TO COMPARE THE EFFECTIVENESS OF PERCUTANEOUS NEPHROSTOMY VERSUS DOUBLE-J STENT IN OBSTRUCTIVE UROPATHY

Ishtiaq Ur Rehman[1], Murad Ali[2], Adil Muhammad[2], Muhammad Danish[2], Asghar Ali[2], Syed Abdul Basit Ali Shah[2], Pir Sabir Shah[2]

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[1]Senior Registrar, Department of Urology, Khyber Teaching Hospital, Peshawar

Correspondence

[2]Murad Ali, Post Graduate Resident, Department of Urology, Khyber Teaching Hospital, Peshawar
: +92-345-9484886
: muradalik46@gmail.com

ABSTRACT

OBJECTIVES

This study aimed to compare the short-term effectiveness of percutaneous nephrostomy and double-J ureteral stenting in patients with obstructive uropathy.

METHODOLOGY

This retrospective observational study was conducted at Rehman Medical Institute, Peshawar, from January to December 2024. All positive blood cultures during the study period were processed using standard microbiological techniques and the Vitek 2.0 system. Antimicrobial susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) and European Committee on Antimicrobial Susceptibility Testing (EUCAST) 2024 guidelines. Organisms were categorized as per standard resistance classification. Data were analyzed in SPSS v27, with $p<0.05$ considered significant.

RESULTS

Mean age was 35.6 ± 8.4 years, and 76.7% of participants were male. Treatment effectiveness was higher with percutaneous nephrostomy than with double-J stenting (88.5% vs 77.9%, $p = 0.004$). After adjustment, percutaneous nephrostomy remained associated with higher odds of success (adjusted odds ratio 2.05, 95% confidence interval 1.18 to 3.55, $p = 0.01$). Female sex and malignant etiology were independently associated with lower treatment success. Procedure time and hospital stay were similar between groups.

CONCLUSION

Percutaneous nephrostomy was associated with higher short-term treatment effectiveness than double-J stenting in obstructive uropathy. Clinical context and underlying etiology should guide treatment selection.

KEYWORDS: *Obstructive Uropathy, Percutaneous Nephrostomy, Double-J Stent, Prospective Cohort, Urinary Drainage, Effectiveness.*

INTRODUCTION

Obstructive uropathy is a common condition in urological practice and an important reversible cause of acute kidney injury. Obstruction to urinary flow increases pressure within the collecting system, leading to hydronephrosis and, if untreated, progressive renal impairment. Patients commonly present with flank pain, fever, or uremic symptoms, and delayed treatment may result in urosepsis or irreversible loss of renal function.[1,2] The etiology of obstructive uropathy is diverse and includes ureteric calculi, ureteral strictures, benign prostatic enlargement, retroperitoneal fibrosis, and extrinsic compression from pelvic or abdominal malignancy.[3] In the local setting, urolithiasis remains a major cause of obstruction and contributes substantially to the acute urological workload.[4] Because timely decompression is essential, prompt diversion of the obstructed urinary system remains a key component of management. The two most commonly used methods for upper urinary tract decompression are retrograde double-J ureteral stenting and percutaneous nephrostomy.[5] Double-J stenting provides internal drainage and avoids the need for an external appliance, but it may be associated with irritative lower urinary tract symptoms, hematuria, migration, and later encrustation.[6] Percutaneous nephrostomy provides direct and reliable external drainage and is particularly useful when retrograde access is difficult or has failed. Its disadvantages include the need for an external drainage system, risk of tube dislodgement, and local site-related complications.[7] Current guidelines accept both approaches, and the choice between them depends on the patient's condition, the underlying cause of obstruction, anatomical feasibility, local expertise, and procedural availability.[8] Previous comparative studies have reported mixed findings. Some have shown higher technical or clinical success with percutaneous nephrostomy, particularly in complex or malignant obstruction, whereas others have emphasized the less

invasive nature and greater comfort of internal stenting.[9,10] Prospective data from South Asian populations remain limited despite differences in case mix, stone burden, and resource availability. This prospective cohort study was conducted at a tertiary care center to compare the short-term effectiveness of percutaneous nephrostomy and double-J stenting in patients with obstructive uropathy and to evaluate which approach provides more reliable early decompression in routine clinical practice.

