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ORIGINAL PAPER

Is complete supine percutaneous nephrolithotripsy feasible in all patients?

Siavash Falahatkar · Alireza Farzan · Aliakbar Allahkhah

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Abstract Although complete supine percutaneous nephrolithotomy (csPCNL) is routine in some surgical centers throughout the world, its popularity in the field of urology due to a deficiency in its training in educational centers, as a whole, is still minimal. We evaluated the outcomes of tubeless csPCNL in this study. This study was a clinical trial, conducted by one surgical team from January 2009 to January 2010, on 117 patients in complete supine position. Percutaneous access was created under fluoroscopic or ultrasonographic guidance in complete supine position. All patients underwent csPCNL without nephrostomy tube (tubeless). Stone disintegration was performed with pneumatic lithotripsy. Pre- and post-operative data of patients were evaluated. The mean operative time was 98 min. The mean reduction in hemoglobin level was 1.5 g/dl. A total of 129 punctures (105 single and 12 double) was performed. The ureteral catheter was left for 1–3 days. The mean hospital stay was 3.7 days. The stone-free rate was 77.77%. Seventeen patients required blood transfusion. Eight patients had fever. Fistula, extravasation or wound infection did not occur. This study demonstrated that csPCNL is a good option for all patients. Furthermore, csPCNL offers potential advantages including better urethral access, less handling of patients, better control of the airway during procedures and reducing overall operative time, a surgeon seated more comfortably, no density overlap with vertebra, easier access to upper calyces, more rapid access to the airway with less hazard, especially in patients with compromised cardiopulmonary function and morbid obesity.

Keywords Complete supine PCNL · PCNL · Tubeless · Stone

S. Falahatkar · A. Farzan · A. Allahkhah (✉)
Urology Research Center, Razi Hospital,
Sardare Jangal Street, Rasht, Iran
e-mail: mallahkhah@yahoo.com

S. Falahatkar
e-mail: urc1384@yahoo.com

A. Farzan
e-mail: urc1384@yahoo.com

Introduction

Percutaneous nephrolithotomy (PCNL) is a well known and established technique for treatment of renal and upper ureteral stones, even staghorns [1]. csPCNL offers potential advantages including better urethral access, less handling of patients who need to be draped only once, better control of the airway during procedures and reducing overall operative time, a surgeon seated more comfortably, no density overlap with vertebra, easier access to upper calyces, easier ability to perform cystoscopy or ureteroscopy during the procedure, more rapid access to the airway with less hazard, especially in patients with compromised cardiopulmonary function and morbid obesity [2].

Although csPCNL is routine in some surgical centers throughout the world, its popularity in the field of urology due to a deficiency in its training in educational centers, as a whole, is still minimal.

Placement of a nephrostomy tube after the completion of PCNL has been considered as a standard procedure by most of urologists [3]. Fear of complications (bleeding, leakage, collections, and prolonged hospital stay) was the reason for this consideration [4].

In several different investigations, tubeless PCNL was found to be a safe and effective method that reduces

postoperative hospital stay and pain [3]. Thus, the tubeless PCNL has been reported only for such selected cases.

This study was done to evaluate the outcomes of csPCNL in the treatment of the urinary stones.

Materials and methods

This study is a clinical trial performed on 117 patients. They underwent PCNL from January 2009 to January 2010 in urologic clinic. One surgical team performed the procedure with the patients in the supine position.

The inclusion criteria for PCNL in our center were renal stone ≥2 cm in diameter, stone size ≥1.5 cm in lower calyx and stones resistant to ESWL ≥1cm.

One hundred and eleven patients underwent general anesthesia and 6 patients underwent spinal anesthesia and 5 Fr ureteral catheter was placed transureterally.

Percutaneous access was created under fluoroscopic or ultrasonographic guidance.

Patients underwent PCNL in the complete supine position without flank elevation; there was no rolled towel under the flank and there was no change in leg position (Fig. 1a, b). The tract was dilated to 28–30 Fr using Amplatz dilators and then Amplatz sheet was placed. During csPCNL, the surgeon was seated in a comfortable position (Fig. 1c). Stone disintegration was performed with pneumatic lithotripsy. We had done tubeless csPCNL but all patients had external ureteral stents for at least 1 day.

