

ORIGINAL ARTICLE

DETERMINING THE OUTCOME OF REDUCED FUNCTIONING KIDNEY AFTER PERCUTANEOUS NEPHROSTOMY

Agha Mohammad Zubair¹, Jamal Mustafa Khan², Najeebullah³, Syed Rafiuddin Shah¹, Muhammad Yaqoob¹, Rehan Mohsin¹¹Sindh Institute of Urology and Transplantation Karachi-Pakistan, ²Benazir Institute of Urology and Transplantation Nawabshah-Pakistan, ³Timergara Teaching Hospital Dir Lower-Pakistan

Background: Significant impairment of renal function can result from unilateral urinary tract blockage, especially if the split renal function falls below 20%. Renal function preservation occurs through the early placement of percutaneous nephrostomy (PCN). The research utilizes Technetium-99m Mercaptoacetyltriglycine (MAG-3) scans to evaluate the impact of PCN on renal function of patients suffering from severe blockage. **Methods:** A total of 36 patients with unilateral urinary tract blockage involving kidneys with split function below 20% were participants in this prospective research. Evaluation of renal function used MAG-3 scans before the intervention and after it was performed. Blood urea nitrogen (BUN) along with creatinine was measured in participants before and after the PCN procedure. A paired sample t-test evaluated data changes in renal function as well as other variables including age and gender and comorbidities. **Results:** The participants' average age was 41.58 (± 14.84) years, and 69.4% of the group were men. The split renal function scores improved significantly after PCN, rising from 16.53 (± 1.95) to 23.64 (± 3.49) (mean difference: -7.11; 95% CI: -8.54 to -5.68, $p < 0.001$). Creatinine and BUN levels also sharply dropped. The effectiveness of PCN in recovering renal function was confirmed by subgroup analyses that produced similar findings across clinical and demographic parameters. **Conclusion:** In patients with unilateral blockage and divided renal function $< 20\%$, PCN efficiently improves renal function. In these situations, it is advised as a conventional intervention.

Keywords: Unilateral urinary tract obstruction; Split renal function; Percutaneous nephrostomy; MAG-3 scan; Renal salvage; Kidney function improvement

Citation: Zubair AM, Khan JM, Najeebullah, Shah SR, Yaqoob M, Mohsin R. Determining the outcome of reduced Functioning kidney after percutaneous nephrostomy. J Ayub Med Coll Abbottabad 2024;36(4 Suppl 1):991–4.

DOI: 10.55519/JAMC-S4-14165

INTRODUCTION

A frequent urological disorder called obstructive uropathy is defined by decreased urine flow brought on by mechanical blockage at any level of the urinary system. Chronic kidney disease (CKD), increasing renal dysfunction, and perhaps irreversible renal failure can result from blockage if treatment is not received.¹ Reduced-functioning kidneys are frequently found in individuals with severe blockage, requiring prompt operation to remove the obstruction and perhaps maintain or enhance renal function.^{2,3}

A common minimally invasive treatment for obstructive uropathy is percutaneous nephrostomy (PCN). PCN relieves blockage, lowers intrarenal pressure, and permits the damaged kidney to decompress by inserting a catheter straight into the renal pelvis.⁴ The procedure has become a fundamental intervention for treating obstructive renal disease because it controls symptoms and protects the kidneys from further injury.^{5,6} Several aspects affecting kidney

functional recovery during PCN include blockage duration and severity and original cause and baseline renal function.

Dynamic renal imaging needs to be used with MAG-3 (mercaptoacetyltriglycine) scans as an essential approach for renal functional assessments. MAG-3 scans demonstrate an objective way to measure PCN outcome by showing renal perfusion and drainage and also demonstrating excretion levels.^{7,8} There is a lack of evidence about local people's kidney function decline following PCN even though the intervention proves helpful. The results play a vital role in clinical decision-making specifically regarding renal salvage or nephrectomy decisions for damaged kidneys.^{9,10}

The research objective examines the functional consequences of obstructed kidneys post-PCN by using MAG-3 scanning as an evaluation method. Clarifying these results will help to improve the framework for treating individuals with obstructive uropathy and guide clinical practice techniques that maximize kidney preservation.

