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Original Article

Comparative Effect of Percutaneous Nephrostomy Versus Double J Ureteral Stenting on Split glomerular filtration rate in Obstructive Uropathy caused by Ipsilateral Urolithiasis

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ABSTRACT

Background: Obstructive uropathy as a result of Ipsilateral urolithiasis can cause significant and potentially reversible renal dysfunction. Percutaneous nephrostomy (PCN) and double J ureteral stenting (DJ stent) are commonly used decompressive procedures; however, the comparative effect of these procedures on Split glomerular filtration rate is debated. This study aimed to compare the effects of PCN and DJ stenting on split glomerular filtration rate, serum creatinine, and renal cortical thickness of unilateral obstructive uropathy. **Methods & Materials:** This quasi-experimental study was carried out at Bangladesh Medical University, Dhaka, Bangladesh, between April 2022 and April 2023. 32 patients with ipsilateral obstructive uropathy due to Ipsilateral urolithiasis were enrolled as adults. Eighteen underwent PCN, while fourteen underwent DJ stenting. Split glomerular filtration rate was measured by 99mTc-DTPA diuretic renography, and serum creatinine and parenchymal thickness were measured preoperatively and 1 month. Data were analyzed on SPSS version 26 with paired and unpaired t-tests at a $p<0.05$ level of significance. **Results:** Baseline demographic, clinical, and laboratory parameters were similar. At least for one month, a significant improvement in split GFR was achieved in both groups. In the PCN group, the rise in GFR was from 17.93±3.75 to 24.59±4.28 ml/min/1.73 m2, $p<0.001$. In the DJ group, it was increased from 17.21±3.87 to 21.94±3.55 ml/min/1.73 m2, $p=0.002$. Serum creatinine was decreased significantly only in the PCN group, $p=0.016$. Between-group comparison indicated an increased mean split GFR in the PCN group at one month, but without statistical significance, $p=0.071$. **Conclusion:** Both PCN and DJ stenting had a significant beneficial effect on glomerular filtration rate in obstructive uropathy. PCN showed better short-term changes in Split glomerular filtration rate and cortical thickness.

Keywords: *Obstructive Uropathy, Percutaneous Nephrostomy, Double J stent*

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INTRODUCTION

Obstructive uropathy secondary to Ipsilateral urolithiasis is a very common and potentially reversible cause of spilit rate impairment worldwide. Ureteric obstruction causes an increase in intrapelvic pressure, a decrease in blood supply to the renal system, tubular dysfunction, and progressive interstitial fibrosis if not relieved soon [1, 2]. The degree of renal recovery depends on the severity and duration of obstruction, baseline renal reserve, and promptness of decompression [3]. Therefore, urgent urinary diversion is a cornerstone in the management of obstructive uropathy to avoid irreversible loss of nephrons and septic complications. Percutaneous nephrostomy (PCN) and retrograde double J ureteral stenting (DJ stent) are the 2 commonly used techniques of emergency decompression. PCN provides direct drainage of the renal pelvis via a percutaneous tract guided by imaging, which allows for quick pressure reduction [4]. In contrast, DJ stenting restores the antegrade urine flow through the natural ureteral lumen and obviates the use of an external drainage system and therefore enhances the patient's comfort [5]. Despite their wide use, controversy still exists as to which modality offers better glomerular filtration rate recovery, especially in unilateral obstruction due to Ipsilateral urolithiasis. Assessment of renal recovery after decompression is of clinical importance. Serum creatinine, although a commonly used test, may fail to accurately reflect the level of improvement in function in unilateral obstruction because of compensation by the opposite kidney [6]. Nuclear renography with 99mTc-DTPA is possible for quantitative assessment of split glomerular filtration rate (GFR, and is also a more sensitive test to assess ipsilateral glomerular filtration rate [7]. Several comparative studies have assessed procedural success, complications, and hospital outcomes of PCN versus DJ stenting; however, few data address short-term changes in split glomerular filtration rate [8,9]. Some investigations have suggested similar results for the two modalities in terms of overall renal recovery [8]. On the other hand, other reports suggest that PCN may ensure a superior drainage capacity in cases of severe obstruction, with a consequent rapid biochemical normalization and an increased renal perfusion [4,10]. Differences in patient selection, severity of obstruction, and follow-up periods may be responsible for the inconsistency in the results among various studies. Given the prevalence of stone disease in South Asian populations and the requirement for urgent decompression in a tertiary care setting, region-specific comparative evidence is important. Identifying the modality that provides better early functional recovery could have an impact on clinical decision-making and the best ways to preserve the kidney. Therefore, this study aimed to compare the effect of percutaneous nephrostomy vs. double J ureteral stenting on split glomerular filtration rate, serum

creatinine, and cortical thickness in patients with obstructive uropathy due to Ipsilateral urolithiasis.

