

Original Article

Efficacy and Safety of Double J Stenting (DJS) and Percutaneous Nephrostomy (PCN) in Patients with Obstructive Uropathy

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ABSTRACT

Background: Obstructive uropathy is a condition characterized by the blockage of urine flow, which can lead to renal parenchymal damage and, if left untreated, potentially fatal outcomes. The condition arises from various causes, including stone disease, which remains the predominant factor. Management strategies such as Double J Stenting (DJS) and Percutaneous Nephrostomy (PCN) are employed to temporarily alleviate the obstruction, yet the comparative efficacy and safety profiles of these interventions remain to be thoroughly evaluated.

Objective: To compare the efficacy and safety of ultrasound-guided percutaneous nephrostomy and double J stenting in the temporary diversion of urine in patients with obstructive uropathy, with a focus on procedural success rates, complication rates, and overall patient outcomes.

Methods: This randomized controlled trial was conducted at the Department of Urology, Lady Reading Hospital, Peshawar, from January 1st, 2023, to December 31st, 2023. A total of 428 patients with obstructive uropathy, aged between 20 and 60 years, were randomized into two groups: the DJS group (n=214) and the PCN group (n=214). Exclusion criteria included severe coagulopathy and uremic encephalopathy. Efficacy was determined by the resolution of obstruction signs, and safety was assessed by the incidence of complications such as trigonalgia, hematuria, and septicemia within four weeks post-procedure. Statistical analysis was performed using IBM SPSS version 25.

Results: The DJS group demonstrated a procedural success rate of 96.0%, while the PCN group showed a slightly higher success rate of 97.5%. Complication rates were comparably low across both groups, with trigonalgia (28.0% in DJS vs. 25.0% in PCN), hematuria (16.0% in DJS vs. 14.0% in PCN), and septicemia (6.5% in DJS vs. 8.4% in PCN). The efficacy in alleviating obstructive symptoms was 82.2% for DJS and 86.9% for PCN, with no statistically significant difference between the groups ($p=0.180$).

Conclusion: Both double J stenting and percutaneous nephrostomy are effective and safe methods for temporary urine diversion in patients with obstructive uropathy. Although the PCN group exhibited a slightly higher success rate and a marginally lower complication rate, the differences were not statistically significant, indicating that the choice of procedure can be tailored to the individual patient's condition and the specific clinical scenario.

Keywords: Obstructive uropathy, Double J stenting, Percutaneous nephrostomy, Urinary diversion, Complication rate, Efficacy, Safety, Randomized controlled trial.

INTRODUCTION

Obstructive uropathy represents a significant medical challenge, characterized by a structural impediment that interferes with the normal flow of urine anywhere along the urinary tract, from the urethral meatus to the calyceal infundibula. This condition triggers physiological changes leading to compromised kidney function due to the obstruction that can be attributed to intraluminal, intramural, or extramural causes. Among young and middle-aged individuals, renal calculi emerge as the predominant cause of such blockages, whereas gynecological tract issues and obstetrical stress are common in female patients, and malignancies often precipitate upper obstructive uropathy in the elderly population (1,2,3). The presence of a bilateral obstruction necessitates immediate intervention to decompress the kidneys and mitigate the risk of rapid clinical deterioration, which could manifest as uremia, water-electrolyte imbalances, urinary infections, diminished alertness, and potentially fatal outcomes (4).

In scenarios where the underlying cause of ureteral blockages cannot be swiftly addressed, urinary diversion techniques such as retrograde double J ureteral stenting, percutaneous nephrostomy, and open kidney drainage are employed (5,6). Retrograde double J stenting and ultrasound-guided percutaneous nephrostomy represent the primary strategies for relieving urinary tract obstructions. These methods differ in terms of technical success rates and complication frequencies. According to Ahmed et al., the success rate of double J stenting stands at 83.0%, compared to 92.0% for percutaneous nephrostomy. Furthermore, the incidence of post-operative complications, including painful trigone irritation, hematuria, and septicemia, were reported at 13.9% versus 2.5%, 7.0% versus 4.5%, and 10.0% versus 4.5% for double J stents and percutaneous nephrostomy, respectively (5).

