

Endourology/Urolithiasis

# Efficacy of Percutaneous Nephrostomy During Flexible Ureteroscopy for Renal Stone Management

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**Purpose:** Preoperative percutaneous nephrostomy (PCN) can be applied to urinary stone patients with pyelonephritis as well as obstructive uropathy; thus, some patients undergo flexible ureteroscopy (fURS) in the presence of a PCN tube. We evaluated the effectiveness of PCN during fURS for the management of renal stones.

**Materials and Methods:** We retrospectively analyzed 130 consecutive patients who underwent fURS for renal stones between January 2009 and December 2011. All fURS procedures were performed by a single experienced surgeon. The patients were divided into two groups depending on the presence of PCN during the surgery: patients with PCN (group 1, n=41) and patients without PCN (group 2, n=89). To evaluate operative outcomes, we compared success rates, operative times, and complication rates. We defined success as the absence of any residual stones in the kidney or stone fragments less than 2 mm that were too small to be extracted during follow-up.

**Results:** There were no significant differences in age, sex, body mass index, stone laterality, burden, or location between the two groups. The mean operative times of groups 1 and 2 were 50.1 and 58.3 minutes, respectively (p=0.102). The success rates of groups 1 and 2 were 95.1% and 82.0%, respectively (p=0.044). There was no statistically significant difference in the complication rate between groups 1 and 2 (p=0.888).

**Conclusions:** Flexible ureteroscopy in the presence of PCN produced a superior outcome in terms of the success rate without increasing the operative time or complication rate. PCN may be helpful to induce better outcomes of fURS.

**Keywords:** Kidney calculi; Percutaneous nephrostomy; Ureteroscopy

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## INTRODUCTION

Since Marshall [1] first described the visualization of a ureteral calculus with a 9-Fr flexible, passively deflectable ureteroscope in 1964, advances in distal-tip deflection and scope durability have expanded the role of flexible ureteroscopy (fURS) [2]. Owing to technological improvements in fURS that enable the management of intrarenal stones, such as the ureteral access sheath, holmium laser, and tipless stone basket, fURS has been established as a minimally invasive modality to treat intrarenal calculi [3-7]. However, fURS still has weak points; multiple procedures may be needed, and a longer operative time may be required to clear renal stones depending on their size and

number. Moreover, when renal stones are large or multiple in number, the operative time becomes longer and irrigation fluid volume may increase, resulting in complications such as fornix rupture.

Since 1955, percutaneous nephrostomy (PCN) has been a standard procedure for urinary diversion in the management of postrenal obstruction or as a prelude to an endourological procedure [8-11]. The efficacy of PCN for decompression of a urinary obstruction associated with infection due to ureteral calculi has been firmly established; furthermore, PCN shows high success and low complication rates [12,13]. It is a procedure enabling access to the renal collecting system and is considered to be the most reliable, consuming less time and material and without intravenous

administration of an iodinated contrast agent. Owing to such benefits, PCN has been widely used in the management of urinary stones in many institutions.

Our previous experience with fURS in the presence of PCN showed that this facilitates stone drainage and reduces the operative working space by decreasing the incidence of hydronephrosis. In this study, we assessed the effectiveness of PCN during retrograde intrarenal lithotripsy by fURS.

## MATERIALS AND METHODS

We retrospectively analyzed data for 130 patients who underwent fURS for renal stones between January 2009 and December 2011. All fURS procedures were performed by a single experienced surgeon. All patients were divided into two groups depending on the presence of PCN during surgery: patients with PCN (group 1) and patients without PCN (group 2). The patients in group 1 underwent PCN when azotemia, acute pyelonephritis, or severe flank pain owing to renal stones occurred. PCN was performed as an outpatient-based procedure with radiologist consultation. fURS was then performed after the patient's medical condition had improved. In the case of urinary tract infection, fURS was performed after the infection had been cleared. The duration between nephrostomy tube placement and fURS was about 2 to 4 weeks. Eight patients in group 1 had renal stones accompanied by ureter stones. However, ureter stones were spontaneously passed before surgery in all patients. The patients who underwent fURS combined with rigid URS simultaneously were excluded, as were patients with stones > 2 cm.

The demographic parameters included age, body mass index, gender, and stone laterality. The stone data included location and burden. Stone burden was determined by measuring the longest diameter on preoperative radiologic investigation; in the case of multiple nonstaghorn calculi, stone burden was defined as the sum of the longest diameter of each stone. To evaluate operative outcomes, we compared success rates, operative times, hospital days, and complication rates. We defined success as the absence of any residual stones in the kidney or stone fragments less than 2 mm that were too small to be extracted during follow-up. Evaluation for success took up to 2 months after the procedure.

