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ORIGINAL PAPER

Complete supine percutaneous nephrolithotomy (csPCNL) in patients with and without a history of stone surgery: safety and effectiveness of csPCNL

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Abstract To determine the effects of previous stone surgery on the results of complete supine percutaneous nephrolithotomy (csPCNL), we reviewed 81 patients undergoing csPCNL at our center between March 2008 and March 2009. The principal aim in our study was whether prior renal surgery affects the outcome of PCNL. The results of the study were analyzed using SPSS 11 software. Our patients were divided to in two groups. Group 1 consisted of patients with a previous history of renal stone surgery and group 2 consisted of patients without history of renal surgery. Mean operative time in group 1 was 98.75 ± 56.31 min, and in group 2 99.71 ± 45.9 min ($p = 0.93$). Bleeding requiring transfusion occurred in four (14.2%) patients in group 1, and in eight (15.09%) patients in group 2 ($p = 0.826$). Fever was detected in no patients in group 1, and in four (7.5%) patients in group 2 ($p = 0.136$). Postoperative hematoma was seen in one (3.5%) patient in group 1 and in no patient in group 2 ($p = 0.166$). Other major complications including extravasations, sepsis, pleural effusion, pelvis perforation, and visceral organ trauma were not seen in any groups. This is the first experience of csPCNL in patients with and without a previous history of renal surgery. We found that there was no difference in results between the two groups that underwent complete supine PCNL. So csPCNL in patients with a history of stone surgery can be safe and effective. csPCNL offers the potential advantages of less patient handling, easier access to the urethra, easier possibility of changing spinal or regional anesthesia to general anesthesia if needed, better airway control and less hazard, especially for patients with compromised cardiopulmonary function, morbid obesity, or those who require a prolonged procedure and easier access to upper calyx. Its popularity is still minimal in the field of urology as a whole, because of fear of colon injury and a lack of training in this position in educational centers.

Keywords Complete supine percutaneous nephrolithotomy · Renal stone surgery · Complication · Percutaneous nephrolithotomy · Previous renal surgery

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Introduction

Urolithiasis affects 5–15% of the population worldwide [1, 2]. Recurrence rates are close to 50%, [3] and the cost of urolithiasis to individuals and society is high. Percutaneous nephrolithotomy (PCNL) has been recognized as generally acceptable for treating renal calculi both in the elderly and in the young [4–6]. In view of the fact that the minimally invasive approach of PCNL allows stone removal with less morbidity, shorter convalescence, and reduced cost compared with open techniques, PCNL has almost completely

replaced open surgical procedures for removal of large or complex renal calculi [7].

Complete supine nephrolithotomy (csPCNL) offers the potential advantages of less patient handling, the ability to perform simultaneous PCNL and ureteroscopic procedures, better drainage of Amplatz sheath, and better airway control during procedures. Higher tolerance especially in patients with pulmonary or cardiovascular disease in complete supine position was observed. If PCNL is performed with spinal or regional anesthesia initially, changing to general anesthesia would be easier, if needed [8].

Compared with other methods, such as open surgery, PCNL is cheaper and has lower morbidity and better postoperative patient comfort [9, 10], and it thus has almost replaced open intervention for treating renal calculi [11]. PCNL may entail significant complications, such as severe hemorrhage, water intoxication, arteriovenous fistula formation, perirenal hematoma, sepsis, disseminated intravascular coagulation, local infection, or damage to adjacent organs that may lead to nephrectomy [12, 13].

Scar tissue around the kidney and distortion of the anatomy of the collecting system attributable to previous open surgery may affect subsequent PCNL. A higher rate of treatment failure has been reported in patients with prior lumbotomy [14, 15]. In general, when performing operation in a patient with previous surgery, the surgeon can expect a technical challenge that may be associated with a longer operating time, higher complication rate, and, possibly, a lower success rate [7].

In our other study we noticed that the duration of step one of dilation in prone PCNL was longer in reoperated group [16]. To our knowledge, this study is the first one performed on csPCNL in patients with and without history of renal surgery, but other studies performed on the standard prone PCNL [7, 9, 16, 18, 19]. The principal question addressed in our study was, "Can also csPCNL be safely offered to patients previously operated?"