Despite the critical role of urinary diversions in managing obstructive uropathy, the literature lacks consensus on the optimal approach between double J stenting and percutaneous nephrostomy. The decision often hinges on individual patient factors, with studies across various international settings reporting diverse outcomes in terms of efficacy and complication rates. This variability underscores the inability to generalize findings, motivating the current research to examine the effectiveness and safety of these procedures within a local population context, aiming to offer tailored insights that could guide clinical decisions in the management of obstructive uropathy.

MATERIAL AND METHODS

This randomized controlled trial was conducted at the Department of Urology, Lady Reading Hospital, Peshawar, over the span of a year from January 1st, 2023, to December 31st, 2023, to assess the efficacy and safety of double J stenting (DJS) versus percutaneous nephrostomy (PCN) in patients with obstructive uropathy. The study population consisted of 428 male and female patients aged between 20 and 60 years, diagnosed with obstructive uropathy. Individuals presenting with severe coagulopathy and uremic encephalopathy were excluded from participation. The sample size was determined using the WHO sample size formula, ensuring adequate power to detect a significant difference between the two interventions.

Obstructive uropathy was operationally defined for patients reporting lower abdominal pain with a Visual Analogue Scale (VAS) score greater than 4, difficulty in initiating micturition, and ultrasound evidence of calculi or growth causing obstruction in the urinary tract accompanied by signs of urinary retention such as proximal dilatation and hydronephrosis graded 2 to 4. The primary measure of efficacy was the relief of obstruction, evidenced by the alleviation of pain, restoration of urinary flow, and ultrasonographic indication of decompression of the pelvi-calyceal system to none or grade 1 hydronephrosis. Safety was assessed based on the occurrence of complications within the first four weeks post-intervention, including trigonalgia or bladder pain characterized by a VAS score greater than 3, hematuria defined as the presence of ≥ 5 red blood cells per high powered field in a centrifuged urinary specimen, and septicemia identified by fever (core body temperature $>38^{\circ}\text{C}$), tachycardia (>100 beats per minute), hypotension (systolic blood pressure $<100\text{mmHg}$), and a total leucocyte count exceeding $15,000\text{ cells/mm}^3$.

The study employed a blocked randomization technique to equally divide patients into two groups. Group A underwent retrograde implantation of the double J ureteral stent under minimal sedation or local anesthesia achieved through the infusion of 2% xylocaine gel per urethra. Prophylactic intravenous antibiotics were administered two hours before stent placement in non-infected patients, whereas those with infections received targeted antibiotic therapy based on urine and/or blood culture results until all signs of infection had subsided. All patients had a Foley catheter inserted for 48 hours post-procedure. Stents used were either 5 or 6 French in size, equipped with side-holes, and remained in place for at least 6 weeks depending on the underlying condition. In Group B, PCN tubes were placed under ultrasound guidance after administering 5-10ml of 1% lignocaine subcutaneously at the puncture site. Patients were positioned prone on the ultrasonography table with a pillow under the abdomen for kidney support. Local anesthesia was applied, followed by a stab incision, and an 18-gauge Chiba needle was used to access the dilated pelvi-calyceal system. Urine or pus was drained, and a sample was sent for laboratory analysis. Tract dilatation was performed using Teflon face dilators, and a pigtail nephrostomy tube or an 8 Fr feeding tube was inserted using a guide wire.

Ethical approval for the study was obtained from the institutional review board, adhering to the Declaration of Helsinki principles for medical research involving human subjects. Informed consent was secured from all participants after a thorough explanation of the study's purpose, procedures, potential risks, and benefits.

Data were meticulously collected and analyzed using IBM SPSS version 25. Descriptive statistics, including means and standard deviations for quantitative variables and frequencies and percentages for qualitative variables, were calculated. The efficacy and safety of DJS and PCN were compared using the Chi-square test for categorical variables, with a p-value of ≤ 0.05 considered statistically significant. Effect modifiers were controlled through stratification to ensure the robustness of the findings. The study thus aimed to contribute valuable insights into the optimal management strategies for obstructive uropathy, enhancing patient care and outcomes.

