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Original article

Evaluating Outcomes of Percutaneous Nephrolithotomy Versus Flexible Ureteroscopy for Renal Calculi: A Retrospective Observational Study in Misrata, Libya

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Abstract
Nephrolithiasis is a significant and growing global health burden with rising prevalence and recurrence rates. Management of renal calculi sized 1–2.5 cm remains debated, with percutaneous nephrolithotomy (PCNL) and flexible ureteroscopy (fURS) being the most commonly used minimally invasive approaches. Evidence comparing both procedures in the Libyan setting is limited. This study aimed to compare the efficacy and safety outcomes of PCNL and fURS in patients with renal stones sized 1–2.5 cm, with a focus on perioperative characteristics, renal function, stone-free rate (SFR), and postoperative complications. A retrospective, multicenter observational study was conducted at two hospitals in Misrata, Libya, between January 2020 and December 2024. A total of twenty patients were included, equally divided between PCNL (n=10) and fURS (n=10). Demographic, clinical, and perioperative variables were collected from patient records. Outcomes assessed included renal function, SFR, drainage method, complications, blood transfusion, and need for secondary intervention. The mean age was 49.2 ± 12.2 years, with male predominance 55%. Solitary stones (75%) and renal pelvis location (60%) were the most common. The fURS group had a significantly higher prevalence of patients with a history of renal stones (70% vs. 20%, p=0.025) and previous extracorporeal shockwave lithotripsy (ESWL) (60% vs. 10%, p=0.019). Postoperatively, renal function abnormalities occurred only in fURS cases (p = 0.025). Drainage methods differed significantly, with fURS exclusively using double J stents and PCNL with a nephrostomy tube (p = 0.001). No statistically significant differences were found in SFR, operation time, hospital stay, fever, or transfusion rates between the two groups. Both PCNL and fURS are effective and safe for managing 1–2.5 cm renal stones, with comparable SFRs and complication rates. fURS were more commonly employed after failed conservative management and were associated with transient renal function impairment, whereas PCNL required nephrostomy drainage. Larger, prospective studies are needed to confirm these findings and guide practice in Libya.
Keywords*. Percutaneous Nephrolithotomy, Flexible Ureteroscopy, Renal Calculi, Kidney Stones, Libya.*

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Introduction

Nephrolithiasis (kidney stones) represents a growing global urological burden, with a lifetime prevalence up to 13% in North America, 9% in Europe, 5% in Asia, and 4.6% in Sub-Saharan Africa [1,2]. Epidemiological studies have shown a substantial increase in incidence across regions, reflecting changes in demographics, lifestyle, and improved imaging-based detection [3,4]. The clinical picture accompanying this condition varies with a wide clinical spectrum from asymptomatic, incidentally detected stone to those that cause severe pain, infections, or renal impairment. Their presentation, composition, and size are influenced by patient factors (age, sex, direct occupational exposure, genetic constitution, metabolic comorbidities, and dietary patterns), environmental exposures (temperature, latitude, and hydration), all of which contribute to a different management approach [4-6].

Over the years, interventional management of intermediate- to large-sized stones (1.0–2.5 cm) has evolved steadily [7-12]. Extracorporeal shockwave lithotripsy (ESWL) was considered the standard for intermediate-sized stones of ≤ 2 cm, while percutaneous nephrolithotomy (PCNL) was favored for larger diameters > 2 cm [8,10]. Since the early 2000s, flexible ureteroscopy (fURS) and miniaturized PCNL (mPCNL) have emerged as alternatives to address the limitations of ESWL [10,11].

This retrospective observational study is the first in Libya to compare the efficacy and safety of PCNL versus fURS for renal calculi measuring 1.0–2.5 cm. It describes perioperative and postoperative outcomes and complications, with emphasis on renal function and the stone-free rate (SFR), aiming to provide evidence relevant for clinical practice and policy making.

In Libya, the significantly limited evidence provided in only one documentation of data in Benghazi shows an alarming prevalence of KSD 27.1% with higher rates in males and a peak incidence in the 40–49 age group [13]. For a broader context, the age-standardized incidence rate of urotheliasis in total is (827 – <1006 per 100,000), while the age-standardized death rate is (0.07 – <0.13 per 100,000), which reflects relatively lower rates compared to the other countries [3]. Although nephrolithiasis constitutes a considerable proportion of urolithiasis cases, the relatively lower mortality rates are reassuring prognostic indicators.

