

SUPINE PERCUTANEOUS NEPHROLITHOTOMY IN COMPARISON WITH THE PRONE STANDARD TECHNIQUE

Ashraf Mohamed A. Aal

Urology Department, Benha Faculty of Medicine, Egypt

ABSTRACT

Percutaneous nephrolithotomy (PCNL) in the prone position has been considered the treatment of choice for large kidney calculi, however, supine (PCNL) can be used as an alternative management procedure. We compare both procedures in the management of renal stones. Since June 2009 to March 2011, 60 consecutive PCNL were performed at Benha university hospital, group (A) 30 patients in prone position, and group (B) 30 patients in supine position. The mean operative time in prone group was 76.8 ± 16.6 min. while in supine group was 55.43 ± 22.5 min. The stone free rate in prone group was 86.7% and in supine group was 83.3%. The blood loss required blood transfusion in prone group was 10% and in supine group was 6.7%. The intra-operative morbidity of prone group was 16.7% and in supine group was 10%. The postoperative morbidity of prone group was 20% and in supine group was 23.3%. The mean hospital stay of prone group was 3.87 ± 2.77 days, and in supine group was 3.33 ± 2.12 days with no statistically significant differences between both groups. PCNL in supine position is safe, effective and suitable for all patients.

Keywords: Percutaneous nephrolithotomy, supine, prone

INTRODUCTION

Fernstorm and Johansson, at 1976, first described the percutaneous nephrolithotomy (PCNL) procedure. Since then the PCNL in the prone position undergone many innovations and has been accepted globally because its familiarity, excellent understanding of the anatomy in this position and reduced risk of visceral complications (1). Percutaneous nephrolithotomy (PCNL) is considered the treatment of choice for large kidney calculi based on superior outcomes and accepted low morbidity. Recent advances in instrumentations and techniques have improved the factors, including stone free rates, increased treatment efficiency and decreased morbidity (2). The fear of colonic or splanchnic organ injuries has probably conditioned patient's prone positioning when the technique of percutaneous nephrostomy was first described (3), and percutaneous nephron-lithotomy has been traditionally performed in the prone position for a safe approach to the kidney (4, 5 and 6).

However, PCNL in the prone position has some disadvantages especially in cardiac, obese and elderly patients (7). To overcome these disadvantages, Valdivia Uria *et al.*, 1998 first described the supine position for percutaneous stone surgery (8). Not only does PCNL in the supine position has similar advantages as prone position, but also has greater versatility of stone manipulation along the whole upper ureter less patient handling, needing drape only once, ability to perform Simultaneous PCNL and ureteroscopic procedures, and better control of the airway during the procedure. (1,2).

PATIENTS AND METHODS

Since June 2009 to March 2011, 60 consecutive percutaneous nephrolithotomy were randomly performed at Benha university hospital, group (A) 30 patients in prone position, and group (B) 30 patients in supine position. Written informed consents were taken from the patients and approved by our Human Ethics Committee. The exclusion criteria were renal anomalies and bleeding diathesis.

At presentation, all patients were assessed by Plain x-ray urinary tract (PUT), abdomino-pelvic ultrasound (US) and Spiral C-T. All patients with positive urine cultures were treated appropriately before the procedure.

Surgical technique:

General anesthesia was performed to all patients according to standard technique. In both groups the first step was in the lithotomy position for ureteric catheter insertion, which was fixed to a urethral catheter.

Group (A): (Prone PCNL), the patient was turned prone with putting a bridge or towel under his chest & pelvis leaving the abdomen



Fig.1: patient in supine position

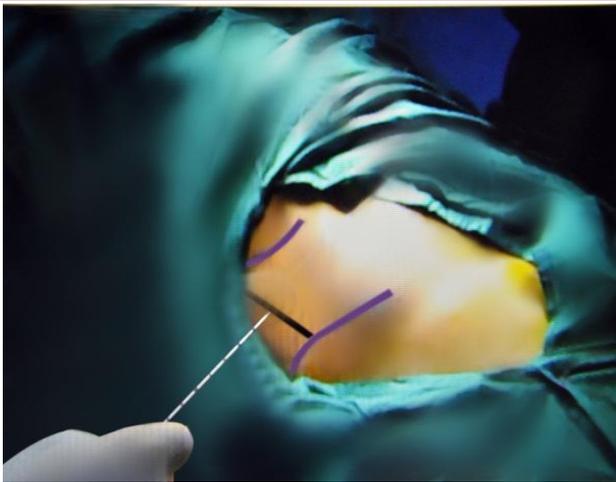


Fig. 2B. Puncture needle pass through the mid axillary line.

