MJMR, Vol. 35, No. 3, 2024, pages (75-81)

Open Access
ISSN: 2682-4558

Research Article

Safety and Efficacy of Mini percutaneous nephrolithotripsy in supine position versus prone position for treatment of pediatric renal stones, a prospective randomised study

Mostafa Magdi Abdel Ghani[1], Ahmed Esmat Abd El-Maksoud[1], Mohamed Salah Eldin M. Elbadry[1] and Ahmed Hakim Abd-elgawad[1],

[1] Department of Urology, Faculty of Medicine, Minia University

DOI: 10.21608/mjmr.2024.309167.1767

Abstract

Background: PCNL has been established as a gold standard minimally invasive procedure for treatment of paediatric nephrolithiasis more than 20 mm. The aim of our study to compare the safety and efficacy of mini-percutaneous nephrolithotomy with laser lithotripsy in supine position vs prone position in treatment of paediatric renal stones. **Patient and methods:** At our outpatient clinic of Urology department at Minia university, Nephrology and Urology hospital ,There were 60 children attended , diagnosed as renal stone disease, fulfilled our criteria and included to our thesis .Patients were randomized by single blind technique into two groups: (Group 1) underwent mini PCNL in supine position (30) and (Group 2) underwent mini PCNL in prone position (30) .All patients were evaluated 1 month postoperatively by: plain X-ray KUB or CT KUB (if radiolucent stones) for assessment of stone clearance. **Results:** There were no statistically significant differences in access time, number of punctures, or stent type between the two groups. However, positioning time was significantly shorter for the supine group compared to the prone group. Additionally, the supine group had notably shorter operative and fluoroscopy times than the prone group. **Conclusion:** Both mini PCNL in supine and prone positions are safe and effective in treatment of paediatric renal stones However, supine position relatively shorter operative time and fluoroscopy consumption.

Key words: PCNL (percutaneous nephrolithotomy), supine position, prone position

Introduction

The prone position has traditionally been used for percutaneous nephrolithotomy (PCNL) because of the wide surgical field, easy access through a distended pyelocaliceal system, and the surgeon's experience with the technique[2]. However, a supine approach has been developed for adults and has proven to be safer in terms of tube displacement or cervical trauma[3], more physiologic for ventilation during surgery, and more reproducible for the surgeon[4]. This is particularly relevant for children. The original description of spine PCNL was given by Valdivia et al., [3]. In 2015, Gamal was the first to describe it in a pediatric population.[5] Both the prone and supine PCNL methods achieve the same stone free rate (SFR).

We were motivated to conduct supine PCNL in a pediatric population to assess the technique's safety and effectiveness among pediatric group patients.

Patients and methods

Study Design:

Between September 2023 and March 2024, researchers at the Urology department of Nephrology and Urology Minia University Hospital conducted a prospective randomized comparative study to compare the efficacy of Mini-Percutaneous Nephrolithotomy with laser lithotripsy in the supine position versus the prone position for the treatment of pediatric renal stones.

The ethical committee registered the trial, evaluated it, and gave their approval; all patients gave written informed permission.

Study population:
All children diagnosed with renal stones attending at our outpatient clinic of Urology department at Minia university, Nephrology and Urology hospital.
At our outpatient clinic 120 child attended, diagnosed as renal stone disease only 60 patients fulfilled our criteria an included to our thesis

Inclusion criteria:
We included in this study All patients less than 16 years old of both sex who had a solitary renal pelvic stone or lower calyceal stones with stone size ranged from 10mm up to 25mm indicated for Mini-Percutaneous Nephrolithotomy. We excluded Patients who had renal anomalies such as Horse shoe kidney, Ectopic pelvic kidney and crossed fused renal ectoptia as well as; Patients with active urinary tract, medically diseased kidney and Patients with uncontrolled coagulation disorder.

Study groups
The patients were randomized into two groups:
(**Group I**) underwent Mini-Percutaneous Nephrolithotomy in supine position (30)
(**Group II**) underwent Mini-Percutaneous Nephrolithotomy in prone position (30)

Methodology:
All patients were evaluated to complete the diagnosis of renal stones, evaluation of previous line of management if present, confirm indication for surgery and fitness for surgical procedure, where patients selected for operative procedure were counseled and written consent was obtained for the surgical procedure, then admitted patients were assigned to certain hospital admission number.