Clinical Presentation and Burden

The initial presentation of nephrolithiasis is often with renal colicky severe pain caused by stone passage triggered by movement of a stone from the renal pelvis into the ureter, which leads to ureteral spasm and possibly obstruction [14]. Pain typically begins in the flank and radiates downward and anteriorly into the genital region as the stone descends. The pain is usually unaffected by position and may be accompanied by nausea, vomiting, or hematuria, which may be microscopic [14].

Stones lodged at the ureterovesical junction can cause a sensation of urinary frequency and urgency. All symptoms are relieved quite abruptly when the stone moves out of the ureter into the bladder and passes [14]. Hospitalization and active management are required in the presence of urinary tract infection, inability to tolerate oral fluids, or obstruction of a solitary functioning kidney [15]. Between 2000 and 2019, global kidney stone-related incidence, deaths, and disability-adjusted life years increased by 26.7%, 60.3%, and 34.5%, respectively, highlighting the growing public health burden [16].

Management Approaches

Medical Treatment

Several drugs are available to be used as medical expulsive therapy (MET) for urolithiasis. These include α-blockers, calcium channel inhibitors, and phosphodiesterase type 5 (PDE5) inhibitors. Although an off-label indication, a class effect of α-blockers has been demonstrated as MET through various meta-analyses [12]. The EAU strongly recommends α-blockers for distal ureteral stones >5 mm, while the AUA strongly recommends α-blockers for distal ureteral stones ≤10 mm [12].

Oral chemolitholysis, based on the alkalinisation of the urine by alkaline citrate or sodium bicarbonate, can be used to dissolve uric acid stones [12]. Although long used, no randomized controlled trials (RCTs) have evaluated this treatment. Potassium citrate should be offered for the alkalinisation of urine to patients with uric acid and cystine stones [12]. However, favourable outcomes in the form of stone dissolution are inconsistent (AUA: expert opinion). Patients receiving this treatment should be monitored during and after chemolysis, instructed on urinary pH self-monitoring, and have their drug dose adjusted accordingly (EAU: strong recommendation) [12].

Interventional Treatment

The AUA and EAU guidelines differ in their recommendations for interventional management, which includes ESWL, fURS, PCNL, and open/laparoscopic surgery.

ESWL

ESWL is considered safer but less practical than fURS or PCNL, which are comparable in efficacy. Its limitations and contraindications—including uncontrolled infection, severe obesity, skeletal deformities, pregnancy, and other conditions—have reduced its role in treating 10–20 mm renal stones [10,12].

fURS

Both guidelines discourage routine pre-stenting before ureteroscopy, though the AUA notes potential benefits without strong evidence [12]. Post-procedure stents should be avoided in low-risk patients, and alpha-blockers are advised if stents are used [12]. The EAU recommends direct visualization during stone removal, the use of ureteral access sheaths for prolonged procedures, and the Ho: YAG laser for fragmentation, while the thulium fiber laser (TFL) needs more studies [12]. Both sets of guidelines recommend the use of prophylactic antibiotics. The EAU suggests fURS for stones >2 cm if other options fail, and both recommend URS for patients on anticoagulants. Aside from standard surgical risks, URS has no major contraindications [12].

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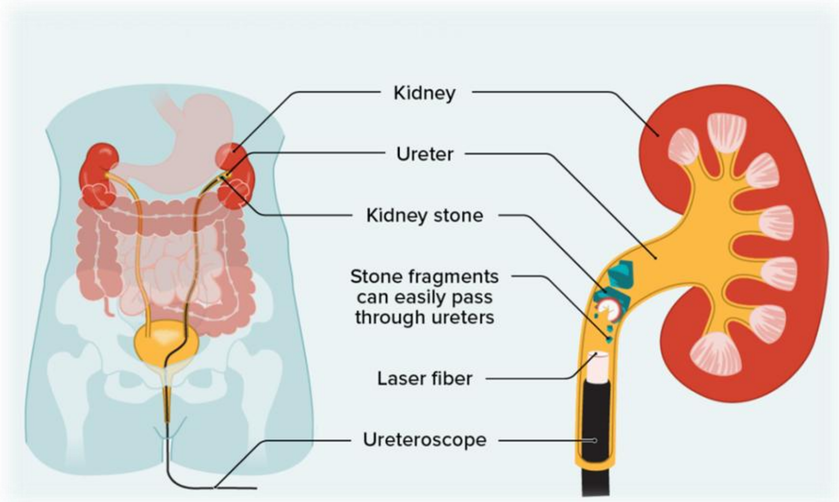

