

## Percutaneous Nephrolithotomy with and without Retrograde Pyelography: A Randomized Clinical Trial

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### ABSTRACT

*Objective:* Since the introduction of percutaneous nephrolithotomy (PCNL), many changes have been added regarding the entrance to pyelocalyceal system such as insertion of the needle pointed to an opaque stone as a guided landmark. We aim at comparing the outcomes of managing renal calculi with and without retrograde pyelography.

*Materials and Methods:* In a randomized clinical trial, 55 cases with opaque renal calculi candidates for PCNL with stone in one calyce, in the pelvis or both in one calyce and the pelvis simultaneously were included in a nine-month study. They were randomized into 2 groups, noncatheterized (n = 28) and catheterized (n = 27), called intervention and control groups, respectively.

*Results:* The 2 groups had similar distributions regarding gender, age, duration of operation, length of hospital stay, past history of any surgical procedures on kidney, and stone size. Outcome (residual stone based on aforementioned management) was evaluated with plain X-ray on the morning following the operation. Postoperative hemoglobin decrease was significantly higher in controls than in the intervention group ( $p < 0.001$ ) (with no clinical significance). No difference in outcome, postoperative fever, duration of surgery, duration of hospital stay and radiation exposure was observed between the 2 groups.

*Conclusion:* Our findings showed no differences in major clinical outcomes between the 2 groups (with and without catheter insertion for retrograde pyelography).

**Key words:** urolithiasis; percutaneous nephrolithotomy; pyelography

*Int Braz J Urol. 2007; 33: 19-24*

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### INTRODUCTION

Since the introduction of percutaneous nephrolithotomy (PCNL), many changes have been added regarding the entrance to pyelocalyceal system such as insertion of the needle pointed to an opaque stone as a guided landmark (1) (vs. the classic method of system enhancement with retrograde injection of air or contrast media) (2). Both methods have been

widely used but we did not find any randomized clinical trial comparing them. In the classic method, the surgeon must perform an additional procedure to insert a ureteral catheter. Thus, if the latter is as efficient as the former in the elimination of stones, it is a good idea to perform PCNL without catheter insertion. In this study, we aim at comparing the clinical outcomes of renal calculi management with and without retrograde pyelography.

## MATERIALS AND METHODS

In a randomized clinical trial, 55 cases with opaque renal calculi in one calyce, renal pelvis or one calyce and renal pelvis simultaneously who were candidate for PCNL were included in a 9 month study (from September 2003 to June 2004). All patients had intravenous pyelography without any anatomical abnormality before surgery. They were randomized into 2 groups without (n = 28) and with ureteral catheter insertion (n = 27) (called intervention and control groups, respectively). Age, gender, past history of any surgical procedures on kidneys, side of the involved kidney, postoperative hemoglobin decline, postoperative fever, duration of PCNL (in minutes), radiation duration, length of hospital stay and outcome (stone-free, insignificant residuals, need for extracorporeal shock wave lithotripsy, need for additional PCNL and need for transureteral lithotripsy were recorded for each patient. PCNL was performed classically in the controlled group, with the insertion of the ureteral catheter and the performance of a retrograde pyelography (with air or contrast media) and the assessment to the proper calyce.

In the intervention group, the pyelocalyceal system was approached with the insertion of a small needle toward the opaque stone, without any ureteral catheter insertion. In fact, after viewing the stone with fluoroscopy, the needle is inserted toward it. In case it is proved to be successful for the system, entrance (i.e. urine aspiration) the contrast media (urographin)

is injected to find out if the direction of the needle in the system is appropriate (a blood-less route like calyceal caps or fornices). If so, dilatation is performed. Otherwise, a better direction is tried using the enhanced system toward the stone. On the other hand, if the first trial for the system entrance was not successful, the second puncture is performed under the guide of fluoroscopy targeting the stone. Enhancement of the system with intravenous pyelography is used only if multiple attempts for the system entrance were not successful. After dilatation, lithotripsy was performed with lithoclast (ballistic source).

Postoperative outcome was evaluated using plain X-ray performed on the morning after procedure.

SPSS version 10 was used for statistical analysis. Kolmogrov-Smirnov test was used to test for normality of quantitative variables. Student t test and non-parametric (Mann-Whitney U) test were used for statistical analysis. P ≤ 0.05 was considered as significant.

## RESULTS

The 2 groups had similar distributions regarding gender, age, past history of any surgical procedures on kidneys except for the side of kidney stone. Demographic features and other characteristics of the two groups are demonstrated in Table-1. There was no significant difference between the 2 groups

**Table 1** – Demographic characteristics of the 2 studied groups.

Characteristic	Group		p Value
	Control (with retrograde pyelography)	Intervention (without retrograde pyelography)	
Gender (% male)	77.78 (21 patients)	64.28 (18 patients)	0.27
Age (mean ± SD)	43.81 ± 13.78	45.93 ± 13.14	0.56
History of any surgical procedure on kidneys	96.15% (25 patients, one missing)	85.71 (24 patients)	0.186
Side of the involved kidney (% right)	77.8 (21 patients)	48.1 (13 patients) (one missing)	0.027*
Stone size (mean of 2 diameters)	3.2 ± 0.7	2.9 ± 0.5	0.7

\* Significant

regarding stone location (calyce, pelvis, or calyce and pelvis simultaneously). The findings of the major outcomes are presented below.

