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Original Article

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Supine Percutaneous Nephrolithotomy: Our Experience

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Abstract

Background: *Treatment of renal stone is a common practice in urology. A total of four minimally invasive therapy options, including ESWL (Extracorporeal shock wave lithotripsy), PCNL (Percutaneous nephrolithotomy), RIRS (retrograde intrarenal stone surgery), and LSS (laparoscopic stone surgery), are now available for the treatment of kidney stones. PCNL is the gold standard for large renal stones. The prone position for doing PCNL is the standard of teaching and used by most of the urologists. Supine positioning for PCNL is also another well-established method but urologists do not frequently use it due to unfamiliarity with the positioning and puncturing technique under fluoroscopic guidance. The objective of the current study was to evaluate the safety and effectiveness of supine PCNL for the treatment of big renal stones and paying close attention to the complications.*

Methods: *This study was a prospective cross sectional study which was conducted at the department of Urology in Mugda Medical College Hospital & some private hospital in Dhaka. The study was conducted during the period of January 2020- December 2021. The total sample size for this study was 84.*

Result: *The mean age of the patients was 39.7 ±15. Most of the patients 48(57.1%) were male and 36(42.9%) were female. Mean BMI, kg/m^2 was 25.2 ±6.9 and mean Stone burden (mm) was 29.9 ±10.9. Most of the stone 44(52%) were on right side and 40(48%) were on left side. Radio-opaque was seen in 58(69%) cases, Radiolucent in 17(20.2%) and mixed in 9(10.7%) cases. Mean time for initial puncture was 12.24±5.19, mean intraoperative period (in minutes) was 52.42 ±10.28, mean haemoglobin drop (gm/dl) was 0.91 ±0.51, mean duration of hospital stay (post-operative in days) was 3.2 ±1.7, auxiliary procedure were required in 4 cases. The stone free rate was 80(95.2%).*

Conclusion: *Supine PCNL can be used to treat all stone sizes and is technically viable. It also has a number of potential benefits, particularly for individuals who are obese and at high risk when under anaesthesia or where simultaneous use of ureterorenoscopy (URS) is needed.*

Keywords: Renal Stone, Supine, Percutaneous Nephrolithotomy, PCNL, Nephrostomy, Prone.

Introduction

Treatment of renal stone is a common practice in urology. Percutaneous nephrolithotomy (PCNL) is now the gold standard[1] for renal stone disease, especially for stones larger than 2 cm and it is considered that about 70% of the patients were treated with PCNL in prone position and 30% in supine. The prone position for doing PCNL is the standard of

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teaching and used by most of the urologists as it is the standard of care and most recommended minimal invasive procedure. It is considered that the posterior approach offers a large working space with a decreased incidence of splanchnic and vascular injuries for puncturing and dilatation of the kidney during PCNL with the patient in the prone position for renal stone disease.[2,3] Supine positioning for PCNL is also another well-established method but urologists do not frequently use it due to unfamiliarity with the positioning and puncturing technique under fluoroscopic guidance. With the potential benefits of less patient handling, a speedier procedure, improved drainage through the Amplatz sheath, and the opportunity to do PCNL and ureteroscopic operations simultaneously, the complete supine PCNL is an alluring alternative to the prone PCNL.[4,5] The prone position is associated with patient discomfort, a compromised circulation and ventilation, especially in obese patients, and it is also time-consuming and poses more radiological risks to the urologist.[3] Despite the rarity of severe anesthesia-related issues being documented with the patients prone, the supine position is more comfortable for the anesthetist, for the surgeon and for the patients particularly in cases of obese patients who are at high risk for difficulties during anesthesia.[4] The objective of the current study was to evaluate the safety and effectiveness of supine PCNL for the treatment of big renal stones and paying close attention to the complications.