The preoperative diagnosis was based on noncontrast computed tomography of the abdomen and plain abdominal radiography. Our follow-up protocol consisted of urinalysis, serum creatinine, and noncontrast computed tomography in the first month after the operation.

In this study, the indications for fURS included failed or contraindicated shock wave lithotripsy, radiolucent stones, and patient preference. fURS was performed with the patient in the lithotomy position. We inserted a guide wire through the ureteral orifice into the renal pelvis and an 8/10 Fr dilator was passed through. A ureteral access sheath was placed and a flexible ureteroscope (URF P-5, Olympus,

**TABLE 1.** Comparison of patients' demographic and stone data between groups 1 and 2

Variable	Group 1 (n=41)	Group 2 (n=89)	p-value
Age (y)	57.1±7.4	55.5±10.3	0.347
Sex (M/F)	28/13	60/29	0.921
Body mass index (kg/m <sup>2</sup> )	24.7±2.6	25.0±3.7	0.573
Stone laterality (right/left)	10/31	33/56	0.153
Stone location			0.389
Pelvis	30	53	
Upper calyx	2	9	
Mid calyx	2	10	
Lower calyx	7	17	
Stone burden (cm)	1.52±0.45	1.37±0.49	0.974

Values are presented as the mean±standard deviation.

Group 1, patients with preoperative percutaneous nephrostomy (PCN) during surgery; Group 2, patients without PCN during surgery.

Tokyo, Japan) was passed with fluoroscopic guidance up to the level of the stone. The stone was then fragmented by use of a holmium laser. Without routine extraction of stone fragments, a ureteral stent was alternatively inserted in all cases. If PCN was present, the PCN access was kept open during the operation so that irrigation fluid could properly drain from the renal collecting system. Once the operation was finished, urine was drained through the PCN opening for 1 day and then the PCN catheter was removed.

Continuous variables were compared by performing an independent Student t-test, and categorical variables were assessed by chi-square test. All p-values were two-sided, and  $p < 0.05$  was considered significant. Analyses were conducted by using IBM SPSS ver. 18.0 (IBM Co., Armonk, NY, USA).

## RESULTS

Groups 1 and 2 included 41 and 89 patients, respectively. There were no significant differences in age, sex, body mass index, or stone laterality between the groups (Table 1). The stone data, including stone burden and location, were not significantly different between the two groups ( $p=0.974$  and  $p=0.389$ , respectively) (Table 1). In group 1, the indications for PCN were acute pyelonephritis ( $n=33$ ), severe flank pain ( $n=6$ ), and azotemia ( $n=2$ ). No complications occurred during PCN in any case.

Operative time was measured from the time when the cystoscope was introduced to the point when the endoscope was finally removed. The mean operative times of groups 1 and 2 were 50.1 and 58.3 minutes, respectively. Operative time was shorter in group 1 than in group 2, but there was no statistically significant difference ( $p=0.102$ ) (Table 2). In groups 1 and 2, the procedure was successful in 39 of 41 (95.1%) and 73 of 89 patients (82.0%), respectively. The success rate was significantly higher in group 1 ( $p=0.044$ ) (Table 2). Hospital stay was not significantly different be-

**TABLE 2.** Comparison of perioperative outcomes between groups 1 and 2

	Group 1	Group 2	p-value
Mean operative time (min)	50.1±5.6	58.3±2.8	0.102
Success rate (%)	39/41 (95.1)	73/89 (82.0)	0.044
Hospital stay (d)	3.5±2.7	2.9±2.7	0.243
Complication rate (%)	4/41 (9.8)	8/89 (9.0)	0.888
Urinary tract infection	4	6	
Severe flank pain	0	1	
Fornix rupture	0	1	

Values are presented as the mean±standard deviation or number (%).

Group 1, patients with preoperative percutaneous nephrostomy (PCN) during surgery; Group 2, patients without PCN during surgery.

tween the 2 groups (Table 2).

The complication rate was not statistically different between group 1 and group 2 (9.8% vs. 9.0%,  $p=0.888$ ). There were no major complications that required conversion to an open procedure or reoperation. According to the complication classification system suggested by Clavien et al. [14], most complications shown in the two groups were grade I, except for one case of grade IV. Group 1 included four cases of postoperative urinary tract infection and Group 2 included 6 cases of postoperative urinary tract infection, with a case of grade IV, 1 case of postoperative severe flank pain, and 1 case of fornix rupture (Table 2).