All patients were evaluated pre operatively as follows: -
The evaluation begins with a thorough medical history, focusing on upper urinary tract symptoms and any previous medical treatments if applicable. The surgical history is reviewed to determine whether prior interventions were open or endoscopic. The physical examination includes a general assessment, abdominal examination, and genital examination. Laboratory investigations are conducted, including urine analysis, complete blood count (CBC), renal function tests (serum creatinine and serum urea), and a coagulation profile (prothrombin concentration and INR). Imaging studies are also performed, encompassing a pelvic-abdominal ultrasound, plain X-ray of the kidneys, ureters, and bladder (K.U.B.), computed tomography of the kidneys, ureters, and bladder (CT KUB), and intravenous urography (IVU).

Surgical technique:
Group I: mini-percutaneous nephrolithotomy (PCNL) with in supine position.
Preoperative:
A single dose of broad-spectrum parenteral prophylaxis antibiotic was administered to all patients one hour prior to surgery.

Anesthesia: General anesthesia.

Surgical procedure:
The patient was put into the lithotomy position after being given general endotracheal anesthesia with a muscle relaxant. A 4 or 5 Fr open tip ureteric catheter was advanced to the renal pelvis under fluoroscopic guidance using a pediatric semi-rigid ureteroscope (URS). An infusion set containing iodinated non-ionic contrast material was attached to this catheter, which was in turn coupled to a 6, 8, or 10 Fr urethral catheter. By lifting the flanks and stabilizing using bolsters, patients randomized to the 'Flank-Free' Modified Supine position were able to attain an intermediate supine-lateral posture tilted 15 degrees. The right leg was bent at the knee and extended, the left leg was bent at the hip and abducted; the right arm was crossed across the chest and tucked under the body. Injecting contrast material via the ureteric catheter allowed visualization of the collecting system following routine

wrapping and disinfection. Through the use of an oblique C-arm view and fluoroscopic guidance, an 18-gauge Chiba needle was inserted into the target calyx. By the time the needle moved in tandem with the patient's breathing, it was clear that it had lodged itself in the kidney. After that, the C-arm was turned so that it was facing vertically, and the needle was advanced until urine could be seen. A needle was used to insert a very rigid 0.035 Fr guide wire, which was then maneuvered to the ureter or upper calyx. If necessary, the wire was allowed to coil in the collecting system. Under fluoroscopy, a lengthy hemostat was used to puncture and split the lumbo-dorsal fascia. Surgeons would continuously apply pressure as they advanced the central Alken dilator over the guide wire, followed by a metallic dilator with 16 Fr or 14 Fr openings. The last dilator was passed over by the metal sheath. In order to see and find the stone, an 8 Fr semi-rigid nephroscope was passed through the sheath. Subsequently, a high-power Ho laser with a 365-μm fiber was used to dissolve it. Following the successful removal of all stones and completion of the treatment, ureteral catheters were retained in 8 cases and DJ stents were implanted in 22 cases. Any big fragments were carefully removed using the nephroscope.

Group II: Mini-Percutaneous nephrolithotomy (PCNL) with in prone position.

Surgical procedure:

The patient was put in the lithotomic position after general anesthesia was inducted with an endotracheal tube, and a retrograde ureteric catheterization was then done. To avoid major injury, this maneuver must be performed when the patient is in the prone position, as all preceding procedures were. To prevent decubitus injuries, lay protective pads beneath the chest, shoulders, and arms. To fix the kidney and decrease the potential of pleural damage, position a pillow under the abdomen.

Before achieving the percutaneous axis under the supervision of C-arm fluoroscopy, the surface was marked to highlight the lower rib edge, posterior axillary line, and iliac crest.

Following the identical procedures as group I, a needle was guided into the target calyx using fluoroscopic imaging and a functional channel was created using metallic dilators. In order to visualize the collecting system and localize the stone, the 8 fr semi-rigid nephroscope was introduced to it through a sheath. after which the stone will be broken down by use of laser lithotripsy.

Twenty instances required the insertion of a DJ stent after stone removal, whereas ten cases required the retention of a ureteral catheter. then go to group I for post-operative follow-up.