Exclusion criteria for tubeless csPCNL in our center were excessive bleeding at the end of the procedure (our endoscopic vision was not clear and the hemorrhage did not allow us to see the collecting system transparently), significant extravasation due to perforation of pelvis, significant residual stone (for second-look PCNL), and ureteral obstruction.

Demographic data of patients and stone characteristics are shown in Table 1.

The duration of hospitalization and the complication rate were evaluated in this study.

KUB or sonography was performed and the stone-free rate was evaluated 1 day and 2 weeks after surgery. We defined the stone-free rate when the residual stone was ≤5 mm in KUB or ultrasound.

Treatment details are shown in Tables 2 and 3.

Results

The operative time ranged between 20 and 180 min (mean 98 min). The mean reduction in hemoglobin level was 1.5 g/dl (range 0–4.7 g/dl). A total of 129 punctures (105 single and 12 double) was performed. Our policy was to preserve the ureteral catheter for 1–3 days. The mean hospital stay in our patients was 3.7 days (range 1–7 days). We found totally stone-free rate in 66 renal units and there were residual fragments in 51 renal units, but only 26 patients were managed by ESWL. Therefore, the overall success rate was 77.77%.

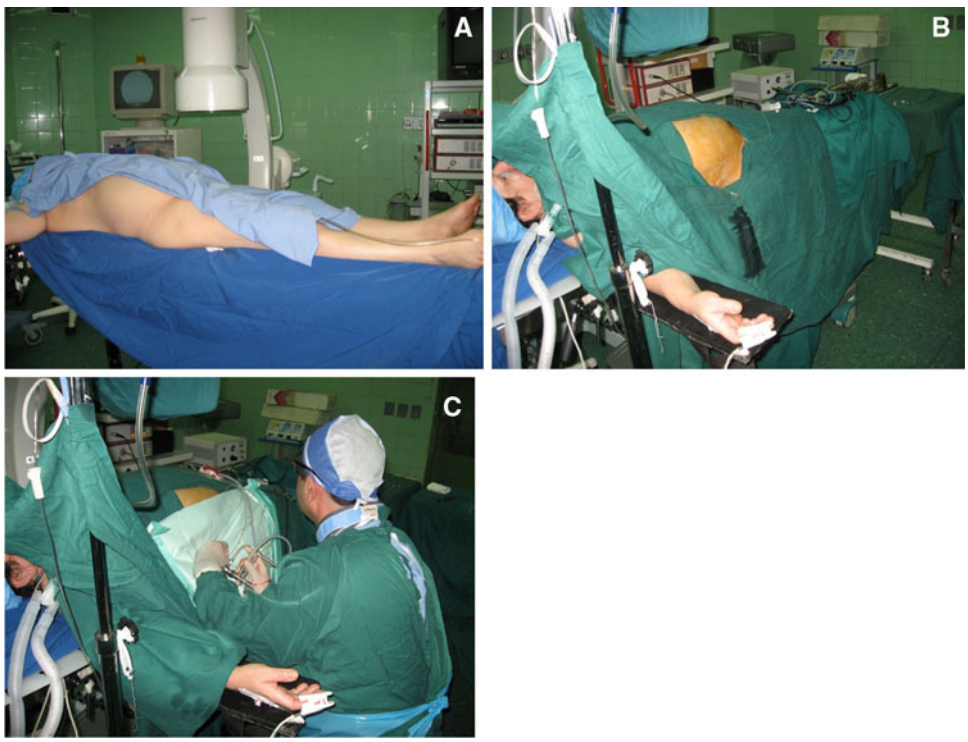

Fig. 1 **a**, **b** These figures show the patient in the complete supine position without flank elevation, there was not any rolled towel under the flank and there was no change in leg position. **c** This figure shows the surgeon in sitting position and this position is comfortable for him

Table 1 This table shows the demographic data in all of the patients

Gender	
Male	64
Female	53
Total	117
Age (years)	
Minimum	21
Maximum	75
Mean	47.2
Renal units	
Right	64
Left	53
Lucency	
Radio-opaque	107
Radiolucent	10
Stone size (cm)	
Minimum	1
Maximum	8
Mean	3.6
Stone site	
Pelvis	66
Upper calyx	11
Mid-calyx	13
Lower calyx	46
Staghorn	11
Multiple	14
Concomitant ureteral stone	4
Access	
Subcostal	117
Supracostal	–
Stone disintegration	
Pneumatic	117
Ultrasonic	–
Mechanical	–
BMI (kg/m^2)	
Minimum	18.6
Maximum	38
Mean	27.1
Preoperative assessment	
Sonographic	117
IVP	115
CT	2
Preoperative creatinine	
Minimum	0.6
Maximum	2.7
Mean	1.2
Morbidity	
HTN	31
DM	17
IHD	4
Pulmonary	5
History of previous surgery	33

