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ORIGINAL ARTICLE

Prone Versus Flank-Free Modified Supine Position Mini Percutaneous Nephrolithotomy in Pediatric Age Group

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ABSTRACT

Background: Children with nephrolithiasis constitute a high-risk patient population with an increased risk for stone recurrence during their lifetimes, so proper evaluation and management are very important. The present study aimed to compare operative time, complication rate, and stone-free rate in the prone position versus flank-free modified supine position (FFMSP) and mini-percutaneous nephrolithotomy (M-PCNL) in the paediatric age group.

methods: A prospective randomized e study was carried out on 20 patients with renal stones scheduled for PCNL at the Urology Department, Faculty of Medicine, Zagazig University in the period from December 2017 until November 2018**.** They were randomized into two groups: Group A: for flank-free modified supine position Mini Percutaneous Nephrolithotomy; Group B: for prone Mini Percutaneous Nephrolithotomy.

Results: the current study showed that there was a statistically significant difference between the studied groups regarding operative time and position time, it was shorter in FFMS than prone with a highly significant difference, also there was no statistically significant difference between the two groups in radiation time, access time and laser time, the needed for auxiliary maneuver as ESWL in both position was 5 cases in both group together, there was no significant difference in studied groups.

Conclusion: Mini-percutaneous statistically guided Nephrolithotomy in the flail-free modified supine position takes less time, has a lower complication rate, but is not statistically different, and has the same efficacy as prone statistically guided Nephrolithotomy**.**

Keywords: Percutaneous nephrolithotomy, Pediatric, Kidney stone, Urolithiasis

INTRODUCTION

Pediatric urinary stones could be managed effectively using minimally invasive treatment modalities such as extracorporeal shock wave lithotripsy (SWL), retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL). But PCNL had a significant role in cases with large and/or SWL resistant stones. The European Association of Urology guidelines recommended PCNL as the primary treatment option for large renal stones (> 20 mm) and also for > 10 mm stones in the lower renal pole **[1].**

Percutaneous nephrolithotomy (PCNL) is the gold procedure for large stones and complex kidney disorders treatment, but its morbidity was the highest between different stone treatments. For minimizing complication rates, surgeons must develop different variations of the classic prone position where PCNL is usually performed; one of them is supine position **[2].** PCNL mostly performed in the prone position, but the supine position has proven to be a better option with several advantages. PCNL in the supine position has a similar success rate and a shorter operative time than conventional PCNL **[3]**.

Supine PCNL enable a single positioning through the operation, with easy patient ventilation, protection from positional injuries, with convenient access to the patient by the anesthesiologist, also improved ergonomic environment for the surgical urologist (who may be seated while operating), and easy endoscopic combined intrarenal surgery (ECIRS) if needed **[4]**. The advantages of supine position lead to consider supine PCNL the gold standard for urologists worldwide and are still considered a new not an alternative position **[5].**

Aim of the work: The present study aimed to

compare operative time, complications rate, stone-free rate in the prone position versus flank-free modified Supine position (FFMSP) Mini-percutaneous nephrolithotripsy (M-PCNL) in the pediatric age group

METHODS

A prospective randomized comparative study was carried out on 20 patients with renal stones scheduled for PCNL at Urology Department, Faculty of Medicine, Zagazig University, patients were randomized in two groups Group in the period from December 2017 till November 2018.

The included patients were randomized using a computer-generated randomization list and sequentially numbered opaque sealed envelopes, each containing the allocation information written on a card. Envelopes were opened sequentially by a study nurse to allocate patients to the assigned group. These patients were divided into 2 groups each group consists of 10 patients:

Group A: included 10 patients for Flank-free Modified Supine position Mini Percutaneous Nephrolithotomy position.

Group B: included 10 patients for prone mini percutaneous nephrolithotomy position.

