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Original Article

Day-Case Retrograde Intrarenal Surgery with Laser Lithotripsy for Renal Calculi in Sri Lanka: Clinical Outcomes and Comparable Costs in a Prospective Cohort of 138 Cases

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Abstract

Introduction: Evidence from exclusively day case Retrograde Intrarenal Surgery (RIRS) with Laser Lithotripsy for Renal Calculi day-case cohorts is limited.

Objectives: To assess day-case RIRS feasibility, outcomes and estimated expenditure in Sri Lanka.

Methods: This prospective cohort included 138 cases treated between June 2023 and June 2026 using flexible ureteroscopy and holmium laser lithotripsy under general anaesthesia, selective access sheaths and structured discharge.

Results: There were 96 males (69.57%). Mean age was 47.41 ± 13.78 years and stone diameter was 15.69 ± 3.49 mm. Pelvic, lower-, middle- and upper-calyceal stones comprised 45.65%, 32.61%, 10.87% and 10.87%, respectively. All procedures were completed without conversion; operating time was 35-65 minutes. Same-day discharge occurred in 121 cases (87.68%); 17 (12.32%) required admission within 14 days. Complications affected 34 cases (24.64%); grade I and II occurred in 18 and 12, grade III and IV in four patients (2.9%), with no deaths. Imaging-defined clearance was 87.68% at 2-4 weeks and 94.20% at later follow-up. Estimated day-case expenditure specific for the institution and operating team was LKR 189,000-229,000 versus 360,000-450,000 for inpatient RIRS for uncomplicated procedures.

Conclusions: Day-case RIRS and laser lithotripsy achieved high discharge and clearance rates, predominantly minor complications and lower estimated initial expenditure. This intrarenal cohort provides a local benchmark; comparative safety and cost-effectiveness in resource limited setup.

Keywords: Retrograde intrarenal surgery, flexible ureteroscopy, day-case surgery, renal calculi, Sri Lanka, treatment costs, Holmium laser lithotripsy

Introduction

Urinary stone disease represents a substantial healthcare burden across Asia, with reported prevalence estimates ranging from 1% to 19.1%. The burden varies considerably between countries, with particularly high rates reported in parts of South, Southeast and West Asia. Hot climates, inadequate fluid intake, dietary patterns and metabolic factors contribute to these geographical differences. Increasing prevalence in several Asian countries has been associated with changes in diet and lifestyle. The recurrent nature of stone disease adds to the demand for treatment and imposes

continuing costs on patients and healthcare systems. This burden highlights the need for effective, affordable treatment pathways, including minimally invasive procedures that can be delivered safely as day-case surgery (1).

Retrograde intrarenal surgery (RIRS) permits endoscopic inspection and laser treatment of renal stones without a percutaneous renal tract and mechanical injury to the renal parenchyma. Treatment selection depends on stone size, location, anatomy and patient circumstances. European Association of Urology guidance generally prefers percutaneous nephrolithotomy (PCNL) for stones exceeding 20 mm but does not rule out RIRS for stones larger than 20 mm. The International Alliance of Urolithiasis guideline provides equal provision for intrarenal surgery for stones less than 20 mm (2,3,4).

Day-case care depends on patient selection, infection control, anaesthetic recovery, symptom management and access to urgent reassessment. Published ambulatory ureteroscopy series support feasibility, but frequently combine ureteric and renal stones or rigid and flexible procedures (4,5,6). An exclusively intrarenal cohort such as the present study therefore provides a useful additional service benchmark.

In private practice, avoiding an inpatient stay may reduce initial expenditure, but requires a safe protocol for subsequent re admissions and treatment. This study assessed clinical outcomes, discharge feasibility and estimated initial treatment expenditure in a planned day-case RIRS pathway at a Sri Lankan non-state tertiary referral center.

Patients and methods

Study design and setting

A prospective observational cohort was assembled at a non-state Centre for Advanced Urological Surgery, between June 2023 and June 2026. Records of 138 consecutive cases scheduled for elective day-case RIRS were analyzed. A single experienced consultant endourologist performed all procedures. The unit followed a common perioperative pathway, although access-sheath use, stenting and the fragmentation strategy were selected according to operative findings and surgeon preference.

Written informed consent was obtained from all adult participants and from the parents of the 14-year-old participant after discussion of alternative treatment options and their respective benefits and risks. The study was approved by the local institutional ethics review committee and conducted in accordance with the Declaration of Helsinki (7).

