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ORIGINAL ARTICLE

Comparative Analysis of Percutaneous Nephrostomy and Double J Stenting in Upper Urinary Tract Obstruction with Acute Kidney Injury: A Tertiary Hospital Based Prospective Study

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Abstract

Background: Upper urinary tract obstruction is a serious condition that can lead to significant renal impairment if not managed promptly. Emergency urinary diversion is crucial for alleviating obstruction and preserving renal function. This study investigates various emergency urinary diversion techniques, compares their outcomes, and evaluates factors influencing recovery. **Methods:** We conducted a prospective study involving 106 patients diagnosed with obstructive uropathy at Jawaharlal Nehru Medical College, Aligarh Muslim University. Patients were classified into upper urinary tract obstruction and lower urinary tract obstruction. 70 patients of the upper urinary tract obstruction cases were further managed by either percutaneous nephrostomy (PCN) or double-J (DJ) ureteral stenting diversion procedures. 68 out of 70 upper urinary tract obstruction underwent either of the two procedures. Clinical, demographic, and laboratory parameters were analysed in such patients, and their outcomes were assessed at one and three months. **Results:** The study included 68 out of 106 patients with a mean age of 48 years. Most patients presented with acute kidney injury (AKI) and had symptoms of loin pain and haematuria. Both PCN and DJ stenting were equally effective in managing upper tract obstruction, with no significant differences in improvement of the laboratory parameters (e.g. Hemoglobin, Serum Creatinine, estimated Glomerular Filtration Rate, Blood Urea Nitrogen) between the two techniques at one and three months. Associated factor like age was associated with unfavourable outcomes. **Conclusion:** Emergency urinary diversion via PCN or DJ stenting effectively manages upper urinary tract obstruction, with comparable outcomes. Early intervention and management of underlying conditions are critical for optimal renal recovery and prevent irreversible kidney damage.

Keywords: per cutaneous nephrostomy (PCN), double J (DJ) stent, Acute Kidney Injury (AKI), Chronic Kidney Disease (CKD)

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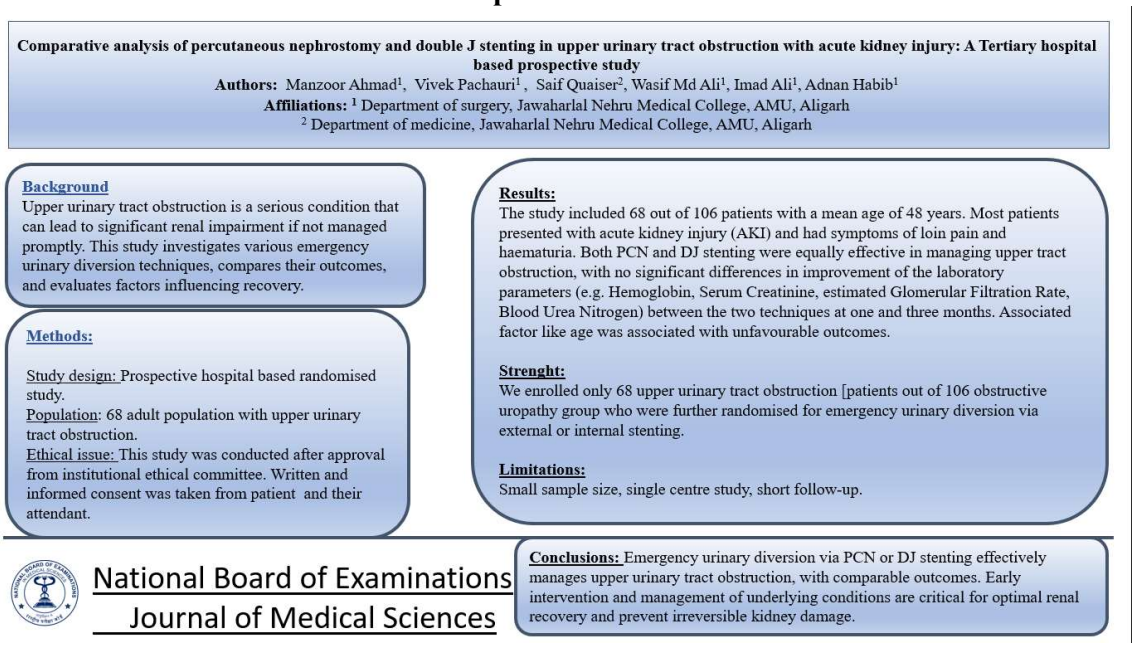
Graphical Abstract



