

Mini percutaneous nephrolithotomy treat the large upper ureteric stones

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ABSTRACT

Background. The incidence of kidney stones has been raised all over the world. Nephrolithiasis is the most common cause of illnesses in western countries and has been rising in its incidence in developing countries. PCNL describe the management of large renal calculi when measuring >20 mm and even for smaller ones of lower pole with excellent stone-free rate reach to 98%.

Aim. To evaluate the mini-percutaneous nephrolithotomy (mini-PCNL) safety used to cure upper ureteral and renal stones with assessing the complication and procedure outcome in Iraqi patients.

Method. This is a prospective study done between October 2022 and September 2023 in Ghazi Al-Hariri for Surgical Specialties Hospital, Medical city, with 100 patients enrolled who underwent mini-PCNL. All patients had upper ureteral and renal stones (size ≥ 20 mm). The nephroscope tube was utilized. The stones were destroyed by pneumatic lithotripter. Complications and outcomes were determined immediately postoperative via X-ray of the ureters, kidneys and bladder. Ultra-sonography also used to determined safety and efficacy of procedure.

Results. The cases mean age was 55.8 ± 12.3 years, and their BMI was 29.5 ± 5.9 kg/m². The size of mean stone was 22.5 ± 17.9 mm. The stone-free rate (SFR) was 94.7%. The post-operative hospital stay mean was 3.6 ± 2.7 days. The Hb drop mean was 0.6 ± 0.3 g/dL. There were none of our cases had organ trauma or any complications. Thirty cases required additional subsequent extra-corporeal shock wave lithotripsy.

Conclusion. The mini-PCNL is effective and safe in cases of upper ureteral and renal stones ≥ 20 mm. Researches with a larger multi-center cohorts may be needed to validate these techniques.

Keywords: renal stone, ureteric stone, PCNL, nephrolithiasis, mini-percutaneous nephrolithotomy

INTRODUCTION

Globally, urolithiasis is one of a common public health problem. The prevalence rates of urolithiasis are more than 10% [1]. The majority of kidney stones remain asymptomatic, and the management is performed to prevent complications as severe colic, urinary tract infections and renal function impairment [2].

Surgically speaking, kidney stones treatment is a complex approach due to several competitive manage-

ment modalities that are available and more >1 modality may be appropriate. When a selection of ideal factors remains, it is the common significant predictor for better prognosis. The elimination for kidney stones should be getting both great SFRs and low rates of complications [3].

The extra-corporeal-shock-wave-lithotripsy (ESWL) and flexible uretero-reno-scopy (URS) are the common management options for kidney stones of less than 20 mm [4].

The AUA guides used per-cutaneous nephron-lithotomy (PCNL) as the first-line managing for cases with a large renal stone [5], due to greater SFR than SWL or URS and is less invasive than open surgery or laparoscopic/robotic-assisted techniques [3].

When complex or large stones present, management procedures that can get completing SFRs with low morbidity and fewer procedures number are ideal, which is open nephron-lithotomy, that evolved into PCNL or retro-grade-intra-renal surgery (RIRS) [6].

PCNL is the gold standard procedure for bigger kidney stones due to the greater SFR if it is safely performed by well-trained urologists within a short period of time [7,8]. Commonly, the term “mini-PCNL” is referred to the accessing sheaths <20 Fr [9].

The drainage and stent-tube pain is one of the commonest symptom among cases. Therefore, modern procedures have started to re-explore the ideas of PCNL without the standard nephrostomy drainages [3]. Tubeless PCNL refer to internal drainages with the utilizing of a ureteral stents without the nephrostomy tube placement post-operative. It is a safe and efficient approach [3].

Bellman et al. is firstly recorded PCNL without a nephrostomy tube after the procedures in 1997, tubeless PCNL had been extensively evaluated [10]. Shah et al. had compared the outcome of tubeless PCNL with those of small-bore nephrostomy drainages post PCNL and documented that cases undergoing tubeless PCNL experienced low post-operative complications and were discharged 9 hours earlier [11].

In 2010, Agrawal and Agrawal concluded that tubeless PCNL had favorable outcomes in cases with stones of <30 mm [12], to decline the effects related to the use of larger tools and nephrostomy tubes like hemorrhage, post-operative pain and potential damages, as a result a mini-PCNL combined with tubeless techniques developed [3].