Materials and methodology

This study was a prospective cross sectional study which was conducted at the department of Urology in Mugda Medical College Hospital & some private hospital in Dhaka. The study was conducted during the period of January 2020- December 2021. The total sample size for this study was 84. Patients with renal stone (upper, middle, or lower calyceal), pelvic stone, pelvic stone extending in upper ureter larger than 2 cm in diameter, single, numerous, or staghorn calculi, sterile urine and above the age of 18 who visited the urology department either male or female were included in the study population. Children, patients with infected urine, pregnant women, people with uncontrolled bleeding disorders, and upper calyceal stone requiring upper calyceal puncture and patients with renal fusion anomaly were all excluded from this study. All patients were evaluated by history-taking, physical examination, and investigation process. Standard pre-procedure investigation was done including complete blood count, renal function test, coagulation profile, ultrasonography (USG) of the urinary system, urine routine examination and culture. All patients were evaluated by intravenous urogram (IVU) or Computed Tomography (CT) scan of the urinary tract to evaluate the stone location, stone burden and radiolucency. Each patient was assessed prior to surgery, and the size, number, and pelvicalyceal dilatation were noted. All patients with urinary tract infections received treatment in accordance with culture and sensitivity. Under spinal anesthesia Galdakao-Modified Supine Valdivia (GMSV) position was used for the procedure [Figure 1]. The procedure was started with the placement of the ureteric catheter in the target kidney to get a pyelogram (RGP). For the puncture C-arm image in a single plane was used in most of the cases but in some cases C-arm rotated 30^0 cranial end for appropriate puncture of the targeted calyx (depth perception). Puncture point was marked in standing or sitting position which was beyond the posterior auxiliary line between 12^{th} rib and iliac crest. After getting access of pelvicalyceal system (PCS), guide wire and guide rod were placed. Serial dilation of the tract by metal dilator was done (24-30Fr) depending on the required size. Amplatz sheath placed accordingly. A standard nephroscope of sizes 22/24 Fr was used for visualization of pelvicalyceal system and identification of stone. Pneumatic lithotriptor was used for stone fragmentation. After fragmentation of stone, stone clearance was assessed by fluoroscopic images and nephroscopic visualization. Placement of Double J (DJ) stent and nephrostomy tube were done in all cases. Hemodynamic changes and need for transfusion were evaluated and recorded during the past 24 hours after surgery. Nephrostomy tube removed 24 hours after surgery. On the tenth post-operative day, patients were scheduled for a follow up with a plain film of the kidney, ureter and bladder (KUB) or CT of the KUB to asses stone clearance. Double J (DJ) stent removed after 4 weeks. Perioperative complications were classified according to the modified Clavien grading system [7]: Grade 1, any deviation from the normal postoperative course but with no need for pharmacological, surgical, endoscopic, or radiological intervention; Grade 2, complications requiring pharmacological treatments or blood transfusions; Grade 3, complications requiring surgical, endoscopic, or radiological intervention with no (grade 3a) or with (grade 3b) general anaesthesia; Grade 4, life-threatening complications requiring a stay in an intensive care unit (grade 4a, single organ; grade 4b, multi-organ dysfunction); Grade 5, death.

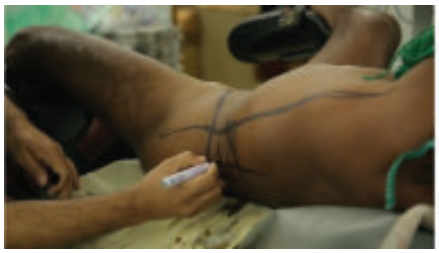

Figure 1: *The patient position and puncture site marked*

Figure 2: *Supine puncturing in progress*

Figure 3: *Supine PCNL in progress*

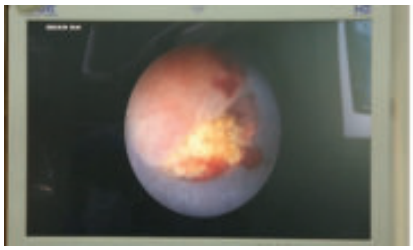

Figure 4: *Stone viewing in renal pelvis*

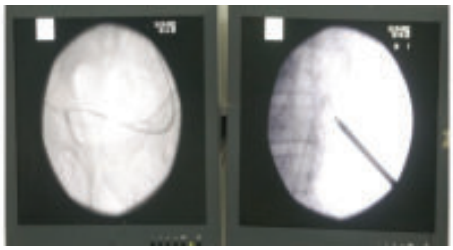

Figure 5: *Post procedure fluoroscopic image*

Figure 6: *Nephrostomy tube placed*

RESULT

Table I: *Demographic Characteristics of the Study Patients*

Characteristics	N	Percentage
Age (years), Mean ±SD (Range)	39.7 ±15	(18-65)
Male	48	57.1
Female	36	42.9
BMI, kg/m^2 (Mean ±SD)	25.2 ±6.9	
Stone burden (mm), Mean±SD	29.9 ±10.9	