free for respiration, sterilization of the skin by povidone iodine 10% solution, towel the patient and marking the site of the stone by a mark. Retrograde urography was done using fluoroscopic image & selection of the proper calyx to gain access to the stone, puncture the skin along the posterior axillary till reaching the pelvicalyceal system with aspiration of urine, the J tip guide wire insertion to be passed through the ureter or coiled to a far calyx and insertion of safety guide wire then dilatation of the tract by Teflon dilators then nephroscopy used for destruction of the large stones by pneumatic lithotripsy & extraction of smaller ones & fragments by stone forceps, then nephrostomy tube is fixed.

Group (B) :(Supine PCNL), after ureteric insertion, the patient remains in the supine position with the side of the interest at the edge of the table with a small cushion was placed under the flank to elevate it 15-20 degrees (fig.1). After sterilization & towel, puncture the skin along the midaxillary line 0 degree with the operating table, till reaching the pelvicalyceal system usually through the



Fig.2A.3-anatomical land marks, last rib, iliac crest and midaxillary line.



Fig.3: Teflon dilator over central alken.

lower or the middle calyx (fig.2 A, B). After gaining urine, a J tip guide wire was inserted through the puncture needle to pass through the ureter or coiled to a far calyx and insertion of safety guide wire. Tract dilatation by Teflon dilators (fig.3), then use the nephroscopy to visualize the stone, large stones were fragmented using pneumatic lithotripsy, and small ones extracted using stone forceps, Then nephrostomy tube was fixed.

Because the tract is horizontal or inclined slightly upward & medially, stone fragments tend to fall out spontaneously, thus speeding stone clearance. During the procedure, the surgeon was sitting comfortable. In one case of this technique, a small stone migrate to the ureter & simultaneous URS was done to extract this stone. In both groups, stone clearance was determined by a combination of fluoroscopy and rigid nephroscopy at the end of the procedure. Postoperative, stone clearance was determined using non-contrast spiral C-T. If the patient was stone free, the nephrostomy tube was removed after 1 day postoperative & the ureteric and the urethral catheters removed

Table 1. Patient and stone characteristic

	Supine group	Prone group	P value
Mean age (y)	34.33 ±11.4	37.27 ± 13.8	>0.05
Sex			
Male	17(56.7%)	12(40%)	>0.05
Female	13(43.3%)	18(60%)	>0.05
Mean BMI	27.17±4.23	26.57±4.28	>0.05
Previous renal surgery	8(26.7%)	10(33.3%)	>0.05
Mean stone size(cm)	2.21 ± 1.2	2.7 ± 0.84	>0.05

Table (2): Stone site of the supine and prone groups:

	supine	prone	P value
Pelvis	6 (20%)	9 (30%)	>0.05
Upper calyx	1 (3.3%)	3 (10%)	>0.05
Middle calyx	3 (10%)	5 (16.7%)	>0.05
Lower calyx	16(53.3%)	10 (33.3%)	>0.05
Multiple	4(13.3%)	3(10%)	>0.05

Table 3. Operative and Postoperative Data

	Supine group	Prone group	P value
Mean operative time (min)	55.43 ± 22.5	76.8 ± 16.6	<0.001
Blood transfusion: no. (%)	2(6.7%)	3(10%)	>0.05
Intra-operative morbidity: no. (%)	3(10%)	5(16.7%)	>0.05
Post-operative morbidity: no. (%)	7(23.3%)	6(20%)	>0.05
Mean postoperative hospital stay (d)	3.33 ± 2.12	3.87 ± 2.77	>0.05
Stone-free rate: no. (%)	25(83.3%)	26(86.7%)	>0.05
Need for second look: no. (%)	4(13.3%)	4(13.3%)	>0.05
Need for ESWL: no. (%)	1(3.3%)	0(0%)	>0.05

after 2 days further, but when there were residual stones , a second look PCNL after 1 week was done.