Introduction

Obstructive uropathy is a urological emergency characterized by impediments to normal urinary outflow, which can lead to renal dysfunction and ultimately renal failure. Obstructive uropathy incorporates approximately 10% of all acute and chronic kidney diseases, including 5% of the chronic dialysis population [1]. The etiopathogenesis varies from benign to malignant conditions largely determined by age of the patient. In young adults urolithiasis is the commonest cause while in elders benign prostatic hyperplasia, urolithiasis and malignancies are the leading etiologies.In young adults urolithiasis is primary cause of upper urinary tract infection [2,3].

Obstruction can be acute or chronic, complete or incomplete, unilateral or bilateral. Both the renal parenchyma and the ureter proximal to the obstruction may undergo long-term alterations as a result of obstructive uropathy. To avoid such morbidity and mortality related to obstruction, it must be promptly diagnosed and treated in time.

It is well recognized that obstructive uropathy frequently contributes to chronic kidney disease/end stage kidney disease (CKD/ESKD) in children and it is also linked to acute kidney injury (AKI) in adults [4]. The diagnosis of obstruction of the urinary system and associated anomalies is done using imaging modalities such as ultrasonography, computed tomography, intravenous urography along with urine analysis and blood investigations. In the emergency setting urinary diversion is the method of choice for pelvic or ureteral obstruction, when the underlying pathophysiology of the obstruction cannot be resolved definitely. Urinary diversion techniques include percutaneous nephrostomy (PCN) and retrograde double J (DJ) ureteral stenting [5]. We conducted this study to compare the outcomes of PCN and DJ stenting in the emergency management of upper urinary tract obstruction.

Materials and Methods

Study Design and Setting

A prospective, hospital-based simple randomised study was conducted from August 2022 to July 2024 at the Urology and Nephrology units of Jawaharlal Nehru Medical College, Aligarh Muslim University, Uttar Pradesh, India.

Sample Size

68 patients with upper urinaryobstructive uropathy.

Inclusion Criteria

- Adults ≥18 years old.
- Diagnosed with AKI, Acute Kidney Disease (AKD), or <G4A3 Chronic Kidney Disease (CKD) due to upper urinary tract obstruction.
- Patients undergoing either PCN or DJ stenting.
- Patients giving informed consent for the participation.

Exclusion Criteria

- Pregnant or lactating women.
- Severe comorbidities (e.g., myocardial infarction, heart failure).
- Known G5A3 CKD.
- Previous PCN or DJ stenting before hospital presentation.
- Severe Chronic Obstructive Pulmonary Disease (COPD).
- PCN as well as DJ stenting in a single patient.

Procedures

Patients were initially assessed through hemogram, serum creatinine, blood urea nitrogen (BUN), and imaging (X-ray KUB, USG KUB, NCCT scan, cystoscopy). Out of 106 obstructive uropathy patients 36 patients with lower urinary obstruction were excluded. 70 out of 106 obstructive uropathy patients were diagnosed with upper urinary tract obstruction and they were randomised for either PCN or DJ stenting. 2 patients who underwent both PCN and DJ stenting on either side were also excluded. In 68 patients, follow-up included clinical assessments and laboratory tests at 1 and 3 months to evaluate renal recovery and identification of factors associated with non-recovery.

Techniques

1. **Percutaneous Nephrostomy (PCN):** A SAMSUNG HS50 ultrasonography machine with 2.2 MHz curvilinear and 4.7 MHz linear transducers was used for the ultrasound examination. We assessed the kidneys' cortical thickness, echogenicity, and dimensions after ultrasonography (USG). The damaged kidney had a longitudinal USG scan, with the help of which the puncture site's location was confirmed. The surface area with the best sonographic visibility of the dilated pelvis and calyx was chosen as the puncture site. The renal calyx was punctured at the location with the shortest skin to pelvic distance following local anaesthetic infiltration of 2% lignocaine. A 15 cm, 18 gauge, two-part trocar needle with a diamond tip is inserted into the renal pelvis through calyx under USG guidance. Free flow of urine was used to verify correct position. Under ultrasound guidance, a 150 cm long, 0.035 inch diameter Terumo guide wire was introduced into the needle. Fascial dilators were used to achieve serial tract dilatation over the guide wire. Thereafter, 8 Fr x 30 cm (blueneem) PCN tube was passed into the renal pelvis. After USG confirmed the PCN

catheter's position, silk 1-0 and adhesive strapping were used to fix the catheter to the skin.

