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Research Article

Renal Functional Recovery and Complication Profile after Ureteroscopic Lithotripsy with Double-J Stenting in Chronic Kidney Disease: A Prospective Single-Centre Study

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ABSTRACT
Background: Chronic kidney disease (CKD) amplifies the risks of urolithiasis management by diminishing renal reserve and pre-disposing patients to bleeding and sepsis. Ureteroscopic lithotripsy (URSL) with adjuvant double-J (DJ) stenting is widely adopted to clear stones and secure drainage, yet dedicated evidence in CKD cohorts remains sparse
Methods: We performed a prospective, single-centre observational study of adults with CKD stages II–IV undergoing URSL with DJ stent placement (January 2022 – December 2024). Pre-operative variables (demography, CKD stage, stone metrics) and peri-operative details were captured. Primary outcome was, change in renal function—serum creatinine and estimated glomerular filtration rate (eGFR)—from baseline to 3-months. Secondary outcomes included stone-free rate (SFR), complications (Clavien-Dindo), lower-urinary-tract symptoms (LUTS) and length of stay. Statistical significance was set at $p < 0.05$.
Results: Sixty patients (mean age 58.4 ± 10.3 years; 70 % men) were analysed. Mean stone diameter was 12.8 ± 4.2 mm; 63.3 % were ureteric. Mean operative time was 52 ± 15 min. SFR at 4 weeks reached 88 %. The mean serum creatinine decreased significantly from 2.11 ± 0.43 mg/dL (pre-op) to 2.00 ± 0.47 mg/dL (Day 1), 1.89 ± 0.45 mg/dL (Day 7), and 1.74 ± 0.40 mg/dL (3 months) ($p < 0.001$). Correspondingly, mean eGFR improved from 35.6 ± 11.5 mL/min/1.73 m^2 to 37.3 ± 11.0, 39.9 ± 11.8, and 44.1 ± 12.6, respectively ($p < 0.001$). Renal functional improvement was observed as early as Day 1 and progressively increased over 3 months. Complications were limited and manageable, with no Clavien-Dindo Grade III or higher events. No patient required dialysis or nephrectomy. Median hospital stay was 3 (IQR 2–4) days.
Conclusion: URSL with DJ stenting is safe and yields meaningful renal recovery in CKD, with high SFR and acceptable morbidity. Vigilant peri-operative infection control remains essential.

Keywords: Ureteroscopy, Chronic Kidney Disease, Double-J Stent, Renal Function, Urolithiasis, Complications.

INTRODUCTION

Urolithiasis affects up to 15 % of adults worldwide and its prevalence parallels the burgeoning burden of metabolic syndrome, climate change and ageing populations [1]. Urolithiasis is known to affect renal functions and is a recognized risk factor for chronic kidney disease (CKD).[1,2,3] In view of associated conditions such as hypertension, diabetes, and other cardiovascular diseases,[4,5] the management of these stones is a challenging task for surgeons. CKD patients represent a particularly vulnerable subset; reduced nephron mass curtails physiologic reserve, while altered immune and haemostatic profiles heighten procedural risk [2]. Contemporary guidelines endorse ureteroscopic lithotripsy (URSL) as first-line therapy for most uretero-pelvic calculi, reserving percutaneous nephrolithotomy (PCNL) for larger or complex stones [1].

URSL offers minimally invasive access, fine calibre optics and holmium-YAG laser fragmentation with stone-free rates (SFR) exceeding 80 % in the general population [3]. Yet data specific to CKD are limited and heterogeneous, often combining solitary-kidney and transplant cohorts or excluding advanced CKD (stage ≥ IV) altogether [4]. Concerns persist regarding transient renal obstruction from oedema or residual debris, post-operative septic complications, and the potential for acute

kidney disease (AKD) that may accelerate CKD progression [4].

Double-J (DJ) ureteral stents mitigate early obstruction, facilitate fragment passage and enable passive ureteral dilatation [2]. Nevertheless, stents may provoke irritative LUTS, promote bacterial biofilms and rarely migrate or encrust—risks accentuated in uraemic milieu [5]. Moreover, the incremental renal benefit attributable to DJ stenting in CKD remains ill-defined.

