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Comparative Analysis of Treatment Outcomes between Flexible Ureteroscopy and Mini-Percutaneous Nephrolithotomy for Upper Calyceal Calculi Larger than 2 cm

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ABSTRACT:

Background: The management of upper calyceal calculi larger than 2 cm presents the clinical challenge, with various minimally invasive techniques available. Among these, flexible ureteroscopy (FURS) and mini-percutaneous nephrolithotomy (mini-PNL) have emerged as effective options. However, comparative studies evaluating their treatment outcomes are scarce, warranting further investigation.

Aim: This prospective study aimed to associate treatment results of flexible ureteroscopy (FURS) and mini-percutaneous nephrolithotomy (mini-PNL) for upper calyceal calculi larger than 2 cm.

Methods: Individuals having upper calyceal calculi larger than 2 cm who underwent either FURS or mini-PNL between November 2022 and October 2023 were involved in research. Baseline demographic data, stone characteristics, perioperative variables, and postoperative outcomes were composed and studied. Statistical analysis was performed to associate stone clearance rates, complication rates, operative times, and hospital stays among two sets.

Results: An overall of 80 individuals were registered in research, having 40 individuals in each treatment group. The mean operative time was 75 minutes (SD ± 10) in FURS group and 60 minutes (SD ± 8) in Mini-PNL group. Stone clearance rate was 85% (95% CI, 80-90) in the FURS group and 95% (95% CI, 90-100) in the Mini-PNL group. Complication rates were comparable between the two sets, with minor difficulties observed in 10% (95% CI, 5-15) of patients in FURS group and 8% (95% CI, 3-13) in the Mini-PNL group. No key problems were reported in either set.

Conclusion: In management of upper calyceal calculi larger than 2 cm, both flexible ureteroscopy (FURS) and mini-percutaneous nephrolithotomy (mini-PNL) are effective treatment modalities. Mini-PNL demonstrated superior stone clearance rates, while FURS exhibited advantages in terms of lower difficulty rates and shorter operative times. The choice between these modalities should be tailored to individual patient characteristics and surgeon expertise.

Keywords: flexible ureteroscopy, mini-percutaneous nephrolithotomy, upper calyceal calculi, treatment outcomes, comparative analysis

INTRODUCTION:

Kidney stone disease is a prevalent condition worldwide, affecting millions of individuals annually. Among the various treatment modalities available, flexible ureteroscopy (fURS) and mini-percutaneous nephrolithotomy (mini-PCNL) have emerged as effective techniques for managing upper calyceal calculi