## DISCUSSION

Recently, fURS has been accepted as an effective modality for the management of intrarenal stones. The technique is useful in patients with coagulopathy, renal anomalies, morbid obesity, solitary kidney, and shock wave lithotripsy failure [4,15,16] and is especially helpful when ureter stones have migrated into the calyx during rigid ureteroscopic stone removal. However, fURS still has a few weak points such as requiring multiple procedures and a longer operative time to clear renal stones completely [4,17].

PCN is a well-established standardized procedure that provides a temporary or permanent drainage for an obstructed urinary system. PCN is mainly performed for urinary stones, urinary tract infections, acute renal failure, and severe flank pain due to urinary tract obstruction [18-20]. Therefore, patients may undergo fURS in the presence of a PCN opening. We experienced several cases of fURS in patients with PCN. However, the efficacy of PCN during fURS is less well known.

In the case of severe hydronephrosis, it is empirically difficult to find renal stones with fURS. Hydronephrosis expands the intrarenal space and surgeons may experience more difficulty in manipulation of the flexible ureteroscope, thus resulting in a longer operation time to find the renal stones. Moreover, excessive fluid irrigation can result in collecting system injury, causing bleeding and inter-

rupting surgical field visibility. Because PCN can reduce the incidence of hydronephrosis, the intrarenal space may also be reduced. Thus, it will be easier to find stones if the irrigation fluid is continuously drained via a PCN. In our study, patients with PCN had various grades of hydronephrosis. They did not have chronic structural changes in the kidney owing to the acute onset. As a result, when the PCN tube was inserted, most of the hydronephrosis improved. When laser lithotripsy is performed during fURS, the storming generated by the stone fragments can obstruct the surgical field visibility. In such case, excessive irrigation may be needed to improve the surgical field visibility. In patients without a PCN opening during fURS, excessive irrigation may induce severe hydronephrosis, increase intrarenal pressure, and cause renal injury such as fornix rupture. Meanwhile, in patients with a PCN opening, excessive irrigation will enable sufficient draining and injury to the renal collecting system may be prevented. We also experienced renal injury and severe flank pain in the patients who underwent fURS without PCN. Despite these advantages of PCN, it is also possible that excessive drainage of irrigation fluid can induce collapse of the renal pelvis and calyx, which can cause mucosal injury by laser firing. However, if we close the PCN in this situation, the intrarenal space is appropriately maintained and we can prevent such complications. Moreover, the PCN catheter can be used as a landmark. When the calyx system is very complex and surgeons have difficulty in finding renal stones, surgeons will be able to find the location by synthesizing information from the PCN catheter, preoperative images, fluoroscopic images, and intraoperative retropyelogram.

When performing the removal of renal stones without a PCN opening, the incidence of hydronephrosis increases and the surgical view can be interrupted by storming of stone fragments. If a large remnant of a stone migrates to the calyx in the case of severe hydronephrosis or storming of stone fragments, it will be more difficult to find the stone, which can reduce success rates. Moreover, success rates may be even lower in patients with radiolucent stones, but PCN can be helpful to reduce the severity of hydronephrosis and the formation of stone fragments.

As mentioned above, with PCN, the time to find renal stones was reduced, visibility in the surgical field was secured, and efforts such as direct stone removal were saved. Given such advantages, we expect PCN to be helpful in shortening operative time. In our study, the mean operative time was shorter in the group with PCN than in the group without PCN, although the difference was not statistically significant.

Despite its many advantage, PCN has weakness that could lead to an increase in hospitalization and discomfort to the patients. However, there was no increased hospitalization in our center because PCN was performed as an outpatient-based procedure with radiologist consultation, although patient discomfort with PCN was inevitable. Nevertheless, PCN was necessary for the control of urinary tract infection and azotemia. We explained sufficiently

about the necessity of PCN and received informed consent from all patients before the procedure.

We expected that postoperative urinary tract infection might occur less frequently in the group with PCN owing to the effective drainage of irrigation fluid and stone fragments regardless of ureteral stent insertion. However, in this study, the incidence of postoperative urinary tract infection was similar in both groups; this might have been due to the inclusion of relatively more infectious stone cases in the PCN group. Although sterile urine was confirmed before fURS, infectious stones may have more chance to spread infectious materials and the inflammatory process during stone fragmentation.

There were some limitations to this study. Our results are based on a relatively small sample size because this study was a retrospective review from a single institution. However, this study confirmed the effects of PCN during fURS.

## CONCLUSIONS

Flexible ureteroscopy in the presence of PCN produced a superior success rate without increasing the operative time or complication rate. Although further studies with larger samples may be needed to validate the findings of this study, the presence of a PCN opening may be helpful to induce better outcomes of fURS for renal stones with urinary tract infection, complex calyceal anatomy, and obstructive uropathy.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

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