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Supine Access for Percutaneous Nephrolithotomy: A Simple and Feasible Option

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Submitted August 7, 2012 - Accepted for Publication January 6, 2013

ABSTRACT

Supine percutaneous nephrolithotomy (PCNL) is a less practiced modality for the treatment of upper-tract calculi. We hereby present our single center experience in 100 patients treated by supine PCNL over a period of 18 months. We found the procedure simple and feasible.

INTRODUCTION

First described in 1976, percutaneous nephrolithotomy (PCNL) has evolved into a widely accepted, safe, and efficacious management system for large upper tract calculi. It is the most widely practiced modality for the treatment of larger renal calculi in all centers throughout the world. Most of the centers perform it in the prone position [14]. Two recent meta-analyses in the literature have shown that supine PCNL has a significantly shorter operating time than PCNL in the prone position and an equivalent stone-free rate, complication rate, transfusion rate, and fever rate [9,12]. There is no clear-cut superiority of either prone or supine technique over the other, but in the last decade supine PCNL has gained wide acceptance at many centers in South America and Europe [13,14]. Although not universally adopted in our country—possibly because of a high efficiency of the prone PCNL and a lack of training of supine PCNL at most educational centers—supine positioning of the patient for PCNL confers several advantages from the patient, urologist, and through anesthesia [1,2,6-8,10,11]. Some centers advocate the use of this technique selectively while dealing with obese patients or high-risk anesthesia patients with cardiorespiratory compromise [6], but there are many who primarily perform PCNL in the supine position [1,2]. We use this technique at our center and have found it to be an immensely convenient, timesaving practice, and one that provides great versatility to the urologist in terms of a combined antegrade and retrograde approach. There is a high rate of calculi clearance in 1 step, at multiple locations in the urinary tract, and with benefits for the anesthetist in terms of ease of management of airways or cardiorespiratory resuscitation if required.

MATERIALS AND METHODS

In our study, a retrospective analysis of our experience with 100 patients having undergone supine access for PCNL is presented. From the period of August 2010 till March 2012, 100 patients were subjected to PCNL in the supine position at our center. There were 78 males and 22 females. Age ranged from 17 to 64 years old, with a mean of 43.4. All patients underwent the procedure under spinal anesthesia. Fourteen patients were ASA grade III or more and had comorbid conditions such as cardiac decompensation, obstructive airway disease, or diabetes mellitus. One patient with a recent fracture of the humerus had a sling applied so it was not possible to lie prone.

The inclusion criteria for PCNL were a stone size of more than 1.2 cm in the upper ureter and more than 1.5 cm in the kidney. In patients who had an infection or obstructive uropathy with renal insufficiency, a percutaneous nephrostomy tube was placed in the supine position and then PCNL performed after improvement in renal parameters and an overall general condition. Access was created under fluoroscopic guidance. The procedure was performed in the complete supine position. The first 2 cases were performed using a rolled towel underneath the ipsilateral flank to cause an elevation of 30 degrees. The

KEYWORDS: Supine PCNL, calculi, kidney

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CITATION: *UroToday Int J*. 2013 February;6(1):art 8. http://dx.doi.org/10.3834/uij.1944-5784.2013.02.08

remaining cases were performed without flank elevation. The system was opacified by the passage of contrast through transurethral placement of a ureteric catheter in the ipsilateral ureter. While dealing with upper ureteric calculi, when the stones were far from the renal pelvis or when the ureter between the stone and the pelviureteric junction was not suitably dilated, the patient was placed in the lithotomy position and stones were pushed into the kidney by ureteroscopy, either in toto or after fragmentation. The punctures were made in the desired calyx through the posterior axillary line just below the subcostal margin in 90 patients and above the twelfth rib in 10 patients. The tract was dilated to 26 or 28 Fr using Alken dilators and an amplatz sheath of an appropriate size, placed depending on the size of the stones and the degree of dilatation of the calyx. The position of the urologist and the assisting nurse was sitting on a stool on the side of the stone, well away from fluoroscopy. In all patients, we needed the assistance of only 1 scrub nurse and 1 technician. In patients with left-sided stones, the IITV needed to be moved to the opposite side. In right-sided stones, no equipment movement was needed. Stone disintegration was carried out using pneumatic or ultrasonic lithotripsy (Calculiclast and Calcuson). In patients with stones both in the ureter and the kidney, the renal stones were dealt with first by PCNL. The ureteric stone was then fragmented or pushed into the kidney, and then retrieved through the renal tract. Postoperatively, an X-ray of the kidney, ureter, and bladder (KUB); ultrasonography (USG); or non-contrast computed tomography (NCCT) were done as deemed necessary after 24 hours for an evaluation of stone clearance. Any residual fragments, if found, were removed by relook PCNL.