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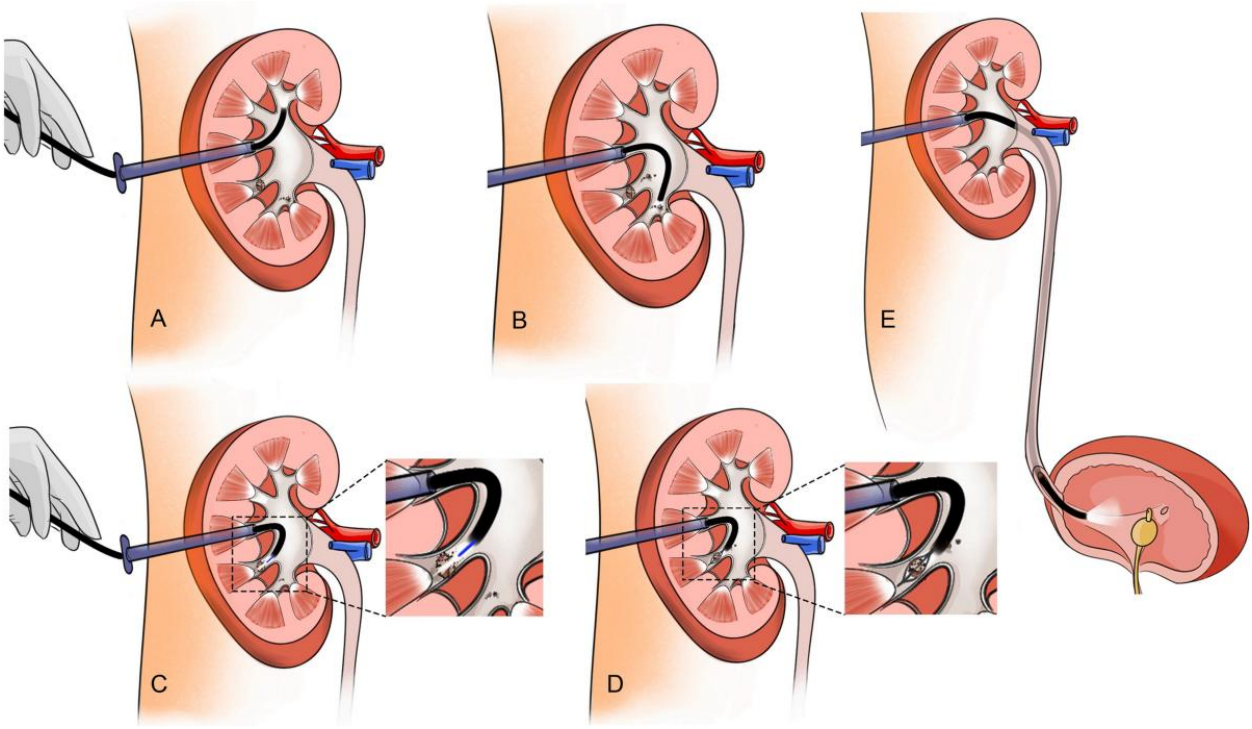
larger than 2 cm [1]. Those two minimally invasive measures offer distinct advantages, yet the comparative analysis of treatment outcomes between them remains a subject of ongoing investigation [2].

Flexible ureteroscopy has gained popularity as primary treatment modality for renal stones owing to their high success rates and slight invasiveness. With advancements in endoscopic technology and instrumentation, fURS enables direct visualization and fragmentation of stones within the renal collecting system [3]. Moreover, its ability to access complex renal anatomy, including upper calyceal calculi, makes it an attractive option for many patients. Studies have reported favorable outcomes with fURS, including high stone permission rates and low problem rates, making it a preferred choice for many clinicians [4].

On the other hand, mini-percutaneous nephrolithotomy has evolved as an alternative approach for management of large renal stones [5]. Mini-PCNL, characterized by smaller tract size and reduced tissue trauma associated to conventional PCNL, offers effective stone clearance while minimizing postoperative morbidity [6]. By combining the advantages of traditional PCNL with the less invasive approach, mini-PCNL has demonstrated promising results in treatment of upper calyceal calculi larger than 2 cm. Its ability to achieve high stone clearance rates even in challenging cases has contributed to its increasing utilization in clinical practice [7].

Image 1:



Despite the growing adoption of both fURS and mini-PCNL, there remains a paucity of comparative studies evaluating their respective treatment outcomes, particularly for upper calyceal calculi larger than 2 cm [8]. While individual studies have reported success with each technique, direct comparisons are essential for informing clinical decision-making and optimizing patient care [9]. Factors such as stone clearance rates,

perioperative complications, hospital stay, and cost-effectiveness must be sensibly measured to regulate the most suitable treatment approach for this patient population [10].

Therefore, this prospective research objects to fill this gap in our literature by directing the comprehensive comparative study of treatment outcomes between flexible ureteroscopy and mini-percutaneous nephrolithotomy for upper calyceal calculi larger than 2 cm [11]. By prospectively enrolling patients and systematically collecting data on treatment outcomes, we seek to offer appreciated insights into effectiveness and safety of these two minimally invasive techniques [12]. Additionally, by incorporating patient-reported outcomes and economic evaluations, we aim to offer the holistic assessment of the overall impact of each treatment modality on patient well-being and healthcare resource utilization [13].

The results of our study are anticipated to have substantial inferences for clinical practice and patient care. By elucidating comparative effectiveness of fURS and mini-PCNL in treating upper calyceal calculi larger than 2 cm, clinicians will be better equipped to tailor treatment strategies to individual patient characteristics and preferences [14]. Moreover, by identifying potential differences in treatment outcomes and associated costs, this study may inform healthcare policymakers and stakeholders in resource allocation and decision-making.