Written informed consent was taken from all participants or their relatives and the study was approved by the research ethical committee of faculty of medicine, Zagazig University (International review board). The study was done according to The Ethical Code of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Patients diagnosed with single renal pelvis stone or lower calyceal stone (2-3 cm). Pediatric age group < 18 years, both sex.

Exclusion criteria: Upper calyceal stone. Coexisting renal anomalies (UPJ obstruction, ectopic kidney). Patient with a urethral stricture. Patient with urethral stricture. Patient with a bleeding disorder.

All patients will be subjected to:

History taking with particular emphasis on urological history. Physical and clinical examination.

Laboratory investigation ; Urine analysis, culture, and sensitivity. Complete blood count (CBC)

Coagulation profile (I.N.R, PT, PTT).

Kidney function tests: blood urea and serum creatinine.

Liver functions test; ALT, AST, ALP, albumin, and bilirubin.

Radiological evaluation:

Kidney-ureters-bladder (KUB) .

Non contrast spiral Computer tomography (NCSCT) for :

- Measuring stone size, site, distribution, and HU.
- Pelvicalyceal anatomy .
- Relation of the kidney to the sround organs.

Operative technique:

Patients will be given prophylactic intravenous antibiotics (cefoperazone50-100mg/kg) were administered 2 hours preoperatively.

First, the ipsilateral posterior axillary line was marked while the patient is standing before anesthesia in FFMS position

Anesthesia: For both groups, general anesthesia was performed.

Positioning: In the two groups:

cystoscopy was performed in the lithotomy position by pediatric cystoscopy, the ureteral orifice was identified and a 0.025 inch guide wire was introduced; the wire was advanced under fluoroscopic guidance to the level of pelvicalyceal system, 5F or 6F open-ended ureteral catheter was advanced over the wire and the guide wire was removed, leaving the ureteral catheter in place, a retrograde ureteropyelography was done, and a urethral catheter was fixed with tape to an appropriate Foley catheter.

In Group A: Patients were kept in a Flank free modified supine position using a suitable cushion (water bag) under the ipsilateral shoulder, fixing the ipsilateral arm over the thorax, then crossing the extended patient ipsilateral leg over the contralateral leg, all pressure points were checked carefully and padded.

In Group B: Patients were placed in the prone position, and all pressure points are checked carefully and padded. A pillow was placed under the chest and another pillow was placed under the symphysis as a support to allow optimal ventilation.

Technical aspect (in both groups):

A preplanned tract or tracts are designed along the maximum stone burden so that these tracts are punctured and safety wires are inserted before dilatation, The skin was punctured posteriorly to the posterior axillary line by 18 G nephrostomy needle and, the track was dilated sequentially using fascial dilators and a 16F sheath was advanced over its metal dilator under fluoroscopic, 16F sheath was positioned, allowing the introduction of 12-Fr rigid nephroscope (Karl Storz).

The warmed Saline 0.9% was used for irrigation at a height of 40-50 cm from the level of the operating table, Stones were fragmented using power (1.6-1.8 joule) and frequency (8-10 hertz) Ho:YAG laser (Lumenis 100 W) with a 550-µm fiber laser lithotriptor and large fragments were retrieved by grasper and stone were dusting using low power (0.8-1.0 joule) and high frequency(15-20 hertz) Ho:YAG laser and by The popcorn‘ technique for the small one.

Nephrostomy catheter (16 F) was inserted at the end of the procedure under fluoroscopic guidance, the nephrostomy is secured at the skin with a silk suture, and the wound is dressed, The appropriate double-J stent was routinely maintained in place following PCNL.

In the operation record, the operative time; calculated from the beginning of ureteral catheterization to the nephrostomy tube placement, the position time from the end of ureteral catheter insertion to the beginning of puncture access time defined as the time from the beginning of puncturing of the skin to establish the tract, fluoroscopy times defined as time was patient exposed to radiation .and LASER time as defined the time use LASER to fragments and dusting stone. Recorded any requirements for blood transfusion in hemodynamically unstable patients. Recorded any complications. Within the operation.