RESULTS

Group A (prone): comprised 30 patients; of them 18 were females (60%) &12 were males (40%). Stone laterality was 17 cases on the right side &13 cases on left side only 2 cases were staghorn stones. Group B(supine): Comprised 30

patients; of them 13 were females & 17 were males. Stone laterality were 14 cases on right side & 16 cases on left side with only 1 case was staghorn stone. Patient and stone characteristics are shown in Table 1. There were no statistically significant differences between the supine and prone groups regarding patient characteristics, stone size or previous renal surgery. Mean age was 34.33± 11.4 years in the supine group vs.

37.27 ± 13.8 years in the prone group. In the supine group, were male 56.7% and 43.3% were female; in the prone group, 40% were males and 60% females. 4 cases of supine group and 2 cases of prone group were morbid obese. we had 8 cases in supine group and 10 cases in prone group were recurrent on the same side. The mean stone size in the supine and prone groups was 2.2 ± 11.2 cm vs. 2.7 ± 0.84 cm, respectively. Stone site of the supine and prone groups are shown in table 2.

The operative and postoperative data are shown in Table 3. The mean operative time of the supine group was statistically significantly shorter than that of the prone group (55.43 ± 22.5 vs. 76.8 ± 16.6 min, respectively). There were no statistically significant differences between the supine and prone groups regarding the percentage of patients who needed blood transfusion (5.5% vs. 10% respectively). There was no statistically significant difference regarding the stone-free rate between the two groups.

The postoperative morbidity of the supine was 7 cases "23.3%" of which 5 cases had residual stones, 4 cases of them required 2nd look PCNL and 1 case required ESWL, 1 case of perinephric collection treated conservatively by blood transfusion intra and post-operatively, fluids, antibiotics and JJ insertion which was removed after 3 months, and 1 case had urinary tract infection (UTI) treated by proper antibiotic according to culture and sensitivity. While the postoperative morbidity of the prone was 6 cases "20%" of which 4 cases had residual stones required a second look PCNL, 1 case had fever treated by antipyretics and 1 case slipped nephrostomy tube which passed under conservative treatment.

DISCUSSION

Although percutaneous nephron-lithotripsy (PCNL) in the prone position has been considered the treatment of choice for large kidney calculi, yet the prone position has some disadvantages: *First*, It compromises blood circulation and ventilation, especially in obese patients (limitation in respiratory movements) (*9 and 10*), *second*, position changes during the procedure is inevitable, because preplacement of a ureteral catheter is commonly required in the dorsal lithotomy position before turning the patient to the prone position, these prolong the duration of the procedure (*11*), *third*, If the procedure is carried out under spinal or epidural anesthesia, conversion to general anesthesia with endotracheal intubation will represent a good challenge to the anesthetist (*10 and 12*), *fourth*, sometimes it is impossible for the patient to lie prone because of body habitus such as ankylosing

spondylitis, severe lordosis or kyphosis, or hip or lower limb contractures (*13*), *fifth*, operating on a patient in the prone position, the surgical team stands in close proximity to the patient, making them relatively more vulnerable to radiation exposure. Whereas in the supine position, the bodies and limbs of the surgical team remain outside the field of fluoroscope (*12*), and *finally*, the prone position is especially dangerous in patients with severe cervical spondylosis, and care of pressure area is problematic (*10*).

Based on their CT studies, *Valdivia Uria et al., 1998* first described the supine position for percutaneous stone surgery they suggested that rather than making the colon more vulnerable to injury, the colon floats away from the kidney when the patient is in the supine position; this makes the colon less likely to be injured by a puncture made in the posterior axillary line (*8*). The supine position has many advantages: reduced cardio circulatory or ventilatory dysfunction, better tolerance when the operation is performed under local anesthesia, and less time needed because patients do not have to be turned after induction of general anesthesia and positioning of the ureteral catheter. Moreover, the surgeon can comfortably sit during the operation and X-ray exposure is reduced because puncture and dilatation of the nephrostomy tract are quite perpendicular to the body and the operating hands are outside the fluoroscopic field (*14*).

