

# ORIGINAL ARTICLES

## Endourology

### Percutaneous Nephrolithotomy with and without Retrograde Pyelography: Preliminary Results of a Randomized Controlled Trial

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#### ABSTRACT

**Introduction:** Since the introduction of percutaneous nephrolithotomy (PNL), many modifications to entering the pyelocalyceal system have been made. One alternative is to insert a needle pointed to an opaque stone as a landmark. The aim of this study was to compare the outcomes of managing kidney calculi by PNL with and without retrograde pyelography.

**Materials and Methods:** In this randomized controlled trial, 55 candidates for PNL with a single opaque kidney calculus in the calyx alone, the pelvis alone, or both the calyx and the pelvis were assigned into 2 groups. Twenty-seven patients underwent PNL with a ureteral catheter, and 28 patients underwent PNL without a ureteral catheter. Clinical outcomes were compared between the 2 groups using plain radiographs taken on the first day after the procedure.

**Results:** Patients had similar distributions regarding sex, age, operative time, hospital stay, past surgical history on the kidneys, and stone size. There was a significantly greater decrease in postoperative hemoglobin level in patients having PNL with a ureteral catheter ( $P < 0.001$ ) than in those having the procedure without a ureteral catheter. No differences were seen among patients in the 2 groups in terms of stone-free rate, and number of patients with insignificant residue, and those needing extracorporeal shock wave lithotripsy, a second PNL procedure, or transurethral lithotripsy.

**Conclusions:** Percutaneous nephrolithotomy without ureteral catheterization has specific benefits: urine leakage is lower and there is no need to perform cystoscopy. Patients with a single kidney calculus are good candidates for PNL without previous ureteral catheter insertion.

**KEY WORDS:** percutaneous nephrolithotomy, retrograde pyelography, kidney calculi

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## Introduction

Many modifications have been made since the introduction of percutaneous nephrolithotomy (PNL). With regard to the entrance to the pyelocalyceal system, different methods (such as inserting a needle pointed to an opaque stone as a landmark<sup>(1)</sup>) have been suggested as a substitute for the classic method of retrograde injection of air or a contrast medium.<sup>(2)</sup> Both methods are widely used today, but to our knowledge, no randomized controlled trial has been done to compare the two. In the classic method, the surgeon must perform an additional procedure to insert a ureteral catheter. If the new method is as effective as the classic one with regard to elimination of stones, it would be wise to perform PNL without catheter insertion. In this study, we compared the clinical outcomes of kidney calculi management with and without retrograde pyelography.

## Materials and Methods

In a randomized controlled trial between September 2003 and June 2004, 55 patients with a single opaque kidney calculus in the calyx alone, the pelvis alone, or both the calyx and the pelvis were studied. The study protocol was approved of by the Research Council of the Urology and Nephrology Research Center, Shaheed Beheshti University of Medical Sciences. All patients were candidates for PNL, and none of them had anatomic abnormalities in their intravenous pyelographies. Informed consent was obtained from all patients. Patients were randomly assigned into 2 groups. Twenty-eight patients in the study group underwent PNL without placement of a ureteral catheter and 27 patients in the control group underwent the operation with placement of a ureteral catheter.

Data including age, sex, past surgical history on the kidneys, side of the involved kidney, postoperative decrease in hemoglobin level, postoperative fever, operative time, duration of radiation, hospital stay, and the surgical outcome were recorded for each patient. The outcome measures were stone-free rate, insignificant residue, need for extracorporeal shock wave lithotripsy, need for re-PNL, and need for transurethral lithotripsy.

In patients in the control group, PNL was performed in the classic manner with insertion of the ureteral catheter, performance of retrograde pyelography (with air or a contrast medium), and then accessing the respective calyx. In patients in the study group, the pyelocalyceal system was approached by a small catheter guided toward the opaque stone without inserting a ureteral catheter. After entering the system with a needle, a contrast medium was injected, and if the first needle were not appropriately aligned (placed directly to the pelvis or between the 2 calyces), access to the enhanced system was attempted again in the proper direction.

