Delayed Versus Same-Day Percutaneous Nephrolithotomy in Patients With Aspirated Cloudy Urine

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Introduction: We present our experience in continuing percutaneous nephrolithotomy (PCNL) versus delayed PCNL when purulent fluid is aspirated during access to the pyelocaliceal system.

Materials and Methods: This randomized controlled study was carried out on patients who had purulent urine in the pyelocaliceal system at the initial puncturing during PCNL. Patients with recent untreated urinary tract infection, thick or foul pus in aspirated urine, fever, and immunocompromised condition were excluded. Thirty-one patients were randomly divided into 2 groups. In group 1, PCNL was continued, but in group 2, nephrostomy tube was placed and PCNL was performed 10 days later after documented sterile nephrostomy urine. The preoperative and postoperative findings were compared.

Results: There were 16 and 15 patients in groups 1 and 2, respectively. All patients had negative urine cultures for microorganisms, preoperatively. The purulent aspirated fluid was infected in 43.8% and 40.0% of the patients in groups 1 and 2, respectively. Postoperative fever was seen in 25.0% and 26.7% of the patients, respectively. No statistical differences were observed between the two groups in terms of bacteriuria, bacteremia, positive calculus cultures, or stone-free rates, and duration of hospitalization between groups 1 and 2, respectively. More analysis with linear regression model showed that postoperative positive blood culture ($P < .001$), fever ($P = .001$), and postoperative positive urine culture ($P = .02$) correlated with duration of hospitalization.

Conclusion: In the absence of untreated recent UTI and aspiration of thick or foul pus, continuing PCNL can be safe while purulent urine is encountered.

Keywords: urinary tract infection, percutaneous nephrolithotomy, suppuration

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INTRODUCTION

Technical advances and increased experience have resulted in considerable refinement of the percutaneous approach to kidney calculi. Significant reductions in morbidity and costs have occurred because of the development of nephrostomy tract balloon dilators, improved grasping instruments, and the use of improved methods of calculus fragmentation and removal.[1,2] However, even in experienced hands, major and minor complications may be occurring in 1.1% to 7% and 11% to 25% of patients, respectively.[3,4] Therefore, more efforts have been performed to minimize the complications of percutaneous approach to kidney

calculi. One of these is recently focused on the patients with purulent fluid culture.[5]

Some patients undergoing percutaneous nephrolithotomy (PCNL) have purulent fluid in the pyelocaliceal system at the time of puncture. On the other hand, aspiration of incidentally detected purulent fluid at the time of puncture in patients who are candidates for PCNL, when there is no fever and bacteriuria or recent urinary tract infection (UTI), is not common. Current recommendation in these situations is to place nephrostomy tube and postpone PCNL until the urine from the nephrostomy tube is clear and sterile.[5] We challenged this strategy with this prospective comparative study by continuing PCNL in selected number of patients with purulent fluid and comparing the results with the ones who underwent delayed PCNL.

MATERIALS AND METHODS

Patients

Between March 2005 and July 2007, a total of 520 patients underwent PCNL at our center. The present randomized controlled trial study was carried out on patients who had purulent urine in the pyelocaliceal system at initial puncture. The study was approved by the medical ethics committee of Iran University of Medical Sciences. Patients with recent untreated UTI, thick or foul pus in aspirated urine, fever, diabetes mellitus, and immunocompromised status were excluded. Of 45 patients with purulent urine, 31 met our inclusion criteria and all of them provided written informed consent. The enrolled patients were randomly divided into 2 groups using simple randomization method with the help of a computer-generated table of random numbers.

Group 1 consisted of 16 patients who underwent PCNL at the same day of aspiration, and in 15 patients in group 2, PCNL was performed 10 days after insertion of nephrostomy tube following purulent urine aspiration. Sterile nephrostomy urine was documented in all of the patients of group 2.

Preoperative Care

All of the patients had documented negative urine cultures preoperatively. All of the patients received intravenous cefazolin, 1 g, 1 hour preoperatively. An intravenous aminoglycoside was also started on for all of the patients when purulent urine was encountered, and it was continued in the postoperative period until the results of urine and blood cultures were ready. Preoperative routine evaluations were done in all of the patients. Routine preoperative laboratory tests were unremarkable.