Mean duration of surgery was  $73.2 \pm 26.37$  minutes in catheterized group and  $62.86 \pm 17.66$  in the noncatheterized group ( $p > 0.05$ ).

The average duration of radiation exposure in the noncatheterized group was  $2.58 \pm 1.47$  and  $2.66 \pm 1.2$  minutes in the other ( $p > 0.05$ ).

Hospital stay in the catheterized group was  $2.7 \pm 1.08$  and  $2.93 \pm 2.16$  days in the noncatheterized group ( $p > 0.05$ ).

Prevalence of post-PCNL fever in catheterized was 23.2% versus 18.5% in the noncatheterized group ( $p > 0.05$ ).

Postoperative hemoglobin decrease was significantly higher in PCNL in the catheterized ( $2.29 \pm 1.25$ ) when compared to the noncatheterized group ( $1.03 \pm 0.9$ ) ( $p < 0.001$ ).

No difference in outcome was observed between the 2 groups ( $p = 0.136$ ). Around 93 percent of the patients in the catheterized group ( $n = 26$ ), were stone free on the day after operation, whereas in the noncatheterized group, only 78.6 percent of the patients ( $n = 22$ ) were stone free on the day after operation. One patient in the noncatheterized group and 5 patients in the catheterized group needed ESWL. Additional PCNL was required in one patient in the noncatheterized group. Even after recoding outcome (stone free vs. else) no difference was detected between the 2 groups ( $p = 0.2$ ).

## COMMENTS

To this date, experience with PCNL without catheter has been limited to catheter insertion preoperatively and removing immediately afterwards (3). In this research, the catheter was not inserted from the beginning in the intervention group and the outcomes were compared with the classic PCNL.

In the classical approach to pyelocalyceal system, the system is opacified with retrograde pyelography with air or contrast media (2). Using a catheter may facilitate access to enhanced system (due to some pyelocalyceal distension) and can provide

us with better directions in PCNL (4); though we did not find such benefit. In PCNL with catheter, a constant access to pelvis is provided and in case of any complications, successful management is more achievable.

Access to enhanced system may theoretically reduce blood loss (5,6) (due to entrance via a hypovascular plane) and decrease the incidence of residual stones (due to most proper direction), but we did not find such benefits. It seems that targeting the stone from a point medial to the posterior axillary line (maximum 4-finger width lateral to the paravertebral muscle), saves this hypovascular plane. Entrance to the system with antegrade pyelography has been widely used (1) and fluoroscopic evaluation of the collecting system during antegrade pyelography is probably the best technique to use (7) but in normal systems with simple stones, like what we had in our cases, performing retrograde pyelography does not sound necessary. In addition, the enhanced system may need less radiation exposure or reduce the total time of surgery; though no difference was observed in this regard.

Using balloon ureteral catheter insertion in PCNL has some benefits such as inhibiting migration of stone particles to the ureter (4). Due to financial implications, it is not a routine to use balloon ureteral catheter for PCNL in our center and simple ureteral catheter is used instead. Nevertheless, migrated ureteral stones are infrequently seen in our cases. In our study, the rate of migrated ureteral stones needing ureteroscopy was not different in the 2 studied groups. This finding is also justifiable, as simple ureteral catheter used in the control group does not provide any protection in this regard as discussed above.

The use of ureteral catheter may introduce bacteria from the lower urinary tract to the upper system and its insertion requires another procedure (cystoscopy) to the patients. In addition to this potential complication, air embolism may rarely occur during retrograde pyelography (8). In this study, no increase in the rate of post-PCNL fever was observed in PCNL either with a catheter or without it. Moreover, PCNL without ureteral catheter can reduce postoperative discomfort due to less pain and less

urine leakage, although this was not assessed in our study.

## CONCLUSION

No differences in major clinical outcomes were observed between PCNL either with or without catheter. Considering other benefits of PCNL without stent insertion (e.g. no need to cystoscopy and lower amount of urine leakage as only one catheter is inserted in the urethra), it is a safe alternative procedure. Selection of patients for PCNL without catheter may be limited to those with opaque stones in pelvis or/and in one calyce. It is also a safe procedure for accessing to pyelocalyceal system in patients with difficulty for cystoscopy (due to positioning or urethral stricture).

## CONFLICT OF INTEREST

None declared.

## ACKNOWLEDGMENT

This research was funded by Urology Nephrology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran. The

authors wish to thank Dr. Fereydoon Khayyamfar and Dr. Esmaeel Moosapour for their contribution to this study.