Eligibility and preoperative assessment

The stated protocol included patients aged over 14 years with renal calculi measuring between 10 mm ± 2 mm and less than 20 mm ± 2 mm in maximum diameter of the stone bulk. Suitability for elective day-case surgery included negative urine culture or appropriately treated bacteriuria, safe transport availability of family /guardian help at home and ability to attend follow-up. Exclusions were active urinary tract infection, pregnancy, untreated obstruction preventing access, ureteric stricture requiring reconstruction, uncorrected coagulopathy, simultaneous major medical comorbidities making non eligible for day case surgery and inability to provide informed consent.

Preoperative assessment comprised history, examination, routine haematological and biochemical investigations, serum creatinine, estimated glomerular filtration rate, urinalysis and urine culture with sensitivity testing. Stone evaluation used non-contrast computed tomography (NCCT) where available, or ultrasonography with a plain kidney-ureter-bladder (KUB) performed by an experience Uro-radiologist according to institutional practice. Maximum stone diameter was recorded from preoperative imaging. The principal recorded location was classified as renal pelvis, lower calyx, middle calyx or upper calyx. The available categories assign location of the largest stone per case and do not quantify the total burden of multiple or multicompartment insignificant stones.

Patients with positive cultures received culture-directed treatment and repeat culture before definitive surgery. Preoperative ureteric stenting was undertaken selectively for difficult access, obstruction, infection requiring drainage or anticipated instrumentation difficulties.

Operative technique

All procedures were performed under general anaesthesia. Intravenous antibiotic prophylaxis was administered at induction according to hospital antimicrobial guidance, with modification guided by culture results. Initial cystoscopy and semirigid ureteroscopy facilitated placement of a hydrophilic guidewire into the renal pelvis. Ureteric dilatation and a 9.5/11.5-Fr ureteral access sheath and mobile fluoroscopy were used selectively to assist access, localization and repeated passage.

A 6.5-Fr flexible ureteroscope passed over the guide wire, was then used for intrarenal inspection and laser lithotripsy.

A 200-µm holmium laser fiber connected to a Quanta 30W laser system™ was used. The operator selected settings according to stone characteristics and the conditions encountered according to recommended standards. (Dusting - 0.3-0.6 J at 20-40 Hz; fragmentation - 0.8-1.2 J at 8-15 Hz) achieving fragmentation size of less than 4mm and mostly 1-2 mm in size with comparison to 200-micron laser fiber tip. Fragments requiring extraction, particularly those exceeding 4 mm, were retrieved with a nitinol basket. A post procedure double-J stent was inserted in a majority of cases especially when ureteric oedema, residual fragments, prolonged surgery, ureteric trauma or other operative concerns. Subsequent stent removal was performed under local anaesthesia at follow-up, where applicable. All patients were administered intra venous broad-spectrum antibiotic with induction of anaesthesia and majority received oral antibiotic for 3-5-days especially when immediate pre-operative culture was not available or based on previous antibiograms.

The programme included an instrument sterilisation institutional protocol comprised of immediate mechanical cleaning with flushing and rinsing with water and 70% isopropyl alcohol, peracetic acid formalin gas immersion disinfection, assessment of active deflection and visibility, proper storage vertically in a clean, dust-free, and ventilated cabinet and periodic microbiological surveillance devices were retired after, unacceptable loss of deflection, deterioration in image quality or positive microbiological testing (8).

Recovery and discharge pathway

Patients were managed within a standardised day case enhanced recovery pathway. Discharge required stable observations, satisfactory recovery from anaesthesia, pain controlled with oral medication, tolerance of oral fluids, independent mobilisation, spontaneous voiding and no clinical concern regarding sepsis or significant haematuria before discharge, targeted approximately 4-6 hours after full anaesthetic recovery.

Patients received written instructions to seek urgent admission for fever, chills or rigors, frank haematuria, urinary retention or excessive abdominal pain. Emergency contact details were provided. Discharge also required an accompanying person and safe transport and ready access to the same institution or to an institution with similar facilities over a short period of developing unexpected symptoms. Patients who did not meet clinical or social criteria were retained for observation or admission for 6-hours or more depending on the necessity. Frank haematuria, undue pain and fever with chills and urinary retention were described as reasons for extended observation or admission.