Surgical Technique

Tubeless PCNL with ureteral catheter placement was performed in the two groups either at the same day of purulent urine aspiration or 10 days thereafter, all by the same surgeon. In both groups, access to the pyelocaliceal system, preferably through the lower calyx, was achieved under fluoroscopic guidance. With the patient under general anesthesia, a 5-F open-ended ureteral catheter was passed cystoscopically and secured to a Foley catheter. Then the patient was placed in the prone position. Access was achieved by advancement of an 18-gauge translumbar angiography needle in the plane of the fluoroscope beam. Tract was dilated over the wire to 30 F using one-shot method. A 30-F Amplatz sheath was placed. The calculi were fragmented using pneumatic lithotripter, and in some cases, plus ultrasonic lithotripter. Additional tracts were created whenever necessary with the aim of complete calculus clearance and drainage of all obstructed calyces. Nephroscopy and calculus fragmentation were performed in low pressure field through the procedures. After complete calculus clearance was confirmed fluoroscopically and endoscopically, the 5-F ureteral catheter was left in place. Then the Amplatz sheath was removed and nephrostomy was not placed in any of the patients.

Postoperative Care

Closed observation and checking of vital signs were performed for all of the patients after the procedure. Noncontrast computed tomography (CT) was done on the first postoperative day. Data including operative time, duration of hospital stay, stone-free rate, cultures of the

purulent fluid, laboratory studies and cultures of urine and blood, and rate of fever and sepsis episodes were recorded. In addition, calculus cultures were performed in all of the patients.

Statistical Analyses

Data were analyzed using the SPSS (Statistical Package for the Social Sciences, version 13.0, SPSS Inc, Chicago, Ill, USA). The Student t test, and the Mann-Whitney U test, and the chi-square test were used for comparisons between the two groups. Also, linear regression model was performed to evaluate the factors affecting duration of hospital stay. Quantitative variables were provided as mean standard deviation. P values less than .05 were regarded significant.

RESULTS

All of the patients completed the study. They were 22 men (71.0%) and 9 women (29.0%) with a mean age of 42.2 12.5 years (range, 19 to 68 years). As it is listed in Table 1, the patients' demographic and clinical characteristics were similar in the two groups. The mean age, sex distribution, operative time, and calculus size and composition did not differ significantly between the two groups. Additionally, all patients had documented negative urine cultures for microorganisms, preoperatively.

The purulent aspirated fluid was infected in 43.8% and 40.0% of the patients in groups 1 and 2, respectively. Enterobacteriaceae were the only detected bacteria, with *Escherichia coli* to be the most common bacterium in both groups. Urine cultures in group 1 showed *Escherichia coli* in 4 patients, *Proteus mirabilis* in 2, and *Pseudomonas aeruginosa* in 1. In group 2, urine cultures revealed *Escherichia coli* in 4 patients, *Proteus mirabilis* in 1, and *Klebsiella pneumoniae* in 1.

Four patients in each group developed mild fever (< 38.5°C) who were treated conservatively. One patient in group 1 developed severe fever (39°C) that was managed conservatively. His hospital stay lasted 7 days. Additional blood cultures were negative in this patient.

Table 1. Demographic and Clinical Parameters in Patients Who Underwent Percutaneous Nephrolithotomy (PCNL) Just After Aspiration of Cloudy Urine (Groups 1) or 10 Days Thereafter (Group 2)*