In patients with a large stone burden, a 16 Fr catheter was placed as a nephrostomy. It was removed once stone-free status was ascertained. All patients had a Foley bladder catheter for 24 hours. DJ stents were placed in all patients where stones were removed piecemeal or in patients with infection.

RESULTS

We had 68 patients with stones on the right side and 32 had stones on the left side. Two patients had stones in solitary kidneys. There was a history of previous surgical interventions for stone treatment in 4 patients. Stones were single in 90 patients and multiple in 10 patients. Four of the multiple stones were staghorn stones. The stones were located in the renal pelvis in 70 patients, the upper calyx in 4, the middle calyx in 4, the lower calyx in10, the upper ureter in 12, the upper ureteric and lower calyx in 3, and the renal pelvis and lower calyx in 3. The size of the stones in the largest dimension ranged from 1.2 cm to 6.8 cm with a mean of 2.3 cm. Five patients were subjected to PCN prior to the PCNL. In 4 of these there was pyonephrosis, and 1 patient had a solitary kidney with an upper ureteric calculus and acute renal failure. We could achieve complete stone clearance in 90/100 patients (90%). In 10 patients, we had to resort to prone PCNL to achieve complete clearance. This included 3 patients with staghorn calculi, 1 patient with a solitary kidney who had multiple calculi, 4 patients with calyceal calculi and an undilated system, 1 renal pelvic calculus, and 1 upper ureteric calculus. One of the 3 patients with staghorn calculi had complete clearance but a fragment migrated unnoticed into the ureter, presenting 1 month later with a perinephric abscess. This abscess was drained percutaneously via percutaneous nephrostomy, and the stone was removed via ureteroscopy. This case was considered a failure.

The operative time ranged from 45 to 230 minutes, with a mean of 50 minutes. The procedure was completed in a single sitting in 80 patients, 2 sittings in 14, and 3 sittings in 6 patients. The mean number of sittings was 1.2. The number of tracts made was 1 in 84 patients, 2 in 14 patients, and 3 in 2 patients. The tracts were supracostal in 10 patients. There was no incidence of pleural injury or colonic perforation. In 1 patient there was renal-pelvic perforation that occurred during tract dilatation. The incidence of blood transfusions was 4/100 patients. Postoperatively, there was fever in 8/100 patients (which responded to antibiotics), insignificant hematuria in 12/100 patients, and pain in 20/100 patients. The punctures were through the lower calyx in 86 renal units, the middle calyx in 22, and through the upper calyx in 10. The mean hospital stay was 3.2 days, ranging from 2 to 12 days.

DISCUSSION

At our center, we have been performing PCNL in the prone position for the last 15 years and have no doubt about the efficacy, ease of performance, and near total success of the procedure. The need to use the supine position arose during our encounter with an obese female patient, where we performed a PCN in the supine position. She had a staghorn calculus of 4.5 cm in the largest dimension, multiple lower calyceal calculi in the lower moiety of the right duplex kidney, and pyonephrosis. She was a high risk for anesthesia. Her abdomen was protuberant, and she had respiratory distress and could not lie prone. Although we had no prior experience with supine PCNL, we attempted and succeeded in doing a PCN in the supine position.

As her renal function improved after PCN in a few days, we felt encouraged to do PCNL in the same position. We performed the procedure as originally described by Valdivia-Uria [1]. We could remove the entire calculus in a relatively short time (75 minutes) and experienced the convenience of this position. Having met with total success, we decided to pursue the procedure in more patients. In the period from August 2010 to March 2012, we performed supine PCNL in 100 patients at our center.

