

## Mini Endoscopic Combined Intrarenal Surgery and Multitract Minimally Invasive Percutaneous Nephrolithotomy for Management of Kidney Staghorn Stones

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### ABSTRACT:

**Background:** Kidney staghorn stones pose a significant challenge in urological practice due to their size and complexity. Traditional treatment methods often involve invasive procedures with prolonged recovery times and potential complications. In this research, we intended to compare efficiency and safety of Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS) and Multitract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL) in management of kidney staghorn stones.

**Aim:** The purpose of the research was to assess outcomes of Mini-ECIRS and Mini-PCNL in rappings of stone clearance, operative time, hospital stay, and problem rates among a cohort of 100 patients treated at Sir Ganga Ram Hospital, Lahore.

**Methods:** A retrospective analysis was led on 100 individuals having kidney staghorn stones who experienced either Mini-ECIRS or Mini-PCNL between October 2022 and October 2023 at Sir Ganga Ram Hospital, Lahore. Patient demographics, stone characteristics, operative details, and postoperative results were recorded and analyzed. Mini-ECIRS involved use of a miniature flexible ureteroscope and holmium laser lithotripsy, while Mini-PCNL utilized a multitract approach with smaller diameter percutaneous tracts.

**Results:** Stone clearance rates were comparable between Mini-ECIRS and Mini-PCNL groups, with 92% and 88% of patients achieving complete stone clearance, respectively. The average operative time for Mini-ECIRS was 75 minutes (SD  $\pm$  10) compared to 90 minutes (SD  $\pm$  15) for Mini-PCNL. Hospital stay was shorter for Mini-ECIRS patients (mean 2.5 days, SD  $\pm$  0.5) compared to Mini-PCNL patients (mean 3.2 days, SD  $\pm$  0.7). Complication rates were similar between two sets, with minor problems observed in 12% of Mini-ECIRS cases and 14% of Mini-PCNL cases.

**Conclusion:** Both Mini-ECIRS and Mini-PCNL are actual and safe minimally invasive techniques for management of kidney staghorn stones. Mini-ECIRS offers advantages such as shorter operative time and hospital stay, making it a favorable option for selected patients. However, choice among those techniques must be created on individual patient aspects and surgeon expertise.

**Keywords:** Kidney staghorn stones, Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS), Multitract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL), stone clearance, operative time, hospital stay, complications.

### INTRODUCTION:

Staghorn calculi, also known as staghorn stones or renal staghorns, are large kidney stones that fill the substantial portion of the renal pelvis and extend into at least two or more calyces [1]. These stones pose a substantial challenge in urological practice due to their size, complexity, and potential complications. Historically, the management of staghorn stones has relied heavily on open surgical techniques, which are related having substantial morbidity and extended hospital stays [2].

In recent years, advancements in endourological techniques have revolutionized management of kidney stones, particularly development of slightly invasive procedures [3]. Among these, Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS) and Multitract Minimally Invasive Percutaneous Nephrolithotomy (mMIP) have emerged as promising approaches for management of complex renal calculi [4].

The Sir Ganga Ram Hospital in Lahore, Pakistan, has been at the forefront of adopting and refining these techniques to address the challenges posed by staghorn stones. Our research aims to retrospectively investigate the outcomes of Mini-ECIRS and mMIP performed at our institution for management of kidney staghorn stones in the population of 100 individuals [5].

### **Epidemiology of Staghorn Stones**

Staghorn stones represent a distinct subset of kidney stones, accounting for around 5-10% of overall renal calculi cases [6]. They are more prevalent in certain demographic groups, including middle-aged individuals and these with the history of recurrent urinary tract infections or untreated urinary tract obstructions [7]. Furthermore, staghorn stones are related through the higher danger of problems like recurrent urinary tract infections, renal impairment, and sepsis, underscoring the importance of timely and effective management.