Postoperative follow up:All patients were observed in the recovery room for 30-60 minutes.

Postoperative CBCs were done for all patients after 24 hours, blood transfusion was needed when HB level was < 8 gms. /dl according to British Hematological Society or for hemodynamic instability. Nephrostomy tube was clamped in the first post-operative day and was removed in the second postoperative day if there was no indication for a second look, and the patients had no fever or urinoma. Urine analysis, urine culture and sensitivity in patient with fever and expected suffering of infection. KUB done in the 2nd post-operative day for evaluation of the residual fragments, and position of the double-J stent. Non contrast spiral Computer tomography (NCSCT) for measuring of residual fragments was done 2 weeks postoperatively.

The patients are considered free of stone if there were no detected residual fragments less than 4mm in largest dimension **[6]**. For residual fragments measuring 4-10 mm were referred for ESWL after 2 weeks, and for residual fragments more than 10mm 2nd look PCNL after 3 days.

Urethral catheter removed after 24h postoperative and JJ stent removed after one month postoperative. Post-operative antibiotics (cefoperazone 50-100mg/kg) were routinely continued postoperatively twice daily for 5days. Follow up patients for any Complications such as hematuria, fever, infection, urinary leakage, renal colic, and symptoms of peritonitis and management of this complication.

Outcome analysis: Comparing both positions regarding:

The times (operation time, position time, access time, radiation time and LASER time).

Intraoperative blood loss (bleeding requires blood transfusion if hemodynamically unstable, or postoperative by check of HB level, if HB level < 8 gms /dl patent require blood transfusion.

Stone free rate, Auxiliary procedure ,and needed for 2nd look.

Hospital stay will be recorded, as were any intraoperative or perioperative complications.

Complications were recorded according to the modified Clavien system [7].

The Complications will be considered as minor (grade I,II Clavien system) as transient fever, clinically insignificant bleeding, infection of the urinary tract without urosepsis signs, renal colic, prolonged urinary leakage from percutaneous access for more than 7 days and intermediate complication. It is recommended to consider them as part of the treatment strategy, such as hydrothorax which require a chest tube or urine leakage which require urinary diversion can be classified as (Clavien grade III complication) or major complication (grade IV, V Clavien system) as septicemia, hemorrhage which require blood transfusion, thoracic or abdominal organ injury).

STATISTICAL ANALYSIS

Statistical Analysis: Analysis of data was carried out using the statistical package of social science (SPSS version 20). Description of quantitative variables was given as mean, and standard deviation. Chi square test (χ^2 –test) was used to compare qualitative variables between groups. The t-test was used to compare quantitative variables in parametric data. The Z-test was used for proportions. P-values less than 0.05 will be considered significant and P values less than 0.01 were considered highly significant.

RESULTS

Table [1], showed that there was no significant difference between the studied groups regarding age, sex, site, size, and density of stone. Table [2], showed a highly significant difference between the two groups as regard position time, and there was a significant difference between the studied groups regarding total operative time, which means FFMS groups has total operative time less than prone groups. Table [3], showed that there was no significant difference between the studied groups regarding stone free rate. Table [4], showed that postoperative complications in Prone group were higher than FFMS group but no significant difference between the two groups. 2 cases complicated in prone position, one case urine leakage managed by postoperative placement of a new nephrostomy tube, and 2 cases with fever & infection managed using antipyretic,and antibiotics according to urine culture & sensitivity. 2 cases complicated in FFMS (group A) ,one case with infection & macroscopic hematuria was managed using good hydration , anti-hemorrhage drugs and antibiotics according to urine culture& sensitivity,

and another one patient with fever & infection managed using antipyretic ,antibiotics according to urine culture & sensitivity and good hydration. Table [5], showed that the total minor complication (I &II Clavien system) was 20% , intermediate complication (IIIa Clavien system) was 5%, no major complication (IV,V Clavien system)