Parameter	Group 1 (Same-Day PCNL)	Group 2 (Delayed PCNL)	*P*
Patients	16	15	…
Age, y	42.2 ± 12.4	42.1 ± 13.0	.99
Sex			
Female	12 (75.0)	10 (66.7)	
Male	4 (25.0)	5 (33.3)	.70
Calculus size, mm	33.94 ± 5.26	36.20 ± 5.43	.25
Stone composition			
Calcium oxalate	10 (62.5)	9 (60.0)	
Uric acid	2 (12.5)	2 (13.3)	
Struvite	4 (25.0)	4 (26.7)	.99
Operative time, min	68.1 ± 14.9	67.3 ± 14.6	.89
Number of tracts	1.3 ± 0.5	1.3 ± 0.5	.79
Blood transfusions	1 (6.3)	2 (13.3)	.60
Postoperative results			
Positive urine culture	5 (37.5)	33.3	.81
Positive purulent fluid culture	7 (43.8)	6 (40.0)	.83
Positive blood culture	1 (6.3)	1 (6.7)	.58
Fever			
Negative	12 (75.0)	11 (73.3)	
< 38.5°C	3 (18.8)	4 (26.7)	
> 38.5°C	1 (6.3)	0	.56
Stone-free rate, %	93.7	93.3	.77
Duration of hospitalization, d	2.7 ± 1.4	2.5 ± 0.9	.96

*Values in parentheses are percents. Values of continuous variables are demonstrated as mean ± standard deviation. Ellipsis indicates not applicable.

Table 2. Linear Regression Model for Prediction of Hospital Stay Duration ($R^2 = 0.895$)*

Variable	Unstandardized Coefficient B (SE)	Standardized Coefficient Beta	*t*	*P*
Constant	2.01 (0.09)	…	22.30	< .001
Postoperative positive blood culture	2.15 (0.32)	0.55	6.64	< .001
Postoperative fever	0.77 (0.21)	0.35	3.65	.001
Postoperative positive urine culture	0.48 (0.19)	0.20	2.48	.02

*Ellipsis indicates not applicable. SE indicates standard error.

No statistical differences were observed between two groups in terms of bacteriuria, bacteremia, positive calculus cultures, or postoperative fever. Additionally, there were no significant differences in the stone-free rate (93.7% versus 93.3%, $P = .77$) and duration of hospitalization (2.69 ± 1.40 days versus 2.53 ± 0.91 days, $P = .96$) between groups 1 and 2, respectively. However, more analysis with linear regression model showed that postoperative positive blood culture ($P < .001$), fever ($P = .001$), and postoperative positive urine culture ($P = .02$) significantly correlated with duration of hospitalization ($P < .001$, $R^2 = 0.895$). Table 2 outlines the results of linear regression model.

DISCUSSION

Percutaneous extraction of kidney calculi in patients whose urines are sterile is considered to be a *clean-contaminated* surgery. Postoperative infections, if any, are thought to be the result of the urethral catheter, nephrostomy tube, obstructed calyxes or pelvis, calculus-bearing bacteria, and blood transfusion.[6]

It is not uncommon to find purulent fluid at the time of achieving access during PCNL. The aspirated fluid is not always infected, but the microorganisms which are more implicated are the Gram-negative bacteria. Aron and colleagues[7] reported that fewer than half of the patients in their series had organisms recovered on the culture of the purulent fluid from the kidney, indicating that the pus may be sterilized by previous antibiotic use or that it may represent a sterile inflammatory tissue response to the calculus. Even turbidity secondary to macroscopic crystalline or amorphous calculi debris can cause such a fluid.[7]

A patient with intracollecting system abscess, such as a pyocalix or pyonephrosis secondary to infection and distal obstruction, presents with an acute septicemia or a chronic condition. The patient's symptoms may be so minimal if they suffer from a chronic condition. Fever and a slight flank discomfort might be the only symptoms which are prone to negligence. These patients may have only a mild leukocytosis and the urine culture is often negative for infection.[8] It is usually advised not to attempt to perform PCNL in such situations. It is reported that after 5 to 7 days of antibiotic coverage, the urine cultured from the bladder and the drained catheter is usually sterile. At this time, therapy for kidney calculi can be safely pursued.[9]

In a study of the cultures of urinary calculi obtained from patients with preoperative bacteriuria, it was revealed that 77% of the calculi harbored bacteria.[10] Hence, urinary calculi provide a good condition for the bacteria. On the other hand, the presence of sterile urine in a patient with calculus does not preclude postoperative bacteriuria. Charton an coworkers[11] recorded a 35% incidence of bacteriuria after PCNL among patients with sterile preoperative urine culture in whom prophylactic antibiotic therapy was not used. In another study to evaluate the risk factors of postoperative complications of PCNL, Vorrakitpokatorn and colleagues[12] reported that infection is the most serious complication of PCNL and increase length of hospital stay, and antibiotics started at the beginning of the surgery could not always prevent this event.

