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EVALUATE THE RESULTS OF KIDNEY STONE TREATMENT USING MINI-PERCUTANEOUS NEPHROLITHOTOMY IN FLANK POSITION

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ABSTRACT

Background: *Minimally invasive approaches for kidney stone management, notably mini-percutaneous nephrolithotomy (mini-PCNL), are increasingly favored over traditional open surgical techniques. The prone position is predominantly utilized during mini-PCNL procedures; however, it poses challenges in patients with respiratory limitations or anesthetic concerns. Consequently, the flank position, frequently adopted by urologists due to familiarity and anesthetic convenience, has emerged as an alternative approach.* ***Objective:*** *This study aims to evaluate the clinical outcomes of mini-percutaneous nephrolithotomy performed in the flank position for kidney stone treatment at Can Tho University of Medicine and Pharmacy Hospital.* ***Materials and Methods:*** *This investigation was conducted using a descriptive cross-sectional design. All patients diagnosed with kidney calculi measuring ≥ 20 mm undergoing mini-PCNL at Can Tho University of Medicine and Pharmacy Hospital were included.* ***Results:*** *Between November 2022 and March 2024, a total of 60 patients underwent mini-PCNL, comprising 32 males and 28 females, with a mean age of 50.5 years (ranging from 30 to 80 years). The mean stone diameter was recorded as 30.8 mm. All procedures were successfully completed in a 90-degree flank position. Kidney access was achieved through the lower calyx in 55% of cases and via the middle calyx in 45%. The average duration of surgery was 70.4 minutes. No intraoperative complications occurred. Postoperative complications were identified in 4 patients (6.7%). The mean length of hospital stay was 6.5 days. An early postoperative stone-free rate of 78.3% was achieved.* ***Conclusion:*** *Mini-PCNL in the flank position proves to be a safe and effective approach for managing kidney stones, providing a high stone-free rate with minimal complications.*

Keywords: *Kidney stones, percutaneous nephrolithotomy, mini-PCNL, flank position.*

I. INTRODUCTION

Kidney stone disease remains a common urological condition with substantial health and socioeconomic burdens. Despite advancements in preventive care, recurrence rates remain high, affecting more than 50% of patients over time [1]. For renal calculi larger than 20 mm, percutaneous nephrolithotomy (PCNL) has long been the gold standard. Among its modern variants, mini-percutaneous nephrolithotomy (mini-PCNL) has gained widespread adoption due to its advantages over traditional open surgery, including reduced tissue trauma, smaller incisions, less postoperative pain, and shorter hospital stays [2].

While mini-PCNL is conventionally performed in the prone or supine position to optimize renal access, these postures pose notable limitations-particularly for anesthetic safety and intraoperative logistics in patients with obesity or compromised cardiopulmonary function [3]. In response to these challenges, Kerbl K first introduced the flank position in

1994 for obese patients undergoing PCNL at a 90-degree lateral angle [4]. This approach has since been increasingly adopted internationally, and more recently in select Vietnamese centers, as a viable alternative.

The flank position offers multiple perioperative benefits. It enhances airway control and ventilation in high-risk patients [4], eliminates the need for intraoperative repositioning, and reduces pressure-related complications [5]. From a surgical standpoint, it enables direct, ergonomic access to the renal collecting system, allowing for precise calyceal puncture-typically targeting the lower or middle calyx-and minimizing injury to adjacent organs [6]. Additionally, the combined use of ultrasonography and fluoroscopy enhances procedural safety while reducing radiation exposure [7]. In cases of hemorrhage or iatrogenic injury, this orientation also permits easier conversion to open surgery [3].

At Can Tho University of Medicine and Pharmacy Hospital, the flank position has been routinely implemented in mini-PCNL procedures-the first in the Mekong Delta region to do so. This study aims to evaluate the clinical outcomes of mini-PCNL in the flank position and contribute to the growing body of evidence on its safety and efficacy.

II. MATERIALS AND METHODS

2.1. Materials

Sample Selection Criteria: Patients were included if they had

- Kidney stones ≥ 20 mm located in the kidney pelvis or lower calyx.
- Staghorn or partial staghorn calculi.
- Kidney stones with a history of prior surgical scars.

Exclusion Criteria: Patients were excluded if they had

- Active urinary tract infections inadequately treated.
- Severe comorbidities increasing surgical risks.
- Kidney tumors or anatomical abnormalities, such as kyphoscoliosis, horseshoe kidney, kidney malrotation, or solitary kidney.

2.2. Methods

- **Study Design:** A prospective, cross-sectional study was conducted to assess outcomes of mini-PCNL in the flank position. The study was conducted from November 2022 to March 2024 at Can Tho University of Medicine and Pharmacy Hospital.

Figure 1. Image of the flank position during Mini-PCNL surgery performed in the operating room of Can Tho University of Medicine and Pharmacy Hospital.

- **Sampling Method:** All eligible patients diagnosed with kidney stones meeting the inclusion criteria during the study period were enrolled. A total of 60 patients were included.

- **Data Collection**

Clinical data were retrospectively collected from electronic medical records, operative reports, and postoperative imaging studies. The variables were categorized as follows:

+ **Preoperative parameters**: including patient age, sex, anatomical location of the stone (renal pelvis or lower calyx), and maximal stone diameter measured on imaging.

+ **Intraoperative variables**: including patient positioning (e.g., modified flank), number of percutaneous tracts created, anatomical location of each tract, and whether nephrostomy tube or ureteral stent was placed for postoperative drainage.

+ **Postoperative outcomes**: including stone-free status as confirmed by imaging (ultrasound or non-contrast CT), presence and severity of complications and total duration of hospitalization.