Figure **1.** ***Flexible Ureteroscopy With Laser Lithotripsy.***

PCNL

CNL is the first-line treatment for large stones, as it has no size or composition limitations. Preoperative imaging is required: ultrasound or CT according to the EAU, and non-contrast CT (NCCT) according to the AUA.

Over the years, various technical modifications have been developed to improve outcomes and reduce complications. Regarding patient positioning, both prone and supine approaches are considered safe. The development of mini-PCNL has further enhanced the procedure by reducing blood loss and shortening hospital stay [12]. Irrigation with normal saline is strongly recommended by the AUA to minimize electrolyte disturbances.

In uncomplicated cases, tubeless or totally tubeless PCNL may accelerate recovery, with the EAU giving a strong recommendation and the AUA a conditional recommendation [12]. To reduce postoperative infectious complications, the EAU also advises obtaining pelvic urine or stone cultures during the procedure, as they may help predict sepsis. Contraindications include pregnancy, untreated infection, anticoagulation, and tumors in the access tract [12].

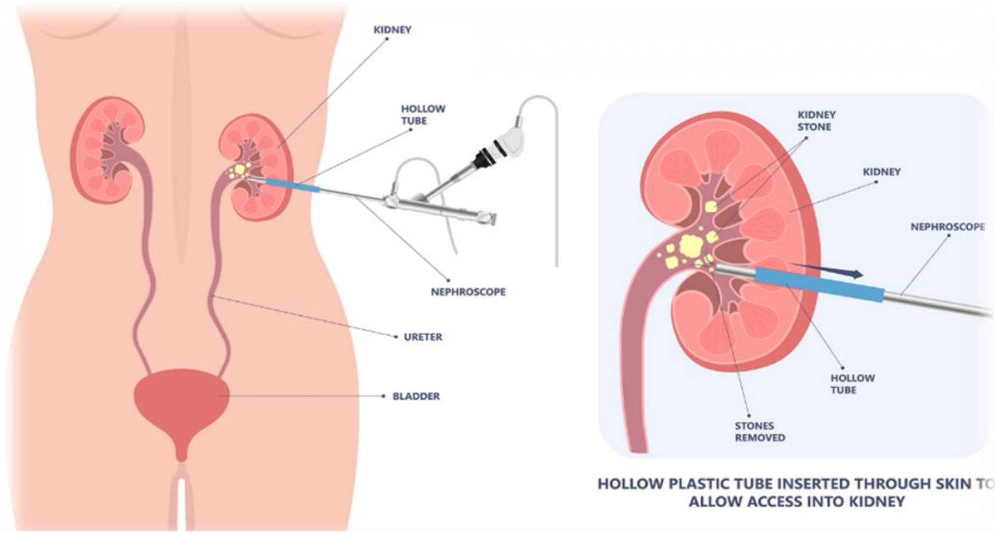

Figure **2.** ***Percutaneous Nephrolithotomy.***

Open/Laparoscopic surgery:

Open and laparoscopic surgery are now rarely performed for nephrolithiasis, as minimally invasive techniques such as ESWL, fURS, and PCNL are generally preferred. Both the AUA and EAU guidelines reserve open or laparoscopic approaches for complex cases in which less invasive methods are likely to fail. In addition, the AUA highlights its potential role when anatomical reconstruction is required, such as in patients with significant urinary tract abnormalities [12]. Although effective, these procedures are associated with longer recovery, greater morbidity, and higher healthcare costs compared to endourological options, which explains their limited use in current practice [12].