Postoperative outcome was evaluated using plain radiographs performed on the morning of the first postoperative day.

Data analyses were performed using SPSS software (Statistical Package for the Social Sciences, version 11.5, SSPS Inc, Chicago, Ill, USA), with the Kolmogorov-Smirnov test, Student *t* test, and Mann-Whitney *U* test, as appropriate. Values for *P* less than 0.05 were considered statistically significant.

## Results

Patients in the 2 groups had similar distributions with regard to sex, age, and past surgical history on the kidneys, except for the

**TABLE 1.** Demographic and clinical characteristics of the patients in the two groups

	Group		P value
	Control	Study	
Sex (% male)	21 (77.8)	18 (64.3)	.27
Age (mean ± SD)	43.81 ± 13.78	45.93 ± 13.14	.56
History of surgical procedure on the kidneys (%)	25 (96.2)*	24 (85.7)	.186
Side of the involved kidney (% right)	21 (77.8)	13 (48.1)*	.027
Stone size (mean of 2 diameters ± SD)	3.2 ± 0.7	2.9 ± 0.5	.7

side of kidney stone. Demographic features and other characteristics of the 2 groups are shown in Table 1. There were no significant differences in stone location (the calyx alone, the pelvis alone, or both the calyx and the pelvis) between the 2 groups.

The mean operative times were  $73.20 \pm 26.37$  minutes and  $62.86 \pm 17.66$  minutes in the control and study groups, respectively. The mean radiation durations were  $2.66 \pm 1.20$  minutes and  $2.58 \pm 1.47$  minutes, respectively. Mean hospital stays were  $2.7 \pm 1.08$  days and  $2.93 \pm 2.16$  days, respectively. Post-PNL fever was seen in 23.2% versus 18.5% of patients, respectively. No significant differences in any of the above variables were seen between the 2 groups.

Postoperative decreases in hemoglobin levels were significantly higher in patients undergoing PNL with a ureteral catheter compared with those undergoing PNL without a ureteral catheter ( $2.29 \pm 1.25$  mg/L vs  $1.03 \pm 0.9$  mg/L,  $P < 0.001$ ).

With regard to final outcomes, no significant differences were seen between the 2 groups ( $P = .136$ ); 26 patients in the control (96.3%) and 22 patients in study group (78.6%) were stone-free on the first postoperative day. Five patients in the control group and 1 patient in the study group needed extracorporeal shock wave lithotripsy. Percutaneous pyeloplasty was required again in 1 patient in the study group. There was no difference between the 2 groups with regard to whether or not patients were stone-free at the end of the procedure ( $P = 0.20$ ).

## Discussion

To date, experience with PNL without a ureteral catheter has been limited to catheter insertion preoperatively and immediate removal afterwards.<sup>(3)</sup> In this study, in the study group, the catheter was not inserted from the beginning, and outcomes were compared with the classic PNL.

In the classic approach to the pyelocalyceal system, the system is opacified with retrograde pyelography using air or a contrast medium.<sup>(2)</sup> In theory, using a catheter may facilitate access to the enhanced system (owing to some pyelocalyceal distension) in PNL,<sup>(4)</sup> although we did not find this to be true in the current study. In PNL with a catheter, constant access to the pelvis is provided and in case of any complications, successful management is more

easily done. However, the rarity of complications, especially in operations on simple kidney stones, undermines any potential advantage.

Access to the enhanced system theoretically may reduce blood loss owing to entrance via a hypovascular region<sup>(5,6)</sup> and may decrease the incidence of residual stones, but our findings did not confirm this. It seems that targeting the stone from a point medial to the posterior axillary line (maximum 4-finger width lateral to the paravertebral muscle) preserves this hypovascular region. Entering the system with antegrade pyelography has been widely used<sup>(1)</sup> and fluoroscopic evaluation of the collecting system during antegrade pyelography is probably the best technique to use;<sup>(7)</sup> however, in normal systems with simple stones (like those in our patients), retrograde pyelography is not necessary. In addition, the enhanced system may require less radiation exposure or may reduce the total operative time, although this was not apparent in our study.