Materials and methods

We reviewed 81 patients (41 adult males and 40 adult females) undergoing PCNL at our center between March 2008 and March 2009. Inclusion criteria were stone burden more than 2 cm or more than 1.5 cm in lower calyx or stone resistance to ESWL. Demographic data and stone characteristics of two groups are shown in Table 1.

Preparation evaluation included laboratory tests, IVU (intra venous urogram), ultrasonography, and CT-scan (computed tomography scanning) if it was needed. Before PCNL, urine culture was obtained, and if positive, appropriate antibiotics were administered.

Table 1 This table shows the patient characteristics in our study

		p value
Age (year)	44.75 ± 12.29*	
Sex		
Male	41 (50.6%)	
Female	40 (49.4%)	
Stone burden (mm^2)	34.3 ± 17.2	
Side		0.87
Left	35 (43.2%)	
Right	46 (56.8%)	
History of stone surgery		0.72
Negative	53 (65.4%)	
Positive	28 (34.6%)	
PCNL	3 (10.7%)	
Pyelolithotomy	25 (89.3%)	
Associated comorbidities		0.08
HTN	12 (42.9%)	
DM	8 (28.6%)	
Pulmonary disease	3 (10.7%)	
HTN, DM, IHD	3 (10.7%)	
HTN, DM	2 (7.1%)	
Stone location		0.187
Pelvic	18 (22.2%)	
Superior calyx	4 (4.9%)	
Inferior calyx	7 (8.6%)	
Staghorn	17 (21%)	
Multiple	35 (43.2%)	

* mean ± SD

HTN Hypertension, DM Diabetes mellitus, *IHD* Ischemic heart disease

For both groups a ureteral catheter was inserted in a retrograde fashion cystoscopically to the ureteropelvic junction or just beneath the obstructive stone for the injection of saline or contrast media. Then, PCNL was performed in supine position and under general anesthesia.

All patients were placed in complete supine position without flank elevation. There was no rolled towel under the flank and there was no change in leg position. The patients in supine position were placed at the bed edge. Figure 1 shows this position.

We achieved collecting system puncture by 18-gauge needle under fluoroscopic guide. In csPCNL, the puncture site for access is the posterior axillary line, which is far from the fluoroscopy tube. Therefore, more space is availabe for the surgeon to work and he can perform the procedure from a more comfortable seated position. The patient's position on the operating table during csPCNL can be near the edge of the table, but kept a safe distance from the metal density of the work surface to minimize interference during imaging.