MATERIAL AND METHODS

The Sindh Institute of Urology and Transplantation's Urology Department carried out this quasi-experimental investigation. Patients were recruited using non-probability consecutive sampling. After receiving clearance from the College of Physicians and Surgeons Pakistan (CPSP) and the Ethics Review Committee (ERC), the study was conducted over a six-month period. The following criteria were used to determine the sample size using G*Power software: a correlation value of 0.5, a 95% confidence interval, a research power of 90%, and preoperative and postoperative mean split renal functions of 7.29 ± 2.059 and 11.26 ± 7.849 , respectively. A sample size of 36 patients was determined.

Patients between the ages of 14 and 66 who had been diagnosed with unilateral urinary tract obstruction, those whose split renal function was less than 20% of its capacity as assessed by Technetium-99m Mercaptoacetyltriglycine (MAG-3) scans, and those who were willing to give informed consent were all included in the study. Patients with a single working kidney, those with upper urinary tract infections such as obstructive pyelonephritis, sepsis, or pyonephrosis, and those with conditions that exclude percutaneous nephrostomy (like bleeding diathesis or renal mass) were not included.

The inclusion of eligible patients who presented throughout the research period was evaluated. Baseline clinical and demographic information was documented following informed permission. A MAG-3 scan was performed on each patient prior to percutaneous nephrostomy in order to assess renal function. Less than 20% of renal units had blocked renal function when the surgery was carried out. A second MAG-3 scan was used to assess renal function after surgery occurred four weeks post-operatively. Healthcare providers documented the recorded variables age, gender, height, weight, BMI, diagnostic information, diabetes or hypertension status, smoking behaviours, and split renal function findings in a standardized proforma before and after treatment. The assessment used predetermined operational criteria as the basis for interpreting the results.

A statistical analysis of data was performed using SPSS version 26. Statistical analysis showed the quantitative variables, age along with height, weight and BMI and preoperative and postoperative split renal function were presented as standard deviation (SD) values and mean scores or interquartile (IQR) and median scores. The researchers depicted gender distribution and diabetic and hypertensive conditions and smoking

habits of participants as percentages and frequencies. The study used paired t-tests followed by Wilcoxon Signed Rank Tests for assessing kidney function changes between pre-procedure and post-procedure measurements depending on data distribution. Split renal function changes between groups were analyzed using independent t-tests and Mann-Whitney U tests by the study variables of age, gender, comorbidities, smoking status and diagnosis. The research used a p -value of ≤ 0.05 to determine statistical significance. Tables and graphical representations provided the results for clear understanding and better interpretation.

RESULTS

The study comprised 36 individuals ($n=36$) of either gender with a diagnosis of unilateral urinary tract blockage, ages ranging from >14 to 66 years. Participants ranged in age from 18 to 66 years old, with a mean age of $41.58 (\pm 14.84)$ years. Forty-three was the median age. Of the patients, 21 [58.3%] were under 40 years old, and 15 [41.7%] were over 40. According to Table 1, the average height, weight, and BMI were $27.33 (\pm 4.09)$ kg/m², $71.33 (\pm 10.33)$ kg, and $161.89 (\pm 10.38)$ cm, respectively.

Blood urea nitrogen (BUN), creatinine, and split renal function utilizing a Technetium-99m Mercaptoacetyltriglycine (MAG-3) scan showed significant improvements before and after the intervention. While creatinine levels improved from $1.15 (\pm 0.36)$ to $0.99 (\pm 0.18)$, BUN levels dropped from $9.03 (\pm 3.03)$ to $8.18 (\pm 2.33)$. Furthermore, there was a notable rise in the MAG-3 split renal function scores, which went from $16.53 (\pm 1.95)$, to $23.64 (\pm 3.49)$. Table 2 provides specifics on these results.