The prone position has been the popular approach for PCNL since its inception [1,2,10] and is the only known approach for many urologists across the globe. It has stood the test of time and merits the gold-standard status in treatment of larger renal calculi. The supine position till some time ago was used rarely and only in special situations such as patients with renal allografts and pelvic ectopic kidneys [6]. However there are some concerns regarding the prone approach especially in morbidly obese patients and patients with compromised cardiopulmonary states [3]. First and foremost, a patient anaesthetized in the supine position needs to be turned prone for the procedure and then turned supine again, once the procedure is completed, to be woken up. Anaesthetized patients are unable to protect themselves or assist during positioning so there is a risk of injury to the neck, limbs, or spine in both the patient [2] and staff. This problem is more pronounced in patients subjected to general anesthesia. There is the risk of dislodgement of the endotracheal tubes, intravenous lines, and epidural, ureteral, or urethral catheters. In our series we performed the procedure under regional aesthesia in all patients. The prone position may be difficult for patients with some deformities such as kyphoscoliosis or neck or limb contractures [1,2]. We had 1 patient with an upper ureteric calculus with a fracture in the right humurus and he could not be made to lie prone. The PCNL was comfortably accomplished in the supine position. In prone PCNL, a safe positioning of the patient should involve a minimum of 6 people trained in the movement of patients into the prone position: 1 for the head, 2 on each side, and 1 controlling the feet and legs [11]. Finding this number of trained personnel can be even harder in non-institutional, solo practice set-ups. Furthermore, space gets limited once the trolley, the workstation comprising of electrically connected gadgets and imaging equipment, is in place. In prone PCNL, turning the patient and the movement of all the equipment may be difficult. This affects time and economic attributes for the operating surgeon, patient, and hospital in this cost-conscious era.

In our series, we have 68 patients with stones on the right side. This high number of right-sided patients is because the IITV along with the workstation in our operating room were positioned on the left side of the patient. So in patients with stones on the right side, the supine position did not require movement of these gadgets for the procedure. This saved time and ensured uninterrupted procedures. Reduced mobility and portability of heavy electrical equipment surely adds to the prolonged durability of equipment.

The posterior axillary line is the preferred site for puncture by most centers [1,2,5,4], but some also advocated punctures in the mid axillary line [4,7]. We preferred the posterior axillary line in all our patients. These laterally placed punctures decrease the chances of injury to the pleura, which have been reported in only 0.5% patients [7]. We did not have any pleural injuries even when punctures were supracostal in 10/100 patients. The risk of colon injury is lower in the supine position and to date only 1 patient has been reported to have had a colon injury [7]. The colon is retro-renal in only 2% of patients while in the supine position, whereas the incidence rises to 10% in the prone position [12]. There was no colon injury in our series.

In 4 patients with staghorn calculi, we needed more sittings and more than 1 tract. There were limitations for access to the anterior calyces as lateral deflection of the nephroscope is difficult because of the side of the table; hence, limited vision and lower success rates. In 3 of these 4, we needed to resort to prone conversion for the clearance of residual fragments (considered a failure of supine PCNL), whereas in 1 we achieved total clearance in the supine position. The success rates in such situations may be improved by judicious use of flexible nephroscopes [6].

Most series had operative times ranging from 15 minutes to 350 minutes. In most of the studies, the operative time was not clearly defined, but it is obvious that the operation time for PCNL is dramatically less in the supine position compared to the prone position [3]. In fact, the only parameter that has a statistically significant advantage of the supine position over the prone is the operative time [2,8,12]. The authors stated that this difference was attributed to turning the patient at the beginning and the end of PCNL in the prone position. We calculated the time from the time of induction of anesthesia to the placement of the Foley catheter at the end of the procedure. It ranged from 45 to 230 minutes, with a mean of 50 minutes. We believe that the dependent drainage provided by the oblique position of the Amplatz sheath is a great contributor for a shorter operative time in the supine position (Figure 1). The small fragments and dust created by fragmentation needs no attention and flows out while the fragmentation is in progress [12]. In the prone position, the small fragments tend to migrate to remote corners, increasing operative time and punctures.

With the available literature and from our experience with supine PCNL, we feel the procedure is here to stay. However, some factors we observed are bothersome during the process. First, the presence of the air bubble at the front of the nephroscope constantly obscures vision during the entire procedure. The tip of the sheath toward the stone end is at a higher position than the point of entry so the air that enters by the side of the nephroscope during the procedure tends to rise up and remain at the tip of the sheath and nephroscope. This is unwanted and requires constant "to and fro" movements of the nephroscope to displace it and achieve clear vision (Figure 2). This technical difficulty has not been mentioned in any of the studies so far but none can deny its existence. It would be interesting to explore the possibilities of effectively dealing with it. Another difficulty we observed was the limitation caused by the attachment of the light source cable on the inferior aspect and the water tubing

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Figure 1. The downward-pointing Amplatz sheath facilitates the spontaneous passage of fragments.