Table I shows the demographic characteristics of the study patients. The mean age of the patients was 39.7 ±15. Most of the patients 48(57.1%) were male and 36(42.9%) were female. Mean BMI, kg/m^2 was 25.2 ±6.9 and mean Stone burden (mm) was 29.9 ±10.9.

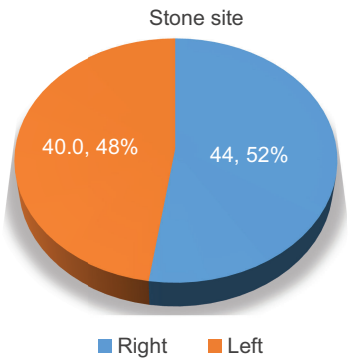

Figure I: *Stone Site*

Figure I shows the stone site of the patients. Most of the stone 44(52%) were on right side and 40(48%) were on left side.

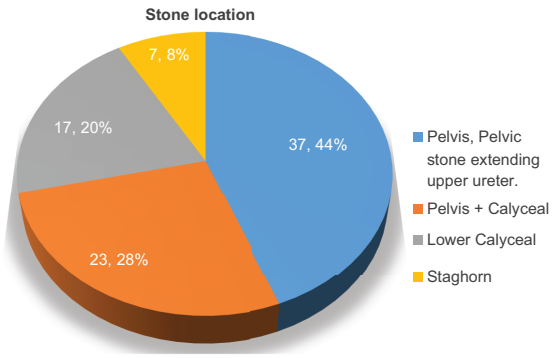

Figure II: Stone Location Figure II shows the stone location among the study patients. Majority of the stone were located on pelvis and pelvic stone extending upper ureter, 23(28%) were pelvis+calyceal, 17(21%) were Lower calyceal and 7 were staghorn stones.

Table II: *Stone Radiolucency*

Stone radiolucency	N	Percentage (%)
Radio-opaque	58	69.0
Radiolucent	17	20.2
Mixed	9	10.7

Table II shows the stone radiolucency. Radio-opaque was seen in 58(69%) cases, Radiolucent in 17(20.2%) and mixed in 9(10.7%) cases.

Table III: *Surgical Outcome of the Study Patients*

Surgical outcome		Value
Time for initial puncture, (mean±SD)	12.24±5.19	
Mean Intraoperative period (In minutes), (mean±SD)	52.42 ±10.28	
Access	Single	79(94%)
	Multiple	5(6%)
Stone-free rate, n(%)	80(95.2%)	
Auxiliary Procedure	2nd PCNL	2(2.4%)
	ESWL	2(2.4%)
	DJ Stenting + ESWL	1(1.2%)
Requirement of blood transfusion n(%)	8(9.5%)	
Angio embolization	1(1.2%)	
Organ injury(colon,liver,spleen,pleura)	0	
Complications (N=22)	Grade 1	3(3.2%)
	Grade 2	14(17%)
	Grade 3	5(6%)
Mean Duration of hospital stay (Post-operative in days), (mean±SD)	3.2 ±1.7	

Table IV shows the surgical outcome of the study patients. Mean time for initial puncture was 12.24±5.19, mean intraoperative period (in minutes) was 52.42 ±10.28. The stone free rate was 80(95.2%). Blood transfusion were needed in 8(9.5%) cases. Angio embolization needed in 1 case. 22 patients had complications; 3 (3.2%, grade 1) of them had persistent urine leaks for more than 24 hours following nephrostomy removal, and they were treated conservatively. Grade 2 problems affected 14 patients (17%), of which 6 had a fever of more than 38°C and were treated with antibiotics and antipyretics. 5 patients (6% grade 3) patients required an auxiliary endoscopic procedure 2 patients needed 2nd PCNL, 2 ESWL and one patients needed Double J stent insertion and ESWL. No organ damage or fistula occurred. Mean duration of hospital stay (post-operative in days) was 3.2 ±1.7.