Post operative outcomes and follow up

The clinical outcomes such as immediate and late postoperative complications, readmission and imaging-defined stone clearance were recorded at successful discharge, first visit in 2-4 weeks and at the second visit in 3 months. Complications were classified using Clavien-Dindo grades (9,10).

The first imaging assessment was scheduled 2-4 weeks after surgery. A further assessment was held at three months after the procedure and double-J stent removal done in 2-3 weeks. Ultrasonography and/or KUB radiography were used routinely, with NCCT reserved for clinical indications. Clearance was assessed using the imaging performed at each visit. The reported endpoint was no detectable residual renal stone or significant upper tract dilatation.

Treatment expenditure

Patients were made aware of estimates of approximate time-indexed procedural costs depending on healthcare Inflation which were

compared for day-case RIRS, inpatient RIRS, PCNL and ESWL. They were time specific and compared descriptively in Sri Lankan rupees (LKR). Cost was presented as ranges and an arithmetic midpoint was used for an illustrative comparison. The costing included professional team and hospital charges specific for the institution including stent removal, excluding expenditure related to complications and readmissions.

Results

Demographic and stone size characteristics

The cohort comprised 138 recorded cases. Demographic and stone characteristics are consolidated in Table 1, with principal stone locations in Table 2. The population was pre-dominantly male (Table 1).

Stone characteristics including principal location

Most recorded stone diameters were between 9 and 22 mm. The pelvis was the most frequent principal location, followed by the lower calyx. (Table 2).

Operative and day care service outcomes

All index procedures were completed using flexible ureteroscopy and holmium laser without immediate conversion to PCNL or open surgery. Operative duration ranged from 35 to 65 minutes, excluding anaesthesia and recovery. Pre operative stents were recorded in 38 (27%) cases out of which 27 were already present and 11 inserted in a planned manner to facilitate the subsequent procedure. One hundred and twenty-one (88%) patients were discharged on the same-day. Seventeen cases (12%) required readmission within 2 weeks for pain, fever, haematuria, stent symptoms or sepsis or a combination (Table 3).

Complications

Clavien-Dindo complication grades were recorded in 34 of the 138 cases (24.64%). Grade I complications were the most frequent, occurring in 18 cases (13.04% of the entire cohort), followed by grade II complications in 12 cases (8.70%) which were predominantly urinary tract infections. Together, grades I-II accounted for 30 cases (21.74% of the cohort) and 88.24% of all complication-coded cases.

Grade III and grade IV complications were each recorded in two cases (1.45% of the cohort). Collectively, these higher-grade complications occurred in four cases (2.90%), representing 11.76% of complication-coded cases. No grade V complications were reported. The recorded complication profile was therefore predominantly low grade, although the grade III and IV events should be described individually, including their clinical nature, treatment and outcome. No significant complaints were reported for the remaining 104 cases (75.36%). No preoperative complications such as ureteric injury were encountered (Table 4).

Table 1. Demography

Demography	Result
Total recorded cases	138
Male	96 (69.57%)
Female	42 (30.43%)
Male to female ratio	2.29 to 1
Age mean ± SD	47.41 ± 13.78 years
Age median and range	47 years; 16-82 years
Male age mean ± SD	47.11 ± 14.34 years
Female age mean ± SD	48.07 ± 12.53 years

Table 2. Stone size characteristics

Stone diameter median and range	15.69 ± 3.49 mm (9-22) mm	
Stone diameter <10 mm	11 (7.97%)	
Stone diameter 10-20 mm	111 (80.43%)	
Stone diameter >20 mm	16 (11.59%)	
Location	**Cases**	**Percentage**
Renal pelvis	63	45.65%
Lower calyx	45	32.61%
Middle calyx	15	10.87%
Upper calyx	15	10.87%
Total	138	100.00%

Table 3. Operative and day care service outcomes

Outcome	**Result**
Index procedure completed without immediate conversion	138 / 138 (100%)
Operative duration excluding anaesthesia and recovery	35-65 minutes
Access sheath usage	26/138 (19%)
On table radiology guidance	37/138 (27%)
Preoperative stenting	38/138 (27.54%)
Postoperative double-J stenting	135/138 (97.83%)
Same-day discharge	121/138 (87.68%)
Target discharge interval	Approximately 4-6 hours after total anaesthetic recovery
Reported inpatient admission within 14 days	17/138 (12.32%);
Readmission indications	Pain, fever, haematuria, stent symptoms or sepsis or combination