Previous prospective series report modest rises in eGFR (≈ 5–10 mL/min) after URSL in CKD stage III–IV, with complication profiles paralleling non-CKD controls [6]. Systematic reviews of solitary-kidney URSL similarly demonstrate renal preservation with low dialysis conversion rates [3]. Yet many studies lack granular staging, unified outcome definitions or robust follow-up.

The present study prospectively evaluates renal outcomes and complication rates of URSL with DJ stenting across the CKD spectrum. We hypothesised that timely stone removal with stent-assisted drainage achieves clinically significant renal functional gain while maintaining an acceptable safety profile. Our findings aim to inform evidence-based decision-making, optimise peri-operative pathways and refine counselling of this high-risk group.

MATERIALS AND METHODS

A. Study Design and Setting

A prospective observational study was conducted at the Department of Urology, Basaveshwar Hospital attached to M.R Medical College, after institutional-review-board approval (REF #2021-UR-CKD-URS-01). The study adhered to the Declaration of Helsinki and STROBE recommendations.

Participants: Sample size- 60 patients

Inclusion Criteria

1. age ≥ 18 years;
2. CKD stage II–IV (eGFR 15–89 mL/min/1.73 m²) (KDIGO 2021);
3. radio-imaging-confirmed renal or ureteric calculi requiring URSL; and
4. Intra-operative placement of a 4-5Fr polyurethane DJ stent.

Exclusion Criteria

1. active UTI at presentation
2. Stage 5 CKD or dialysis dependence
3. uncorrected coagulopathy,
4. bilateral obstruction necessitating staged procedures, and
5. Prior ipsilateral open/PCNL surgery within 6 months.

B. Operative Technique

Procedures were performed by our urologist under Spinal anaesthesia. A semi-rigid ureteroscope was used for distal ureteric stones; flexible digital ureteroscope (8.5Fr) with access sheath (12/14Fr) for proximal and renal stones. Holmium-YAG laser settings: 0.6–1.2 J, 8–12 Hz (dusting) or 1.5 J, 5 Hz (fragmentation). Fragments were retrieved. A 4.8-6.0 Fr DJ stent was deployed over a guidewire. Antibiotic prophylaxis followed EAU urological-infection guidelines [11].

C. Post-Operative Care and Follow-Up

On postoperative day 1, renal function test were done along with the X-ray of kidney, ureter, and bladder (KUB). Follow-up evaluations of Serum creatinine and eGFR were done on postoperative day 1, day 7, and at 3 months. Non-contrast CT or ultrasound verified SFR at 4 weeks; residual fragments > 4 mm were considered failures. DJ stents were removed cystoscopically at 8 weeks.

D. Outcomes

- **Primary:** Change in renal function (serum creatinine, eGFR).
- **Secondary**: SFR, complication rate (Clavien-Dindo), LUTS (validated core lower urinary tract score), need for readmission/re-intervention, and length of stay.

E. Statistical Analysis

Continuous variables are presented as mean ± SD or median (IQR); categorical data as counts (%). Paired t-test or Wilcoxon signed-rank test assessed renal function change. $P < 0.05$ signified significance (SPSS v25, IBM).

RESULTS

A. Cohort Characteristics

Sixty patients fulfilled criteria (Table 1). Most were CKD stage III (47 %). Diabetes and hypertension were present in 40 % and 60 %, respectively.

B. Stone Parameters and Operative Metrics

Mean cumulative stone diameter was 12.8 ± 4.2 mm; 80 % were ureteric, predominantly distal. Flexible URSL was required in 39 cases (65 %). Mean laser time was 19 ± 6 min; no intra-operative ureteric perforation occurred (Table 2).

C. Renal Outcomes

At three-months, mean serum creatinine decreased by 0.37 ± 0.4 mg/dL (17 %) and eGFR increased by 8 ± 3 mL/min/1.73 m² (23 %; $p < 0.05$, Table 3). Figure 1, illustrates the creatinine trend. Improvement (>10 % eGFR gain) occurred in 75 % of patients, was neutral in 25 %.