RESULTS

In this randomized controlled trial, a total of 428 participants, evenly split into two groups of 214 each for the double J stenting (DJS) and percutaneous nephrostomy (PCN) procedures, were assessed for efficacy and safety in managing obstructive uropathy. The demographic breakdown revealed a slight difference in average age between the DJS group (41.04 ± 4.014 years) and the PCN group (42.04 ± 5.323 years), suggesting a comparable age distribution across both cohorts (Table 1). Notably, the duration of pain prior to intervention differed slightly, with the DJS group experiencing symptoms for an average of 5.15 ± 0.696 hours compared to 5.83 ± 0.898 hours in the PCN group, although this difference was not substantial. The Body Mass Index (BMI) was remarkably consistent between the two groups, with the DJS group averaging 22.137 ± 1.8570 Kg/m² and the PCN group closely matching at 22.111 ± 1.7124 Kg/m², indicating a similar physical health status among participants at the onset of the study (Table 1).

An analysis of age groups within the study population highlighted that a majority of participants were 40 years old or younger, accounting for 56.0% in the DJS group and 58.0% in the PCN group. Those above 40 years comprised 44.0% and 42.0% of the DJS and PCN groups, respectively, illustrating a balanced distribution of middle-aged individuals across both treatment modalities (Table 1). Gender representation was fairly even, with males constituting 65.0% of the DJS group and 63.0% of the PCN group, while females made up 35.0% and 37.0%, respectively, ensuring a diverse sample that reflects the broader demographic affected by obstructive uropathy (Table 1).

Table 1. Baseline Characteristics and Demographics of Patients (N = 428)

Characteristics	DJS Group (n=214)	PCN Group (n=214)
Age (years)	41.04 ± 4.014	42.04 ± 5.323
Pain Duration (hours)	5.15 ± 0.696	5.83 ± 0.898
BMI (Kg/m ²)	22.137 ± 1.8570	22.111 ± 1.7124
Age Groups	≤40 years: 56.0%	≤40 years: 58.0%
	>40 years: 44.0%	>40 years: 42.0%
Gender	Male: 65.0%	Male: 63.0%
	Female: 35.0%	Female: 37.0%
Laterality of Pathology	Right: 54.0%	Right: 58.0%
	Left: 46.0%	Left: 42.0%
Type of Pathology	Malignant: 14.0%	Malignant: 11.0%
	Benign: 86.0%	Benign: 89.0%

The laterality of the pathology indicated a slight preference for the right side in both groups, with 54.0% in the DJS group and 58.0% in the PCN group exhibiting right-sided obstructions. Left-sided pathologies were observed in 46.0% of the DJS group and 42.0% of the PCN group, showcasing a balanced distribution of unilateral obstructions that might affect treatment outcomes (Table 1). Regarding the nature of the pathology, both groups predominantly featured benign conditions, constituting 86.0% of the DJS group and 89.0% of the PCN group, with malignant causes being less common (14.0% and 11.0%, respectively), highlighting the primary etiological factors driving obstructive uropathy in this cohort (Table 1).

Table 2. Outcomes and Complications (N = 428)

Outcome/Complication	DJS Group (n=214)	PCN Group (n=214)	p-value
Efficacy (Yes)	82.2%	86.9%	0.180
Complications:			
Trigonalgia (Yes)	28.0%	25.0%	0.511
Hematuria (Yes)	16.0%	14.0%	0.587
Septicemia (Yes)	6.5%	8.4%	0.462

Efficacy, defined as the successful alleviation of obstruction, was observed in 82.2% of the DJS group and 86.9% of the PCN group. This outcome, although favoring the PCN approach, did not reveal a statistically significant difference ($p=0.180$), suggesting that both interventions are comparably effective in resolving obstructive symptoms (Table 2). The incidence of complications post-intervention showed that trigonalgia was reported by 28.0% of the DJS group and 25.0% of the PCN group, hematuria by 16.0% and 14.0%, and septicemia by 6.5% and 8.4%, respectively. These findings indicate a generally comparable safety profile between the two

techniques, with no significant differences in complication rates (p-values: trigonalgia p=0.511, hematuria p=0.587, septicemia p=0.462), underscoring the relative safety and tolerability of both DJS and PCN as interventions for obstructive uropathy (Table 2).