METHODOLOGY

This prospective cohort study was conducted in the Department of Urology, Khyber Teaching Hospital, Peshawar, from April 23, 2025, to December 2025. Patients with newly diagnosed obstructive uropathy were enrolled during the study period. As treatment selection was based on clinical decision-making rather than random allocation, the study design was observational. The sample size was calculated to detect a clinically meaningful difference in treatment effectiveness between the two procedures. Assuming percutaneous nephrostomy effectiveness of 92% and double-J stenting effectiveness of 83%, with 80% power and a two-sided alpha of 0.05, the required sample size was 416 patients, with 208 patients per group.[11] Consecutive non-probability sampling was used. All eligible patients presenting during the study period were considered for inclusion until the required sample size was achieved. Patients were allocated to either the percutaneous nephrostomy or the double-J stent group based on the treating urologist's clinical judgment, anatomical feasibility, and procedural suitability. The age between 20 and 80 years and newly diagnosed obstructive uropathy confirmed on ultrasonography and flank pain with a visual analog scale (VAS) score greater than 5 were included. The Prior surgical or endoscopic intervention for the current obstructive episode, Severe or uncorrected coagulopathy, Uremia secondary to bladder outlet obstruction as the primary cause, and Bladder outlet obstruction from benign prostatic hyperplasia. Operational definitions included: *Obstructive Uropathy*: Defined as a structural or functional obstruction to urinary flow with hydronephrosis confirmed on ultrasonography. *Percutaneous Nephrostomy (PCN):* Ultrasound-guided placement of an 8 Fr nephrostomy tube into the renal pelvis for external drainage. *Double-J (DJ) Stent:* Cystoscopic-guided retrograde placement of a ureteral stent. Stent size was 5 or 6 Fr. Polyurethane stents were used. Local anesthesia with 2% lignocaine gel was administered. *Treatment effectiveness:* Successful decompression at 15-day follow-up without procedural failure, septicemia, significant bleeding, or painful trigonal irritation. Successful decompression was assessed clinically and by documented relief of obstruction after the index procedure. Procedural failure included the inability to place the intended drainage device or the need for immediate alternative diversion. The study protocol was approved by the Institutional Research and Ethical Review Board of Khyber Medical College/Khyber Teaching Hospital on April 18, 2025. Written informed consent was obtained from all participants, and patient confidentiality was maintained throughout the study. Patients were screened in the outpatient and emergency departments. Baseline data were recorded on a structured proforma, including age, sex, side of obstruction, clinical presentation, and relevant examination findings.[11] Laboratory evaluation included complete blood count, renal function tests, urine analysis, coagulation profile, and viral markers. Ultrasonography was used to confirm hydronephrosis and the affected side. The underlying etiology of obstruction, infection status at presentation, and grade of hydronephrosis were recorded from the clinical and imaging assessment, where available in the patient record. In the double-J stent group, patients underwent retrograde ureteral stent placement under cystoscopic guidance using a 5 to 6 Fr stent. Local anesthesia with 2% lignocaine gel, with or without mild sedation, was used according to procedural requirements. Prophylactic intravenous antibiotics were administered, and a Foley catheter was retained for 48 hours when indicated. In the percutaneous nephrostomy group, patients underwent ultrasound-guided placement of an 8 Fr nephrostomy tube in the prone position under local infiltration with 1% lignocaine. The tube was connected to an external drainage bag. Peri-procedural antibiotics were administered according to unit protocol. All patients were followed for 15 days after the index procedure. During follow-up, treatment effectiveness and early complications were recorded, including procedural failure, septicemia, significant bleeding, and painful trigonal irritation. Data were analyzed using SPSS version 22. Continuous variables, including age, procedure duration, and hospital stay, were expressed as mean ± standard deviation. Categorical variables, including sex, side of obstruction, and treatment effectiveness, were presented as frequencies and percentages. Group comparisons were performed using the independent-samples t-test for continuous variables and the chi-square test for categorical variables. Multivariable logistic regression was performed to adjust for potential confounding. The primary outcome variable was treatment success at 15 days. The treatment group was the main predictor variable. Covariates included age, sex, etiology of obstruction, hydronephrosis grade, pre-operative urine culture

