CUA 2023 Annual Meeting Abstracts – Podium Session 1: Endourology

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POD 1.1

Ambulatory tubeless mini-percutaneous nephrolithotomy (mini-PCNL) vs. retrograde intrarenal surgery (RIRS) in treatment of 1–2 cm lower calyceal renal stones: A randomized controlled clinical study

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Introduction: We aimed to compare the safety and efficacy of flexible ureteroscopy (F-URS) and ambulatory tubeless mini-percutaneous nephrolithotomy (mini-PCNL) in the treatment of 1–2 cm lower calyceal renal stones.

Methods: Patients who underwent F-URS and mini-PCNL for the treatment of 1–2 cm lower calyceal renal stones between October 2020 and July 2022 were evaluated in a randomized controlled trial. Sixty-four participants have been included in the study thus far. All participants underwent a CT renal colic scan preoperatively, on postoperative day one (POD 1), and at three months followup. Outcome measures, including stone characteristics, operative time, hospital stay, and stone-free rate (SFR), in addition to complication rates, were collected and compared. All patients were discharged home on the same operative day.

Results: There were no significant differences in preoperative baseline data between the two surgical groups (Table 1). A significantly longer median operative time was reported in the mini-PCNL group (p=0.04). The median hospitalization times were five hours and four hours in the mini-PCNL and F-URS groups, respectively (p=0.14). The SFR on POD 1 was 23.5% in the F-URS group and 80% in the mini-PCNL group (p<0.001). At three months followup, the SFR was 67.6% in the F-URS group and 90% in the mini-PCNL group (p=0.03) (Table 2). There was no significant difference in hemoglobin drop or postoperative complications between the two groups. One patient in the F-URS group required retreatment.

Conclusions: Ambulatory mini-PCNL and F-URS are effective treatment options for 1–2 cm lower calyceal renal stones. Both techniques have comparable hospital stay and complication rates, with a significantly better SFR with mini-PCNL.

POD 1.1. Table 1. Patient demographics and perioperative findings

Parameter		Mini-PCNL (30 patients)	F-URS (34 patients)	p
Age, median, years (range)		62 (39–76)	67 (44–87)	0.08
Gender	Male, n (%)	19 (63.3)	20 (58.8)	0.71
	Female, n (%)	11 (36.7)	14 (41.2)	
Side	Right, n (%)	14 (46.7)	12 (35.3)	0.18
	Left, n (%)	16 (53.3)	22 (64.7)	
Stone size, median, mm (range)		14 (10–20)	12.5 (10–20)	0.15
Stone volume, median, mm^3 (range)		736.7 (323–2968)	648.5 (121–2317.7)	0.09
Stone density, median, HU (range)		990 (350–1262)	803.5 (218–1384)	0.12
OR time, median, minutes (range)		55 (35–100)	49 (18–116)	0.04
Stent use, n (%)		2 (6.7)	34 (100)	<0.001
Intraoperative complications, n (%)		1 (3.3)	0 (0)	0.28
% hemoglobin drop, median (range)		11 (1–19)	6 (0–21)	0.06
Pain score in recovery, median (range)		1 (0–7)	1 (0–8)	0.92
Morphine in recovery, n (%)		8 (26.7)	5 (14.7)	0.24
Hospital stay, median, hours (range)		5 (3–7)	4 (3–6)	0.14