Table 2 This table shows treatment details, in all of the patients

Site of punctures	
Posterior	117
Anterior	–
Number of punctures	
Single	105
Double	12
Triple	–
Anesthesia time (min)	
Maximum	180
Minimum	20
Mean	98
Blood transfusion	
No/total	17/117
Rate (%)	14
Stent time (day)	
1 day	38
2 days	73
3 days	6
Hospital stay (day)	
Minimum	1
Maximum	7
Mean	3.2
Stone free rate	
Stone free (*n*)	91
Significant residual stones(>5 mm) (*n*)	26
Success rate (%)	77.77
Complications (*n*)	
Blood transfusion	17
Fistula	–
Extravasations	–
Wound infection	–
Fever	8
Colon or visceral injury	–
Reductive hemoglobin level	
Minimum	0
Maximum	4.7
Mean	1.5

The procedure was performed in csPCNL

In our study, 17 patients (14.52%) needed blood transfusion. It may be due to our academic and training center and the small number of cases.

Eight patients had fever. Fistula, extravasation or wound infection did not occur.

Discussion

The PCNL is generally performed with the patient in a prone position [5], but there are some reports performed

Table 3 This table shows the comparison of major complications in obese patients and the patients with the history of previous surgery

	Tubeless csPCNL	Previous surgery	Obesity (BMI ≥ 30)
Number of patients	117	33	26
Colon or visceral injury (%)	0	0	0
Stone free rate *n* (%)	91 (77.77)	20 (60.60)	19 (73.07)
Blood transfusion rate, *n* (%)	17 (14.53)	4 (12.12)	1 (3.85)
Adjacent organ trauma (%)	0	0	0
Morbidity (%)	0	0	0

in flank, modified supine, and complete supine positions [2, 6, 7].

Improvements in endourologic instruments, lithotripsy devices, and surgical techniques over the past two decades have resulted in higher success rates and lower complication rates for percutaneous renal surgery. Recently, several investigations have focused on the reduction of morbidity and improvement of postoperative patient comfort without sacrificing the efficacy and safety of the procedure [3].

Therefore, it appears that csPCNL is a safe, effective, and suitable procedure. It offers the potential advantages of better ureteral access with less handling of patients who need to be draped only once. The ability of the surgeon, while sitting, to perform simultaneous PCNL and ureteroscopic procedures gives him better control of the airway during the procedures, which reduces the overall operative time as compared to the traditional prone position of the patients and performing PCNL while the surgeon is sitting. Furthermore, in the complete supine position there was no density overlap with vertebra which is observed in the semi-supine position. Furthermore, access to the upper calyces in this method is easier than in the prone position [2].

We evaluated preoperative and postoperative data in patients who underwent csPCNL, such as stone-free rate, hospital stay, blood transfusion rate, fever, colon injury, and history of previous surgery. The results of residual stones in percutaneous nephrolithotomy were reported as 11–16% in one study, and another study reported 88.7% stone-free rate in the supine position [6, 9].

The stone-free rate was 77.77% in our study and it was similar to the other studies. We defined residual stone ≤5 mm as the stone-free rate, although it is controversial according to some authors. Residual stone more than 5 mm scheduled for ESWL or second-look PCNL.

Sharifi et al. [10] in their study reported that the frequency of fever after PCNL was 25.8%. In the similar study, 13.6% of patients who underwent PCNL in modified supine position had fever [11].

In our present study, the incidence of postoperative fever was 6.83%. Our results were lower than theirs and we guess it could be explained by using the supine position in our patients. We believe that the supine position is a normal position. In the supine position, atelectasis and the other systemic complications may be lower than in the prone position.

In the study by Shoma et al. [9] the incidence of acute bleeding was 5–9% of cases. In our study, the blood transfusion rate was 14.52% of cases.

In the other studies, patients with acute bleeding requiring transfusion have been reported in 3–12% of cases, so our results were similar to theirs [12, 13].

One of the advantages of complete supine PCNL, which was mentioned in many studies was shorter operative time [2, 6, 14].