status, and baseline serum creatinine. These variables were selected based on clinical relevance and prior literature. Results are presented as adjusted odds ratios with 95% confidence intervals. Model calibration was assessed using the Hosmer-Lemeshow test, and discriminatory ability was evaluated by the area under the receiver operating characteristic curve. An interaction term between treatment and sex was tested to assess effect modification. A p-value less than 0.05 was considered statistically significant. Stratified analyses by age, sex, and side of obstruction were also performed.

RESULTS

A total of 416 patients with newly diagnosed obstructive uropathy were enrolled during the study period. Of these, 208 underwent percutaneous nephrostomy and 208 underwent double-J stenting. All patients completed the 15-day follow-up, and no loss to follow-up was recorded. Participant flow is shown in Figure 1.

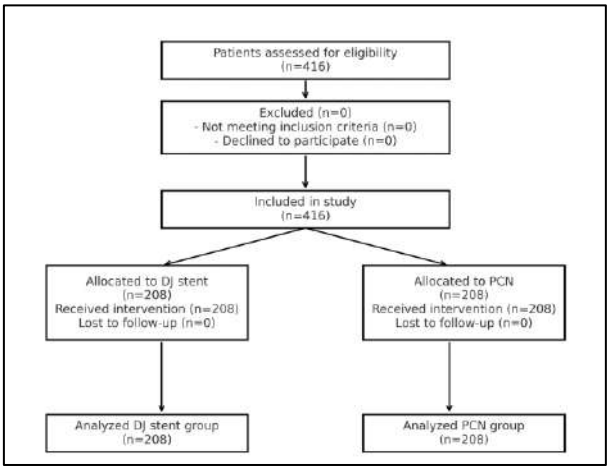

Figure 1: Cohort Flow Diagram of Patient Inclusion, Allocation to Intervention, and Follow-Up

Baseline demographic and clinical characteristics are presented in Table 1. The mean age of the study population was 35.6 ± 8.4 years, and 76.7% of participants were male. The percutaneous nephrostomy and double-J stent groups were comparable with respect to age, sex distribution, etiology of obstruction, side of obstruction, hydronephrosis grade, pre-operative urine culture status, and baseline serum creatinine. Mean procedure duration and mean hospital stay were also similar between groups, with no statistically significant differences observed for any baseline or peri-procedural variable.

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	PCN (n = 208)	DJ Stent (n = 208)	p-value
Age, years, mean ± SD	35.2 ± 7.7	36.1 ± 9.1	0.281
Sex, n (%)			0.202
Male	154 (74.0)	165 (79.3)	
Female	54 (26.0)	43 (20.7)	
Etiology of obstruction, n (%)			0.41
Stone	153 (73.6)	160 (76.9)	
Stricture	26 (12.5)	28 (13.5)	
Malignant	29 (13.9)	20 (9.6)	
Side of obstruction, n (%)			0.623
Left	101 (48.6)	96 (46.2)	
Right	107 (51.4)	112 (53.8)	
Hydronephrosis grade, n (%)			0.55
Grade I/II	109 (52.4)	115 (55.3)	
Grade III	99 (47.6)	93 (44.7)	
Positive pre-op urine culture, n (%)	48 (23.1)	36 (17.3)	0.14
Serum creatinine, mg/dL, mean ± SD	1.5 ± 0.7	1.4 ± 0.6	0.31
Procedure duration, min, mean ± SD	26.3 ± 6.4	27.0 ± 6.6	0.259
Hospital stay, days, mean ± SD	3.0 ± 1.6	3.1 ± 1.4	0.515

At 15-day follow-up, treatment success was achieved in 184 of 208 patients (88.5%) in the percutaneous nephrostomy group and in 162 of 208 patients (77.9%) in the double-J stent group. This difference was statistically significant (p = 0.004). The crude odds ratio for treatment success with percutaneous nephrostomy compared with double-J stenting was 2.18 (95% confidence interval 1.27 to 3.72).

