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RESEARCH ARTICLE

Which Surgical Decompression Method to Choose for Acute Upper Urinary Obstruction Due to Stones? A Comparison of JJ Stenting and Percutaneous Nephrostomy

Ali Ayrancı[1], Faruk Özgör[1]

[1] Department of Urology, Haseki Training and Research Hospital, Istanbul, Türkiye

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Corresponding Author;
Ali Ayrancı, MD
Address: Haseki Training and Research Hospital, Millet Street, Istanbul, Türkiye
E-mail: draliayranci@yahoo.com

ORCID
A.A. 0000-0003-3747-0869
F.Ö. 0000-0001-8712-7458

Abstract

Objective: Acute upper urinary tract obstruction due to stones is treated with surgical decompression with percutaneous nephrostomy catheter (PNC) or retrograde ureteral stent (RUS). There is not enough data to show the superiority of these two treatments. In this study, we aimed to compare the two treatment approaches in terms of success and complications.

Material and Methods: Between January 2017 and January 2022, patients who underwent emergency JJ stent and emergency nephrostomy catheter insertion due to ureteral stones in a tertiary healthcare institution were retrospectively analyzed. Patients who underwent intervention for reasons other than ureteral stones, pregnant patients, patients under 18 years of age, patients with coagulopathy and patients with chronic renal failure were excluded. A total of 131 patients, including 112 patients in the JJ stent group and 19 patients in the nephrostomy group were included in the study.

Results: Statistically higher creatinine levels were found in the JJ stent group in the 12th hour post-treatment comparison (p=0.042). There was no difference between the groups in creatinine values at the 48th hour after treatment (p=0.579). The intraoperative complication rate was 14.3% in the JJ stent group, compared to 10.5% for the nephrostomy group. There was no statistically significant difference between the groups (p=0.660). Postoperative complication rates were statistically similar between the groups (p=0.490).

Conclusion: In cases where urgent surgical decompression is required, PNC or RUS placement are equally effective and reliable treatments for the management of the disease. There is no significant difference between the two treatment approaches in terms of complications.

Keywords: urinary obstruction, acute obstruction, renal colic, nephrostomy, jj catheter, ureter stone, hydronephrosis

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INTRODUCTION

In today's urology practice, acute upper urinary tract obstruction caused by stones and its management occupies a significant place. In the United States, more than one million emergency department visits annually are attributed to urinary stones (1). In Türkiye, urolithiasis remains a significant health issue, with a prevalence of 11.1%, and the lifetime incidence of at least one colic episode reported as 2.1% (2).

Ureteral stones are responsible for a substantial portion of cases involving acute upper urinary tract obstruction and the associated renal colic (3). Patients with acute upper urinary tract obstruction due to ureteral stones typically present with flank pain radiating to the groin, vomiting, and, less frequently, fever (4). The standard diagnostic modality is non-contrast computed tomography (CT) (5).

Acute upper urinary tract obstruction can lead to complications such as persistent pain, acute kidney injury (AKI), which is characterized by a sudden decline in kidney function indicated by an increase in serum creatinine or decreased urine output, and, if untreated, renal failure. If obstruction is accompanied by infection, it may progress to urosepsis and septic shock, a life-threatening condition caused by an unregulated host response to infection, which carries a high mortality risk (6).

Although conservative management may be an option in certain cases of acute upper urinary tract obstruction due to stones, surgical decompression is performed via percutaneous nephrostomy catheter (PNC) or retrograde ureteral stenting (RUS) (7). However, there is insufficient data to determine the superiority of one approach over the other in terms of success rates and complications (8,9).

In this current study, we aimed to compare these two treatment modalities in terms of success and complication rates. In addition,we hope to gather more definitive evidence on the management of cases involving acute kidney injury, refractory colic, and urosepsis treated with surgical decompression.

MATERIAL AND METHODS

Between January 2017 and January 2022, patients who underwent emergency JJ stent and emergency nephrostomy catheter insertion due to ureteral stones in a tertiary healthcare institution were retrospectively analyzed. The study was approved by Ethical Board (Meeting Decision No:112-2022). Patients who underwent intervention for reasons other than ureteral stones, pregnant patients, patients under 18 years of age, patients with coagulopathy and patients with chronic renal failure were excluded from the study. A total of 131 patients, including 112 patients in the JJ stent group and 19 patients in the nephrostomy group, were included in the study.

The preoperative demographic data of the patients, stone characteristics, emergency intervention indications and laboratory values were recorded. Operation data, postoperative follow-up results, perioperative complications and postoperative complications were evaluated. Postoperative creatine follow-ups were noted.