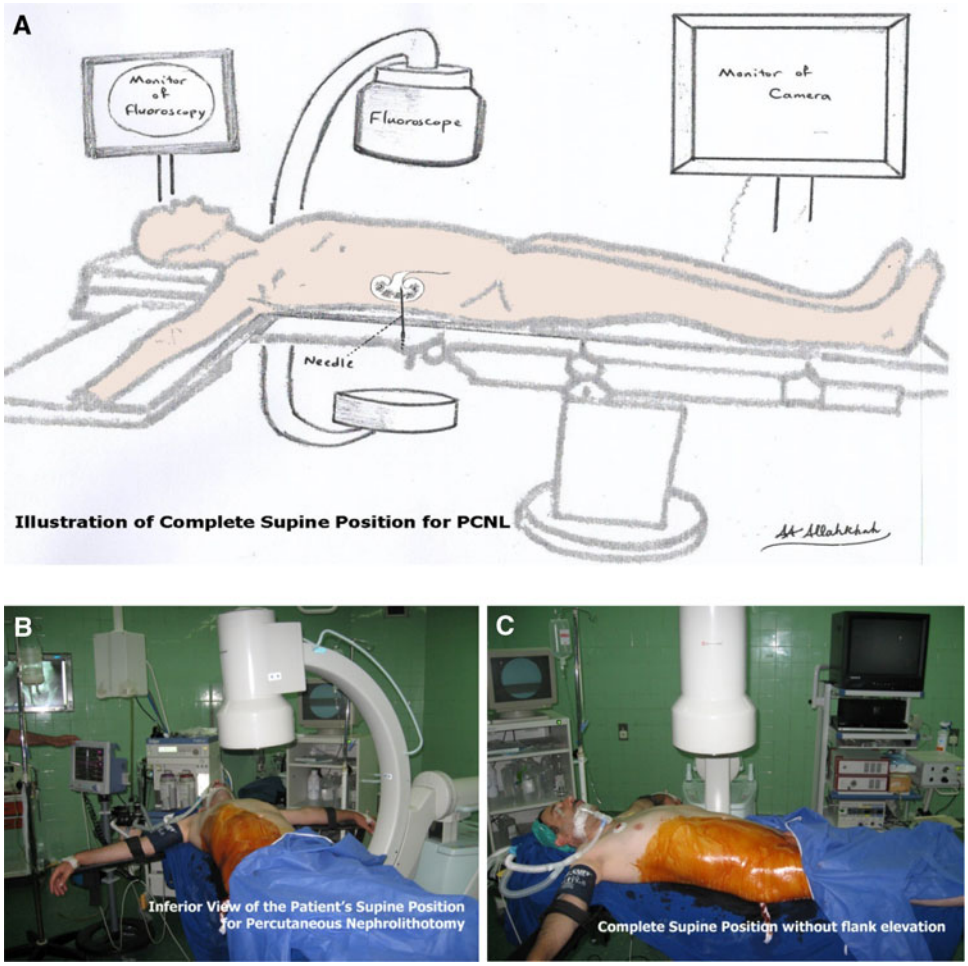

Fig. 1 The patient's complete supine position for percutaneous nephrolithotomy (csPCNL). Note that csPCNL perform in the complete supine position without any towel under the patient's flank and with no change in leg position

csPCNL was suitable for patients and our access was subcostal in all patients; also access to upper calices with subcostal approach was easy in this method [8]. The superior calyx was accessible in csPCNL with the renal displacement technique (lung inflation) subcostally while intrathoracic complications could be avoided [17].

Dilatation is performed in one-shot dilation technique. Figure 2 shows all steps of csPCNL of the left kidney during and after procedure.

csPCNL was performed in both groups without any problem. Acute dilatation had some difficulty in some cases with history of previous renal surgery. Dilatation difficulties in these cases depended on adhesions and fibrosis or previous nylon suturing.

Tract dilatation was established by acute dilatation from the skin to the collecting system. We used one-shot technique for dilatation in csPCNL with two steps: step 1 was insertion of guidewire and dilatation with 9F dilator; step 2 was dilatation with Amplatz dilator.

In patients with previous open renal surgery, the kidney was fixed because of adhesions and fibrosis, and the distance between the skin and kidney was shorter in these patients. If there were some difficulties in dilatation with 9F dilatators, we used Fasciatum to solve this problem. The remaining steps were done easily.

Small stones were directly extracted by grasper and large stones were first treated by pneumatic devices. Foley catheter and ureteral stent were removed 1–3 days after the operation. Residual stones <4 mm in size were considered to be stone free based on KUB (kidney, ureter, and bladder), and/or ultrasonography on postoperative follow-up 2 weeks after the operation. In the presence of significant perforation, ureteral obstruction, large residual stone, and active bleeding, the patient was allocated to insertion of a nephrostomy tube. Figure 2 shows steps of csPCNL during and after procedure.

Results

Patient mean age was 44.75 ± 12.29(19–75 year). Forty-one (50.6%) patients were males and 40(49.4%) were females. Renal surgery had been done in 28(34.6%)