Methods

Study Design

This was an observational, retrospective multicenter study, utilizing data of patients undergoing procedures (PCNL or fURS) for treatment of kidney stones measuring 1cm to 2.5 cm to determine the procedure with better outcomes.

Study Setting

The study was conducted in two medical centers in Misrata city: Misurata Medical Center and Assafwa Hospital, in the northwest part of Libya. Data were collected between January 1, 2020, and December 31, 2024.

Study Population.

All patients who underwent either fURS or PCNL during the study period were eligible for inclusion

Inclusion and Exclusion criteria

Inclusion criteria:

Patient age >18 years.
Patients confirm the diagnosis of unilateral or bilateral nephrolithiasis and even in the renal pelvis or renal calyces.
Patient has more than 1cm and less than 2.5 cm stone sizes.
Patient underwent one of the two procedures: percutaneous nephrolithotomy or flexible ureteroscopy.

Exclusion Criteria

All the following categories were excluded: Children under 18 years of age, patient who has a stone of more than 2.5 cm or less than 1 cm, patient under open technique, and combined with ureteric stones.

Ethical Approval

Permission to access and analyze patient records was obtained from the administration of Misurata Medical Center. Patient confidentiality was strictly maintained throughout the study, and data were used solely for research purposes.

Data collection

Data were collected from patient records, encompassing a range of demographic, clinical, pre- and post-operative outcomes. The collected variables included: Demographics as age (years) and gender (male/female), Renal stone history in terms of stone number, laterality, size, site, and local stone complication (Hydronephrosis degree), crucial history including chronic diseases, e.g., (DM, HTN, others), and congenital anomalies, Pre-operative anti-infection protocol in terms of pre-operative antibiotics (yes/no) and pre-operative sterile culture (yes/no), post-operative outcomes including Renal filtration rate, SFR, drainage approach, complication (s), operation time, blood transfusion, hospitalization, bilateral intervention and need for 2nd intervention.
N.B: Postoperative stone-free rate (SFR) was defined as the absence of any residual fragments (0 mm) on imaging. Assessment was performed at 4 weeks post-procedure using non-contrast computed tomography (NCCT). Residual fragments were categorized by their largest diameter as measured on axial imaging.

Data Analysis

All statistical analyses were performed using Jamovi software (version 2.3.28). Descriptive statistics were calculated for all variables, with continuous data presented as mean ± standard deviation (SD), and categorical data summarized using frequencies and percentages.
For comparative analyses, independent t-tests were used to compare means between groups when data were normally distributed, while the Mann-Whitney U test was applied for non-normally distributed variables. Statistical significance was defined as $p < 0.05$.

Results

Characteristics of the Included Population

This study included a total of 20 patients; equally distributed between the fURS (n = 10) and PCNL (n = 10) groups. The mean age was 49.2 (±12.2) with a range of 29.0 - 80.0 years, while many ages (50%) fell between 44 - 56 years. More than half of the population is male gender (55%).

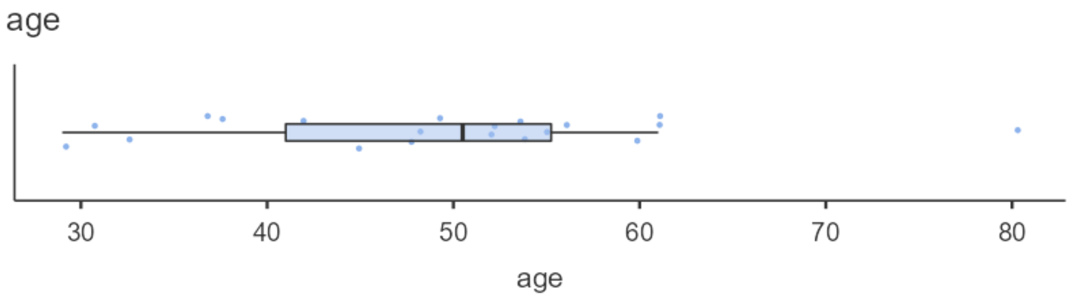

Figure 3. A box plot elaborating the distribution of age among the population.