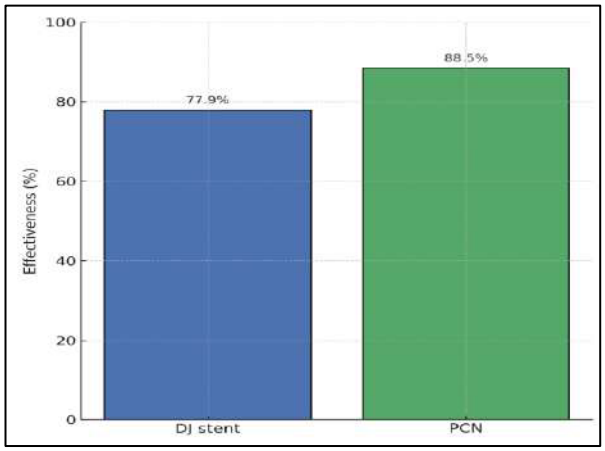

Figure 2: Comparison of treatment effectiveness between PCN and DJ stent groups

Mean procedure duration did not differ significantly between the two groups (26.3 ± 6.4 minutes for

percutaneous nephrostomy versus 27.0 ± 6.6 minutes for double-J stenting; p = 0.259). Mean hospital stay was also similar (3.0 ± 1.6 days versus 3.1 ± 1.4 days; p = 0.515). Stratified analysis by sex is presented in Table 2. Among male patients, treatment success was 136 of 154 (88.3%) in the percutaneous nephrostomy group and 145 of 165 (87.9%) in the double-J stent group, with no significant difference between groups (p = 0.905). Among female patients, treatment success was 48 of 54 (88.9%) in the percutaneous nephrostomy group compared with 17 of 43 (39.5%) in the double-J stent group (p < 0.001). Among women who underwent double-J stenting and did not achieve treatment success, the reported causes included procedural failure due to inability to pass the guidewire in 16 patients, persistent painful trigonal irritation in 8 patients, and septic deterioration in 2 patients.

Table 2: Stratified Analysis of Treatment Effectiveness

Subgroup	PCN Effective /Total (%)	DJ Stent Effective/ Total (%)	P-Value	Crude OR (95% CI)
Male	136/154 (88.3)	145/165 (87.9)	0.905	1.04 (0.53–2.05)
Female	48/54 (88.9)	17/43 (39.5)	<0.001	12.24 (4.30–34.82)

Multivariable logistic regression was performed to account for potential confounding. After adjustment for age, sex, etiology of obstruction, hydronephrosis grade, pre-operative urine culture status, and baseline serum creatinine, percutaneous nephrostomy remained independently associated with higher treatment success than double-J stenting (adjusted odds ratio 2.05, 95% confidence interval 1.18 to 3.55; p = 0.01). Female sex was independently associated with lower treatment success (adjusted odds ratio 0.41, 95% confidence interval 0.22 to 0.76; p = 0.005), as was malignant etiology compared with stone disease (adjusted odds ratio 0.38, 95% confidence interval 0.17 to 0.85; p = 0.02). Stricture etiology showed a non-significant trend toward lower treatment success. Age, high-grade hydronephrosis, positive pre-operative urine culture, and baseline serum creatinine were not significantly associated with treatment success in the adjusted model. The full multivariable model is presented in Table 3

Table 3: Multivariable Logistic Regression Analysis of Factors Associated with Treatment Success

Variable	aOR	95% CI	p-value
Treatment group			
DJ Stent	Reference		
PCN	2.05	1.18 - 3.55	0.01
Age (per year)	0.99	0.96 - 1.02	0.48
Sex			
Male	Reference		0.005
Female	0.41	0.22 - 0.76	
Etiology			
Stone	Reference		
Stricture	0.72	0.38 - 1.36	0.31
Malignant	0.38	0.17 - 0.85	0.02
Hydronephrosis grade			
Grade I/II	Reference		
Grade III	0.83	0.51 - 1.35	0.45
Pre-op urine culture			
Negative	Reference		
Positive	0.68	0.39 - 1.19	0.18
Baseline serum creatinine (per mg/dL)	0.87	0.58 - 1.31	0.51

aOR = adjusted odds ratio; CI = confidence interval, Model fit: Hosmer–Lemeshow $\chi^2 = 6.84$, p = 0.55; area under ROC curve = 0.78 (95% CI 0.72–0.84) A formal test for interaction between treatment group and sex was statistically significant (p for interaction = 0.01), indicating that the association between treatment type and treatment success differed by sex. This finding was consistent with the stratified analysis.