2. **Double-J (DJ) Ureteral Stenting:** The Karl Storz 19 Fr rigid cystoscope was inserted after lubrication with 2% lignocaine jelly. The bladder trigone was identified following the ureteral ridge with both vesico-ureteric junctions at opposite ends. After locating the Ureteric Orifice (UO) with a cystoscope, a Terumo 0.035 x 150 cm guidewire was placed into the scope and routed through the UO to enter the ureter. 6 Fr x 26 cm Uromed Double 'J' stent with both ends open was pushed above it. C- arm was used to confirm the correct placement of DJ stent. It was then removed 3- 4 weeks after discharge, if serum creatinine returned to baseline.

Statistical Analysis

Descriptive statistics, Pearson Chi-Square test, independent and paired t-tests were used for data analysis. P-value of <0.05 was considered significant. SPSS version 25.0 was employed for statistical computations.

Results

Patient Demographics

- Mean age: 48 years.
- Majority were males with common symptoms including loin pain and haematuria.
- Most common aetiology in upper urinary tract obstruction in our study was b/l nephrolithiasis.

Table 1. Comparison of laboratory parameters in patients undergoing PCN vs DJ stenting

Changes in Laboratory Parameters from baseline		**PCN (n=32)**	**DJ Stenting (n=36)**	**P-Value**
		Mean	**Mean**	
Hb (g/dL)	At 1 Month	0.06	-0.45	0.294
	At 3 Months	-0.21	0.12	0.062
BUN (mg/dL)	At 1 Month	-21.71	-19.50	0.715
	At 3 Months	-1.07	-4.00	0.106
eGFR (ml/min)	At 1 Month	42.36	41.29	0.889
	At 3 Months	13.43	9.53	0.537
Serum Creatinine (mg/dL)	At 1 Month	-2.93	-2.48	0.255
	At 3 Months	-0.36	-0.22	0.247

*Anova-t test (minus sign (-) indicates decrease in value)

(Abbreviations: Hb= Hemoglobin, BUN= Blood Urea Nitrogen, eGFR= estimated Glomerular Filtration Rate)

Table 1 represented the changes in various laboratory parameters between PCN and DJ ureteral stenting at one month and three months. The mean change and p-value were provided for each parameter.

There was no significant difference in the changes in haemoglobin levels

between PCN and DJ stenting at one month (p=0.294) or three months (p=0.062). The changes in BUN levels were not significantly different between PCN and DJ stenting at one month (p=0.715) or three months (p=0.106).The changes in eGFR were not significantly different between PCN and DJ stenting at one month (p=0.889) or three months (p=0.537). Similarly, changes in serum creatinine levels were not significantly different between PCN and DJ stenting at one month (p=0.255) or three months (p=0.247). This suggested that both procedures had similar effects on these laboratory parameters and were equally effective in patients with obstructive uropathy.

Table 2. Outcome of patients undergoing Per Cutaneous Nephrostomy (PCN) or Double J stenting in upper urinary tract obstruction.

Outcome	PCN (n=32)	DJ Stenting (n=36)	P-Value
Recovered	22	31	0.084

*chi-square test (recovered: return of serum creatinine to baseline)

This data (Table 2) presented recovery outcomes between two renal drainage techniques: Double J (DJ) Stenting and Bilateral PCN. The analysis focuses on the number of patients who recovered and those who did not, with a total of 32 patients undergoing bilateral PCN and 36 patients receiving bilateral DJ stenting. In the PCN group, 22 out of 32 patients (68.75%) recovered, while in the DJ stenting group, 31 out of 36 patients (86.11%) recovered. Additionally, 10 patients (31.25%) in the PCN group did not recover, compared to just 5 patients (13.89%) in the DJ stenting group The P-value associated with this comparison is 0.084. This p-value indicates that there is no statistically significant difference in recovery rates between the two groups.