In the report by Rana et al. [14] the mean operative time in the supine position was 65 min (range 45–110 min).

In the other study, the mean operative time in supine PCNL was 162.1 min (range 60–300 min) [11].

In another study of ours, the mean operative time was 74.7 ± 25.1 min in the supine group and it was less than in the prone group (106.87 ± 17.5) with a significant statistical difference ($P < 0.0001$) [2].

In this study similar to other studies, the mean anesthesia time was 20–180 min in the supine position (mean = 98 min).

We guess that the anesthesia time in csPCNL is lower than in prone PCNL and it could be due to the time lost during the preparing of patients at the beginning and the end of the procedure in the prone position.

Shoma et al. [9] reported that the mean hospital stay was 2.5 and 2.7 days for the supine and prone positions, respectively ($P = 0.4$).

In the same way, the mean hospital stay in the Rana et al. [14] study was 2 days in the supine position (range 1–7 days).

In another study, that analyzed the efficacy and safety of PCNL with the patient in a modified supine position, the mean hospital stay was 5.4 days (range 2–21 days) [11].

In the other study, the mean hospital stay was reported as 4.3 days in the supine position versus 4.1 days in the prone position ($P = 0.18$) [6].

But Sergeyev et al. [15] showed that patients with BMI <25 kg/m^2 revealed statistically significant ($P = 0.01$) longer hospital stays.

In our study, the mean hospital stay was 24–168 h in the supine position (mean = 77 h). So, it seems that the hospital stay was similar to that of other studies.

The placement of percutaneous nephrostomy tubes and internal ureteral stents after completion of percutaneous renal surgery has long been considered standard practice. The purposes of the tubes are: to tamponade bleeding emanating from the nephrostomy tract, to allow the renal puncture to heal, to provide proper drainage of urine, and to permit access to the collecting system if a secondary procedure is required [4, 16].

Investigations have recently focused on reducing the morbidity of the procedure and improving postoperative patient comfort by using smaller endoscopic instruments [17].

Several studies omitted percutaneous drainage in selected patients and they reported good outcomes. Also they reported a reduction in hospital stay and other complications in the tubeless group with morbidity comparable to patients with standard nephrostomy tube drainage [18–20].

In several different investigations, tubeless PCNL was found to be a safe and effective method that reduces postoperative hospital stay and pain [3].

The other researchers have suggested that to minimize PCNL morbidity, no nephrostomy tube ought to be placed after PCNL in selected patients [21].

We have performed tubeless PCNL in patients requiring csPCNL and have demonstrated that it is a safe procedure with no significant complications. We demonstrated that tubeless csPCNL can be safe and effective [8, 22].

We performed tubeless PCNL for our patients. We inserted external ureteral stent (5 Fr) in all patients for at least 1 day.

It seems that tubeless PCNL was a safe and effective procedure in supine position.

According to our knowledge, there is no report of csPCNL after open nephrolithotomy, but there are few studies specifically addressing prone PCNL after that.

Two reports claim higher failure rates of prone PCNL in patients with prior open intervention or lobotomy [13, 23].

In the other studies, there were no differences in failure rates of patients with a history of lobotomy. Sofikerim et al. [24, 25] compared the results of PCNL on 27 patients with previous open surgery and 62 patients without any intervention. They found no differences in success or complication rates which were similar to our study.

Some reports mentioned that a history of open nephrolithotomy does not adversely affect the efficacy or morbidity of PCNL [25, 26].

In contrast, the other study showed higher failure rates of PCNL in patients with prior open renal surgery [23].

In this study, 33 patients had history of renal surgery (28.20%).

Major complications were not seen in any patients with history of renal surgery, so it seems that csPCNL was safe in patients with history of renal surgery.

Conclusion

This study showed that csPCNL is feasible in all patients.

csPCNL offers the potential advantages including better urethral access, less patient handling, needing drape only once, better control of the airway during procedures and reducing overall operative time, a seated and more comfortable surgeon, no density overlap with vertebra, easier access to upper calyces, easier ability to perform cystoscopy or ureteroscopy during the procedure, more rapid access to the airway and less hazardous, especially in patients with compromised cardiopulmonary function and morbid obesity.

Although csPCNL is routine in some surgical centers throughout the world, its popularity in the field of urology due to a deficiency in its training in educational centers, as a whole, is still minimal.

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