D. Stone-Free and Complications

Overall SFR was 88 %. Complications are summarised in Table 5 and Figure 3. Hematuria resolved with conservative measures. UTIs were culture-positive E. coli (n = 7) or Enterococcus (n = 2) and responded to targeted antibiotics. Three patients (5 %) developed sepsis requiring HDU monitoring; all recovered. No ureteric strictures or dialysis initiation were noted at 90 days. Median length of stay was 3 days.

Table 1. Baseline Demographics (N = 60)

Variable	Value
Age (years)	58.4 ± 10.3
Male sex	42 (70 %)
CKD stage II / III / IV	17/ 28 / 15
Diabetes mellitus	24 (40 %)
Hypertension	36 (60 %)

Table 2. Stone and Operative Details

Parameter	Value
Mean stone size (mm)	12.8 ± 4.2
Location—ureteric / renal pelvis	48 / 12
Laterality—right / left	32 / 28
Operative time (min)	52 ± 15
Flexible URSL used	39 (65 %)
DJ stent dwell time (days)	60 ± 6

Table 3. Renal Function Pre- and Post-URSL+DJ Stent (Mean ± SD)

- **Serum Creatinine:** Decreased progressively from 2.11 mg/dL pre-op to 1.74 mg/dL over 3 months, indicating improvement in renal filtration.
- **eGFR:** Increased from 35.6 pre-op to 44.1 at 3 months, showing steady improvement in kidney function.

Time Point	Serum Creatinine (mg/dL)	eGFR (mL/min/1.73 m²)	P Value (Creatinine)	P Value (eGFR)
Pre-op	2.11 ± 0.43	35.6 ± 11.5	--	--
Post-op Day 1	2.00 ± 0.47	37.3 ± 11.0	0.540	0.193
Post-op Day 7	1.89 ± 0.45	39.9 ± 11.8	0.127	0.0059
3 Months Post-op	1.74 ± 0.40	44.1 ± 12.6	0.0001	0.0002

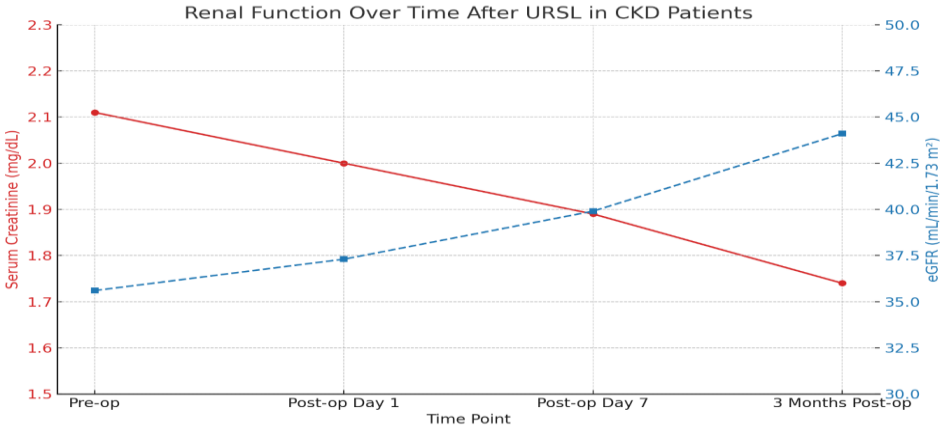

Figure 1. Renal Function over Time after Ursl+ DJ Stent

Table 4. Post Op Statistical Changes in Renal Parameters

Time Point	Parameter	Mean Difference	95% CI	p-value
Post-op Day 1	Creatinine(mg/dl)	-0.11 (↓)	[–0.14, 0.36] mg/dL	0.540
	eGFR(mL/min/1.73m^2)	+1.7 (↑)	[–2.76, 6.16] mL/min/1.73 m²	0.193
Post-op Day 7	Creatinine(mg/dl)	-0.22 (↓)	[–0.05, 0.49] mg/dL	0.127
	eGFR(mL/min/1.73m^2)	+4.3 (↑)	[1.36, 7.24] mL/min/1.73 m²	0.0059
3 Months Post-op	Creatinine(mg/dl)	-0.37 (↓)	[–0.14, 0.60] mg/dL	0.0001
	eGFR(mL/min/1.73m^2)	+8.5 (↑)	[5.39, 11.61] mL/min/1.73 m²	0.0002