The male-to-female ratio of 2.27:1 indicates a male predominance, with 25 (69.4%) of the total participants being male and 11 (30.6%) being female. In terms of comorbidities, 23 patients (63.9%) did not have diabetes, whereas 13 persons (36.1%) did. Nineteen people (52.8%) did not have hypertension, whereas seventeen persons (47.2%) did. Furthermore, 30 patients (83.3%) did not smoke, whereas 6 patients (16.7%) currently smoked as illustrated in figure 1.

The split renal function score showed a substantial improvement after the intervention, increasing on average from $16.53 (\pm 1.95)$ to $23.64 (\pm 3.49)$, with a mean difference of -7.11 (95% CI: -8.54 to -5.68 , $p < 0.001^*$), (Table 4).

Significant mean changes in MAG-3 scores before and after the intervention were found using paired sample t-tests for each of the following subgroups: age, gender, diabetes, hypertension, smoking status, and diagnosis. (Table 6)

Table-1: Demographic and Anthropometric Statistics

Parameter	Mean (\pm SD)	Min - Max	Range	Median
Age (Years)	41.58 (\pm 14.84)	18–66	48	43
Weight (kg)	71.33 (\pm 10.33)	52–90	38	70
Height (cm)	161.89 (\pm 10.38)	130–180	50	160
BMI (kg/m ²)	27.33 (\pm 4.09)	21.51–36.31	14.8	26.44

Table-2: Pre- and Post-Intervention Lab and MAG-3 Parameters

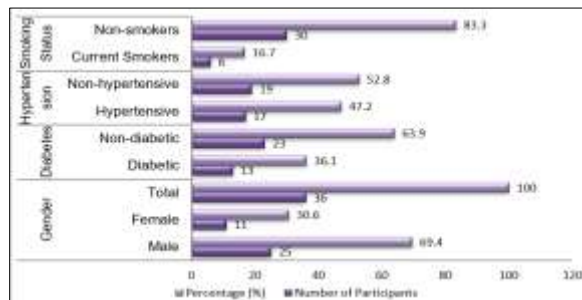
Parameter	Mean (\pm SD) Pre	Mean (\pm SD) Post	Min-Max	Range	Median
BUN (mg/dL)	9.03 (\pm 3.03)	8.18 (\pm 2.33)	5–15	10	8
Creatinine (mg/dL)	1.15 (\pm 0.36)	0.99 (\pm 0.18)	0.3–1.8	1.5	1.2
MAG (Units)	16.53 (\pm 1.95)	23.64 (\pm 3.49)	14–30	12	23.5

Table 4: Improvement in MAG-3 Split Renal Function Post-Intervention

Parameter	Pre-MAG (\pm SD)	Post-MAG (\pm SD)	Mean Difference	95% CI of Mean Difference	t-value	p-value
MAG (Units)	16.53 (\pm 1.95)	23.64 (\pm 3.49)	-7.11	-8.54 to -5.68	10.09	<0.001*

Table 6: Pre- and Post-MAG-3 Split Renal Function by Subgroup

Subgroup	Pre-MAG (\pm SD)	Post-MAG (\pm SD)	p-value
Age <40	16.4 (\pm 2.1)	22.27 (\pm 3.06)	<0.001*
Age \geq 40	16.62 (\pm 1.88)	24.62 (\pm 3.51)	<0.001*
Male	16.24 (\pm 2.05)	23.56 (\pm 3.36)	<0.001*
Female	17.18 (\pm 1.6)	23.82 (\pm 3.95)	<0.001*
PUJO	17.17 (\pm 1.95)	23.58 (\pm 3.32)	<0.001*
Stone	16.15 (\pm 1.95)	23.35 (\pm 3.17)	<0.001*
Non-smokers	16.63 (\pm 2.01)	23.83 (\pm 3.42)	<0.001*

