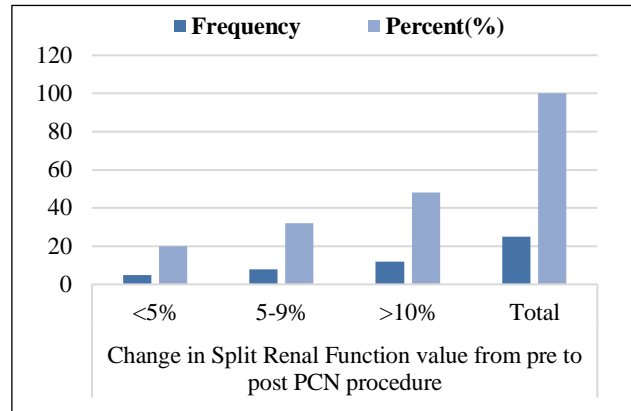


Figure 1: Comparison of frequency of overall improvement in SRF-groups.

Mean average PCN output at different time-intervals

In our study, the average PCN output/day at different time intervals was measured. At 2 weeks, the mean average PCN output was 279.80 ± 93.90 ml/day, with a range of 120 ml to a maximum of 450 ml/day. At 4 weeks, the mean average PCN output of 384 ± 121.518 ml/day, with a range of 100 ml/day to a maximum output of 600 ml/day. At 6 weeks, the mean average PCN output was 445.20 ± 160.341 ml/day, with output ranging from a minimum of 150 ml/day to a maximum average output of 800 ml/day (Table 4).

Table 4: Change in mean average PCN output/day at different time-interval.

PCN output	N	Minimum (in ml)	Maximum (in ml)	Mean PCN output (ml)	Std. Deviation (ml)
At 2-Weeks	25	120	450	279.80	93.902
At 4-Weeks	25	100	600	384.00	121.518
At 6-Weeks	25	150	800	445.20	160.341

Frequency of average PCN output ≥ 400 ml/day

In our study, at 2 weeks, 84% (21) of patients had average PCN output of less than 400 ml/day, whereas 16% (4) of patients had average PCN output of equal to more than 400 ml/ day.

At 4 weeks, 44% (11) patients had an average PCN output of less than 400 ml/ day whereas 56% (14) of patients had achieved average PCN output of equal to or more than 400 ml/day. At 6 weeks, only 28% of patients had an average PCN output of less than 400 ml/day whereas 72% of patients had achieved average PCN output of equal to or more than 400 ml/day (Figure 2).

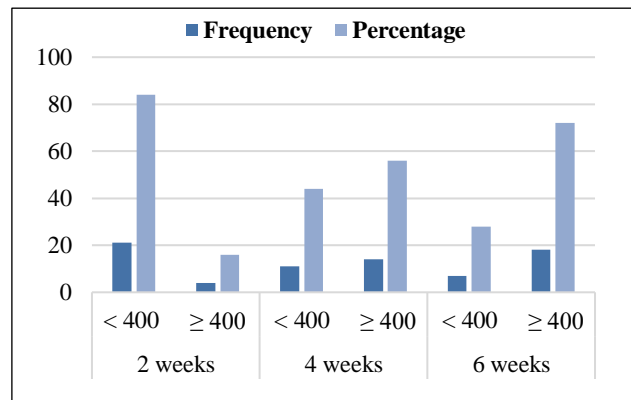


Figure 2: Comparison of frequency of average PCN output at different time-interval.

Mean improvement in SRF with average PCN output ≥ 400 ml/day

In this study, 18 patients had average PCN output more than 400 ml/day after the procedure and 7 patients had average PCN output less than 400ml after the procedure after 6 weeks. The mean SRF improvement in the patients with average PCN output more than 400 ml/day

was $10.33 \pm 05.48\%$ whereas in case of patients with average PCN output less than 400 ml/day was $03.71 \pm 06.75\%$. Though there was a significant improvement in SRF in patients with PCN output more than 400ml /day of 10.33%, there was no statistically significant relationship between the two variables, a p-value for the above relation was 0.248, which is not statistically significant (Table 5).

Table 5: Mean improvement in SRF with average PCN output ≥ 400 ml/day.