Figure 2. Vision through the air bubble that constantly remains at the tip of the nephroscope.

on the superior aspect of the nephroscope. This decreases the operating length and reachability of the nephroscope (Figure 3). This may be overcome by the use of extra long nephroscopes and sheaths, or the use of nephroscopes that have the water tubing and light source connections on the superior aspects, or nephroscopes that have rotating sheaths where both can be placed wherever suited. The third problem is that during imaging in some patients the overlap of some of the operating table artifacts can't be eliminated and we may have to proceed despite these artifacts or devise tables with radiolucent borders (Figure 4).

Other disadvantages of the supine position mentioned are a collapsed collecting system, difficulty in approaching the upper calyx, and a small surgical field for the access site [12]. We had puncture failure in 2/100 (2%) patients vs 2.7% mentioned in a survey conducted by clinical research of the Endourological Society [14]. We had 2 patients with solitary kidneys. One of these had total clearance of a renal pelvic calculus, whereas the other had multiple calyceal and renal pelvic calculi and needed to be turned prone for the removal of 2 small calculi that had migrated to the upper anterior calyces during supine PCNL. There were 2 patients with stones in horseshoe kidneys, 1 patient with malrotation, and 3 patients had duplex systems. These renal anomalies did not influence the outcome and we

Figure 3. The length of the nephroscope becomes limited due to the light cable.

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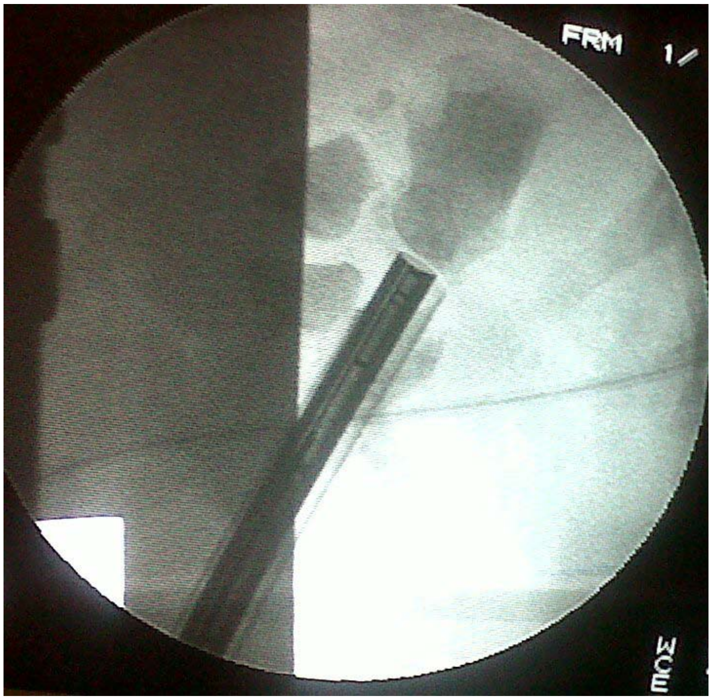
Figure 4. Operating table artifacts that sometimes can't be eliminated.



achieved total clearance in all of them.

CONCLUSION

We found that supine PCNL is technically an easy and safe procedure in the hands of an endourologist who has expertise with the prone version of it. The limitation of our study is its retrospective nature and design, which is descriptive rather than comparative, but our observations can be a guiding example for urologists keen on adding more to their versatility and expertise.

There are a few technical difficulties in the procedure but they are clinically insignificant and easily surmountable. Moreover, it has a short learning curve and provides the endourologist the ability for simultaneous antegrade and retrograde manipulations for stones in the ureter and the kidney and thus reduces operative time. It increases self-sufficiency and reduces the need for additional support staff. If used in the right cohort of patients, its use may greatly facilitate successful outcomes and improve anesthetic risk handling. It is indeed an additional tool in the hands of the urologist for the treatment of renal calculi and we firmly believe that every endourologist must familiarize him or herself with this novel, emerging technique.

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