Previous clinical history of renal stones revealed that nine patients (45.0%) had prior renal stones, and seven patients (35.0%) had previously undergone ESWL. Most of the stones show solitary stones as the most frequent in 15 (75 %) cases, mostly prevalent in the renal pelvis 12 (60.0%), with a mean size of 1.195 ± 0.42 cm. All patients had a degree of hydronephrosis as a complication, mostly between first and second degree. Comorbidities were present in 11 patients (55%), resembling diabetes mellitus (DM) and systemic hypertension (HTN) being the most common. A comprehensive summary of the clinical and demographic characteristics can be found in (Table 1).

Table 1. Characteristics of the Included Population.

Variable	Overall (N=20)
Surgery type, n (%)	
fURS	10 (50.0%)
PCNL	10 (50.0%)
Age (years)	
Mean (SD)	49.2 (12.2)
Range	29.0 - 80.0
Gender, n (%)	
F	9 (45.0%)
M	11 (55.0%)
Renal stone history, n (%)	
No	11 (55.0%)
Yes	9 (45.0%)
History of ESWL	
No	13 (65.0%)
Yes	7 (35.0%)
Stone number, n (%)	
1	15 (75 %)
2	3 (15%)
Bilateral	2 (10%)
Stone site, n (%)	
lower calyces	5 (25.0%)
pelvic-ureteric junction	2 (10.0%)
Renal pelvis	12 (60.0%)
renal pelvis and lower calyces	1 (5.0%)
Stone size (cm)	
Mean (SD)	1.195 (0.42)
Range	1.0 – 2.5
Bilateral nephrolithiasis, n (%)	
No	18(%)

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Yes	2 (%)
Hydronephrosis degree	
0	2 (10.0%)
1	9 (45.0%)
2	8 (40.0%)
3	1 (5.0%)
Hospital stay (day)	
Mean (SD)	2.8 (1.4)
Range	1.0 - 6.0
Fever, n (%)	
No	9 (45.0%)
Yes	11 (55.0%)
Blood transfusion, n (%)	
No	15 (75.0%)
Yes	5 (25.0%)
Comorbidity, n (%)	
No	9 (45.0%)
DM	1 (5.0%)
DM, HTN	3 (15.0%)
HTN	4 (20.0%)
Old CVA	1 (5.0%)
Smoker	1 (5.0%)
Vasculitis	1 (5.0%)
Congenital anomaly, n (%)	
No	20 (100.0%)
Pre-operative antibiotics, n (%)	
No	3 (15.0%)
Yes	17 (85.0%)
Pre-operative sterile culture, n (%)	
No	1 (5.0%)
Yes	19 (95.0%)

Pre- and Post-Operative Analysis

Outcomes were categorized as statistically significant or non-significant.

Statistically significant outcomes

The fURS group showed a higher frequency in all statistically significant outcomes. The pre-operative outcomes, a history of renal stones in the fURS group was more than the PCNL group (p-value = 0.025). Additionally, previous

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ESWL was more frequent in the URS group (p= 0.019). Most notably, in post-operative outcomes, renal function abnormalities were seen only in the fURS group (p-value = 0.025).
Post-operative drainage differed between groups, as shown in Figure 4, fURS was almost exclusively followed by double J stenting, while PCNL used all recorded nephrostomy procedures. Detailed perioperative outcomes are summarized in (Table 2).