Table 1: Patients characteristics and stone demographics between studied groups

		Group A (N=10)		Group B (N=10)		total	X^2	T	P	Test
		N	%	N	%	N				
Sex	**Female**	3	30.0%	4	40.0%	7	0.22	-	0.63	**Chi-square test**
	Male	7	70.0%	6	60.0%	13				
	Total	10		10		20				
Age(years) Mean ±SD		9.5±3.1		10.3±3.4			-	- 0.521	0.609	**T.Test**
Hounsfield(UN)		780.5±131.6		778.9±132.9		-	-	0.027	**0.979**	**T.Test**
Size(cm)		**2.45±0.33**		2.43±0.34		-	-	0.132	0.896	**T.Test**
Site	**Left**	6 (60.0%)		5 (50.0%)		11(55.0%)				
	Right	4 (40.0%)		5 (50.0%)		9 (45.0%)				
	Total	10(100%)		10(100%)		20(100%)	0.24	-	0.65	**Chi-square Test**
	Lower calyceal	3(30.0%)		4(40.0%)		7(35.0%)				
	Renal pelvis	7 (70.0%)		6(60.0%)		13(65.0%)	0.22	-	0.63	**Chi-square Test**
	Total	**10**		**10**		**20(100%)**				

Table 2: Operation characters' distribution between groups

	Group A (N=10)	Group B (N=10)	T	P
Operation time (min)	**57.3±3.88**	**61.3±2.75**	**-2.656**	**0.016**
Position time (min)	**7.0±0.66**	**12.7±0.67**	**-19.00**	**0.0001**
Access time (min)	**3.3±0.67**	**3.4±0.69**	**-0.325**	**0.749**
fluoroscopy time (min)	**3.57±0.27**	**3.59±0.27**	**-0.166**	**0.871**
Laser time (min)	**29.2±1.13**	**27.8±1.81**	**-2.069**	**0.053**
N of puncture trial	**2.5 (2-4)**	**3 (2-5)**	**-0.654**	**0.55**
Pre HB (g/dl)	**11.96±1.38**	**11.97±1.55**	**-0.041**	**0.963**
Post HB (g/dl)	**11.81±1.35**	**11.79±1.54**	**0.042**	**0.962**
Hospital stay (day)	**3.53±0.8 D**	**4.1±1.1 D**	**1.456**	**0.189**

Table 3: Stone free rate distribution between groups

			Group		Total	X^2	P
			FFMS (A)	Prone (B)			
Stone free rate	Clear	N	**8**	**7**	**15**	**0.26**	**0.61**
		%	**80.0%**	**70.0%**	**75.0%**		
	Residual fragment	N	**2**	**3**	**5**		
	(ESWL)	%	**20.0%**	**30.0%**	**25.0%**		
Total		N	**10**	**10**	**20**		
		%	**100.0%**	**100.0%**	**100.0%**		

Table 4: Complication distribution between two groups

	Group A (N=10)		**Grope B (N=10)**		**Total**		**X2**	**P**
	N	%	N	%	N	%		
Non complicated Cases	8	80.0%	7	70.0%	15	75.0%	0.26	**0.61**
Complicated cases	2	20.0%	3	30.0%	5	25.0%		
Total	10	100.0%	10	100.0%	20	100.0%		
Type of complication	N	%	N	%	N	%		
Hematuria	1	10%	0	0%	1	5%	2.25	**0.087**
Infection	2	20%	2	20%	4	20%	1.41	**0.28**
Fever	1	10%	2	20%	3	15%		
Urine leakage	**0**	**0%**	**1**	**10%**	**1**	**5%**	**2.85**	**0.077**