METHODS & MATERIALS

This quasi-experimental study was carried out in the Department of Urology, Bangladesh Medical University, Dhaka, Bangladesh, between April 2022 and April 2023. Adult patients aged between 18 and 60 years with obstructive uropathy due to ipsilateral urolithiasis and in need of urgent urinary diversion were enrolled purposely, having met predefined inclusion and exclusion criteria. Patients with multiple calculi, obstruction of the bladder outlet, previous urinary diversion, failed procedures, or pregnancy were excluded. A total of 32 patients were distributed in two groups based on clinical condition and surgeon's decision: Group A was treated with percutaneous nephrostomy and Group B with retrograde double J ureteric stenting. Baseline evaluation included detailed history, physical examination, laboratory investigations, ultrasonography of the kidney, ureter, and the region of the bladder, and DTPA diuretic renogram. Laboratory parameters included complete blood count, serum creatinine and urea, electrolytes, glucose, urinalysis, and coagulation profile. Clinical symptoms such as pain, pain during urination, bleeding from urine, and fever were recorded. Hematological parameters and serum creatinine were measured pre-procedure, 3 to 7 days, and 4 weeks post-procedure. Cortical thickness and ipsilateral split glomerular filtration rate were evaluated preoperatively and at time 4 weeks by ultrasonography and 99mTc-DTPA diuretic renography. Statistical analysis was performed using the SPSS version 26. Continuous variables were represented as mean±standard deviation, and t-tests were used for paired and unpaired comparison of continuous variables; Chi-square or Fisher's exact test was used for categorical variables. A p-value smaller than 0.05 was considered statistically significant.

RESULTS

In the PCN group, 77.8% were under 40 years as compared to 85.7% in the DJ stent group, with no significant difference in age, p=0.672. Mean age was 36.7±11.67 years in PCN and 35.1±10.38 years in DJ stent, p=0.693. Males were more numerous in both groups, 72.2% and 78.6%, respectively (*Table I*).

Table I
Demographic Profiling of the Study Population (*n*=32).

Demographic Variables	Group A (n=18) n (%)	Group B (n=14) n (%)	p-value
Age (in years)	-	-	-
< 40	14 (77.8)	12 (85.7)	0.672
≥ 40	4 (22.2)	2 (14.3)	
Mean ± SD	36.7 ± 11.67	35.1 ± 10.38	0.693
Sex	-	-	
Male	13 (72.2)	11 (78.6)	-
Female	5 (27.8)	3 (21.4)	-

Preprocedural symptoms were similar in the two groups. Pain was the most common presentation in 77.8% of patients in the PCN group and 57.1% of patients in the DJ stent group, p=0.267. Dysuria was reported in 61.6% and 50%, respectively. Hematuria was found in 16.7% compared to 28.6%. Fever was seen in 16.7% of PCN and 14.3% of DJ stent patients (*Table II*).

Table II
Clinical variables of the Study Population (*n* = 32).

Symptoms	Group A (n=18) n (%)	Group B (n=14) n (%)	p-value
Pain	14 (77.8)	8 (57.1)	0.267
Dysuria	11 (61.6)	7 (50.0)	0.530
Hematuria	3 (16.7)	4 (28.6)	0.669
Fever	3 (16.7)	2 (14.3)	1.000

Preprocedural laboratory investigations revealed similar values in groups. Mean Total white blood cell count was 11.75±2.04 in PCN and 11.61±2.00 in DJ stent, p=0.838. Neutrophil percentage was 67.22±7.91 and 65.21±8.37, p=0.493. Serum creatinine levels in PCN and DJ stent were 1.14±0.18 mg/dL and 1.06±0.17 mg/dL, p=0.251 (*Table III*).

Table III
Distribution of the respondents according to preprocedural laboratory investigation

Per-operative parameters	Group A (n=18) (mean±SD)	Group B (n=14) (mean±SD)	p-value
TC-WBC (×10⁹/L)	11.75 ± 2.04	11.61 ± 2.00	0.838
Neutrophil (%)	67.22 ± 7.91	65.21 ± 8.37	0.493
Serum creatinine (mg/dL)	1.14 ± 0.18	1.06 ± 0.17	0.251

Preprocedural ultrasonographic and renographic results were similar. Parenchymal thickness was 0.69±0.28 cm in PCN and 0.81±0.34 cm in the DJ stent. Split GFR of the affected kidney was 17.93±3.75 in PCN and 17.21±3.87 in DJ stent, p=0.596 (*Table IV*).

Table IV
Distribution of the respondents according to preprocedural ultrasonogram of the kidney and DTPA diuretic renogram.