- **Statistical Analysis:** Data were analyzed using SPSS 22.0 software. Descriptive statistics, including means, percentages, and standard deviations, were used to summarize patient characteristics and outcomes.

- **Ethical Approval:** The study was approved by the Ethics Committee of Can Tho University of Medicine and Pharmacy (protocol code 22.003.NCS/PCT-HĐĐĐ, dated November 30, 2022).

III. RESULTS

From November 2022 to March 2024, 60 patients with kidney stones were treated using mini-percutaneous nephrolithotomy in the flank position at Can Tho University of Medicine and Pharmacy Hospital. This section outlines the patient characteristics, surgical procedures, and postoperative outcomes.

3.1. Patient Profiles

Table 1. Patient details

Feature	Data
Average age	50.5 ± 12.7 years
Gender	
- Male	32 (53.3%)
- Female	28 (46.7%)
Stone location	
- Kidney pelvis	18 (30%)
- Calyces	11 (18.3%)
- Kidney pelvis + Calyces	21 (35%)
- Staghorn/Partial staghorn	10 (16.7%)
Average stone size	30.8 ± 7.2 mm

The study included 60 patients (mean age 50.5 years) with 53.3% males. Stones were located in the renal pelvis (30%), calyces (18.3%), both sites (35%) and staghorn or partial staghorn stones (16.7%). Mean stone size was 30.8 mm, indicating a significant stone burden.

3.2. Surgical Procedures and Results

Table 2. Procedure details

Aspect	Data (N = 60)
Flank position (90°)	100%
Single access tract	100%
Access location	
- Middle calyx	27 (45%)
- Lower calyx	33 (55%)
Nephrostomy tube	100%
Average procedure time	70.4 ± 14.6 minutes

All procedures (100%) used a 90° flank position with single-tract access: 55% via lower calyx, 45% via middle calyx. All patients had postoperative nephrostomy tube placement. Mean operative time was 70.4 minutes (Table 2).

Table 3. Post-Surgery results

Outcome	Data (N = 60)
Follow-up procedure required	2 (3.3%)
Stone-free patients	47 (78.3%)
Complications	
- Fever	3 (5%)
- Septic	1 (1.7%)
Average hospital stay	6.5 ± 1.8 days

Postoperatively, 78.3% of patients were stone-free on imaging. Two (3.3%) required re-intervention via the same tract. Intraoperative complications were absent. Four patients (6.7%) had postoperative complications: three febrile (5%), one developed sepsis (1.7%) managed medically. Mean hospital stay was 6.5 days (Table 3).

IV. DISCUSSION

4.1. Stone-Free rates

The stone-free rate is a key indicator of mini-PCNL success. Our study achieved a stone-free rate of 78.3% after a single intervention in 60 patients, with a mean stone size of 30.8 mm and 16.7% of cases involving staghorn or partial staghorn calculi. According to the European Association of Urology (EAU) guidelines, stone-free rates for PCNL range from 77.5% to 97.8%, depending on stone characteristics and surgical techniques [1]. In comparison, Inanloo SH (2018) reported a rate of 87.7% using the flank position [8], and Hoang Long (2020) recorded 83.3% [6]. The slightly lower rate in our study, still within acceptable limits, may result from the larger stone size and higher proportion of complex calculi. Similar efficacy was observed by Duong Van Trung (2018) with mini-PCNL in the flank position [9]. These findings confirm that the flank position is both feasible and effective, even for challenging cases.

4.2. Operative time

In our study, the mean operative time was 70.4 minutes, measured from tract creation to nephrostomy tube placement. This duration exceeds the 56.6 minutes reported by Inanloo SH (2018) [8] and 68.5 minutes by Hoang Long (2020) [6]. The longer time may be attributed to the use of combined ultrasound and C-arm guidance, a method shown by Chi Q (2014) to improve safety but increase procedure duration [7]. Additionally, the large

mean stone size of 30.8 mm necessitated extended fragmentation. Compared to standard PCNL, however, mini-PCNL in the flank position maintains an acceptable operative time while reducing complication risks due to smaller access tracts [10]. This indicates that the flank position supports efficient surgery without substantially prolonging duration.

4.3. Hospital stay

The mean hospital stay in our study was 6.5 days, longer than the 2.7 days reported by Karami H (2013) [5] and 3.8 days by Basiri A (2008) [11]. This difference likely reflects our institution's initial experience with the flank position, leading to cautious postoperative monitoring and delayed discharge to ensure patient safety. A shorter stay of 3.9 days was reported by Hoang Long (2020), possibly due to variations in postoperative protocols [6]. Despite the longer duration, a 6.5-day stay demonstrates relatively rapid recovery for mini-PCNL compared to standard PCNL, attributed to reduced tissue trauma and postoperative pain [2].

4.4. Complications

A postoperative complication rate of 6.7% was recorded in our study, with 5% of patients experiencing fever and 1.7% developing sepsis, all managed successfully. No intraoperative complications occurred. This rate was lower than the 2.4% incidence of septic shock reported by Liu L *et al.* (2010) after PCNL [12]. The flank position may reduce infectious complications, potentially due to improved drainage and decreased respiratory pressure [8]. No blood transfusions were required, consistent with the reduced bleeding risk in mini-PCNL compared to standard PCNL [10]. Basiri A (2008) also noted that the flank position minimizes pleural injury risk due to favorable anatomical alignment [11]. These results highlight the enhanced safety profile of the flank position.

V. CONCLUSION

Mini-percutaneous nephrolithotomy in the flank position is a safe and highly effective surgical approach for treating kidney stones, offering a high stone-free rate, low complication rates, short postoperative recovery time and favorable cosmetic outcomes.

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