Surgical Technique

The procedure was performed in the lithotomy position under sedo-analgesia in patients who underwent JJ stent placement. After entering the bladder with the 8Fr ureterorenoscope, a guide-wire was sent to the obstructed ureter. After imaging the pelvicalyceal system with opaque material, the JJ stent was placed in the renal pelvis over the guide-wire under fluoroscopy. In cases where the guide-wire or JJ stent did not pass proximal due to stone, the ureter was entered with the ureterorenoscope, and the guide-wire was sent from the stone edge. The operation period for JJ stenting includes the time from initial ureterorenoscopic access to successful stent placement and verification under fluoroscopy.

Nephrostomy catheter placement procedure was performed by interventional radiologists. In the prone position, under sedo-analgesia, the pelvicalyceal system was entered with an accessory needle under the guidance of USG. The pelvicalyceal system was visualized under fluoroscopy with opaque material. After re-accessing the appropriate calyx, a 14Fr nephrostomy catheter was placed with serial dilatations. The location was checked with fluoroscopy. The operation period for nephrostomy catheter placement includes the time from initial percutaneous puncture to proper catheter positioning and confirmation under fluoroscopy.

Statistically Analysis

The Statistical Package for the Social Sciences version 25 (SPSS IBM Corp., Armonk, NY, USA) program was used. Normality of distribution of the variables was checked by Shapiro-Wilk test. Independent student t test was used for comparison of the normally distributed variable between the groups, and Mann Whitney u test was used for non-normally distributed data. Quantitative data are given as mean ± standard deviation values. Categorical variables were grouped and compared using the $\chi 2$ test or Fisher's exact test. Creatinine change graph was generated by repeated measures ANOVA test. The data were analyzed at a 95% confidence level, and a P value of less than 0.05 was accepted as statistically significant.

RESULTS

The demographic data and kidney stone characteristics of the patients included in the study were compared in Table 1. The mean age was 48.1 years in the JJ stent group and 45.8 years in the nephrostomy group (p=0.565). Gender, BMI, previous stone surgery, and grades of hydronephrosis were statistically similar between the groups (p=0.574, 0.081, 0.147 and 0.104, respectively). The mean stone size was 8.9±4.4 in the JJ stent group and 9.6±3.1 in the nephrostomy group, and there was no statistical difference between the groups (0.492). The stone localizations were evaluated as anatomically distal, mid and proximal ureter, and no statistical difference was found in the comparison between the groups (p=0.299). Thirteen patients in the first group and 1 patient in the second group had solitary kidneys (0.691). The reasons requiring intervention were similar between the groups (0.073).

Table 1. Comparison of demographic data between groups

	JJ stent (n=112)	Nephrostomy (n=19)	P value
Age (years)*	48.1±15.9	45.8±16.9	0.565[a]
Sex (Male/Female)	63/49	12/7	0.574[b]
BMI (kg/m^2) *	27.8±3.4	26.3±4.3	0.081[a]
Previous stone surgery	29 (25.9%)	8 (42.1%)	0.147[b]
Grade of hydronephrosis			0.104[b]
Grade 1	31 (27.7%)	3 (15.8%)	
Grade 2	70 (62.5%)	11 (57.9%)	
Grade 3-4	11 (9.8%)	5 (26.3%)	
Stone size (mm)*	8.9±4.4	9.6±3.1	0.492[a]
Stone localization			0.760[b]
Distal	57 (50.9%)	6 (31.6%)	
Mid	23 (20.5%)	5 (26.3%)	
Proximal	32 (28.6%)	8 (42.1%)	
Solitary kidney	13 (11.6%)	1 (5.3%)	0.691[b]
Side			0.155[b]
Right	51 (45.5%)	7 (36.8%)	
Left	53 (47.3%)	8 (42.1%)	
Bilateral	8 (7.2%)	4 (21.1%)	
Reason			0.073[b]
Renal colic	49 (43.8%)	3 (15.8%)	
Acute kidney injury	34 (30.3)	9 (47.4%)	
Infection/Sepsis	29 (25.9%)	7 (36.8%)	

*mean±standard deviation, BMI: Body Mass Index

[a]: Independent student t test, [b]: $\chi 2$ test

The mean creatinine levels before treatment were found to be similar between the groups (p=0.345). Statistically higher creatinine levels were found in the jj stent group in the 12th hour post-treatment comparison (p=0.042). There was no difference between the groups in creatinine values at the 48th hour after treatment (p=0.579). Pretreatment WBC and pretreatment CRP values were similar between the groups (p>0.05). The mean procedure time for JJ stent insertion was significantly longer than the mean time for nephrostomy application (17.9±4.6 min and 13.7±3.7 min, p=0.001). The duration of fluoroscopy was similar between the groups. The length of hospital stay was statistically significantly longer in the nephrostomy group (p=0.001) (Table 2). The changes in creatinine values before the treatment and at the 12th and 24th hours after the treatment are shown in figure 1.