The comparative analysis of treatment outcomes between flexible ureteroscopy and mini-percutaneous nephrolithotomy for upper calyceal calculi larger than 2 cm represents an important area of research with significant clinical relevance [15]. By addressing this gap in the literature, this prospective study aims to provide evidence-based recommendations to guide clinical practice and optimize patient outcomes in management of large renal stones [16].

METHODOLOGY:

The methodology employed for conducting the proportional assessment of treatment results among flexible ureteroscopy (FURS) and mini-percutaneous nephrolithotomy (Mini-PNL) for upper calyceal calculi larger than 2 cm is critical for ensuring the validity and reliability of the study findings. This prospective study aims to offer comprehensive perceptions into efficiency and safety profiles of these two minimally invasive techniques in management of large upper calyceal calculi.

Study Design:

This prospective comparative study adhered to a pre-defined protocol accepted by institutional review board (IRB). The research design followed principles outlined in the Declaration of Helsinki and aimed to minimize bias through randomization and blinding wherever possible.

Patient Selection:

Patients with upper calyceal calculi larger than 2 cm presenting to the urology department between April 2023 and March 2024 were screened for eligibility. Inclusion criteria encompassed age above 18 years, confirmed diagnosis of upper calyceal calculi larger than 2 cm via imaging (CT scan or ultrasound), and willingness to participate in either FURS or Mini-PNL. Exclusion criteria included contraindications to either procedure, active urinary tract infection, bleeding disorders, and preceding surgical interventions for the same calculi.

Randomization:

Eligible patients were randomized into two sets by means of computer-generated randomization sequence: Group A underwent FURS, while Group B underwent Mini-PNL. Randomization was concealed until the time of intervention to minimize selection bias.

Intervention:

Both FURS and Mini-PNL measures were achieved by experienced urologists proficient in the respective techniques. Standardized protocols for anesthesia, perioperative care, and postoperative management were followed for all patients to ensure consistency across groups.

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Outcome Measures:

The primary outcome measures included stone clearance rate, defined as absence of residual stones on postoperative imaging at 3 months, and perioperative problems evaluated using the Clavien-Dindo classification system. Secondary outcome measures comprised operative time, hospital stay duration, analgesic requirements, and patient-reported outcomes such as postoperative pain scores and satisfaction rates.

Data Collection and Analysis:

Data pertaining to patient demographics, stone features, perioperative variables, and postoperative results were collected prospectively and entered into the dedicated electronic database. Statistical analysis was performed using proper parametric or non-parametric tests based on data distribution. A p-value <0.05 was measured statistically substantial.

Sample Size Calculation:

The sample size was calculated based on previous studies reporting stone clearance rates for FURS and Mini-PNL, aiming to detect a clinically significant difference among the two sets having 80% power and a two-sided alpha level of 0.05.

Ethical Considerations:

Informed consent was gained from altogether applicants after amplification of nature of research, potential risks, and benefits associated with each intervention. Patient confidentiality was maintained throughout the study, and data were anonymized during analysis to protect privacy.

RESULTS:

The research intended to measure efficiency and safety of these two slightly invasive techniques in managing this challenging condition.

Table 1: Treatment Results of Flexible Ureteroscopy (fURS):

Treatment Outcome	Value	Percentage (%)
Stone-free rate	85 patients	72%
Mean operative time -	58 minutes	
Mean hospital stay	1.5 days	-
Complication rate	12 patients	10%
Reintervention rate	7 patients	6%
Auxiliary procedures	22 patients	19%

In the fURS group, 85 out of 118 patients (72%) achieved a stone-free status postoperatively. The mean operative time for fURS was 58 minutes, having the relatively short hospital stay of 1.5 days on average. Difficulties occurred in 12 patients (10%), including ureteral injury and postoperative fever. Reintervention was required in 7 patients (6%) due to residual fragments or complications. Auxiliary procedures such as stenting and ancillary stone treatment were performed in 22 patients (19%) to optimize treatment outcomes.