Average PCN Output	N	Mean SRF improvement (%)	Std. Deviation (%)	P value
PCN output ≥ 400 ml /day	18	10.33	05.488	0.248
PCN output <400 ml/day	7	03.71	06.751	

Complications

In our study, various complications associated with PCN like hematuria, fever, major bleed at the puncture site and catheter displacement were evaluated and their frequency were calculated. Out of 25 patients, 20% (5) patients experienced hematuria after PCN placement that was managed conservatively. About 8% patients complained of fever, 16% had PCN catheter displaced before 6 weeks and required PCN revision. None of the patients in our study experienced major bleed at the puncture site during placement of the PCN catheter (Table 6).

Table 6: Complication after PCN procedures.

Complication (s)	Present	Absent	Total
Hematuria	5 (20%)	20 (80%)	25
Fever	2 (8%)	23 (92%)	25
Catheter displacement	4 (16%)	21 (84%)	25
Major bleed	0 (0%)	25 (100%)	25

DISCUSSION

The management for unilateral UPJO with poor function kidney is debatable.⁴ The underlying principle behind the management of UPJO is to improve urine flow, preserve renal parenchyma and mitigation out of symptoms.⁷ But the question arises regarding potential of recovery of kidney function, as no accurate method is available to predict its recoverability.⁴ The best method to assess potential recovery of poorly functional kidney due to UPJO is a period of therapeutic trial using percutaneous nephrostomy, recommended for the purpose.⁸

Demography

In our study, out of 25 patients with severe hydronephrosis due to UPJO and $SRF \leq 20\%$, 10 patients were male and 15 were female. Mean age of male and

female patients was 31.60 ± 7.168 and 30.47 ± 8.667 , respectively. In our study, 12 (48%) improvement in $SRF \geq 10\%$ after 6 weeks following PCN drainage.

Our study procedures was comparable to study by Zhang et al, who did PCN in 53 patients of severe hydronephrosis due to UPJO and $SRF < 10\%$, with mean age of 38.66 ± 14.01 years (range:18-69 years).⁴ Male to female patient ratio in their study was 35:18. In their study, 30 (56.6%) patients showed improvement in SRF after PCN placement.

Split renal function

In our study, all patients had split renal function measured along with the measurement of average urine output through drainage PCN. The mean pre and post-PCN SRF was $13.88 \pm 4.80\%$ and $22.36 \pm 10.32\%$, respectively. Out of 25 patients, 48% (12) had improvement of $\geq 10\%$ in SRF following PCN, 32% (8) had improvement between 5 - 9% compared to initial SRF and 5 (20%) patients had no significant improvement in SRF after PCN procedure. In patients with aged ≥ 30 years, pre-PCN mean SRF was $12.13 \pm 4.674\%$ which improved to become $19.06 \pm 9.678\%$. In patients with aged < 30 years, the mean pre-PCN SRF was $17 \pm 3.354\%$ which improved to become $28.22 \pm 9.148\%$.

Our finding were similar to that of Zhang et al., in their study, they included 53 patients, with severe hydronephrosis due to UPJO and $SRF < 10\%$ before the PCN procedure.⁴ These patients underwent PCN procedure, both pre and post intervention SRF were measured along with average urine output through PCN. Out of their 53 patients, 30 had shown significant improvement in SRF, the mean SRF before and after the procedure were $4.53 \pm 3.21\%$ and $16.07 \pm 5.49\%$, respectively.

In another study conducted by Irving et al, they took into account PCN drainage as a method to assess the recoverability of function in obstructed renal units.⁹ In this study, out of 9 patients of severe HDN due UPJO, 4 patients showed improvement in renal function after PCN, which was sufficient to avoid nephrectomy.

Similarly, in a study by Heloury et al, 6 out of 11 UPJO patients showed improvement in renal function after PCN, measured using diuretic test which made them to conclude as that only dysplastic kidneys are refractory to improvement, thus subjected to nephrectomy.¹⁰

Pode et al, in their study took into account 4 adult UPJO, out of which 2 kidneys showed significant improvement in function after PCN procedure and they recommended 4 weeks period as minimum time for PCN drainage to assess recoverability of renal functional.⁸ In this series, PCN was described as the most precise and predictive test for renal units with UPJO associated with functional deficit. In their study, 70% of the poorly functioning UPJO had improvement in their SRF after PCN and the kidneys which even showed improvement, they maintained their improved SRF after pyeloplasty. Therefore, in all poorly functioning kidneys due to UPJO should undergo trial of PCN before extirpative nephrectomy.