Complications during or after PCNL may be present with an overall rate of up to 83%, of which fever is a frequent one.[13] The reported frequency of fever after PCNL is between 25.8% and 35% in the current literature.[13-16]

The duration of surgery and the amount of irrigation fluid can be significant risk factors for postoperative fever.[17] Systemic absorption of irrigation fluid containing bacteria or endotoxin may lead to fever and urosepsis after percutaneous nephrolithotomy.[18] Fluid can be absorbed through pyelovenous-lymphatic back-flow, pyelotubular backflow, and forniceal rupture.[18] In our study, when purulence was encountered after Amplatz sheath placement, we sucked out all the fluid and then gently irrigated the pyelocaliceal system directly under low pressure without the use of nephroscope. Saltzman and coworkers[19] showed that using a nephroscopy sheath results in lower intrarenal pressure than using a telescopic dilating system in creating the nephrostomy tract. In another study by Troxel and Low,[18] 64% and 24% of the patients with infectious and noninfectious calculi had post-PCNL fever, respectively. They suggested that there was no association between renal pressure greater than 30 mm Hg and fever; however, postoperative fever and PCNL done for infection-related calculi were correlated significantly.

Conversely, urosepsis during PCNL can be catastrophic despite prophylactic antibiotic therapy and sterile preoperative urine.[20,21] Sepsis may seen in 0.3% to 2.5% of patients undergoing PCNL.[3,4] Vorrakitpokatorn and colleagues[12] reported septic shock in 4.7% of patients. There are various putative factors and variables that may predict the development of postoperative sepsis.[20] Bladder urine culture has been found to correlate poorly with infection in the upper urinary tract.[21] It has been postulated that bacteria in the calculus may be responsible for systemic infection. On the other hand, positive calculus culture and pelvic urine culture are better predictors of potential urosepsis than bladder urine. Therefore, routine collection of these specimens is recommended.[20]

Finding pus during the performance of a PCNL should alert one to the possibility of sepsis, which can occur whether the procedure is completed in the same setting or in two stages.[7] Sepsis after PCNL indicates a poor technique with high pressure within the collecting system during manipulation. This problem can be avoided by using continuous flow instruments or an Amplatz sheath.[18,22] For this reason, we used Amplatz sheath in all of the patients in our study.

It is advised that all patients undergoing percutaneous procedures should have urine cultures preoperatively with the administration of an appropriate antibiotic to sterilize the urine. In a randomized prospective study, Inglis and Tolley showed that prophylactic antibiotic treatment reduced the incidence of UTI in patients with preoperative sterile urine who underwent PCNL (2% versus 12% with and without antibiotic prophylaxis, respectively).[23] Hosseini and colleagues[24] showed that when the urologist incidentally find purulent fluid in the puncture site, performing PCNL is possible with full antibiotic coverage in the same session. We also found prompt PCNL when purulent fluid is aspirated during the procedure is safe; however, there were factor such as fever, positive blood culture, and positive urine culture could potentially increase the length of hospitalization. We performed the procedure in selected patients with cloudy urine at the time of PCNL and the same-day PCNL was done considering factors mentioned above. We did not have any infection-related complication.

CONCLUSION

Same-day PCNL in patients with aspirated cloudy urine can be performed if a low pressure 30-F Amplatz sheath is used, increasing intrarenal pressure during the procedure is avoided, multiple tracts are obtained if needed, and good antibiotic coverage is considered. However, in patients with obstructing semiopaque calculi, leukocytosis, untreated recent UTI, and aspiration of thick or foul pus, it is safer to drain the urine through percutaneous nephrostomy tube alone and postpone PCNL to a later time. In the absence of the above factors, we do not face any uncontrollable complications with continuing PCNL, if the pyelocaliceal system is drained completely. However, regarding our small sample size, it seems that statistical powers of the test are not high enough. Therefore, large prospective studies with greater sample sizes are required to validate our conclusions.

CONFLICT OF INTEREST

None declared.

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