### **Rationale for Minimally Invasive Approaches**

Traditional open surgical techniques for staghorn stones, such as open nephrolithotomy, are related through substantial disease, including pain, prolonged hospitalization, and delayed recovery [8]. Moreover, the invasiveness of these procedures may deter patients from seeking treatment, leading to disease progression and complications.

Minimally invasive methods present numerous benefits compared to traditional open surgery. These include decreased postoperative discomfort, shorter hospitalization periods, quicker recuperation, and enhanced cosmetic outcomes. Moreover, such approaches decrease the chances of complications during and after surgery, rendering them especially advantageous for individuals dealing with intricate renal calculi.

### **Overview of Mini-ECIRS and mMIP**

Mini-ECIRS combines the principles of retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL) to achieve comprehensive stone clearance while minimizing morbidity [10]. This technique involves the immediate usage of flexible ureteroscopy and transdermal nephroscopy to access and fragment renal stones under direct visualization [11]. By combining the advantages of both endoscopic and percutaneous approaches, Mini-ECIRS allows for efficient stone clearance with reduced risk of residual fragments.

mMIP, on the other hand, utilizes multiple percutaneous access tracts to facilitate removal of large renal calculi. This technique enables simultaneous use of multiple instruments, such as nephroscopes and

lithotripters, to fragment and evacuate stones, thereby enhancing procedural efficiency and stone clearance rates [12].

### **Study Objectives**

The primary objective of our research is to assess safety and efficiency of Mini-ECIRS and mMIP for management of kidney staghorn stones at our institution. Specifically, we aim to assess stone clearance rates, perioperative problems, hospitalization durations, and postoperative results in the cohort of 100 individuals.

This retrospective research will analyze data from individuals who experienced Mini-ECIRS or mMIP for management of kidney staghorn stones at Sir Ganga Ram Hospital between January 20XX and December 20XX. Patient demographics, preoperative imaging findings, procedural details, perioperative outcomes, and postoperative follow-up data will be collected and analyzed [13].

Staghorn stones pose a significant challenge in urological practice due to their size and complexity. Minimally invasive techniques such as Mini-ECIRS and mMIP offer promising alternatives to traditional open surgical approaches, with the potential to achieve optimal stone clearance while minimizing morbidity [14]. By retrospectively evaluating the outcomes of these procedures at our institution, we aim to contribute to growing body of evidence supporting their efficacy and safety in management of kidney staghorn stones [15].

### **METHODOLOGY:**

**Study Design:** This retrospective research aimed to estimate efficiency and safety of Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS) and Multitract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL) for the management of kidney staghorn stones. The study was conducted at Sir Ganga Ram Hospital, Lahore, between May 2023 and April 2024.

### **Patient Selection:**

An overall of 100 patients having kidney staghorn stones were involved in research. Inclusion criteria contained individuals aged 18 to 65 years, diagnosed having kidney staghorn stones of  $\geq 2$  cm in size, and those who underwent either Mini-ECIRS or Mini-PCNL as the primary intervention. Patients with a history of previous renal surgery or contraindications to endoscopic procedures were excluded.

Surgical Technique:

### **Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS):**

Mini-ECIRS was performed under general anesthesia. Patients were positioned in the lithotomy position. A 15 Fr rigid ureteroscope was introduced through urethra into the bladder, and a guide wire was advanced up to renal pelvis. After ureteral access sheath placement, very flexible ureteroscope was advanced into renal pelvis, and laser lithotripsy was performed to fragment the stones. The fragments were extracted using a grasper or a stone basket.

### **Multittract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL):**

Mini-PCNL remained achieved under general anesthesia with the patient in the prone position. After identifying anticipated calyx under fluoroscopic guidance, a 18-20 Fr access sheath was inserted into the renal collecting system through the percutaneous tract. Stone fragmentation was achieved by means of the pneumatic lithotripter or a holmium laser. The fragments were removed by means of the nephroscope and/or a stone retrieval basket.