Pre-procedure parameters	Group A (n=18) (mean±SD)	Group B (n=14) (mean±SD)	p-value
Parenchymal thickness of the affected kidney (cm)	0.69 ± 0.28	0.81 ± 0.34	0.301
Split GFR of the affected kidney (ml/min/1.73 m²)	17.93 ± 3.75	17.21 ± 3.87	0.596

At 1 month, postprocedural symptoms significantly improved in both groups. Pain at 16.7% in PCN and 14.3% in DJ stent patients. Dysuria was found in 5.6% vs 21.4%. Hematuria occurred in 0% of PCN and 7.1% of DJ stent patients (*Table V*).

Table V
Distribution of the respondents' postprocedural symptoms at 1 month between PCN and DJ stent.

Symptoms	Group A (n=18) N (%)	Group B (n=14) N (%)	p-value
Pain	3 (16.7)	2 (14.3)	1.000
Dysuria	1 (5.6)	3 (21.4)	0.295
Hematuria	0 (0.0)	1 (7.1)	0.438
Fever	0 (0.0)	0 (0.0)	-

Postprocedural laboratory findings after 1 month demonstrated improvement in both groups. Total white blood cell count fell to 9.67±2.08 in PCN and 10.36±1.47 in the DJ stent, p=0.303. Neutrophil percentages were 60.52±4.71% and 58.19±7.38%, p=0.286. Serum creatinine level was 0.94±0.19 mg/dL in PCN and 1.04±0.13 mg/dL in DJ stent, p=0.117 (*Table VI*).

Table VI
Distribution of the respondents according to postprocedural laboratory investigations findings at 1 month.

Post-procedure parameters	Group A (n=18) (mean±SD)	Group B (n=14) (mean±SD)	p-value
TC-WBC (×10⁹/L)	9.67 ± 2.08	10.36 ± 1.47	0.303
Neutrophil (%)	60.52 ± 4.71	58.19 ± 7.38	0.286
Serum creatinine (mg/dL)	0.94 ± 0.19	1.04 ± 0.13	0.117

At one month, both groups improved structural and functional renal parameters. Parenchymal thickness was increased to 1.08±0.34 cm and 0.96±0.23 cm in PCN and DJ stent, p=0.259. Split GFR was improved with PCN (24.59±4.28 versus DJ stent 21.94±3.55), p=0.071 (*Table VII*).

Table VII
Distribution of the respondents according to postprocedural ultrasonogram of the kidney and DTPA diuretic renogram findings at 1 month.

Post-procedure parameters	Group A (n=18) (mean±SD)	Group B (n=14) (mean±SD)	p-value
Parenchymal thickness of the affected kidney (cm)	1.08 ± 0.34	0.96 ± 0.23	0.259
Split GFR of the affected kidney (ml/min/1.73 m²)	24.59 ± 4.28	21.94 ± 3.55	0.071

A significant improvement was found within the PCN group at one month. Serum creatinine, from 1.14±0.18 mg/dL to 0.94±0.19 mg/dL, p=0.016. Split GFR was increased from 17.93±3.75 to 24.59±4.28 p<0.001. Parenchymal thickness increased from 0.69±0.28 cm to 1.08±0.34 cm, p<0.001 (*Table VIII*).

Table VIII
Comparison of preprocedural and postprocedural glomerular filtration rate and cortical thickness at 1 month in PCN group (*n* = 18).

Investigations	Preoperative value (mean±SD)	Postoperative value (mean±SD)	P-value
Serum creatinine (mg/dL)	1.14 ± 0.18	0.94 ± 0.19	0.016
Split GFR of the affected kidney (ml/min/1.73 m²)	17.93 ± 3.75	24.59 ± 4.28	<0.001
Parenchymal thickness of the affected kidney (cm)	0.69 ± 0.28	1.08 ± 0.34	<0.001

Within the DJ stent group, there was a significant improvement in split GFR (17.21 ± 3.87 to 21.94 ±3.55 p=0.002). However, serum creatinine had minimal changes from 1.06 ±0.17 mg/dL to 1.04±0.13 mg/dL, p=0.742. Parenchymal thickness increased from 0.8±0.34 cm to 0.96±0.23 cm, p=0.159 (*Table IX*).

Table IX
Comparison of preprocedural and postprocedural glomerular filtration rate and cortical thickness at 1 month in double J (DJ) ureteric stent group (*n* = 14).