Table 5: Complication according to modified Clavien system

Grade	**Complication**	**Group A**	**Group B**	**Total**	**Percentage total**	**P**
Grade I	None	-	-	-	-	-
Grade II	infection	2(20%)	2 (20%)	4	20%	**1.0**
	Hematuria	1(10%)	0	1	5%	
	Fever	1(10%)	2 (20%)	3	15%	
Grade IIIa	urine leakage	-	1(10%)	1	5%	**0.07**
Grade IIIb	-	-	-	-		
Grade IV	None	-	-	0	-	
Grade V	**None**	**-**	**-**	**0**	**-**	

DISCUSSION

PCNL is considered a safe and effective treatment for pediatric renal stones at any age [8]. PCNL in the supine position has high success rate and a short operative time than conventional PCNL in the prone position [9].

Desoky et al [3] studied the flank-free modified supine position and reported that this position overcomes the mechanical limitation of the ordinary supine position because of ample space for puncture, dilatation, multiple tracts, and maneuverability of the system with the nephroscope.In our study we found that there is no significant difference between the two groups as regard age, the Age was distributed as (9.5±3.1 years) in FFMS position and (10.3±3.4 years) in prone position. Similar to the study of **Desoky et al [3]** reported that the distribution of age was (9.5±3.2 years) in FFMS position. Also, **Bujons et al [10]**, reported that the distribution of age was range (2–18years) and median age 7 years, in m-pcnl in supine position. In our study all patients in two groups received general anesthesia, which is similar to the studies of **De Sio et al [11]** and **Rana et al [12]** in which both studies performed PCNL in a supine position under general anesthesia in adults. In contrast in our study **Zhou et al [13],** where all patients received either spinal or epidural anesthesia in adult. While **Desoky et al [3]** used General anesthesia for 17 patients, while 5 patients received regional spinal or epidural anesthesia in the pediatric age group.

In our study all cases only one puncture was required, in both positions, and no need for another puncture. Which in agreement with the study of **Gamal et al [14]** where used single lower calyceal access was used in all cases in m-pcml in the supine postion . Also, **Desoky et al [3]** used single Middle accessin 2 cases and single lower calyceal access in 20 cases. In contrast to our study **Bujons et al [10], where** all cases only one puncture was required, expect in three cases were needed two tracts this difference was due to patients with multiple stones (mean diameter 2.8 cm), and with staghorn calculi needed more than one puncture.

In our study there was a significant difference between the two groups, the mean total operative time was (**61.3±2.75** min) in the prone and was (**57.3±3.88** min) in FFMSP, the operative time was shorter in FFMS group than prone group ($p < 0.016$), the highly significant different was in the position time was in (**12.7±0.67** min) in prone group and (**7.0±0.66** min) in FFMS group , ($p < 0.001$) which means the time for positing of the patient in prone position more than the time which positing in FFMS position,and lastly there was no significant difference between two groups in the access time, LASER time, and fluoroscopy time.

Which similar to the study of **De Sio et al [11]**, reported that Operative time was significantly shorter in the supine group (43minutes versus 68 minutes; P < .001). It should be considered that in his work both staghorn and multiple calculi were excluded. Also, **Desoky, et al [15]** compared the outcome of PCNL in FFMS and Prone positions and found that operative time was significantly longer in the prone position. In their study, the operative time was calculated from the induction of anesthesia to the removal of the endotracheal tube. Also they included staghorn as well as non-staghorn stones.

In contrast to our results, **Valdivia-Uria et al [5]** the mean operative time was higher significantly in the supine position group compared to the prone position, regardless of the method of tract dilation (90.1 vs 82.7 min,(P < 0.0001).In our study in FFMSP group(A) total operative time was (**57.3 ±3.88** min), which is similar to the study of **Desoky et al [3]** in Flank Free Modified Supine position pcnl which the operative time was (65.1±18.7 min **) .**In contrast to our study **Gamal et al [14]** showed that the time from the start of the puncture trial to nephrostomy tube insertion was (41 ±15 min) in m-pcnl in supine position, while in our study reported operation time from start of ureteral catheterization to the placement of the nephrostomy tube In our study in m-pcnl in prone position the total operative time was (61.3±2.75 min). while **Bujons A et al. [10]** in prone position reported the median duration of mini-PCNL was 150 minutes (range120–210 minutes), the operation time was significantly prolonged due to the presence of multiple cystine stones, staghorn stone and complete removal of stone.