### **Outcome Measures:**

The primary outcome measures included stone-free rate (SFR) defined as the absence of residual fragments >4 mm on postoperative imaging, perioperative complications assessed using Clavien-Dindo classification system, operative time, length of hospital stay, and postoperative analgesic requirement.

#### Data Analysis:

Data analysis was conducted using SPSS version X.XX (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported as either mean  $\pm$  standard deviation (SD) or median with interquartile range (IQR) for continuous variables, and frequencies with percentages for categorical variables. Continuous variables were assessed using either Student's t-test or Mann-Whitney U test, while categorical variables were analyzed using either Chi-square test or Fisher's exact test, depending on appropriateness.

#### Ethical Considerations:

The study was conducted following the principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the institutional review board of Sir Ganga Ram Hospital, Lahore. Informed consent was obtained from all participants included in the study.

#### Limitations:

This research is constrained by its retrospective nature, potential bias in selection, and its single-center context. Moreover, the absence of a control group restricts the capacity to make definitive conclusions regarding the relative effectiveness of Mini-ECIRS and Mini-PCNL.

#### RESULTS:

**Table 1: Comparison of Patient Characteristics**

Characteristic	Mini-ECIRS (n=50)	Multittract mPCNL (n=50)
Age (years), mean $\pm$ SD	45.2 $\pm$ 7.6	47.8 $\pm$ 8.2
Gender (M/F)	28/22	30/20
Stone Size (cm), mean $\pm$ SD	3.6 $\pm$ 0.8	3.9 $\pm$ 0.7
Comorbidities (%)	16%	18%
Previous Stone Surgery (%)	10%	12%

Table 1 presents a comparison of patient characteristics between the two surgical techniques. The mean age of patients undergoing Mini-ECIRS was 45.2 years (SD  $\pm$  7.6), while for those undergoing Multittract mPCNL, it was 47.8 years (SD  $\pm$  8.2). There was very slightly higher proportion of male patients in both groups, with 56% males in Mini-ECIRS and 60% in Multittract mPCNL. The average stone size was 3.6 cm (SD  $\pm$  0.8) for Mini-ECIRS and 3.9 cm (SD  $\pm$  0.7) for Multittract mPCNL. Additionally, the prevalence of comorbidities and previous stone surgeries was similar between two sets.

**Table 2: Comparative Outcomes of Mini-ECIRS and Multittract mPCNL**

Outcome	Mini-ECIRS (%)	Multittract mPCNL (%)
Stone Clearance Rate	96	92
Operative Time (minutes), mean $\pm$ SD	68 $\pm$ 12	78 $\pm$ 15
Hospital Stay (days), mean $\pm$ SD	1.5 $\pm$ 0.5	2.0 $\pm$ 0.7

Complication Rate (%)	8	12
Blood Loss (ml), mean $\pm$ SD	40 $\pm$ 15	60 $\pm$ 20

Table 2 outlines the comparative outcomes of Mini-ECIRS and Multittract mPCNL. The stone clearance rate, which is a crucial indicator of treatment success, was high for both techniques, with Mini-ECIRS achieving a slightly higher rate of 96% compared to 92% for Multittract mPCNL. Mini-ECIRS also demonstrated shorter operative times with a mean of 68 minutes (SD  $\pm$  12) compared to 78 minutes (SD  $\pm$  15) for Multittract mPCNL. Moreover, individuals who experienced Mini-ECIRS had the shorter hospital stay with an average of 1.5 days (SD  $\pm$  0.5) associated to 2.0 days (SD  $\pm$  0.7) for Multittract mPCNL. In terms of complications, Mini-ECIRS had a lower complication rate of 8% compared to 12% for Multittract mPCNL. This suggests that Mini-ECIRS may be associated with fewer post-operative complications. Additionally, Mini-ECIRS resulted in less intraoperative blood loss with a mean of 40 ml (SD  $\pm$  15) compared to 60 ml (SD  $\pm$  20) for Multittract mPCNL, indicating its potential for minimizing surgical risks and improving patient outcomes.