Table 3. Factors responsible for non-recovery of study subjects

S.No.	Non Recovery Patients		Cases (n=15)	P-Value
1	Age	Older Age (>60)	1	<0.01
		Younger Age (<60)	14	
2	Sex	Male	7	0.796
		Female	8	
3	Co-morbidities	Nil	13	0.004
		Present	2	
4	Urine Culture at Presentation	Negative	8	0.796
		Positive	7	

*Chi-square test

Above mentioned table (Table 3) represents association of various factors like age, sex, co-morbidities, urine culture profile with non-recovery in patients undergoing urinary diversion in upper urinary tract obstruction. On analysis for age with non-recovery, we found that 14 out of 15 cases were young adults whereas 1 out of 15 was in older group with p-value of <0.01. 7 out of 15 were male patients whereas 8 patients were female. This data had a p-value of 0.796 which suggest it to be an insignificant data. Only 2 out of 15 non-recovery patients had co-morbidities and 13 patients were without any associated disease.This suggest that most of the patients in non-recovery group were without any co-morbidity with a p-value of 0.004. On analysis of urine culture profile at presentation among non-recovery patients, we found 8 patients with sterile culture profile and vice-versa with p-value of 0.796.

Discussion

This study aimed to compare the efficacy and outcomes of PCN and DJ ureteral stenting in the emergency management of upper urinary tract obstruction with AKI. Our results show that both PCN and DJ stenting were effective in managing upper urinary tract obstruction. The changes in laboratory parameters, including haemoglobin levels, BUN, estimated glomerular filtration rate (eGFR), and serum creatinine, did not differ significantly between the two techniques. These finding aligns with study conducted by Azwadi et al. and Mertens et al., as they have also demonstrated comparable outcomes between these two methods in terms of renal function recovery and symptom relief [6,7]. PCN is often preferred in cases of severe obstruction or when DJ stenting is not feasible. It provides immediate relief from obstruction and can be quickly performed under local anesthesia. On the other hand, DJ stenting offers the advantage of preserving renal anatomy and function over a longer period, which can be beneficial in cases where a temporary solution is needed while addressing the underlying cause of obstruction.

The study also explored factors associated with non-recovery, including age, sex, co-morbidities, and urine culture results. Furthermore, we identified age and co-morbidities as significant factors influencing recovery. As explained by Tang (2014), urolithiasis is leading cause of obstructive uropathy in younger population [2]. Most of the patients in our study belong to less than 60 age group and most common diagnosis in this group was stone disease. This helped us to correlate positive association of young adults with non-recovery in upper tract obstruction. Whereas, patients with no comorbidities were more common in non-recovery group with significant p-value of 0.004 as most of the patients were young. There is no other recent study with similar non-recovery outcomes. This could be attributed to small sample size and highlights the need of further research on upper urinary obstructive uropathy.

Limitations

Small sample size, single centre study, short follow-up.

Conclusion

PCN and DJ ureteral stenting are both equally effective for management of upper urinary tract obstruction in the context of acute kidney injury. The choice of technique should be individualized based on patient-specific factors and clinical circumstances. Early and effective management, including addressing underlying factors like age, co-morbidities and duration of symptoms is essential for optimizing recovery and preventing long-term renal damage. Future research should focus on validating these findings across different populations and exploring the long-term outcomes of these emergency interventions.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

No funding was received for conducting this study.

Ethical approval

This study was conducted after approval from institutional ethical committee. Written and informed consent was taken from patient and their attendant.

References

1. Yaxley J, Yaxley W. Obstructive uropathy – acute and chronic medical management. World J Nephrol. 2023;12(1):1-9.
2. Tang X, Lieske JC. Acute and chronic kidney injury in nephrolithiasis. Curr Opin Nephrol Hypertens. 2014;23:385-90.
3. El Imam M, Omran M, Nugud F, Elsabiq M, Saad K, Taha O. Obstructive Uropathy in Sudanese Patients. Saudi J Kidney Dis Transpl. 2006;17:415-19.
4. Wang, S. J., Mu, X. N., Zhang, L. Y., Liu, Q. Y. & Jin, X. B. The incidence and clinical features of acute kidney injury secondary to ureteral calculi. Urol. Res. 2012;40:345–8.
5. Sood A, Mishra GV, Khandelwal S, Saboo K, Suryadevara M. A Rare Case of Obstructive Uropathy in an Elderly Male From Rural India - A Case Report. Cureus. 2023;15(7):e42590.
6. 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.
7. Mertens S, Zeegers AG, Wertheimer PA, Hendriksz TR, van Bommel EF. Efficacy and complications of urinary drainage procedures in idiopathic retroperitoneal fibrosis complicated by extrinsic ureteral obstruction. Int J Urol. 2014;21(3):283-8.