Discussion

Around the world, PCNL is regarded as a superior therapeutic option for big renal stones, including staghorn stones. PCNL is usually done in prone position but due to some disadvantages supine position PCNL tried and found safe and effective. Compared to open kidney surgery, it is less invasive, more effective, safe, and has a lower rate of complications.[8] Valdivia et al.[9] In their study, reported on the viability of PCNL in patients who were supine. In addition, in 1998, these authors discussed their prior 10-year experience with PCNL in patients who were supine.[4] The findings supported the findings of some earlier studies that evaluated the effectiveness and safety of supine PCNL for the treatment of patients with renal stones.[9-14] However the supine position offers many advantages. Anesthesia is safer, doesn't involve moving the patient, and makes the surgeon's job easier and can operate the patient in sitting position. Because the surgeon's hands are no longer in the fluoroscopic field and stone pieces are quickly cleared, the total amount of X-ray exposure to the surgeon during the surgery is reduced. In the current study, 84 patients had PCNL; the mean ±SD of BMI was 25.2 ±6.9 kg/m2, indicating that the majority of the study's participants were overweight. Mean Intraoperative period was 52.42 ±10.28 minutes. Valdivia et al.[4] and Falahatkar et al.[12] reported mean operating times of 85 and 98 minutes, respectively. A mean (range) operating time was 123(50-245) minutes reported by Hoznek et al.[10] While it is nearly hard to puncture the upper calyces with the patient supine, staghorn stones were manageable with supine PCNL. The mean ±SD stone burden for the patients with 7 staghorn stones included in the current study was 29.9 ±10.9 mm. In the study of Hoznek et al.[10] seven patients (14% of the total) had a staghorn stone. In their investigation, Falahatkar et al.[12] included 11 individuals (9%) who had a staghorn stone. 95.2% of the patients in the current study had their stones removed, which was a higher rate than that attained by Hoznek et al.[10] and Falahatkar et al.[12] who reported stone clearance rates was 81% and 77.5%, respectively. This might be as a result of the present study's stone burden being lower

than that of the previous two studies. According to Shoma et al.[13], 89% stone clearance rate was found in their investigation of 53 patients. De Sio et al.[14] found that stone clearance rate was 88.7% in their investigation of 39 renal patients, providing a similar conclusion. PCNL has some restrictions when the patient is supine. It makes the collecting system continually compressed and less filled, making nephroscopy more challenging. To reduce fluid absorption, it might be crucial to keep the pressures in the renal cavities low. Because the upper pole is extensively buried within the rib cage and lies more medially and posteriorly, upper-pole calyceal puncture is very difficult. Additionally, supine renal puncture required the needle-pass to be horizontal, which means that an upper calyceal puncture will strike into the calyceal neck rather than the infundibulum. The technique was made more challenging by anteromedial renal displacement during tract dilatation, which was handled by supporting the kidney as the tract was made. Four patients in the current cohort had staghorn stones, despite having very low stone burdens; all but two had no large remaining pieces, and three required several renal punctures, which were straightforward to perform. In our opinion, these findings point to the viability of supine PCNL for staghorn stones in carefully chosen individuals. According to a recent review of the development of PCNL positions over the last 35 years, there is no ideal position for PCNL, and urologists who perform PCNL should be aware of the differences in the positions and be able to use the method appropriate for each patient, evaluating their safety, advantages, and limitations.[15] The present study has a number of limitations, including a small sample size and a modest stone load even among individuals with staghorn stones. This study was not randomized and was a descriptive study without a comparative arm.

Conclusion

Supine PCNL can be used to treat all stone sizes and is technically viable. It also has a number of potential benefits, particularly for individuals who are obese and high risk when under anesthesia or where simultaneous use of ureterorenoscopy (URS) is needed. It has a high percentage of stone-free patients, a lower morbidity rate, a quicker recovery time, and an earlier return to work. By carefully selecting a single nephrostomy tract, it is possible to eliminate stones while minimizing problems. Utilizing this method does not appear to carry any additional risks, and both the stone clearance and complication rates are within the acceptable ranges previously mentioned for the conventional prone PCNL.

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