Multiple important measures were used to compare the two groups. The amount of time that each group spent under fluoroscopy was documented. From inserting the cystoscope until fastening the nephrostomy to the skin, the entire duration of the surgery was recorded. After the operation, the first day after the procedure, the hemodynamic alterations and the need for packed red blood cell transfusions were evaluated. Complications were categorized using the Modified Clavien Grading System, and stone clearance rates were assessed [1].

All patients will be assessed during post-operative period as follows: All 24 hours following the operation, patients underwent a complete blood count (CBC) and serum creatinine (S cr) evaluation, and 48 hours after the procedure, a plain X-ray was taken. The percutaneous nephrostomy (PCN) tube is removed after 48 hours of monitoring if the patient does not have any immediate post-procedure problems. Within three to five days after the treatment, the ureteral catheter was withdrawn, and the double J stents were removed within three to four weeks. If patients had radiolucent stones, they were assessed for stone clearance one month after surgery with a computed tomography (CT) KUB scan; otherwise, they were evaluated with a plain X-ray of the kidneys, ureters, and bladder (KUB). Several patients experienced UTIs, which were cautiously treated with antibiotics according to culture and sensitivity findings. A significance level of $P < 0.05$ will be used to conduct statistical analysis in SPSS version 16, which will include the following tests: paired T-Test, independent T-Test, Wilcoxon signed ranks test, and Mann-Whitney test.

Results

Intra-operative data:

In the context of intraoperative comparisons between the two groups, there were no statistically significant differences observed in access time (minutes), number of punctures, and type of stent ($p > 0.05$).

However, a significant distinction was evident in Time for positioning ($p < 0.05$), where the mean time for positioning was markedly shorter among patients of group I (supine group) (5.7±1.4 minutes) compared to those of group II (prone group) (9.6±2.3 minutes).

Furthermore, a statistically significant difference was found in operative time (minutes) ($p < 0.05$). The mean operative time and fluoroscopy time were notably shorter in group I (supine group) (65.2±9.6 minutes and 3.9±1.2 minutes, respectively) compared to group II (prone group) (82.6±10 minutes and 5.4±5.6 minutes, respectively) as in table (1).

Table (1): comparison of intraoperative data according to PCNL position either supine or prone

	Group I (Supine group) (N=30)	Group II (Prone group) (N=30)	p value
Access time (min) Mean ±SD (Range)	 11.2±3.5 5-19	 10.5±3.1 5-19	0.44
Operative time (min) Mean ±SD (Range)	 65.2±9.6 55-85	 82.6±10 65-99	0.000 *
Number of punctures 1 >1	 30(100%) 0(0%)	 30(100%) 0(0%)	___
Fluoroscopy time (min) Mean ±SD (Range)	 3.9±1.2 1-5	 5.4±5.6 2-6.5	0.023*
Time for positioning Mean ±SD (Range)	 5.7±1.4 4-9	 9.6±2.3 4-14	<0.001*
Stent DJ Ureteric	 22(73.3%) 8(26.7%)	 20(66.7%) 10(33.3%)	0.57