In the supine position, the Amplatz sheath is oriented downward, maintaining a low pressure in the renal pelvis and reducing the risk of fluid absorption and, at the same time, facilitating spontaneous stone fragment evacuation. Unfortunately, this collapses the pelvicalyceal cavity, reducing vision but limiting stone dislocation to the calyces or the ureter (*15*). Finally, by rotating the legs into the lithotomy position, combined antegrade and retrograde procedures can effectively be performed. This represents the main advantages of this procedure because it combines the benefits of percutaneous and ureteroscopic intrarenal surgery in selected cases of contemporary treatment of renal and ureteral stones (*1, 16, and 17*).

PCNL in the supine position has also certain disadvantages that make it a disputable alternative. The first problem with the supine position is that there is no enough space for a third tract if needed (*18*). Also, access to the anterior and upper calyces is more difficult, as the angle between the plane of the operation table and the anterior calyces is smaller than that in other positions; it is difficult to access calculi in the anterior calyces (*10, 13 and 18*). Approaching the

upper calyx, especially if placed excessively medially is more difficult in supine position, as well (12 and 16). This problem is more pronounced on the left side. In this study we performed upper calyceal puncture in two cases only. Of other drawbacks of PCNL in the supine position is the mobility of the kidneys which is more than that in the prone position. Therefore, the kidneys are easy to move anteromedially during tract dilatation in the supine position. (10, 12 and 18). Finally, the pyelocalyceal system is constantly collapsed in this position, and consequently, nephroscopy is more difficult. (16).

In this work, we elevate the ipsilateral side of the patient in supine group 15-20 degrees by small cushion. *Valdivia uria et al; 1998* reported the use of a 1-3 serum bag to elevate the patient's flank (8). *Ng et al; 2004* who operated on Chinese patients, who are usually of a slimmer body build than whites, found that a 500-1000 ml water bag was adequate in their series (16). While *Marco et al; 2008* agree with us in the method of patient elevation (14). In supine group, we choose the midaxillary line as a site of skin puncture. But *Marco et al., 2008, valdivia et al., 1998* and *neto et al., 2007* choose the posterior axillary line (8, 14 and 17) and *Ng et al., 2004* choose the anterior axillary line (their nephrostomy tract was, however, created by a radiologist) (16).

As in the prone position, in supine PCNL, we preferred a posterior calyx puncture to limit bleeding, as reported by *Shoma et al., 2002*, and *Neto et al., 2007 (10 and 17)*. On other hands *Valdivia uria et al., 1998* preferred the anterior calyx (8). In our study we performed two anterior calyceal punctures where the stones were in the anterior calyces because we cannot reach the anterior calyx through a puncture in the posterior calyx because the lateral deflection of the nephroscopy to reach the anterior calyx was hindered by the side of the bed. So independently from the calyx and how lateral the puncture is, creating the nephrostomy tract in the supine position is a safe procedure in terms of bleeding, which was similar to that of other series with patients in the prone position, and splanchnic organ injury, which never happened in any of these series (8) or in this study.

In the present study, the mean operative time is 76.8 ± 16.6 min in prone position and 55.43 ± 22.5 min in supine position. In other series like *De Sio et al., 2008* reported that the mean operative time was 68 min in prone position and 43 min in the supine position (13). The stone free rate in this study was 83.33 % in supine position and 86.66% in prone position with no significant statistical differences between both

groups. *Marco et al., 2008* reported that the stone free rate was good in both groups (88.7 % in supine and 91% in prone group (14). Also *Shoma et al., 2002* reported similar results for supine and prone positions (89% vs. 84%, respectively) (10). *Ng et al., 2004* had a primary stone clearance rate of 76% on 67 reno ureteral units, 24 of them simultaneously treated with ureteroscopy (16). *Neto et al., 2007* reported a stone clearance rate of 70.5 % in their series of 88 consecutive patients, 10 of whom underwent concomitant ureteroscopic lithotripsy (17). *Manohar et al., 2007* reported that nearly all the patients (95%) were rendered free of stones by initial PCNL, with or without ureteroscopy (1).