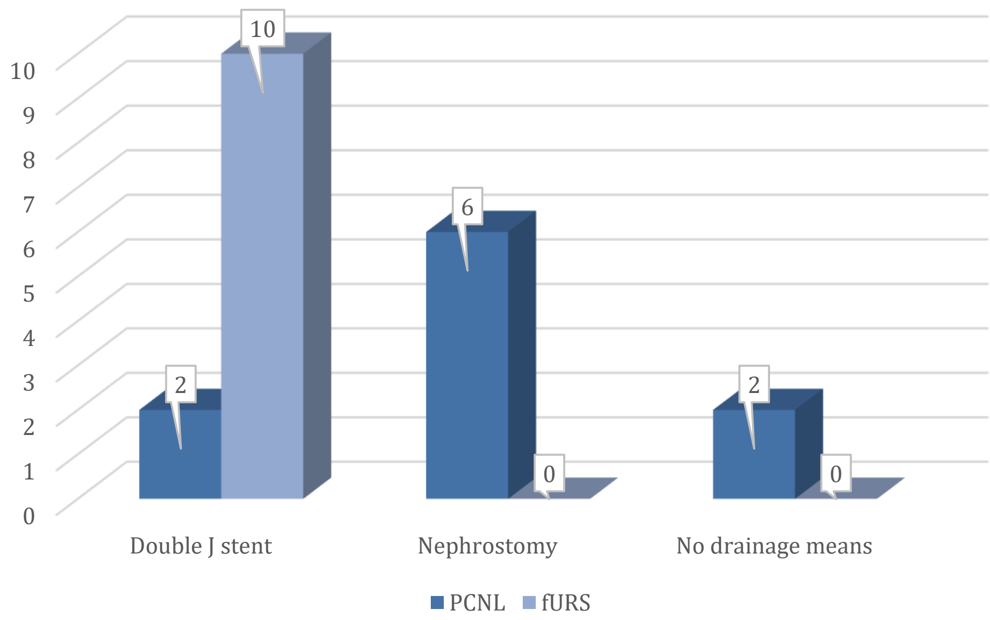

Figure 4. Post-operative Drainage means.

Table 2. Significant perioperative outcomes.

Variable	**fURS (N=10)**	**PCNL (N=10)**	**Total (N=20)**	**P value**
Pre-operative risk factors				
History of renal stones, n (%)				0.025
No	3.0 (30.0%)	8.0 (80.0%)	11.0 (55.0%)	
Yes	7.0 (70.0%)	2.0 (20.0%)	9.0 (45.0%)	
History of ESWL, n (%)				0.019
No	4.0 (40.0%)	9.0 (90.0%)	13.0 (65.0%)	
Yes	6.0 (60.0%)	1.0 (10.0%)	7.0 (35.0%)	
Post-operative outcomes				
Renal filtration post-operative, n (%)				0.025
High	4.0 (40.0%)	0.0 (0.0%)	4.0 (20.0%)	
Normal	6.0 (60.0%)	10.0 (100.0%)	16.0 (80.0%)	
Post-operative drainage, n (%)				0.001
Double J stent	10.0 (100.0%)	2.0 (20.0%)	12.0 (60.0%)	
Nephrostomy	0.0 (0.0%)	6.0 (60.0%)	6.0 (30.0%)	
No drainage means	0.0 (0.0%)	2.0 (20.0%)	2.0 (10.0%)	

Statistically insignificant outcomes

No significant differences were observed in demographic characteristics between groups. Important clinical outcomes, such as stone-free rates and other perioperative parameters, were similar, as were comorbidities, which showed no clear influence on outcome risk. Further details are provided in (Table 3).

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Table 3. Insignificant perioperative outcomes.

Variable	fURS (N=10)	PCNL (N=10)	Total (N=20)	p value
Age (years)				
Mean (SD)	53.3 (11.4)	45.2 (12.2)	49.2 (12.2)	0.142
Range	37.0 - 80.0	29.0 - 61.0	29.0 - 80.0	
Gender, n (%)				
F	4.0 (40.0%)	5.0 (50.0%)	9.0 (45.0%)	0.653[2]
M	6.0 (60.0%)	5.0 (50.0%)	11.0 (55.0%)	
Pre-operative risk factors				
Stone number, n (%)				
1.0	7.0 (70.0%)	8.0 (80.0%)	15.0 (75.0%)	
2.0	1.0 (10.0%)	2.0 (20.0%)	3.0 (15.0%)	
Bilateral	2.0 (20.0%)	0.0 (0.0%)	2.0 (10.0%)	
Stone site, n (%)				
Lower calyces	1.0 (10.0%)	4.0 (40.0%)	5.0 (25.0%)	
Pelvi-ureteric junction	2.0 (20.0%)	0.0 (0.0%)	2.0 (10.0%)	0.162[2]
Renal pelvis	7.0 (70.0%)	5.0 (50.0%)	12.0 (60.0%)	
Renal pelvis, lower calyces	0.0 (0.0%)	1.0 (10.0%)	1.0 (5.0%)	
Stone size (cm)				
Mean (SD)	1.8 (0.3)	2.1 (0.5)	1.9 (0.4)	0.141[1]
Range	1.2 - 2.3	1.1 - 2.5	1.1 - 2.5	
Hydronephrosis degree, n (%)				
0	0.0 (0.0%)	2.0 (20.0%)	2.0 (10.0%)	
1	3.0 (30.0%)	6.0 (60.0%)	9.0 (45.0%)	0.112[2]
2	6.0 (60.0%)	2.0 (20.0%)	8.0 (40.0%)	
3	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Hospital stay (days)				
Mean (SD)	2.3 (1.3)	3.3 (1.4)	2.8 (1.4)	0.122[1]
Range	1.0 - 5.0	2.0 - 6.0	1.0 - 6.0	
Fever, n (%)				
No	3.0 (30.0%)	6.0 (60.0%)	9.0 (45.0%)	0.178[2]