_* significant at p value <0.05

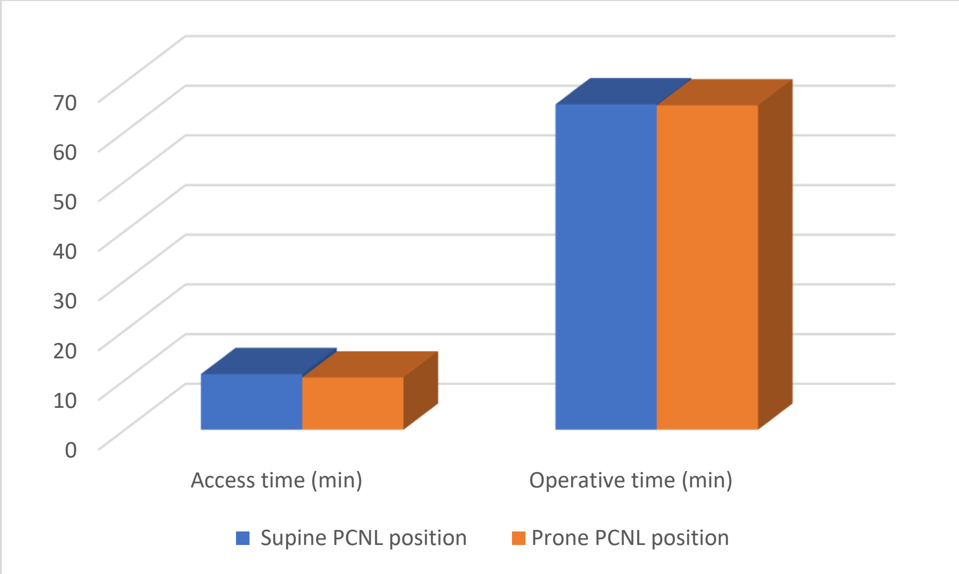

Fig (1) comparison of access time and operative time between studied groups

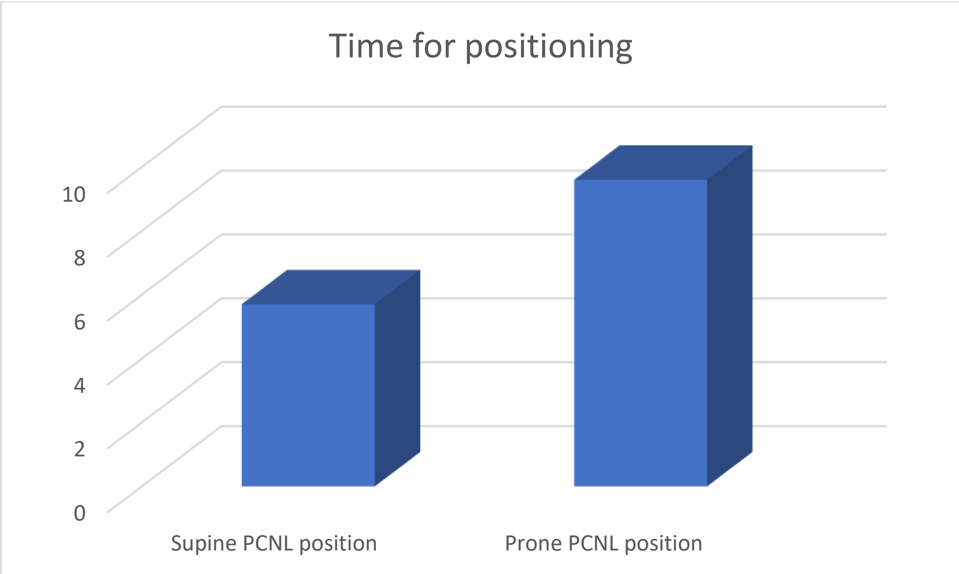

Fig (2) comparison of time for positioning between studied groups

Discussion

PCNL has been established as a gold standard minimally invasive procedure for treatment of pediatric nephrolithiasis more than 20 mm [2].

The first publication of supine PCNL in pediatrics was through the report of Clinical Research Office of the Endourological Society (CROES), where 12% of included pediatric patients were performed in supine position[3]. Prone position gained its popularity as it provides a wider surface area, a more distended Pelvicalyceal system, and easier identification of renal anatomy which led to easier puncture[4]. However, it can have some disadvantages too. It requires changing of position after ureteral catheter fixation. Also, it has its drawbacks for anesthesia, especially in patients with cardiac and pulmonary diseases or those who are obese [5].

On the other hand, the supine position is easier for ventilation and carries a lower risk for anesthesia, which is relevant especially in children[6]. In addition, there is no need for repositioning, and it allows simultaneous use of uretero-scopy, which can be helpful in management of complex stones. However, it has some drawbacks like limiting the surface area for puncture that can increase the risk of trauma to intrarenal vessels [7].

Regarding the comparison of intra-operative data between both groups, the results were non-statistically significant regarding access time (min), number of puncture and type of stent (p value >0.05).

We reported in our thesis that there is statistically significant difference between both groups regarding time for positioning (p value <0.05) as mean time for position was significantly lower among cases who underwent supine PCNL position (5.7±1.4) than in cases who underwent prone PCNL position (9.6±2.3).

A single access from the lower pole of the kidney was used by the majority of patients undergoing supine and prone PCNL in this study. Thanks to this opening, we were able to clean the stones in the lower pole and readily access the stones in the higher pole.