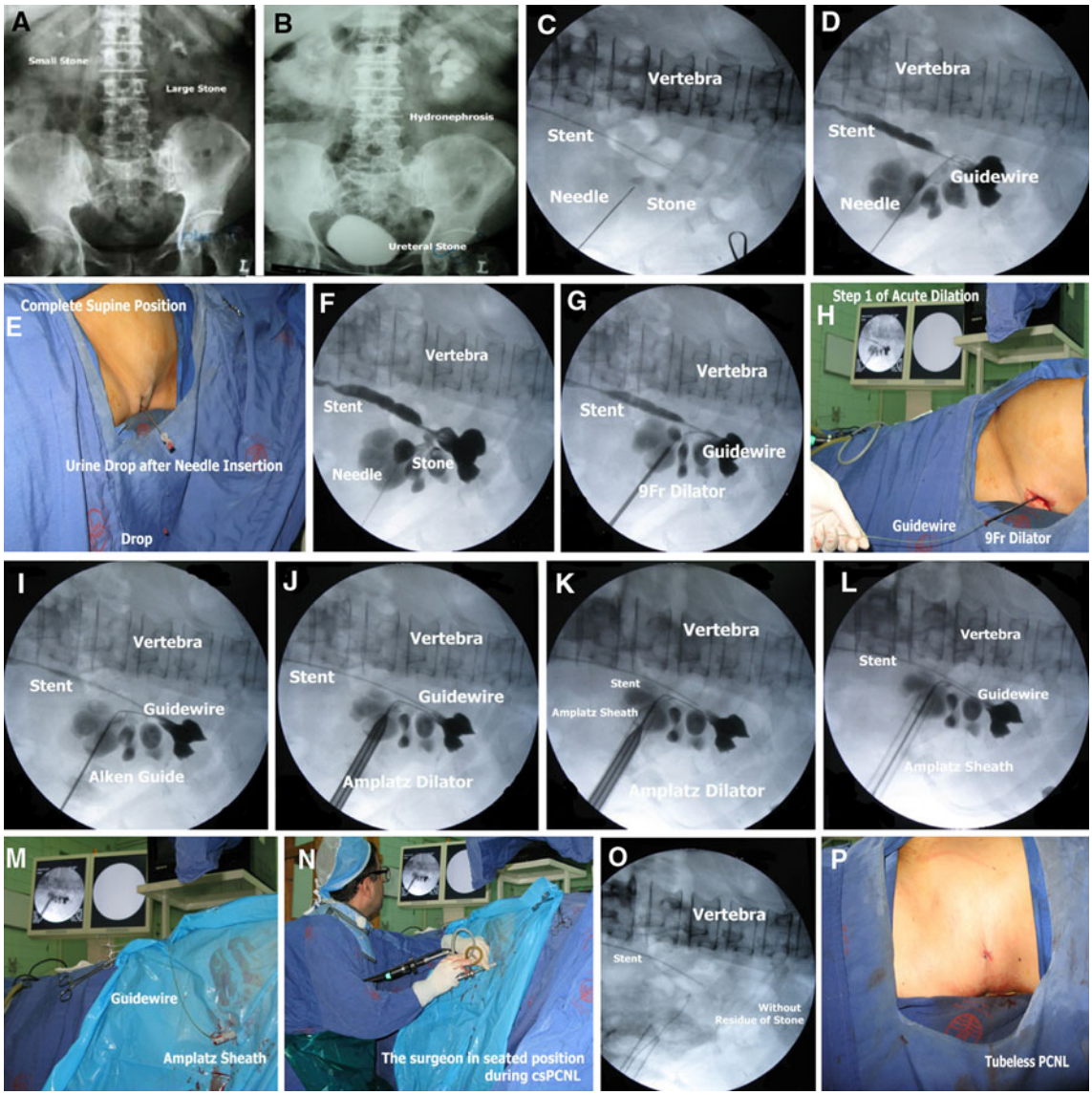

Fig. 2 These figures show steps of csPCNL of the left kidney during and after procedure. **a**, **b** large stone in the left kidney with hydronephrosis and small stone in the right kidney, **c**–**e** the needle placement, the needle entrance to the calyx and urine drop after needle entrance to the Kidney during csPCNL, **f**–**h** step-1 dilatation of one shot dilatation during csPCNL, **i** Alken guide on the fluoroscopic image, **j** step-2 dilatation of one-shot dilatation during csPCNL, **k**–**m** Amplatz sheath insertion after one-shot dilatation during csPCNL, **n** the surgeon in seated position during csPCNL, **o** is fluoroscopic view after stone removal, and **p** skin sutures at the end of the csPCNL(Tubeless PCNL)

patients (group 1). Fifty-three (65.4%) patients had no history of pervious renal surgery (group 2).

The mean stone burden was 3.39 ± 1.78 cm and 3.45 ± 1.71 cm in group 1 and 2, respectively ($p = 0.87$). Totally, the mean stone burden was 3.43 ± 1.72 cm in two groups. The maximum stone burden was 8.5 cm and the minimum size was 1 cm. Two (2.5%) patients had concomitant ureteral stone and 79(97.5%) had not concomitant ureteral stones.