**Figure 1: Demographic and Clinical Characteristics of Participants**

DISCUSSION

This study shows that individuals with unilateral urinary tract blockage benefit greatly with PCN, especially those whose split renal function is less than 20%. Along with decreases in serum creatinine and BUN levels, the significant improvements in the MAG-3 split renal function scores are in line with other studies showing how well PCN restores renal function by removing blockage. Our cohort's mean improvement in MAG-3 split renal function (mean difference of -7.11, $p < 0.001$) is consistent with results from other research, which supports the usefulness of PCN in comparable clinical contexts.¹¹

Some studies, however, show much larger gains, which might be explained by differences in the sample groups, the underlying causes of blockage (e.g., stones vs obstruction of the pelvi-ureteric junction), and the length of follow-up.¹² The majority of individuals in this study were males (69.4%), which is in line with

other studies that found obstructive uropathy is more frequent in men, especially in situations like stones and congenital abnormalities.¹³ Paediatric patients with UPJ blockage and renal function <20% who had PCN insertion had a notable improvement, according to a recent research.¹⁴ Patients with poor renal function having pyeloplasty or nephrectomy were advised to use PCN as their primary technique. Thirty out of fifty-three patients with UPJ blockage showed better renal function following PCN, resulting in a 56.6% success rate. Numerous case reports and case series, such as one that documented recovery following nephrostomy in a case with hydronephrosis and a hyperfunctioning kidney, further corroborated these findings.¹⁵

Patients 40 years of age or older showed a somewhat higher recovery in renal function than their younger counterparts in terms of clinical and demographic characteristics. The adaptive ability of elderly kidneys or variations in baseline renal function might be the cause of this. Furthermore, gains in renal function following PCN were not hindered by the existence of comorbidities including diabetes and hypertension, however the course of recovery may have been impacted by these underlying illnesses.¹⁶

Limitations and Future Suggestions:

There are many restrictions on this study. The results' generalizability is constrained by the very small sample size ($n=36$). Because the study was only carried out at one institution, it might not accurately represent differences in patient demographics or clinical procedures. No unified protocol existed for the duration of post-PCN follow-up which could affect the sustained outcomes. Other relevant variables like length of item

obstruction and renal function status received limited variation throughout the research. Research moving forward should gather wide-ranging patients from multiple medical centers to address the current limitations. Research performance could reach optimized levels by checking additional treatment methods including drug prescriptions and nutritional adjustments. Research evaluations of other treatments like stenting would support the development of optimal obstructive uropathy care approaches. The study strengthens existing scientific evidence about PCN effectiveness yet additional study is necessary to comprehend its long-term implications thoroughly.

CONCLUSION

Research revealed that using percutaneous nephrostomy for drainage purposes led to significant renal function recovery in obstructed kidneys with divided renal function less than 20% of total. The MAG-3 scan scores improved substantially based on pre-test and post-test renal function results of 16.53 (± 1.95) and 23.64 (± 3.49) respectively. This produced a significant mean difference of -7.11 (95% CI: -8.54 to -5.68, $p < 0.001$). PCN stands out as one of the most frequently used medical procedures which effectively restore kidney function when used on single-blocked kidneys.

AUTHORS' CONTRIBUTION

AMZ, JMK: Concept, literature search, write-up. N, SRS, MY, RM: Data collection data analysis, data interpretation.