Desoky et al., (2022) and Jamil, Shaheen, and Farooq (2022) discovered that the operation time was significantly shorter in the supine position when treating kidney stones in pediatric patients compared to prone methods. On the other hand,

According to our thesis, the average operating time for the supine group (65.2±9.6) was noticeably lower than for the prone group (82.6±10). This variation arises from the fact that stone extraction is more manageable in the supine position, because to the suction effect, and because moving the patient is more time-consuming in prone PNL. An benefit of supine PNL was observed in the meta-analysis study of Yuan, D., et al., 2016.[10]: an average operation duration of 18 minutes, which was shown to be statistically significant.

A prospective randomized trial by De Sio, M., et al., European urology, 2008, also verified these results. According to research conducted by Tokatlı, Z., et al., (2015), the operating time for supine m-PNL was 55 minutes, while for prone m-PNL it was 82 minutes. Our research found that prone m-PNL took an average of 18 minutes longer than supine m-PNL.

According to[13] Ramez, M., E.A. Desoky, and A.R. EL-Nahas (2024), the supine posture significantly reduces operation time compared to the prone one. These findings are in line with those of a meta-analysis that compared the two positions in adults and found that the prone position required more time during surgery[10].

The fluoroscopy time in our study was 3.9±1.2 minutes for the supine group and 5.4±5.6 minutes for the prone group, which is similar to the findings in the studies by Ramez, M., E.A. Desoky, and A.R. EL-Nahas (2024) and Erbin, A., et al., (2019).

References

1. Singh, A.K., et al., Using the Modified Clavien Grading System to Classify Complications of Percutaneous Nephrolithotomy. Curr Urol, 2018. **11**(2): p. 79-84.
2. Lao, M., et al., High recurrence rate at 5-year followup in children after upper urinary tract stone surgery. The Journal of urology, 2014. **191**(2): p. 440-444.
3. Guven, S., et al., Percutaneous nephrolithotomy in children in different age groups: data from the Clinical Research Office of the Endourological Society (CROES) Percutaneous Nephrolithotomy Global Study. BJU international, 2013. **111**(1).
4. Doğan, H.S., et al., Percutaneous nephrolithotomy in children: Does age matter? 2011.
5. de la Rosette, J.J., et al., Beyond prone position in percutaneous nephrolithotomy: a comprehensive review. European urology, 2008. **54**(6): p. 1262-1269.
6. Erbin, A., et al., Comparison of supine and prone miniaturized percutaneous nephrolithotomy in the treatment of

lower pole, middle pole and renal pelvic stones: A matched pair analysis. International braz j urol, 2019. **45**: p. 956-964.
7. Steele, D. and V. Marshall, Percutaneous nephrolithotomy in the supine position: a neglected approach? Journal of endourology, 2007. **21**(12): p. 1433-1438.
8. Desoky, E.A., et al., Ultra-mini-percutaneous nephrolithotomy in flank-free modified supine position vs prone position in treatment of pediatric renal pelvic and lower caliceal stones. Journal of endourology, 2022. **36**(5): p. 610-614.
9. Jamil, M.N., R. Shaheen, and U. Farooq, Comparison Between Supine Position Versus Prone Position In Percutaneous Nephrolithotomy: A Single Centered Analysis Of 623 Cases. Journal of Ayub Medical College Abbottabad-Pakistan,2022.34
10. Yuan, D., et al., Supine versus prone position in percutaneous nephrolithotomy for kidney calculi: a meta-analysis. Journal of endourology, 2016. **30**(7): p. 754-763.
11. De Sio, M., et al., Modified supine versus prone position in percutaneous nephrolithotomy for renal stones treatable with a single percutaneous access: a prospective randomized trial. european urology, 2008. **54**(1): p. 196-203.
12. Tokatlı, Z., et al., Supine or prone position for mini-PNL procedure: does it matter. Urolithiasis, 2015. **43**: p. 261-264.
13. Ramez, M., E.A. Desoky, and A.R. EL-Nahas, Supine versus prone pediatric percutaneous nephrolithotomy: A systematic review and meta-analysis. Arab Journal of Urology, 2024: p. 1-8.