Investigations	Preoperative value (mean±SD)	Postoperative value (mean±SD)	P-value
Serum creatinine (mg/dL)	1.06 ± 0.17	1.04 ± 0.13	0.742
Split GFR of the affected kidney (ml/min/1.73 m²)	17.21 ± 3.87	21.94 ± 3.55	0.002
Parenchymal thickness of the affected kidney (cm)	0.81 ± 0.34	0.96 ± 0.23	0.159

DISCUSSION

Timely relief of ureteric obstruction is important to avoid progressive renal damage and irreversible nephron loss. An obstructive type of uropathy from Ipsilateral urolithiasis leads to increasing intrarenal pressure, decreasing renal perfusion, as well as the activation of inflammatory and fibrotic mechanisms that damage glomerular filtration rate [11,12]. In our study, both percutaneous nephrostomy (PCN) and double J ureteral stenting (DJ stent) have significantly improved split glomerular filtration rate at one month. However, the effect of improvement was greater on the PCN group. Baseline demographic and clinical characteristics were similar between groups to reduce confounding bias. The predominance of younger male patients is consistent with studies by Scales et al. and Aiumtrakul et al., which show an increased incidence in males in economically active age groups [13,14]. Preprocedural split GFR and serum creatinine were statistically similar, suggesting similar levels of functional compromise before intervention. Both

groups showed significant improvement in split GFR after one month, indicating the reversal of renal dysfunction after decompression. Experimental and clinical data indicate that immediate relief of obstruction allows recovery of renal blood flow and tubular function, especially if the duration of obstruction is short [15]. Lucarelli et al. found that early decompression is an effective treatment to improve functional recovery, whereas delayed intervention results in decreased regenerative potential [16]. The rise in split GFR seen in our study is consistent with these findings. Although between group comparison was not statistically significant, the PCN group showed an increased mean split GFR at follow-up. This trend may reflect more direct and immediate pelvic decompression with nephrostomy. Hsu et al. noted that PCN provides effective drainage even in such cases of severe hydronephrosis or impacted stones where retrograde access may be technically challenging [17]. In contrast, ureteral stenting is dependent on restoration of intraluminal patency, which may be limited due to edema, inflammatory process, or partial obstruction. Serum creatinine was significantly improved only for the PCN group. However, serum creatinine is known to be an insensitive marker in unilateral obstruction due to the ability of the contralateral (opposite) kidney to compensate [18]. Nuclear renography, therefore, is a more accurate way of assessing ipsilateral functional recovery [19]. The substantial rise in split GFR in both groups supports this concept and makes functional imaging even more important than biochemical markers. Parenchymal thickness significantly improved in the PCN group but not the DJ stent group. Structural recovery following decompression has been linked to the return of renal perfusion and a decrease in interstitial edema [20]. The increased improvement noted in PCN might indicate more efficient pressure reduction and cortical re-expansion. However, the duration of follow-up was short, which may have been a limitation in the detection of structural changes in the DJ group. Symptomatic relief was similar in both groups, with significant improvement in pain, dysuria, and fever at one month. This is consistent with the reports by Horowitz et al., showing similar rates of short-term clinical success between PCN and DJ stenting in obstructive uropathy [21]. Therefore, both modalities are still effective in urgent decompression, and the choice often depends on the clinical context, anatomical feasibility, surgeon's expertise, and patient's preference. That there was no statistically significant intergroup difference in split GFR at one month may be explained by the small sample size. Larger randomized studies have produced mixed outcomes, with some revealing equivalent outcomes while others report a moderate superiority of PCN in severe obstruction [22]. Differences in obstruction severity, infection status, and follow-up duration are likely to affect outcomes. Overall, the results of this study suggest that both PCN and DJ stenting are useful in restoring glomerular filtration rate to the obstructive uropathy secondary to Ipsilateral urolithiasis. However, PCN showed a larger degree of improvement in the split glomerular filtration rate and cortical thickness in short-term follow-up. Further multicenter trials with greater sample sizes and longer follow-up are required to establish long-term functional benefits and the best procedure selection.

LIMITATIONS

The study was limited by a small sample size and short follow-up duration, which may limit the generalizability and interpretation of the long-term outcomes.

CONCLUSION

Both percutaneous nephrostomy and double J ureteral stenting procedures were effective in relieving obstruction and led to a significant percent improvement in the split glomerular filtration rate at one month. Functional recovery was seen in both groups, supporting that renal impairment can be reversed if timely decompression is performed. However, the extent of improvement in the split glomerular filtration rate and cortical thickness was greater in the nephrostomy group. Serum creatinine reduction was significant only after PCN. Procedure selection should therefore take into account the clinical severity, anatomical, and individual patient characteristics.

RECOMMENDATIONS

Larger randomized controlled trials with longer follow-up are needed to assess sustained renal recovery and long-term comparative outcome with the two decompressive modalities.

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CONFLICT OF INTEREST

None declared

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