The primary puncture in all patients was from posterior axillary line. Stone site in 46(56.8%) was in the right side while 35(43.2%) were left-sided. Seventy-five (92.6%) stones were radio opaque and 6(7.4%) were radiolucent. Twenty-eight (34.6%) patients had past medical history of a disease and 53(65.4%) had no history of medical disease. Twelve (42.9%) patients had hypertension, eight (28.6%) had diabetes mellitus, three (10.7%) had pulmonary disease, two (7.1%) had hypertension accompanied with diabetes mellitus and three (10.7%) had hypertension, diabetes mellitus, and ischemic heart disease. Twenty-seven (33.3%) patients had the history of ESWL (extracorporeal lithotripsy) and 54(66.7%) no history of ESWL.

Pre and post operative data in two groups are shown in Table 2. Ten (12.3%) patients in group 1 and five(50%)

Table 2 Intra and postoperative parameters in two groups of our study

	Group 1	Group 2	*p* value
Mean operative time	98.75 ± 56.31*	99.71 ± 45.9*	0.93
Stone-free rate	20 (71.4%)	39 (73.5%)	0.186
Stone burden (mm^2)	3.39 ± 1.78*	3.45 ± 1.71*	0.87
Hb after surgery	11.98 ± 1.67*	10.99 ± 1.88*	0.022
Bleeding requiring transfusion	4 (14.2%)	8 (15.09%)	0.826
Fever	0	4 (7.5%)	0.136
Postoperative hematoma	1 (3.5%)	0	0.166
Stone residue	8 (28.57%)	14 (26.4%)	0.186
Hospital stay (days)	3.6 ± 1.66*	3.96 ± 1.35*	0.304
Nephrostomy tube	1 (3.5%)	2 (3.7%)	
Tubeless PCNL	27 (96.4%)	51 (96.2%)	
Significant perforating of pelvic	0	0	
Sepsis	0	0	
Visceral adjuscent	0	0	
Organ trauma	0	0	
Pleural effusion	0	0	
Extravasation	0	0	

* mean ± SD

patients in group 2 had more than one access ($p = 0.273$). Mean operative time in group 1 was 98.75 ± 56.31 min, and in group 2 it was 99.71 ± 45.9 min. There was no statistically significant difference between two groups ($p = 0.93$). Overall mean operative time was 99.38 ± 49.39 min. maximum operative time was 240 min and minimum operative time was 30 min.

Bleeding requiring transfusion was as a complication during the operation that occurred in four (14.2%) patients in group 1, and in eight (15.09%) patients in group 2 ($p = 0.826$).

Fever (temperature more than 38°C) was detected in no patient in group 1, and in four (7.5%) patients in group 2 ($p = 0.136$). All patients were treated with suitable antipyretic and antibiotics.

Postoperative hematoma (more than 50 mm in diameter) was seen in one (3.5%) patient in group 1, and he was treated conservatively. There was no hematoma in group 2 ($p = 0.166$).

Other major complications including extravasation, sepsis, pleural effusion, pelvis perforation, and visceral organ trauma were not seen in any groups. Stone-free rate was 20(71.4%) in group 1, and 39(73.5%) in group 2 ($p = 0.186$). In group 1, stone residue was 8(28.57%), and in group 2, was 14(26.4%) patients ($p = 0.186$).

Two (3.7%) patients in group 2 and one (3.5%) patient in group 1 had nephrostomy tube. Fifty-one (96.2%) patients in group 2 and 27(96.4%) in group 1 were tubeless ($p = 0.992$).

Mean hemoglobin level after operation was 11.98 ± 1.67 mg/dl in group 1 and was 10.99 ± 1.88 mg/dl in group 2 ($p = 0022$). Hospital stay was 3.6 ± 1.66 days and 3.96 ± 1.35 days in group 1 and 2, respectively ($p = 0.304$). Overall mean hospital stay was 3.83 ± 1.47 days and the maximum hospital stay was 10 days.

Discussion

To the best of our knowledge, there is no report of csPCNL after previous renal surgery, but there are few studies specifically addressing prone PCNL. Higher failure rates of prone PCNL were reported in patients with previous surgery [14]. In another study, there were no differences in failure rates of patients with a history of lombotomy [16, 18].

Sofikerim et al. [18] 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 between two groups that were similar to our study. Operative time was reported 66–203 min in some studies [7, 18]. Mean operative time in the group with a history of previous stone surgery was 75.41 ± 17.21, and in the group without a history of surgery it was 67.42 ± 26.25 in another study ($p = 0.065$) [16].