Among our patients, blood transfusion was required in 3 cases of the prone group "10%", but in supine group only 2 cases "6.66%" who required blood transfusion with no statistical differences between the 2 groups. This bleeding was due to large and multiple stones with excessive manipulations in both groups. As regarding bleeding during supine PCNL, *Valdivia Uria et al; 1998* reported the rate of serious bleeding requiring transfusion to be about 1.5% (8). *Ng MT et al; 2004* reported a rate of 3% (16), and *Shoma et al; 2002* reported a rate of 9%, but attributed it to their learning curve (10). *Rana et al; 2008* reported a rate of 3.8% for bleedings that required transfusion, which was directly related to the calculus size, procedure duration, and creation of multiple tracts. In contrast to all assumptions, the risk of bleeding with the supine position must be less. Obstruction of the inferior vena cava during PCNL in the prone position and backflow of blood to the renal vein may explain why bleeding in the prone position is more likely than in the supine position (12).

In this study, intra-operative morbidity of the group (A) "prone" were 4 cases (13.32 % of the cases), of which 3 cases had a significant bleeding requiring blood transfusion, and 1 case lost tract. While the intra-operative morbidity of the supine group was 3 cases (10 % of the cases), of which 2 cases had a significant bleeding required blood transfusion, and 1 case had inaccessible stone, with no statistical differences between the 2 groups, with no case of colonic injury in both groups. *Valdivia Uria et al., 1998* reported severe bleeding on three occasions (from 557 patients) in patients in the supine position, resulting in one nephrectomy and transfusion in an additional five patients (8). *Ng MT et al., 2004* reported one nephrectomy performed for bleeding in 62 PCNLs performed in patients in supine position (16). *Marco et al., 2008* reported loss of nephrostomy tract in one case after complete

stone fragmentation, which was managed by double J stent. This patient suffered fever >38.8 C for 2 days and its PUT showed a steinstrasse in the distal part of the ureter that resolved spontaneously in 1 month (14). There had been concerns that the supine approach may have put the colon at a higher risk of injury than the prone position. In all the published studies on 1459 cases, there was no colonic injury in patients treated in the supine position. Data regarding PCNL with the patient in the supine position has not yet reported a single incidence of injury to the colon (19). In this study, there was no colonic or any visceral injury in both groups. Among our patients, the postoperative morbidity of the group (A) "prone" was 6 cases "20%" of which 4 cases had residual stones required a second look PCNL, 1 case had fever treated by antipyretics and 1 case slipped nephrostomy tube which passed under conservative treatment. While The postoperative morbidity of the group (B) "supine" was 7 cases "23.33%" of which 5 cases had residual stones 4 cases required a second look PCNL and 1 case required ESWL, 1 case of perinephric collection (hematoma) treated conservatively by blood transfusion intra and post operatively, fluids, antibiotics and double J insertion which was removed after 3 months, and 1 case had (UTI) treated by proper antibiotic according to culture and sensitivity. There is no statistical difference of postoperative morbidity between the 2 groups. *Marco et al; 2008* reported a prolonged leak from the percutaneous access in 4 patients (from 39) in supine group and 3 patients (from 36) in prone group, who were managed by double J insertion. And other cases of minor complications were transient fever in five patients, clinically insignificant bleeding in three patients, and renal colic in three (14). *Steele and marshall 2007* reported the following postoperative complications in their study (322 patients underwent supine PCNL), bleeding requiring immobilization in 1 case, delayed stenting for urine leak in 3 cases, DVT in 1 case, pulmonary embolism in 1 case, and discharge sinus in 1 case (20).

CONCLUSION

PCNL in supine position is a safe, effective as in prone position. It has several advantages like less operative time because of less patient handling and needing drape only once and ability to perform simultaneous PCNL and URS procedures, better control of airway during the procedure and lastly the surgeon is sitting while doing this procedure. Because of its advantages in high risk patients, it is necessary that every urologist increases his/her skills in this technique.

However, the supine position is not a substitute for the prone position for PCNL. We need more prospective randomized studies in this field to draw an affirmative conclusion especially in obese patients.