Intraoperative complications, postoperative complications and final treatment modalities are shown in Table 3. The intraoperative complication rate was 14.3% in the JJ stent group, compared to 10.5% for the nephrostomy group. There was no statistically significant difference between the groups (p=0.660). Postoperative complications were classified as pain, fever, sepsis, and hematuria. Postoperative complication rates were statistically similar between the groups (p=0.490). The procedure was unsuccessful in 9 patients (8.0%) in the JJ stent group and 1 patient (5.3%) in the nephrostomy group (p=1.000). The number of patients who received eswl and urs as the final treatment was statistically similar between the two groups (p=1.000). The mean time between the emergency admission and the last treatment was found to be statistically longer in the nephrostomy group compared to the jj stent group (37.6 days and 23.3 days, respectively) (p=0.019).

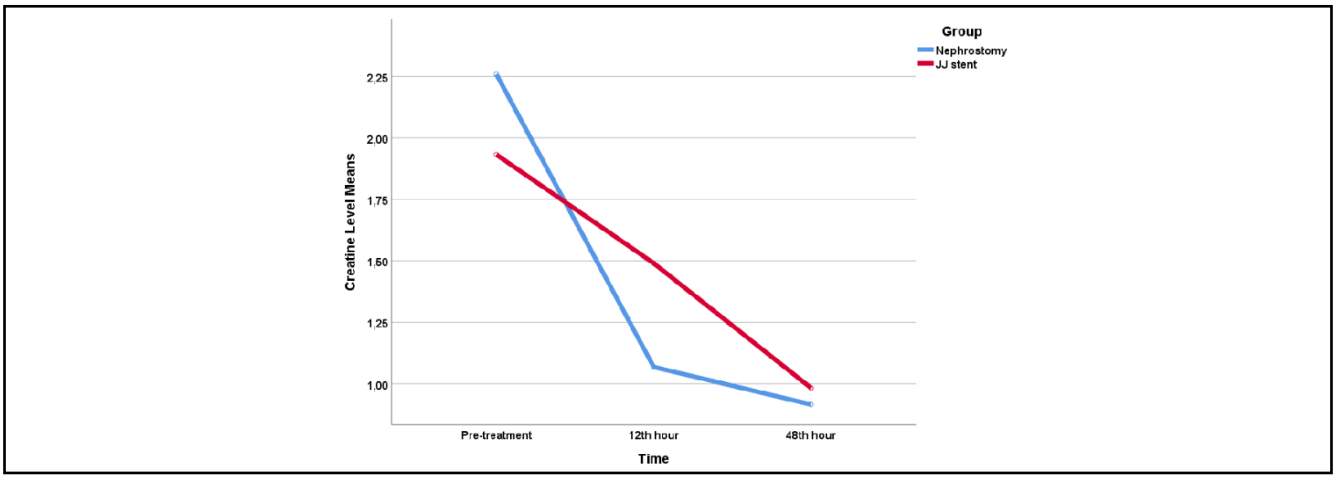

Figure 1. Graph of change of creatinine values before and after treatment

Table 2. Comparison of preoperative and postoperative laboratory values and operation data.

	JJ stent (n=112)	Nephrostomy (n=19)	P value
Creatine level			
Before Treatment	1.9±1.3	2.2±1.6	0.345[c]
Posttreatment 12[th] hour	1.5±1.1	1.1±0.6	***0.042***[c]
Posttreatment 48[th] hour	1.0±0.4	0.9±0.2	0.579[c]
Pretreatment CRP (mg/L)**	75 (21 - 130)	120 (58 - 96)	0.073[b]
Pretreatment WBC (10^3uL)*	11.3±5.6	11.1±3.0	0.814[a]
Operation time (min)*	17.9±4.6	13.7±3.7	***0.001***[a]
Fluoroscopy time (sec)*	16.9±7.6	20.1±6.0	0.091[a]
Hospitalization time (hours)**	48 (24 - 72)	96 (48 - 96)	***0.001***[b]

*mean±standard deviation, ** median (IQR), CRP: C-reactive protein, WBC: white blood cell,

[a]: Independent student t test, [b]: Mann Whitney u test, [c]: repeated measures ANOVA test

Table 3. Comparison of complications and recent treatment modalities between groups.