Also in our study mean operative time was 98.75 ± 56.31 min in group 1, and in group 2 it was 99.71 ± 45.9 min ($p = 0.93$) that there was no significant difference between these two groups. Although in this study we did not assess the duration of step 1 of dilation, it seemed that it is longer in the patients with a history of renal surgery, similar to the findings of another study [16].

The major complications such as high fever rate, bleeding requiring transfusion, bowel perforation, and pleural effusion were reported in several studies [7, 9, 18]. We showed that previous surgery could affect access time, but it has no effect on the outcomes of patients.

In our study overall mean hospital stay was 3.83 ± 1.47 days (2–10 days). Mean hospital stay was 3.6 ± 1.66 days in group 1 and 3.96 ± 1.35 days in group 2 ($p = 0.304$). There was no significant difference with respect to duration of hospital stay.

Mean hospital stay was reported approximately 5 days (3–7 days) in both groups [19]. They reported the mean hospital stay as 3.7 days (1–7 days) and 3.3 days (1–16 days) in group 1 and group 2, respectively. High fever was reported in 11.0 and 9.7% of patients in group 1 and group 2, respectively, by Sofikerim et al. [18] with no significant difference between groups.

Similarly, in the study of Margel et al. [7] high fever was reported in 10% of patients, and there was no significant

difference between both groups. Also in Tugcu et al. [9] study, high fever was observed with similar rates, but there was no significant difference between both groups.

In another study, high fever was observed similarly. They reported sepsis developed as a major complication in two patients in group 1 and one patient in group 2 [9].

In our study, fever (temperature more than 38°C) was detected in no patients in group 1, and in four (7.5%) patients in group 2 ($p = 0.136$). Sofikerim et al. [18] stated that blood transfusion was required in 3.7% of patients in group 1 and 8.1% of patients in group 2.

Blood transfusion was required in 10–14% of patients in some studies [7, 9]. In our study, bleeding requiring transfusion as a complication during the operation time occurred in four (14.2%) patients in group 1, and in eight (15.09%) patients in group 2 ($p = 0.826$). There was no significant difference between these two groups. In Tugcu et al.'s [9] study, sepsis was stated as a major complication in two patients in group 1 and one patient in group 2. One patient in group 1 died due to septic shock.

Also, in the study of Margel et al. major complications were seen in 3% of patients, including one (0.05%) in group 2 with a bowel perforation and four with postoperative sepsis. Of those four patients, one died of septic shock [7]. Pleural effusion, as a major complication, was showed in one study [18]. But in our study major complications including sepsis, pleural effusion, pelvis perforation, and visceral organ trauma were not seen in any groups.

Basiri and associates compared 65 patients who underwent PCNL after an open stone procedure with 117 having primary PCNL and found no difference between the groups in the overall stone-free rate [19]. Another author reported that the stone-free rates were 80.3 and 82.6% in groups I and II, respectively. [21] Their results are similar to our study results and we found no significant difference between two groups. Margel et al. [7] reported that the stone-free rate was similar in the two groups, and the overall stone-free rate was 95%. Another study reported that the stone-free rates were 81.5% in group 1 and 79% in group 2, respectively, with no significant difference [18].

In Tagcu et al.'s [9] study the groups did not differ significantly in terms of the initial stone-free rate (94 vs. 92%). In our study we showed the stone-free rate was not significantly different between both groups ($p = 0.186$). It was 20(71.4%) in group 1, and 39(73.5%) in group 2, respectively. We used pneumatic lithotripter for lithotripsy in all patients. Although we did not collect the stone analysis in this study, we believe it had no effect on our results.

We found that the overall stone-free rate and morbidity of csPCNL were not affected by prior surgery on the same kidney. Efficacy and success rate of csPCNL, and complications such as bleeding and sepsis rate, were similar to other patients. Results of our study were similar to that of other studies in the standard prone PCNL [7, 9, 16, 18, 19, 21].

Conclusion

Our study is the first report of csPCNL in patients with and without a history of renal surgery. We found that complete supine PCNL even in patients with a history of renal surgery is safe and effective. A larger and prospective randomized controlled trial would be required to validate the results of this study.

Although supine PCNL has numerous advantages and is routinely used in some surgical centers throughout the world, its popularity is still minimal in the field of urology as a whole. This general lack of acceptance most likely stems from fear of colonic injury during this procedure and a lack of training in this position in educational centers [20].

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