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مقارنة استخراج حصوات الكلى عن طريق استخدام منظار الكلى من خلال الجلد فى وضع المريض على ظهره وعلى بطنه

يعتبر تفتيت حصوات الكلى عبر منظار الكلى هو العلاج الأمثل الذي له نتائج عظيمة وقليل الخطر على الصحة. ان التطور الحديث في المناظير الجراحية له أثر كبير في التخلص نهائيا من الحصوات مع تقليل الأصابه بالمضاعفات وأول من وصف هذه العملية هما العالمان (فرنستورم و جوهانسون) سنة ١٩٧٦. وقد بدأت هذه العملية بوضع المريض على بطنه وتطورت إلى أن أصبح من الممكن وضع المريض على ظهره .

من مميزات وضع المريض على بطنه: أنها عملية مقبولة عالميا لأنها مألوفة ولفهم الوضع التشريحي للكلى في هذا الوضع وقلة حدوث المضاعفات أثناء العملية مثل إصابة القولون.

ولكن لهذا الوضع عيوب كثيرة منها حدوث مشاكل للجهازين الدوري والتنفسي وخاصة المرضى البدناء بالإضافة إلى إن هذا الوضع يضيف من فرصة الاصابه بالعمى من الضغط المباشر على العين مما يؤدي إلى رفع ضغط العين وتقليل سريان الدم في الشريان المغذى للعين وينتج عنه جلطة دموية واصابه المريض بالعمى ولذلك يلزم رفع جبهة المريض على مسند مبطن حتى يتجنب ارتفاع ضغط العين، وأخيرا انه يستلزم تغيير وضع المريض بعد وضع قسطرة الحالب من وضعه على ظهره إلى وضعه على بطنه لبدء العملية .

وضع المريض على ظهره له نفس مميزات وضعه على بطنه بالإضافة الى قصر وقت العملية وأول من وصف هذه العملية هو العالم فيلادلفيا سنة ١٩٩٨

ويهدف هذا البحث إلى مقارنة النتائج بين الوضعين واختيار ما هو أصلح للمريض وقد تم تطبيق هذا البحث على ستون مريضا : ثلاثون في وضع المريض على بطنه وثلاثون على ظهره ، وتم المقارنة بين الوضعين بالنسبة إلى العوامل الآتية : وقت العملية ، درجة التخلص من الحصوات ، درجة النزف وقت العملية ، مدة أقامه المريض بالمستشفى وحدث المضاعفات الكبيرة والبسيطة .

وكان متوسط وقت العملية بالنسبة للمجموعة الاولى (وضع المريض على بطنه) ٧٦,٨ دقيقة اما بالنسبة للمجموعة الثانية (وضع المريض على ظهره) ٥٥,٤٣ دقيقة . وكان معدل التخلص من الحصوات فى المجموعة الاولى ٨٦,٧% وفى المجموعة الثانية ٨٣,٣% . وكان معدل فقدان الدم فى المجموعة الاولى ١٠% وفى المجموعة الثانية ٦,٧% . أما بالنسبة لمعدل حدوث مضاعفات أثناء العملية فكانت فى المجموعة الأولى ١٦,٧% وفى المجموعة الثانية ١٠% . وبالنسبة لمعدل حدوث مضاعفات بعد العملية كانت فى المجموعة الأولى ٢٠% وفى المجموعة الثانية ٢٣,٣% . وأخيراً معدل الإقامة بالمستشفى للمجموعة الأولى ٣,٨٧ يوماً وللمجموعة الثانية ٣,٣٣ يوماً. ومن الملاحظ أن كلا المجموعتين متقاربتين فى كل أوجه المقارنة ما عدا وقت العملية فهي أقصر فى المجموعة الثانية عن المجموعة الأولى وذلك لتوفير الوقت الذى يضيع فى تغيير وضع المريض الذى يحدث فى المجموعة الأولى.

ويمكن اجمال القول بأن استخراج حصوات الكلى عبر الجلد عن طريق منظار الكلى فى وضع المريض على ظهره يكون آمناً وفعالاً ومناسباً للمرضى البدناء وله مميزات كثيرة منها: تقليل التعامل مع المريض من تغيير أوضاعه داخل العملية وبذلك يقلل التأثير على الجهازين الدوري والتنفسي ، وامكانيه التعامل مع الحصوات بطرق متعددة عبر الجزء العلوي والسفلى من الحالب في نفس الوضع .

ومن المفضل أن ينقن كل جراحين المسالك البولية استخراج حصوات الكلى فى كلا الوضعين .