- No significant changes at Day 1 ($p > 0.05$, CI includes 0)
- At Day 7, eGFR shows significant improvement ($p = 0.0059$), while Creatinine does not.
- At 3 Months, both Creatinine and eGFR show highly significant improvement ($p < 0.001$)

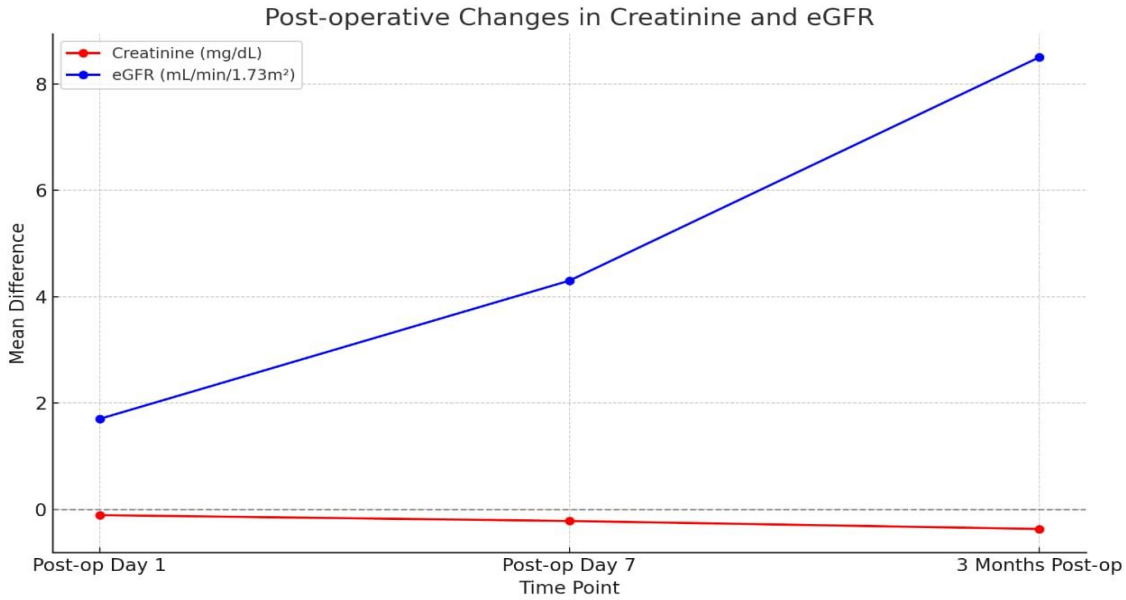

Figure 2. Post-Operative Mean Difference in Renal Parameters

Table 5. Post-Operative Events

Event	N (out of 60)	%
Hematuria	6	10
UTI	9	15
Sepsis	3	5
Stent-related LUTS	18	30
Re-intervention within 90 d	2	3.3
Mean hospital stay (days)	2.8 ± 1.1	—