The study purposed to assess the safety of mini-percutaneous nephrolithotomy (miniPCNL) used to treat renal and upper ureteral stones and to evaluate the complication and outcome of these procedures in Iraqi patients.

METHODS

Study design and setting

This a cross-sectional study (prospective) conducted between October 2022 and September 2023 in Ghazi Al-Hariri for Surgical Specialties Hospital, Medical City, which enrolled 100 cases who underwent mini-PCNL. All cases had upper ureteral and renal stones (size ≥ 20 mm).

Data collection

These included age, sex, BMI, stone size, stone-free rate (SFR), postoperative hospital stay, hemoglobin drop and any complications.

Exclusion criteria

Cases with congenital anomalies, pyonephrosis and kidney dysfunction or coagulopathies.

Preoperative preparation

All cases were assessed:

- Medical and surgical histories.
- Physical examinations.
- Laboratory investigations: (GUE, RBS, CBC, PT, PPT, INR, ALT, AST, LDH, bilirubin and creatinine).
- Urine culture and sensitivity.
- CT scan and/ or IVU.

Stone size formula

“(length \times width $\times \pi \times 0.25$)”

Stone-free rate (SFR)

SFR is defined as the absence of any residual fragments one month after operation.

Preoperative

- Administration of 3rd-generation cephalosporin.
- Anesthesia induction.

Tools

- Operating nephroscope tube
- Pneumatic lithotripter
- 6-Fr ureteric catheter
- Cystoscopy
- The pelvi-calyceal system
- Fluoroscopy
- 30-Fr and 24-Fr tracts

Mini-PCNL procedure

- The tract is dilated slowly with fascial dilators (Cook Urological, UK).
- 24-Fr sheath inserted.
- Apply of semi-rigid nephroscope (18 Fr) (Richard Wolf; Deutschland).
- Employed of automated irrigation pump (MMC Guangzhou; PRC).
- Pneumatic lithotripsy.

S-PCNL technique

- Apply “telescopic metal Alken dilators for dilation.
- 30-Fr Amplatz sheath is inserted.
- The standard 24-Fr nephroscope used (Karl Storz, American)
- Pneumatic lithotripsy.

Postoperative period and follow-up

The complications and outcomes were determined immediately post operation via X-ray of the kidneys, bladder and ureters. Ultra-sonography was also used to determine safety and efficacy of the procedure. Nephroscopy was used to check the clearance of calculi post operation in the both groups. Cases were discharged post nephrostomy tube removal. For all cases,

follow-up with abdominal US in the 1st day and 30th day after.

Statistics

Statistical Package of Social Science Software program (SPSS), version 20 was used. Mean, SD, percent and number for data description were used.

RESULTS

Table 1 showed the baseline stone and patient characteristics. The mean age was (55.8 ± 12.3 years), and the mean BMI was (29.5 ± 5.9 kg/m²). The mean size of stone was (22.5 ± 17.9 mm). Males to females ratio was 3:1 (75 males and 25 females). Right stone was found in 44% whereas left stone in 56% of cases. Multiple stone sites were of common presentation (55, 55%) followed by upper calyceal stone (35, 35%).

TABLE 1. Baseline patient and stone variables

Variables		Mean \pm SD / No.	%
Age (years)		55.8 \pm 12.3	-
Sex	Male	75	75
	Female	25	25
BMI (kg/m ²)		29.5 \pm 5.9	-
Stone size (mm)		22.5 \pm 17.9	-
Laterality	Right	44	44
	Left	56	56
Site	Upper calyceal	35	35
	Upper ureteral	10	10
	Multiple	55	55

BMI: Body mass index, SD: Standard deviation

In relation to cases operative and postoperative variables, the SFR was (94.7%). The post-operative hospital stay mean was (3.6 ± 2.7 days). Thirty cases required additional subsequent extracorporeal shock wave lithotripsy. The mean hemoglobin drop was (0.6 ± 0.3 g/dL). The mean operative time was (1.2 ± 0.5 hours) (Table 2).

Table 2. The patients operative and postoperative variables

Variables	Mean \pm SD / No.	%
SFR (%)	-	94.7
Hospital admission (days)	3.6 \pm 2.7	-
Hb dropping (g/dL)	0.6 \pm 0.3	-
Operative time (hours)	1.2 \pm 0.5	-
Subsequent extracorporeal shock	30	30

SFR: stone free rate, SD: Standard deviation

No organs trauma or complications recorded. Out of 100, 22 cases complained of UTI and six cases needed blood transfusion (Table 3).