Yes	7.0 (70.0%)	4.0 (40.0%)	11.0 (55.0%)	
Blood transfusion, n (%)				0.121[2]
No	9.0 (90.0%)	6.0 (60.0%)	15.0 (75.0%)	
Yes	1.0 (10.0%)	4.0 (40.0%)	5.0 (25.0%)	
Comorbidity, n (%)				0.174[2]
No	3.0 (30.0%)	6.0 (60.0%)	9.0 (45.0%)	
DM	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
DM, HTN	3.0 (30.0%)	0.0 (0.0%)	3.0 (15.0%)	
HTN	1.0 (10.0%)	3.0 (30.0%)	4.0 (20.0%)	
Old CVA	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Smoker	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Vasculitis	0.0 (0.0%)	1.0 (10.0%)	1.0 (5.0%)	
Congenital Anomaly, n (%)				1.000[3]
No	10.0 (100.0%)	10.0 (100.0%)	20.0 (100.0%)	
Ureteral stricture, n (%)				0.329[2]
No	8.0 (80.0%)	10.0 (100.0%)	18.0 (90.0%)	
Yes	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Unknown	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Pre-operative antibiotics, n (%)				0.531[2]
No	1.0 (10.0%)	2.0 (20.0%)	3.0 (15.0%)	
Yes	9.0 (90.0%)	8.0 (80.0%)	17.0 (85.0%)	
Pre-operative sterile culture, n (%)				0.305[2]
No	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Yes	9.0 (90.0%)	10.0 (100.0%)	19.0 (95.0%)	
Post-operative outcomes				
Residual Fragment Size				0.231[2]
0 mm (stone free)	6.0 (60.0%)	9.0 (90.0%)	15.0 (75.0%)	
≤ 4 mm	2.0 (20.0%)	0.0 (0.0%)	2.0 (10.0%)	

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5 mm	0.0 (0.0%)	1.0 (10.0%)	1.0 (5.0%)	
6 mm	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
7 mm	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
Post-operative complication (s), n (%)				0.305[2]
ICU/urosepsis	1.0 (10.0%)	0.0 (0.0%)	1.0 (5.0%)	
No	9.0 (90.0%)	10.0 (100.0%)	19.0 (95.0%)	
Operation time (min.)				0.532[1]
Mean (SD)	135.0 (49.9)	122.5 (36.8)	128.8 (43.2)	
Range	90.0 - 240.0	80.0 - 180.0	80.0 - 240.0	
Bilateral intervention, n (%)				0.157[3]
No	8.0	10.0	18.0	
Bilateral	2.0 (100.0%)	0.0	2.0 (100.0%)	
Need for a 2ry intervention, n (%)				0.060[2]
No	7.0 (70.0%)	10.0 (100.0%)	17.0 (85.0%)	
Yes	3.0 (30.0%)	0.0 (0.0%)	3.0 (15.0%)	

1. Linear Model ANOVA, 2. Pearson's Chi-squared test, 3.Chi-squared test for given probabilities

Discussion

This retrospective study compared pre-operative predictors with the post-operative outcomes between interventions (fURS and PCNL) for treatment of renal calculi. Data elaborates that the fURS group has more cases with a previous history of renal stones, and ESWL suggests a clinical pattern of selection following the conservative and medical management attempts that keeps surgical intervention (PCNL) as the last choice, unless indicated by the earliest presentations. fURS affects renal function, while PCNL is associated with a normal range in the whole group population. An unequal distribution of drainage means mimicking the type of approach where double J stenting and nephrostomy were exclusively introduced.