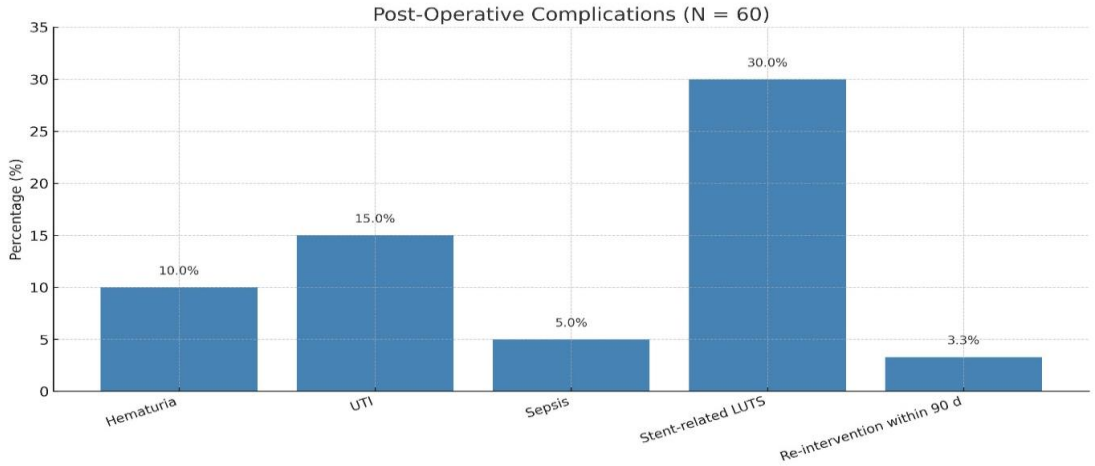

Figure 3. Incidence of Postoperative Complications

- Patients experienced mild to moderate gross hematuria within 48 hours post-op. Most cases were self-limiting and resolved with increased hydration and observation. None required transfusion or intervention.
- Patients presented with fever, dysuria, or cloudy urine (UTI) within the first week. Midstream urine cultures identified common organisms (E. coli, Klebsiella). All were treated successfully with targeted oral or IV antibiotics.
- Three patients developed sepsis features (fever >38.5°C, tachycardia, leukocytosis) postoperatively. All were promptly admitted to ICU or high-dependency unit, stabilized with broad-spectrum IV antibiotics, fluids, and supportive care. Blood cultures were positive in 2 cases. All recovered fully without organ failure.
- Lower urinary tract symptoms (urgency, frequency, suprapubic discomfort) were commonly reported. Patients were managed with alpha-blockers (tamsulosin) and anticholinergics (solifenacin) with good symptomatic relief. Stent removal was scheduled at 6-8 weeks. No cases required premature stent removal.
- Two patients had residual fragments >5 mm identified on follow-up imaging. Both underwent elective re-URS under spinal anesthesia. No major complications were noted during the second procedure, and stone-free status was achieved.

DISCUSSION

Our findings corroborate and extend prior evidence that URSL with routine DJ stenting confers tangible renal benefit in CKD while maintaining complication rates comparable to non-CKD populations [8, 9]. The mean eGFR rise mirrors the 10–15 % improvement reported in flexible ureterorenoscopy series among moderate CKD cohorts [5], suggesting that prompt relief of obstruction and avoidance of high intrarenal pressures are pivotal for nephron salvage.

Complication rates in our study (30 % overall; 5 % sepsis) align with real-world registries where Clavien ≥ III events occur in < 6 % of ureteroscopic cases [10]. DJ stents helped prevent early obstruction but were the main cause of irritative urinary symptoms, seen in 30% of patients. This supports the idea that stent duration should be tailored to the patient, or that medications may help reduce these symptoms. Importantly, no ureteric strictures were noted, highlighting the safety of using modern low-profile access sheaths even in patients with impaired kidney function.

Infection remains the principal threat in uraemic hosts. Our strict adherence to pre-operative urine sterilisation, single-dose prophylaxis and low-pressure irrigation likely curtailed septic events. The 5 % sepsis rate compares favourably with literature quoting 3–11 % in mixed cohorts [4]. The EAU urological-infection guidelines emphasise culture-directed therapy and early recognition, which were integral to our protocol [11].

Our data suggest that, with meticulous technique, URSL delivers high SFR even in stage IV CKD (86 %), challenging dogma that PCNL is requisite for adequate clearance.

Strengths include prospective design, homogeneous technique and comprehensive biochemical follow-up. Limitations comprise single-centre setting, modest sample size, and absence of a non-stented comparator. We also lacked long-term (> 12 month) eGFR trajectories to ascertain sustained renal benefit.

Future multicentre randomised trials should stratify by CKD stage, employ uniform AKD definitions, and explore stent-free URSL or novel suction-enabled ureteroscopes that may further minimise intrarenal pressure [13].

CONCLUSION

Ureteroscopic lithotripsy with adjunct double-J stenting is a safe, efficacious option for stone clearance in CKD stages II–V. It yields a significant early improvement in renal function and achieves an 88 % stone-free rate with low major morbidity. Tailored peri-operative antimicrobial stewardship and vigilant follow-up are paramount, especially in advanced CKD. Our findings support URSL as a kidney-preserving intervention and provide a contemporary benchmark for outcome counselling and future comparative studies.

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