Table 2: Treatment Outcomes of Mini-Percutaneous Nephrolithotomy (mini-PNL):

Treatment Outcome	Value	Percentage (%)
Stone-free rate	97 patients	84%
Mean operative time	74 minutes	-

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Mean hospital stay	2 days	-
Complication rate	9 patients	8%
Reintervention rate	4 patients	3.5%
Auxiliary procedures	15 patients	13%

In the mini-PNL group, 97 out of 115 patients (84%) achieved a stone-free status postoperatively. The average operative time for mini-PNL was 74 minutes, slightly longer than that of fURS. The average hospital stay for mini-PNL individuals was 2 days. Problems happened in 9 patients (8%), including bleeding and sepsis, which were managed appropriately. Reintervention was necessary in 4 patients (3.5%) due to residual stones or postoperative complications. Auxiliary procedures were performed in 15 patients (13%) to optimize stone clearance and ensure optimal outcomes.

DISCUSSION:

In the past, the treatment of upper calyceal calculi larger than 2 cm presented a challenge to urologists, who had to choose between various modalities such as flexible ureteroscopy (FURS) and mini-percutaneous nephrolithotomy (Mini-PNL). Prospective research intended to associate the treatment outcomes of these two techniques, shedding light on their efficacy and safety profiles [17].

The study involved a cohort of individuals having upper calyceal calculi larger than 2 cm who underwent either FURS or Mini-PNL between January 2018 and December 2019. The primary results evaluated were stone-free rates, operative time, hospital stay, and complication rates. Secondary outcomes included postoperative pain scores, analgesic necessities, and patient satisfaction [18].

The results of the study revealed several key findings. Firstly, in terms of stone-free rates, both FURS and Mini-PNL demonstrated comparable efficacy, with no significant difference between the two techniques [19]. This suggests that both modalities are effective in achieving complete stone clearance for upper calyceal calculi larger than 2 cm.

Operative time was found to be shorter with FURS compared to Mini-PNL [20]. This could be attributed to the less invasive nature of FURS, which involves accessing the stone through the urethra and ureter without the need for percutaneous access. In contrast, Mini-PNL requires the creation of a percutaneous tract, which may contribute to longer operative times [21].

Hospital stay was also shorter in the FURS group compared to the Mini-PNL group. This is consistent with the less invasive nature of FURS, which typically allows for quicker recovery and shorter hospitalization periods compared to Mini-PNL [22].

Regarding complications, both FURS and Mini-PNL were associated with similar rates of adverse events. Common complications included postoperative fever, urinary tract infections, and mucosal injury [23]. However, the general problem rates were relatively low for both techniques, indicating their safety and feasibility for the treatment of upper calyceal calculi larger than 2 cm.

In terms of postoperative pain, patients who underwent FURS reported lower pain scores and required fewer analgesics compared to those who underwent Mini-PNL [24]. This is consistent with the less invasive nature of FURS, which may result in reduced trauma to the surrounding tissues and less postoperative discomfort.

Patient satisfaction was high for both FURS and Mini-PNL, with the majority of patients reporting satisfaction with their chosen treatment modality. Factors such as stone-free status, minimal postoperative pain, and quick recovery likely contributed to overall patient satisfaction [25].

The comparative analysis of treatment outcomes between FURS and Mini-PNL for upper calyceal calculi larger than 2 cm demonstrated comparable stone-free rates and safety profiles. While FURS offered

advantages in terms of shorter operative time, hospital stay, and postoperative pain, both techniques were actual and well-tolerated by patients. The choice between FURS and Mini-PNL must be created on individual patient aspects, stone characteristics, and surgeon expertise.

CONCLUSION:

Our prospective study comparing treatment outcomes between flexible ureteroscopy and mini-percutaneous nephrolithotomy (mini-PCNL) for upper calyceal calculi larger than 2 cm provided valuable insights. The findings suggested that both procedures were effective in managing these challenging cases. However, mini-PCNL demonstrated slightly superior stone-free rates and shorter operative times compared to flexible ureteroscopy. Nonetheless, both techniques exhibited favorable safety profiles with low complication rates. Clinicians should consider patient-specific factors and stone characteristics when selecting the most appropriate treatment approach. More researches having larger population sizes and longer follow-up stages are warranted to corroborate those results and optimize clinical decision-making.

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