The subsequent usage of fURS following failed noninvasive protocols, up to having a history of ESWL, perfectly matches the agreed-upon guidelines of a within-size-limit renal stone (s) matches the management algorithms of the current updated guidelines of AUA and EAU ￼￼￼(Adding the National Institute for Health and Care Excellence (NICE) guidelines as it has an implementation-focused perspective, yet forti). Adding the National Institute for Health and Care Excellence (NICE) guidelines as it has an implementation-focused perspective, yet fortifies the opinion of the previous two guidelines [17]. Explanation of this steady opinion is due to the difference in the invasive nature between fURS and PCNL and the fact that fURS is more suitable to get rid of stone fragments left by ESWL, as it is mostly small [18,19]. Needing a percutaneous tract through the renal parenchyma predisposes to typical surgical complications despite having new less invasive variants of PCNL [11].previous two guidelines [17]. Explanation of this steady opinion is due to the difference in the invasive nature between fURS and PCNL and the fact that fURS is more suitable to get rid of stone fragments left by ESWL, as it is mostly small [18,19]. Needing a percutaneous tract through the renal parenchyma predisposes to typical surgical complications despite having new less invasive variants of PCNL [11].

The fURS group exhibited post-operative renal function abnormalities, while the PCNL group generally maintained normal renal function [20]. This difference may reflect procedural factors inherent to fURS, the continuous irrigation

throughout the procedure elevates the risk of increased hydrostatic pressure and its adverse effects, mainly on tubular transport at the level of the tubular collecting system, causing a reduction of net driving force for filtration rate [21]. In contrast, PCNL, despite its more invasive nature, did not show similar renal function compromise, likely because the procedure allows direct stone extraction with minimal intrarenal pressure elevation.
Drainage methods reflected the surgical approach: fURS was almost exclusively followed by double J stenting, whereas PCNL utilized nephrostomy drainage. Double J stents provide adequate drainage while minimizing risks such as infection, bleeding, or displacement, which can be more frequent with nephrostomy tubes. This distinction emphasizes the procedural considerations in post-operative care and highlights the trade-offs between invasiveness and complication profiles [22].
Stone-free rates did not significantly differ between the groups, suggesting that both fURS and PCNL are effective in achieving stone clearance when applied to appropriately selected patients. However, procedure selection should consider patient comorbidities, stone characteristics, and previous treatment history to optimize outcomes and minimize complications [11].
The study further highlights the importance of individualized surgical planning. Patients with comorbidities such as diabetes mellitus or hypertension require careful perioperative monitoring, regardless of the procedure. Similarly, the choice of drainage method should be tailored to minimize post-operative morbidity while ensuring effective urine diversion.

Strengths and Limitations

This multicenter comparison of PCNL versus fURS for 1.0–2.5 cm renal stones fills a huge evidence gap, being the first in Libya, and focuses on clinically meaningful endpoints (post-operative renal function, stone-free rate, complications, and the need for a 2nd intervention). Details of perioperative circumstances (drainage type, transfusion, and hospital stay) make their interpretations applicable for proper local practice and relevance for similar literature settings around the world.
The Design limitations of sample size (n = 20) and dealing with retrospectively retrieved data greatly hinder the statistical potential of the end evidence. Key post-operative findings lack crucial details whether concerning quantification, as categorical data replace continuous data in many outcomes that might have benefited if recorded in further detail, e.g, renal filtration. Methodological steps of measurement for various perioperative outcomes and risk factors were not mentioned, leaving uncertainty about their accuracy. As a sequela, the generalizability of evidence fails to extend beyond Misrata due to the limitations.

Conclusion

Both PCNL and fURS demonstrated comparable efficacy and safety in the management of renal calculi measuring 1–2.5 cm. Stone-free rates, operation time, hospital stay, and major complication rates did not differ significantly between the two modalities. However, fURS was associated with transient post-operative renal function abnormalities, whereas PCNL patients maintained stable renal function. Differences in drainage strategies mirrored procedural characteristics, with double J stenting following fURS and nephrostomy placement after PCNL.

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