REFERENCES

- Hossan MM, Naser MF, Khan MR, Islam MA, Kabir MG. Functional Outcomes After Percutaneous Nephrostomy in Hydronephrotic Kidneys in Adult Population. *Bangladesh J Urol* 2018;21(2):93–7.
- Datu RJ, Arianto E, Atram A, Toreh C. The importance of preoperative evaluation to predict the outcome of percutaneous nephrostomy. *Med Scope J* 2024 28;6(2):172–8.
- Shoshany O, Erlich T, Golan S, Kleinmann N, Baniel J, Rosenzweig B, Eisner A, Mor Y, Ramon J, Winkler H, Lifshitz D. Ureteric stent versus percutaneous nephrostomy for acute ureteral obstruction-clinical outcome and quality of life: a bi-center prospective study. *BMC Urol* 2019;19:1–7.
- Shoshany O, Erlich T, Golan S, Kleinmann N, Baniel J, Rosenzweig B, Eisner A, Mor Y, Ramon J, Winkler H, Lifshitz D. Ureteric stent versus percutaneous nephrostomy for acute ureteral obstruction-clinical outcome and quality of life: a bi-center prospective study. *BMC Urol* 2019;19:1–7.
- Gnech M, Berrettini A, Lopes RI, Moscardi P, Esposito C, Zucchetta P, Dénes FT, Manzoni G, Braga LH, Castagnetti M. Pyeloplasty vs. nephrectomy for ureteropelvic junction obstruction in poorly functioning kidneys (differential renal function < 20%): a multicentric study. *J Pediatr Urol* 2019;15(5):553–e1.
- Ključevšek T, Pirmovar V, Ključevšek D. Percutaneous nephrostomy in the neonatal period: indications, complications, and outcome—a single centre experience. *CardioVascular and Interventional Radiology*. 2020 ;43:1323–8.
- Soeroto AA, Situmorang GR, Rasyid N. Predictive factor of renal function recoverability in upper-tract obstructive uropathy after percutaneous nephrostomy and Double-J stent insertion in Indonesian National Referral Hospital. *F1000Research*. 2022 Oct 7;11:1146.
- Azwadi IZ, Norhayati MN, Abdullah MS. Percutaneous nephrostomy versus retrograde ureteral stenting for acute upper obstructive uropathy: a systematic review and meta-analysis. *Scientific reports*. 2021;11.
- Nyamu BK. *Impact of Percutaneous Nephrostomy on Clinical Outcome in Advanced Cervical Carcinoma With Obstructive Uropathy at Kenyatta National Hospital From 2016-2019: a Descriptive Retrospective Cohort Study* (Doctoral dissertation, University of Nairobi).
- Shabaninia S, Yahyazadeh SR, Mousavi A, Kasaeian A. The characteristics and outcomes of patients treated with percutaneous nephrolithotomy according to the preoperative renal function levels. *Translational Research in Urology*. 2020 Feb 12;2(1):4–8.
- Eshumani W. Percutaneous nephrostomy versus retrograde ureteral stent in adult patients with malignant ureteral obstruction: comparing changes in the renal function and clinical outcomes (Doctoral dissertation, University of British Columbia).
- Pillai S, Kriplani A, Chawla A, Somani B, Pandey A, Prabhu R, Choudhury A, Pandit S, Taori R, Hegde P. Acute Kidney Injury Post-Percutaneous Nephrolithotomy (PNL): prospective outcomes from a university teaching hospital. *Journal of Clinical Medicine*. 2021 Mar 29;10(7):1373.
- Shi X, Peng Y, Li L, Li X, Wang Q, Zhang W, Dong H, Shen R, Lu C, Liu M, Gao X. Renal function changes after percutaneous nephrolithotomy in patients with renal calculi with a solitary kidney compared to bilateral kidneys. *BJU international*. 2018;122(4):633–8.
- New FJ, Deverill SJ, Somani BK. Outcomes related to percutaneous nephrostomies (PCN) in malignancy-associated ureteric obstruction: a systematic review of the literature. *Journal of Clinical Medicine*. 2021 May 27;10(11):2354.
- Mohamed DA, Abdallah AK, Mehany MM, Mahgoub AA. Effect of implementing nursing guidelines on reduction of acute Complications for patient with Percutaneous nephrostomy admitted to emergency unit. *Assiut Scientific Nursing Journal*. 2022 ;10(32):218–30.
- Zul Khairul Azwadi I, Norhayati MN, Abdullah MS. Percutaneous nephrostomy versus retrograde ureteral stenting for acute upper obstructive uropathy: a systematic review and meta-analysis. *Scientific Reports*. 2021 ;11(1):6613.

Submitted: May 5, 2024

Revised: November 27, 2024

Accepted: December 6, 2024

Address for Correspondence:

Agha Mohammad Zubair, Sindh Institute of Urology and Transplantation Karachi-Pakistan

Email: agha.zubair01@gmail.com