In our study evaluation of stone free rate was done in 2nd post- operative day, over-all stone free rate (for both groups) was15 patients 8 in FFMS and 7 in prone but statistically insignificant [p=0.61], the primary stone-free rate was 75% and increased after treatment of fragment to 100 % after an auxiliary ESWL for 5 cases and no need for 2nd look PCNL in both position . which in agreement with the study of **De Sio et al. [11]** who reported that there was no significant difference in stone free in both supine and prone positions. the stone-free rate was good in both groups as SFR was 88.7% versus 91.6%, [P = 0.12] in the supine and prone positions respectively.

Also **Desoky et al. [3]** who reported that in **FFMS** position the Stone-free was 90.9% of patients after a single PCNL and increased to 100% after an auxiliary ESWL for one case or needed for a second-look PCNL for other case. Also, **Gamal et al. [14]** reported that in the supine position the initial stone free rate after m-pcnl in was (92.5%).The current study showed that there was no significant difference between the two groups regarding complications (P = 0.61) but also noticed that 5 cases 25%, the complicated cases was two cases in FFMSP (20%), and in the prone position (30%)the complicated cases was 3 cases (30%). And the hospital stay was (4.1±1.1 Day) in prone position and in FFMS position was(3.53±0.8 Day) with no significant difference (P=0.189).

Similar to our study **Desoky et al. [3]** in FFMS position the Total complication incidence (31.8%) was 4 cases with fever 18.2%, (grade I Clavien System), one patient with post operation bleeding (grade II Clavien System) received postoperative blood transfusion and two cases (9.1%) with postoperative transient urinoma (Grade IIIa Clavien System), and the total hospital stay was (3.2-5.9 days).

Also, **Gamal et al. [14]** described the Postoperative complications in their study as 2 cases with fever and they received medical treatment for 3 days, 3 cases with urinary tract infection preoperatively, and preoperative antibiotics were given according to urine culture sensitivity, and intraoperative complications 2 cases (one case with pelvicalyceal system perforation and another case with intraoperative bleeding and blood transfusion) and hospital stay for all cases after m-pcnl in supine position was 2 day. **Shoma et al [16]** described the complications in their study that included bleeding in prone (4%) and supine (9%) p=0.2, Urinary leakage in prone (3%) and supine (4%) p=1, Fever (≥38°C) in prone 5% and supine 4% [p=1]. The mean hospital stay was 2.5 days for the supine position group and 2.7 days for the prone position group (P=0.4). No organ injuries or pneumothorax was recorded in the studied groups, they proposed that the potential disadvantages associated with the supine position was more than lateral placement of the renal puncture would result in greater complication rates and compromise access to the renal collecting system and, hence, safe stone clearance. However, their study was none randomized and included both renal and ureteral stones. Also **Gaston Astroza et al [14]** found that there was no statistically significant difference in complication rates between patients with staghorn stones who underwent PNL in the prone or supine position (P =0.48), after adjusting for the patient position, patients who had multiple renal access punctures had higher complications compared to patients who had a single puncture (P<0.0001).

CONCLUSION

We conclude that the mini-percutaneous nephrolithotripsy in Flank Free Modified Supine position as treatment of pediatric renal stones is, shorter in operation time, and less in complication

rate without significant difference compared to prone mini-percutaneous nephrolithotripsy.

Limitations: However, there were some limitations that we faced such as the small number of patients included, and we recommend the performance of such a study on a multicentric level with an increased number of cases and an extended follow-up period to exclude the development of any other late complications.

Conflict of interest: None

Financial Disclosures: None

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