Table 4. Recorded Clavien-Dindo complication grades

Grade	Cases (n)	Percentage of all cases (n = 138)	Percentage of complication-coded cases (n = 34)
I - Minor haematuria, dysuria or mild pain	18	13.04%	52.94%
II - Low grade fever	12	8.70%	35.29%
III - Urosepsis, retention	2	1.45%	5.88%
IV a/b - Urosepsis and shock and organ failure	2	1.45%	5.88%
V - Death	0	0.00%	0.00%
All recorded complication grades	34	24.64%	100.00%
Grades I-II combined	30	21.74%	88.24%
Grades III-IV combined	4	2.90%	11.76%

Stone clearance and subsequent management

At the first assessment, 121 cases had no image detectable residual stones or upper tract obstruction and 17 had residual pelvic fragments. At the later assessment, 130 cases had no detectable residual stones and eight retained fragments in the pelvic and calyceal in the table. The study states that nine of the 17 cases with initial fragments had no detectable stones later, equivalent to 52.94% additional stone clearance three month after first post operative assessment. Eight cases were assigned further management: repeat flexible ureteroscopy in four, ESWL in two and observation in two. Thus, six cases were assigned active auxiliary treatment (4.35%) and two observation (1.45%) (Table 5).

Table 5. Imaging defined clearance and further management

Outcome	First visit 2-4 weeks after surgery	Second visit three months after removal of stent in two weeks
No detectable residual stones	121/138 (87.68%)	130/138 (94.20%)
Residual fragments	17/ 138 (12.32%)	8/138 (5.8%)
Recorded residual stone location	Renal pelvis and calyces	Calyces and ureter
Residual stone diameter	4-8 mm	4-8 mm Repeat URS 4
Further management	4mm and calyx stones Conservative treatment	ESWL 2 Observation 2

Estimated cost comparison

Following estimates presents the treatment estimates for the specific institution and the professional team. The midpoint for day-case RIRS was LKR 209,000, compared with LKR 405,000 for inpatient RIRS. The difference was LKR 196,000, or 48.40% of the inpatient midpoint. Relative to the PCNL midpoint of LKR 625,000, the day-case midpoint was 66.56% lower. One ESWL session cost less than day-case RIRS; two sessions approached its midpoint, while three exceeded it. These comparisons do not incorporate differences in clinical indication, treatment success or subsequent expenditure and should not be interpreted as comparative cost-effectiveness (Table 6).

Discussion

Clinical contribution and international comparisons

This exclusively intrarenal cohort supports the practical feasibility of planned day-case RIRS in a Sri Lankan referral service. Same-day discharge was achieved in 87.68% of cases, and imaging-defined clearance increased from 87.68% at the first assessment to 94.2% at later follow-up. Major complications were recorded in 2.90%. These findings should be considered alongside the admission burden, imaging limitations and absence of a concurrent comparator.

Ghosh et al reported a 77.7% day-case rate in 544 adult ureteroscopic procedures (4). Their mixed ureteroscopy population is a useful service comparator, but does not establish equivalent outcomes for an exclusively renal-stone cohort. Oitchayomi et al described 100 outpatient procedures in 87 patients, including rigid and flexible ureteroscopy (5). Balagobi and colleagues reported a United Kingdom district-hospital series of 118 patients, with 90.6% clearance, 8.5% complications and 44% renal stones. The latter publication appeared in a Sri Lankan journal but should not be described as a Sri Lankan clinical cohort. Differences in stone burden, presenting, surveillance and admission definitions limit direct comparisons (6).

Complications and infection

Out of recorded proportion of 24.64%, Grades I-II accounted for 88.24% of complication-coded cases. Although it appears these figures exceeds the 7.4% overall complication figure reported in the mixed CROES global ureteroscopy study by Somani et al, in a mixed cohort of 11,885 Ureteroscopic procedures detailed complications were not reported separately for RIRS or day-case surgery, limiting the significance of direct comparison (10).

The admission figure is important for both patients and service planning. Initial overnight retention, emergency attendance after discharge and subsequent inpatient readmission are reported distinct outcomes. Failed same-day discharge rate and reported subsequent admission were low as 12.5% and 15.2% respectively. Patients who develop delayed infection or obstruction can require admission despite appropriate initial discharge. This includes admissions elsewhere as well as at the operating hospital. These figures are comparable with other studies with a figure of 9.9% (11).