Using balloon ureteral catheter insertion in PNL has some benefits (eg, inhibiting migration of stone particles to the ureter).<sup>(4)</sup> However, owing to financial limitations, it is not routine at our center to use it for PNL, and a simple ureteral catheter is used instead. Nevertheless, migrated ureteral stones are infrequently seen in our patients. In the current study, there was no difference between the 2 groups regarding the rate of migrated ureteral stones necessitating transurethral lithotripsy. This is most likely due to the fact that the simple ureteral catheter in the control group did not provide any protection from migrated stones.

Use of a ureteral catheter may introduce bacteria from the lower urinary tract to the upper system, and its insertion requires that another procedure be imposed on patients. In addition to this potential complication, albeit rarely, an air embolism may occur during retrograde pyelography.<sup>(8)</sup> In this study, no difference was found between the 2 groups with regard to the rate of post-PNL fever. Moreover, PNL without a ureteral catheter may reduce postoperative discomfort owing to decreased pain and less urine leakage, although this was not assessed in the current study.

## Conclusion

No differences were seen in the major clinical outcomes between PNL with and PNL without a

catheter. Considering the other benefits of PNL without stent insertion (eg, no need to perform cystoscopy and lower amount of urine leakage as only 1 catheter is inserted into the urethra), this may be a preferred modality, especially if a balloon ureteral catheter is not readily available. Selection of patients for PNL without a catheter, however, may be limited to those with opaque stones in the pelvis and/or in only 1 in the calyx. It is also a safe procedure for accessing the pyelocalyceal system in patients with problems in being appropriately positioned or with urethral stricture that impede cystoscopy.

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### Editorial Comment

The results of this study offer a modification of performing a less-invasive percutaneous nephrolithotomy. As the authors have mentioned, using a ureteral catheter or balloon has the following advantages: first, instillation of a contrast medium or air can reveal the kidney anatomy (especially the posteroinferior calyx, which is often the entry site); and second, if the stone is impacted, the caliceal system may be obstructed, precluding the introduction of the needle into the caliceal system. Insertion of a catheter and injection of contrast medium or air prevents multiple puncturing and long exposure to radiographs. Finally, a ureteral catheter may prevent passage of a stone to the ureter, later renal colics, and further interventions for extracting a ureteral stone.

Although the results of this study suggest no significant differences between the 2 groups regarding the abovementioned points, the relatively small sample size may have obscured any potential disadvantages. In addition, although no differences in the number of patients with stone migration to the ureter that needed transurethral lithotripsy were reported, no information regarding the total number of migrations was provided.

The final point regards the preoperative intravenous pyelography results and the degree of hydronephrosis associated with a stone. Intravenous pyelography results could be directly related to the results of the primary puncture in PNL without ureteral catheter. Obviously, in the absence of hydronephrosis, access through a percutaneous puncture is not usually successful and in that case, a cystoscopy in the prone position and insertion of a ureteral catheter is warranted. This can be a great problem, especially when a flexible cystoscope is not available.

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### **Reply by Author**

All of the mentioned comments by the editors are accepted in current textbooks of urology (references 4 and 7 of the article). However, many of these are not evidence-based and are only experts' opinions (references 2, 4, and 7 of the article). For example, a ureteral balloon catheter has been proven to decrease passage of stones to the ureter, but this is not true for simple ureteral catheters. When the stone is opaque and single and the anatomy of the kidney is normal (inclusion criteria for our project), retrograde pyelography has not been proven in any studies to be helpful. We introduce this technique only as an alternative to the classic method; thus, the number of patients was not a limiting factor in this study.

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