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*Accepted after revision:  
October 4, 2006*

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## EDITORIAL COMMENT

It is long known that the urinary system may be enhanced by injecting contrast media through a ureteral catheter or directly by a lumbar needle puncture. Such enhancement may ease the establishment of the nephrostomy tract. The choice of the calyx to be punctured, preferentially through a posterior calyceal papilla, is based on the stone size and location, and also on the morphology of urinary tract. Generally the calyx chosen for puncture must offer the best nephroscope access to calyces with stones and to renal pelvis.

In a selected group of patients, the authors clearly demonstrated that percutaneous surgery might be performed with the same efficacy using or not a ureteral catheter. Such conclusion does not necessarily imply in a change of conduct, but reinforces that the ureteral catheter is not an indispensable tool for

percutaneous surgery, especially in patients where it is impossible to insert it.

The insertion of a ureteral catheter is a 10 minutes procedure that allows the injection of contrast media, saline or air, and may be useful to prevent migration of stone fragments to the ureter (not observed in this paper). It may also allow the introduction of a guide wire during the percutaneous surgery for a double J catheter insertion whenever it is needed.

The great merit of this paper is showing that percutaneous surgery may be successfully accomplished without the insertion of a catheter. Nevertheless, the suggestion of abolishing such procedure is unwise, as it has the aforementioned advantages. The surgeon will never regret inserting the ureteral catheter, but may regret not doing so.

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## EDITORIAL COMMENT

The authors of this manuscript have challenged the long-held dogma, that retrograde ureteral catheter insertion and contrast administration is necessary for safe and successful percutaneous renal access prior to percutaneous nephrolithotomy (PCNL). Many of us who perform PCNL have likely been faced with the situation where retrograde opacification of the collecting system was impossible due to previous urinary diversion or ureteral obstruction. In those instances, the use of intravenous contrast or antegrade pyelography to allow collecting system opacification, or the use of ultrasound to guide renal access are alternatives.

In this paper the authors conducted a small randomized trial to compare the outcomes between

a group of patients undergoing PCNL in the conventional way utilizing retrograde ureteral catheter insertion versus a cohort in which percutaneous access was achieved without the use of a retrograde catheter. Exactly how patients were randomized is not detailed in the paper; however it is confirmed that the 2 groups were similar preoperatively with respect to age, sex, previous kidney surgery and stone size. Whether stone location was similar between groups is not mentioned. This would seem to be an important piece of information because if I understand their technique correctly, needle insertion is performed directly onto the stone when retrograde contrast was not used, regardless of whether the stone was calyceal or renal pelvic in location.

The risks with blind insertion into a stone-bearing calyx are likely less than the potential problems with placement of the needle directly into the renal pelvis. Although direct needle access into the renal pelvis is unlikely to cause much harm in most patients, potential vascular concerns must be acknowledged. Once urine is obtained, antegrade contrast is injected to delineate the collecting system. With direct renal pelvic needle placement and if contrast extravasation occurs, one must wonder if this may impede fluoroscopic visualization, and make proper tract access more difficult. The authors indicate that should access not be achievable without the use of retrograde contrast they will resort to intravenous contrast. How often this was required in their series is not documented.

In the presentation of the results, it is mentioned that the duration of surgery, radiation time and hospital stay was not different statistically between the 2 groups. Blood loss was higher in the catheterized group, with no explanation provided to account for this. The authors claim the stone free rates were not different statistically either, however a review of the raw data would suggest otherwise: They report 26 patients in the catheterized group were stone free. With a denominator of 27 this would equal a 96.3% stone free rate, not the 93% rate mentioned in the paper. In the non-catheterized group they report 22/28 (78.6%) stone free rate. As such I would argue the differences are in fact more significant than they have claimed.

In the discussion section, the authors list the potential advantages associated with the avoidance of ureteral catheter insertion. Although it is always healthy to be critical of traditional doctrine, the arguments supporting a change of current practice must be compelling. The authors claim that a separate procedure is required to perform retrograde catheter insertion. At our centre as at many others, flexible cystoscopy and catheter insertion with the patient prone is performed immediately prior to and as a part of the PCNL procedure. The risk of air embolus with retrograde air injection is an extremely rare event if the volume of air used is small. Finally, postoperative patient discomfort from the ureteral catheter is highlighted, but in the majority of instances the ureteral catheter can be removed at the conclusion of the PCNL procedure before the patient is even awakened from anesthesia. In my mind the arguments presented do not seem compelling enough to warrant a modification in technique in my own practice.

Having said that though, the authors have given us food for thought and should be commended for their efforts to further refine PCNL. As I read this paper I recalled the words of one of my earliest endourology mentors, who used to say, "percutaneous nephrolithotomy is a procedure of millimeters". To paraphrase, he was trying to say that surgical precision is important in to the safety and success of this operation. As such whatever technical modifications we consider must preserve that tenet.

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## **REPLY BY AUTHORS**

I read the editorial comments. I agree with the items that are suggested in comments. The less invasive method must be the safer method. This way is only an alternative to classic method in special cases.

We think that only entrance of needle to vessels does not cause any problem. Moving the

needle through that direction (from behind near tip of 12th rib to stone) very rarely may encounter the renal pelvis directly.

In this study no patient need IV administration of contrast media.