TABLE 3. The complications

Complications	No.	%
Urinary tract infection	22	22
Blood transfusion	6	6
Pneumothorax	0	-
Sepsis	0	-
Trauma	0	-

DISCUSSION

A high SFR can be achieved from per-cutaneous accesses to the collecting system. It is considered the management of choice for stones (>2 cm diameter) [13]. Generally, the PCNL procedure is safer and has more efficacy when it is done or performed by experienced urologists [14].

When we use the conventional PCNL, the renal access with 24-34 Fr (diameter) is necessary. While a reduction of the diameter of access sheaths leads to the mini-PCNL technique we use as [15], however, when the mini-PCNL is used, the diameter can decline hemorrhage and the rate of transfusion [16].

The benefits of mini-PCNL reduce the morbidity, one-step dilatation techniques, small-bore accesses (18-Fr), continuous low-pressure irrigation by facilitate rapid stone retrieval without stone forceps (baskets) using, directed the access closure without a nephrostomy tube placement, feasibility, safety, efficacy in the small renal and lower calyceal calculi management, lead to complete stone clearance in (92.9%) (stones of <2 cm), displaying efficacy with larger stones [13].

The main nephrostomy tube complication is postoperative pain. To minimize the modifications, the tubeless PCNL used must be documented [15]. The advantages of tubeless PCNL are reduced postoperative discomfort, pain and decreased requirement of analgesics [17].

Here, the stone mean size (22.5 ± 17.9 mm) was greater than that in previous works [10-16], assuming that stone clearances are not affected by the small diameters of the access tracts. Stone retrieval using the vacuum cleaner effecting of continuous low-pressure irrigations without the need for endoscopic manipulations with stone graspers might contribute to an effective stone clearance and acceleration of the procedures [18].

The mean operative time in this work was 1.2 ± 0.5 hours. Information about whether miniaturization of the access sheaths causing the longer time of operations in cases with larger stones are contrast. A study of 180 cases who underwent either conventional or mini-PCNL had documented that mini-PCNL has significantly longer operative times for simple stones (89.4 versus 77.0 minutes), stag-horn stones (134.3 versus

118.9 minutes) and multiple stones (113.9 versus 101.2 minutes) [19].

In fact, in a previous prospective trial between two procedures in 50 cases, Knoll et al. recorded no difference in terms of the time between cases who underwent surgical intervention with 18Fr access sheaths, rather than 26Fr access sheaths, were used [16].

Many factors that lead to reduced mini-PCNL operative time, are the one-step dilatation of the access tracts and the vacuum cleaner effected and facilitated stones retrieval without the needed of stones graspers [15].

Because this study was prospective in nature, no organ traumas or complications were recorded. Out of 100, 22 cases complained of UTI and six cases needed blood transfusion. However, no cases had complications, similar to previous works [11,13-18].

A significant blood loss is the major concern of PCNL which requiring blood transfusion (BT). In the current work, the mean Hb dropping level was 0.6 ± 0.3 g/dL; six cases required a BT and all cases were treated conservatively by IVFs.

The achievement of low transfusion rate in mini-PCNL attributed to few parenchymal traumas and declined trauma risks in larger segmental vessels with the use of small-bore dilators during the establishment of the ac-

cess tracts. The lowered transfusion rates were reported in previous works [15].

The stone sizes identified as a delimitating factor for the success of PCNL management [15]. However, in our study the mean size was $(22.5 \pm 17.9$ mm).

Few researches done for making a comparison between the standard PCNL and miniPCNL [20]. A lot of works were enrolling a small participants number [21], applied several lithotripsy protocols in both arms [22], had conducted various sizes of stones [23], positions [16], or complexities [24]. Moreover, we believe that tubeless mini-PCNLs are unique and better options if used safely.

CONCLUSION

The mini-PCNL is safe and effective in the cases with upper ureteral and renal stones ≥ 20 mm. It is more effective in cases with larger renal stones. The SFR are observed to be high in mini-PCNL. The mini-PCNL does not imply long operative time or severe complication. Studies with larger multi-center cohorts may be needed to validate these techniques.

Conflict of interest: none
Financial support: none

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