Table 6. Treatment expenditure in Sri Lankan rupees

Treatment	Approximate estimated expenditure LKR (2023-2026)	Approximate arithmetic midpoint LKR
Day-case flexible URS and RIRS	189,000-229,000	209,000
Inpatient flexible URS and RIRS	360,000-450,000	405,000
PCNL	500,000-750,000	625,000
ESWL one session	75,000-95,000	85,000
ESWL two sessions	150,000-190,000	170,000
ESWL three sessions	225,000-285,000	255,000

Bhojani and colleagues reported a pooled urosepsis incidence of 5.0% across 13 studies involving 5,597 patients. Associated factors included positive urine culture, diabetes, older age, ischaemic heart disease, presenting and longer procedures (11). This estimate cannot be compared directly with the present grade IV count, since sepsis and grade IV complications are not interchangeable. EAU and RIRS-specific guidance support preoperative infection assessment and perioperative pro-phylaxis (3). The local routine prophylactic antibiotic with anaesthesia inductions is recommended with selective postoperative antibiotic regimen. The low threshold of using post operative antibiotics on discharge should be described as institutional practice at the discretion of the surgeon rather than inferred to be a strict guideline requirement. Others in retrospective study found that additional postoperative antibiotics did not reduce infection rates beyond a single perio-perative dose. Our practice is adopted as in many instances immediate preoperative urine culture was not available which needs validation in future studies (12,13).

Access sheath with ureteral dilation under fluoroscopy guidance was used in a minority of cases (19%) when narrow ureters or ureters orifice encountered. On-table fluoroscopy guidance was used selectively in 27% cases which reduced the radiation exposure without compromising the procedural outcome. This was in contrast to the recommended wider usage of Access sheaths to facilitate access and drainage with a higher incidence of ureteral injury, as demonstrated by Traxer and Thomas (14).

Stone clearance and treatment selection

Ultrasonography and KUB radiography are accessible follow-up tools, but their sensitivity for small fragments differs from CT. Accordingly, the results describe no detectable stones on the imaging used, rather than CT-confirmed clearance. Imaging modality, follow-up completeness and timing should be stated for each assessment. The manuscript describes fragments of 4-8 mm, which should not be equated with clinically insignificant fragments below 4 mm. Chew et al linked larger residual fragments to growth, complications and reintervention (15,16).

The Cochrane review of 42 trials and 4,571 participants found that PCNL may improve clearance and reduce secondary interventions compared with RIRS, with probably little or no difference in major complications (17). RIRS therefore offers a useful treatment option but cannot be claimed superior from this cohort, particularly for stones above 20 mm. Donaldson and colleagues found better clearance with RIRS than ESWL for lower-pole stones in a systematic review. Individual treatment choice remains dependent on anatomy, burden, anaesthesia, patient preference and the likelihood of repeated sessions (18).

Estimated cost saving in day case procedure

The arithmetic midpoint for day-case RIRS was LKR 209,000, compared with LKR 405,000 for inpatient RIRS: a difference of LKR 196,000 or 48.40%. Against the PCNL midpoint of LKR 625,000, it was 66.56% lower. These are descriptive comparisons of local estimates, not observed patient-level cost differences. ESWL may be less expensive initially, while repeated sessions increase expenditure. Costs of complications, readmissions and auxiliary procedures were excluded, so neither cost-effectiveness nor total episode savings has been established.

The stated local use of peracetic acid and formalin gas combined with mechanical flushing.

Strengths and limitations

Strengths include prospective observational recruitment of a specific cohort, a consistent operator, an intrarenal focus and a structured discharge pathway and a protocol driven patient selection and postoperative management. Limitations include the single-center private setting, no concurrent controls, incomplete event-level complication data, mixed imaging and uncertain timing of auxiliary treatment. Shortage of reporting comorbidity, stone multiplicity and density data which and patient-reported recovery and satisfaction could affect generalisability. These limitations need to be addressed in future multi-center prospective studies of similar nature.

Conclusion

Planned day-case RIRS achieved high same-day discharge and encouraging imaging-defined

clearance, with predominantly minor complications and a low recorded major-complication rate. This exclusive RIRS cohort provides a useful Sri Lankan benchmark for future studies encouraging wider application of the procedure especially in resource poor settings and suggests lower initial treatment expenditure, Comparative safety and cost-effectiveness require further evaluation.

Funding and conflicts of interest

Non to declare.

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