In the study by Gupta et al, 20 patients, out of which 17 had UPJO and grade 4 hydronephrosis with poorly functioning kidney along with $SRF \leq 10\%$ and normal contralateral kidney.⁷ All patients they underwent PCN drainage for a minimum 4 weeks period and in reported SRF improvement on repeat radionuclide renal scan 12 patients. Hence, they concluded that improvement occur in 70.58% of paediatric a trial of after PCN drainage for minimum 4 period.

PCN output

In our study, the mean average urine output through PCN was 445.20 ± 160.34 ml at 6 weeks. Overall, 72% (18) of patients achieved ≥ 400 ml/day PCN output whereas 18% (7) had PCN output < 400 ml/day at 6 weeks. The patients with average PCN output ≥ 400 ml/day had significant improvement in their SRF of $10.33 \pm 0.48\%$ at 6 weeks, though there was not statistical significant relation between the patients with average PCN output ≥ 400 ml/day and patients with average PCN output < 400 ml/day at 6 weeks period.

In the study by Zhang et al, out of 53 patients 30 (56.6%) improved after PCN drainage and when PCN urine output became > 400 ml/day, then standard pyeloplasty was done.⁴ Out of 29 young adults, 24 (82.8%) had developed improved SRF compared to 6 (25%) patients in 24 older adults patients. The remaining 23 extirpative unimproved patients underwent standard nephrectomy. During a mean follow-up of 19.27 ± 7.82 months (range: 12-36 months),

no patient developed hypertension or urinary tract infection.

They concluded that SRF alone, may not be a precise predictor of recovered poorly functioning kidneys in young adults patients, thus observing the recoverability of such kidneys through PCN drainage may be a valuable method in the management of PFK due to UPJO.

However, after 6 weeks of PCN drainage, poorly functioning UPJO kidney with $SRF \leq 20\%$ may be stratified as improved and not improved. In our study, about 48% patients improved, based on SRF and PCN output. The age was a significant factor associated with improvement in young adults. In our study, 9 (36%) young adults patients with aged < 30 year had mean pre-SRF of $17 \pm 3.35\%$, which improved to become $28.22 \pm 9.148\%$ after PCN procedure. In patients, aged ≥ 30 years, 16 (64%) had mean pre-PCN SRF of $12.13 \pm 4.67\%$, which improved to become $19.06 \pm 9.67\%$ after PCN procedure. Overall, patients aged < 30 years had mean SRF improvement of $11.22 \pm 0.703\%$, which was a significant improvement compared to age group of patients ≥ 30 years. Although, the association between two was statistically not significant (P-value- 0.989). Thus, the young adults had comparatively more resilient recovery and regenerative capacity.

Complications

In our study, 20% patients experienced haematuria patients PCN placement which were managed conservatively. About, 8% developed post-PCN, hematuria and 16% had PCN catheter displacement which required PCN revision before 6 weeks. No patients experienced excessive bleeding from puncture site.

In the study conducted by Shah et al, 196 patients of obstructive uropathy underwent PCN placement and complications were recorded.¹¹ In their study, sepsis occurred in 0.51% patients, major haemorrhage in 0.51% patients, pleural effusion in 0.51% and PCN catheter displacement was seen in 5.61% of patients.

In another study by Radecka et al, a total of 558 patients were studied with a diagnosis of obstructive uropathy, the major complications of PCN included septicaemia, bleeding requiring transfusion, cardiac arrest and hydrothorax in 4 % whereas minor complications include UTI, catheter displacement, catheter obstruction by debris and urinary leakage from PCN site.¹² Incidence of UTI was 14% and catheter dislodgment upto 14%.

CONCLUSION

The adult male with severe hydronephrosis due to UPJO and age less than 30 years improved most after therapeutic trial of percutaneous nephrostomy and improvement was maximum after 6 weeks of PCN drainage when average PCN output was also maximum.

Haematuria was most frequent complication and other were less common. Therefore, it may be concluded that PCN was safe and effective procedure which help in predicting the potential recovery of poorly functioning kidney due to UPJO, thus preventing unwarranted renal loss.

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