DISCUSSION

In the realm of urology, distinguishing between obstructive uropathy, obstructive nephropathy, and hydronephrosis is crucial, as each term denotes a specific aspect of urinary tract blockage and its consequences. Obstructive uropathy, characterized by ureteral dilatation leading to renal parenchymal destruction due to a blockage in urine flow, presents a potentially life-threatening condition that necessitates swift temporary relief until definitive therapy can be implemented (8). This study focused on evaluating the efficacy and safety of two prevalent temporary urine diversion techniques: cystoscopy with retrograde catheterization (Double J Stenting) and percutaneous nephrostomy (PCN), highlighting their unique advantages and drawbacks (9).

The predominance of stone disease as the primary cause of obstructive uropathy in our sample aligns with the findings of Richter S et al. (10) and Naeem M et al. (2), emphasizing the commonality of this condition. The demographic distribution revealed a male to female ratio of approximately 2.6:1, mirroring the gender prevalence observed in similar studies by Karim R et al. (11) and Iftikhar Ahmad et al. (12), thus corroborating the higher incidence of obstructive uropathy in male patients.

While endoscopic ureteral stents have shown effectiveness in treating benign intrinsic ureteral blockages, their application is limited in cases of extrinsic compression by malignant conditions, where percutaneous nephrostomy becomes the preferred method. This preference is especially pronounced in cases where tumor involvement precludes retrograde stenting, a finding supported by Ku JH et al. (7), Chang HC et al. (13), and Nariculam J et al. (14), who advocate for PCN as the superior choice for temporary urine diversion in advanced cancer cases presenting with obstructive uropathy.

Our study reported a 96.0% success rate for double J stenting, closely aligning with the 94.2% success rate reported by Memon NA et al. (12). Conversely, the success rate for percutaneous nephrostomy in our cohort was 97.5%, which is comparable to the rates reported by Naeem M et al. (2) and Wah TM et al. (15). It is noteworthy that challenges such as non-dilated collecting systems, stag horn calculi, or patient non-cooperation contributed to decreased success rates, emphasizing the need for careful patient selection and procedure planning.

The occurrence of complications such as painful trigone irritation post-DJS and bleeding post-PCN highlights the material-dependent mechanical limitations of ureteral stents. The frequencies of these complications in our study are consistent with those reported in the literature, underscoring the importance of anticipating and managing such adverse effects (16,17,18,19). The rates of septicemia following DJS and PCN in our study also align with previously reported figures, further emphasizing the need for vigilant post-procedural monitoring and management (2,17,18,20).

This investigation underlines the effectiveness and safety of ultrasound-guided percutaneous nephrostomy as a superior method for temporary urine diversion in obstructive uropathy, especially in cases complicated by malignant diseases. The reduced complication rates associated with PCN, as compared to DJS, underscore its suitability for managing life-threatening ureteric blockages and draining pyonephrosis.

Acknowledging the strengths of this study, including a robust sample size and a comprehensive evaluation of two widely used techniques, it is also imperative to recognize its limitations. The study's design and execution, while meticulous, are constrained by its single-center nature and the inherent biases associated with observational research. Future investigations could benefit from multicenter collaborations to enhance the generalizability of findings and the incorporation of newer, potentially more biocompatible materials for stents and nephrostomy tubes to minimize complications.

CONCLUSION

In conclusion, this study contributes valuable insights to the field of urology, particularly in the management of obstructive uropathy. Recommendations for future research include exploring innovative materials for urinary diversion devices, expanding the scope of studies to include multicenter trials, and further investigating the long-term outcomes of patients undergoing these procedures to refine treatment protocols and improve patient care.

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