	JJ stent (n=112)	Nephrostomy (n=19)	P value
Intraoperative Complications	16 (14.3%)	2 (10.5%)	0.660[b]
Mucosal injury	7 (6.3%)	-	
Bleeding	2 (1.8%)	2 (10.5%)	
Stone migration	7 (6.3%)	-	
Postoperative Complications	38 (33.9%)	8 (42.1%)	0.490[b]
Pain	24 (21.4%)	2 (10.5%)	
Fever	10 (8.9%)	2 (10.5%)	
Sepsis	1 (0.9%)	1 (5.3%)	
Hematuria	3 (2.7%)	3 (15.8%)	
Procedure failure	9 (8.0%)	1 (5.3%)	1.000[b]
Final Treatment			1.000[b]
SWL	22 (19.6%)	4 (21.0%)	
URS	90 (80.4%)	15 (79.0%)	
Time between emergency admission and final treatment (days)*	21 (12 - 31)	35 (16 - 42)	***0.019***[a]

*median (IQR), SWL: Shock Wave Lithotripsy, URS: Ureteroscopy

a: Mann Whitney u test, b: $\chi 2$ test

DISCUSSION

Ureteral stones, the most common etiology causing acute upper urinary obstruction and they are a frequent reason for emergency department visits. Most cases can be managed conservatively (10).

In cases of persistent colic pain or recurrent colic attacks where medical analgesia fails to provide relief, surgical intervention via stenting, percutaneous nephrostomy, or stone removal becomes necessary (11). Indeed, a study by Eaton H. et al. revealed that refractory colic attacks lead to repeated admissions, increasing costs and causing loss of work productivity (12).

In cases accompanied by infection, decompression must be performed due to the risk of developing urosepsis, which may progress to septic shock—a condition with a current mortality rate of 30–40% (13).

Acute kidney injury due to obstructive uropathy, which can arise from acute upper urinary obstruction, has the potential to progress to end-stage renal disease. Untreated or inadequately managed cases can result in tubular damage, inflammation, and interstitial renal fibrosis, leading to permanent kidney damage (14). In our clinical practice, given the emphasis on nephron preservation, surgical decompression is generally preferred over conservative management in cases with elevated creatinine levels suggestive of acute kidney injury.

Placement of ureteral stents was unsuccessful in 9 patients, while percutaneous nephrostomy failed in 1 patient. These rates did not show a significant technical difference. Similarly, the literature reports technical success rates of up to 99% for percutaneous nephrostomy and approximately 98% for ureteral stents (15,16).

In patients undergoing PNC, a significantly faster reduction in creatinine levels was observed at 12 hours post-procedure. However, by the 48th hour, creatinine levels had returned to normal ranges in both groups, and no significant difference was detected. Similarly, Yang S. et al. reported that 1–5% of acute upper urinary obstruction cases presented to the emergency department with acute kidney injury, with renal function recovery primarily depending on the severity and duration of the obstruction and infection (17).

The length of hospital stay was significantly longer in the PNC group. We attribute this to the tendency to use PNC in patients with higher grades of dilation and the prolonged antibiotic therapy necessitated by concomitant urinary infections in this group.

Although there was a tendency to use RUS in distal stones, stone location did not significantly influence the choice of procedure. Similarly, Sivalingam et al. reported that the use of percutaneous nephrostomy and stents was comparable for proximal stones (18% and 16%, respectively), while stents were preferred for mid and distal stones (18).

At our clinic, RUS procedures are performed in the operating room under optimal sterilization conditions to minimize complication rates. In contrast, PNC placement is conducted in the interventional radiology clinic under local anesthesia. The mean operation time for JJ stent insertion was significantly longer than the mean time for nephrostomy application (17.9±4.6 min and 13.7±3.7 min). Both procedures utilized fluoroscopy, and no significant difference in fluoroscopy times was observed between the groups.

Intraoperative complications are shown in Table 3. As expected, complications such as stone migration and ureteral mucosal damage were observed in the RUS group due to intraluminal manipulation, while bleeding occurred in both groups. However, no significant difference in complication rates was detected between the groups. This finding aligns with the study by Pearle M.S. et al., which also found no significant difference in overall complication rates between RUS and PNC (19).

The time from surgical decompression to final treatment was significantly longer in the PNC group. This may be attributed to the extended duration of antibiotic therapy and the need to wait for sterile urine cultures before the final treatment, particularly in patients with infection or sepsis, which were more prevalent in the PNC group. However, the difference between the groups was not statistically significant.

The limitations of our study include its retrospective design and the absence of randomization in case selection. Additionally, performing both procedures by the same surgical team might have provided more definitive insights. Besides the study was conducted at a single center, limiting it's generalizability. The sample size of the nephrostomy group was relatively small, which may have affected statistical power. Long-term follow-up data on renal function and stone recurrence were not included, which could provide a more comprehensive assessment. Nevertheless, given the lack of sufficient evidence regarding procedure selection in emergency upper urinary obstruction cases, we believe the findings of this study will contribute valuable information to the literature regarding disease management.

CONCLUSION

Percutaneous nephrostomy and retrograde ureteral stent placement are equally effective and reliable treatment options for the emergency management of acute upper urinary obstruction due to stones. There are no significant differences in complication rates between the two approaches. The choice of procedure should consider factors such as the patient's infection status, renal function, suitability of anesthesia and operating room conditions at the time of emergency admission, and the type and timing of the final treatment.

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