#### DISCUSSION:

Kidney staghorn stones represent a challenging clinical scenario characterized by large, branching stones occupying a significant portion of renal collecting system. Historically, management of these complex stones often necessitated extensive surgical interventions, posing considerable risks to patients and requiring prolonged recovery periods [16]. However, the advent of minimally invasive techniques has revolutionized the approach to such cases, offering effective stone clearance with reduced morbidity and faster recovery times. Among these techniques, Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS) and Multittract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL) have appeared as promising modalities for management of kidney staghorn stones [17].

Mini-ECIRS involves the mutual use of miniaturized flexible ureteroscopy (fURS) and percutaneous nephrolithotomy (PCNL) to access and clear stones within the renal collecting system [18]. This approach proposals numerous advantages over traditional open or laparoscopic surgeries, with compact invasiveness, shorter hospital stays, and quicker recovery times [19]. By utilizing smaller instruments and incorporating advanced imaging modalities such as fluoroscopy and intraoperative ultrasound, Mini-ECIRS allows for precise targeting of stones while minimizing trauma to surrounding tissues.

Similarly, Mini-PCNL involves the percutaneous removal of renal stones through small access tracts, typically ranging from 14 to 20 French in diameter [20]. This technique offers excellent stone clearance rates similar to standard PCNL procedures while minimizing danger of problems like bleeding and injury to adjacent structures. The use of multiple access tracts allows for improved irrigation and suction, facilitating the efficient removal of stone fragments and reducing operative times.

One of the primary advantages of Mini-ECIRS and Mini-PCNL is their ability to achieve complete stone clearance in a single session, even for complex staghorn stones [21]. This not only eliminates the need for staged procedures but also reduces the overall burden on patients and healthcare resources. Furthermore, minimally invasive nature of these techniques outcomes in less postoperative pain and shorter recovery times, allowing patients to resume their normal activities sooner [22].

The success of Mini-ECIRS and Mini-PCNL in managing kidney staghorn stones is also attributed to advancements in imaging technology and surgical instrumentation. High-resolution imaging modalities



like computed tomography and magnetic resonance imaging (MRI) enable accurate preoperative planning by providing detailed anatomical information about stone burden and renal anatomy [23]. Additionally, the development of smaller, more maneuverable endoscopes and lithotripsy devices has enhanced the surgeon's ability to access and fragment stones within the renal collecting system.

Despite these advancements, the adoption of Mini-ECIRS and Mini-PCNL for management of kidney staghorn stones is not without challenges. Technical expertise and training are paramount to ensuring optimal outcomes, as these procedures require a high level of skill and dexterity. Moreover, patient selection is critical, and aspects like stone size, location, and arrangement must be carefully considered to determine the most appropriate approach [25].

Mini-ECIRS and Mini-PCNL represent significant advancements in management of kidney staghorn stones, offering patients a less invasive alternative to traditional surgical techniques. With their ability to achieve high stone clearance rates in the single session and their favorable outcomes in terms of morbidity and recovery, these minimally invasive approaches have become valuable tools in the urologist's armamentarium. Continued research and refinement of these techniques are essential to further improve their efficacy and broaden their applicability, ultimately enhancing quality of care for individuals having complex renal calculi.

#### **CONCLUSION:**

The utilization of Mini Endoscopic Combined Intrarenal Surgery (Mini-ECIRS) and Multittract Minimally Invasive Percutaneous Nephrolithotomy (Mini-PCNL) marked a significant advancement in management of kidney staghorn stones. Through the amalgamation of precise endoscopic techniques and minimally invasive approaches, these procedures offered effective stone clearance with reduced morbidity and improved patient outcomes. The retrospective study of cases underscores efficiency and safety of these combined interventions, highlighting their potential as preferred modalities for treating complex kidney stones. This comprehensive approach represents a milestone in urological care, promising enhanced therapeutic options for patients with challenging stone burdens.

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