DISCUSSION

This prospective cohort study found higher short-term treatment success with percutaneous nephrostomy than with double-J stenting in patients with obstructive uropathy. This difference remained significant after adjustment for measured confounders. Female sex and malignant etiology were independently associated with lower treatment success. A significant interaction between treatment type and sex was also observed. The main finding of this study was the higher effectiveness of percutaneous nephrostomy at 15 days. Success was achieved in 88.5% of patients in the percutaneous nephrostomy group and 77.9% in the double-J stent group. The adjusted analysis showed a similar effect size. This supports the stability of the observed association. These findings are in line with previous comparative studies and systematic reviews that reported higher procedural success with percutaneous

nephrostomy in selected settings.[12,13,14] Published reviews have also shown that percutaneous nephrostomy may provide more reliable decompression, especially in technically difficult cases.[15] An important finding was the difference observed by sex. In male patients, treatment success was similar in the two groups. In female patients, treatment success was much lower with double-J stenting than with percutaneous nephrostomy. The significant interaction test supported this pattern. The result should be interpreted with care, but it remains clinically important. In women who underwent double-J stenting, failure was mainly related to inability to pass the guidewire, persistent trigonal irritation, and septic deterioration. Previous reports have also suggested that retrograde stenting may be less successful in selected patients with malignant or pelvic obstruction.[15,17] Malignant etiology was also associated with lower treatment success. This is clinically plausible. Extrinsic compression may reduce the chance of successful retrograde stent placement and effective drainage. In such cases, percutaneous nephrostomy may offer a more dependable route of decompression because it bypasses the obstructed ureter.[17] Stricture etiology showed the same direction of effect but did not reach statistical significance in the adjusted model. Procedure duration and hospital stay were similar in both groups. These findings suggest that the higher effectiveness of percutaneous nephrostomy was not offset by longer procedure time or longer hospitalization in this cohort. The regression model also performed well, with adequate calibration and fair discrimination. This supports the internal consistency of the adjusted analysis. The present findings are relevant to routine practice in resource-limited settings. In many centers, treatment choice is influenced not only by anatomy and etiology but also by operator judgment and available equipment. The results suggest that percutaneous nephrostomy may be the more reliable initial option when retrograde access is expected to be difficult or when malignant obstruction is suspected. At the same time, effectiveness is only one part of decision-making. Patient comfort and quality of life were not measured in this study. This remains important because some patients may still prefer internal drainage despite a lower technical success rate.[18]

LIMITATIONS

Treatment allocation was not randomized. Residual confounding and indication bias may therefore remain despite multivariable adjustment. The study was conducted at a single center. Follow-up was limited to 15 days, so long-term outcomes were not assessed. The female subgroup was smaller than the male subgroup, so sex-specific findings should be interpreted cautiously and confirmed in larger studies. The study also has clear strengths. It used a prospective cohort design. The sample size was adequate. Follow-up was complete. The analysis included adjustment for important clinical variables. Interaction testing added depth to the interpretation of subgroup findings. The study also addresses a regional evidence gap in the comparative management of obstructive uropathy.

CONCLUSIONS

Percutaneous nephrostomy was associated with higher short-term treatment effectiveness than double-J stenting in obstructive uropathy. Lower treatment success was observed in female patients and in malignant obstruction. Percutaneous nephrostomy may offer more reliable decompression in selected patients, but these findings should be interpreted cautiously because of the non-randomized design.

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AUTHORS CONTRIBUTION

Ishtiaq Ur Rehman **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval*

Murad Ali **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Final Approval*

Adil Muhammad **-** *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

Muhammad Danish **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Final Approval*

Asghar Ali **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Final Approval*

Syed Abdul Basit Ali Shah **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Final Approval*

Pir Sabir Shah **-** *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.