POD 1.1. Table 2. First day postoperative findings and 3 months followup data

Parameter		Mini-PCNL (30 patients)	F-URS (34 patients)	p
Postoperative day 1 (POD 1)				
Stone-free rate	0 mm, n (%)	16 (53.3)	4 (11.8)	<0.001
	> 0–3.9 mm, n (%)	8 (26.7)	4 (11.8)	0.13
Residual size, median, mm (range)		3 (3–8)	6 (2–12)	0.005
Residual volume, median, mm^3 (range)		13.4 (9.7–125.9)	70.4 (8.2–1813.3)	0.002
Pain score, median (range)		1 (0–10)	1 (0–5)	0.97
Complications, n (%)		2 (6.7)	2 (5.9)	0.63
ER visits, n (%)		2 (6.7)	1 (2.9)	0.48
Readmissions, n (%)		2 (6.7)	0 (0)	0.13
3-month followup				
Stone-free rate	0 mm, n (%)	22 (73.3)	13 (38.2)	0.005
	> 0–3.9 mm, n (%)	5 (16.7)	10 (29.4)	0.23
Residual size, median, mm (range)		3 (3–5)	5 (2–12)	0.41
Residual volume, median, mm^3 (range)		14.5 (11.6–42)	27.1 (3.9–528.5)	0.53
% of volume reduction, median (range)		100 (94.7–100)	96.5 (61.1–100)	<0.001
ER visits, n (%)		0 (0)	0 (0)	–
Readmissions, n (%)		0 (0)	0 (0)	–
Retreatment, n (%)		0 (0)	1 (2.9)	0.34

POD 1.2

First-in-human experience using the LithoVue™ Elite single-use ureteroscope to measure intrarenal pressure: The Canadian experience

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Introduction: Intrarenal pressure (IRP) is thought to play a role in complications following ureteroscopy. This area is poorly studied because of the difficulty in routinely measuring IRP. We report on our first-in-human experience using the LithoVue Elite™ ureteroscope (Boston Scientific).

Methods: A single-arm, retrospective, observational analysis was performed in 46 consecutive patients undergoing ureteroscopic lithotripsy using the LithoVue Elite™ system with pressure sensing capability between April and October 2022 at two centers. A pressure bag set at 150 mmHg or hand irrigation with a 60 cc syringe was used for irrigation, and a ureteral access sheath (UAS) was placed at the physician's discretion. Median and maximum IRPs and relative cumulative time exceeding 20, 40, 60, 80, 100, 120, 140, 160, and 200 mmHg per total procedure time were analyzed. The two-sample Mann-Whitney U-test was used with a statistical significance set at $p<0.005$.

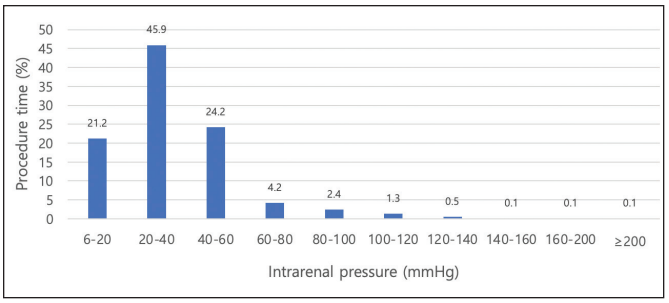
Results: Median patient age and body mass index (BMI) were 62.5 (IQR 47.8–72.0) years and 29.4 (23.3–32.8) kg/m2 (Table 1). During the median total procedure time of 31.9 (IQR 17.4–44.9) minutes, median and maximum IRPs were 30.0 (IQR 21.0–51.5) and 177.0 mmHg (IQR 129.0–266.0), respectively. IRP remained below 60 mmHg 91.3% of the procedure times (Figure 1). Patients with Asian ethnicity and hypertension had higher pressures and a longer relative cumulative time ≥20 mmHg compared to others, while patients with tight ureters and without UAS use exhibited longer cumulative times ≥60 mmHg. The smaller 10/12 Fr UAS did not lower pressures as much as the 11/13 Fr and 12/14 Fr UAS ($p<0.001$). Age, pre-stenting, preoperative α-blockade, and BMI did not show any statistically significant associations with IRP.

Conclusions: IRP can now be routinely measured during ureteroscopy. Patients had a median IRP of 30 mmHg and a maximum of 177 mmHg. The use of a smaller UAS (<12/14 Fr), Asian ethnicity, hypertension, and tight ureters were found to have higher IRPs in our study.

POD 1.2. Table 1. Clinical characteristics of patients

Number	46
Age (years)	62.5 (47.8 – 72.0)
Gender (male: female)	27:19 (58.7%:41.3%)
Race (Caucasian)	37 (90.2%)
Body mass index (kg/m²)	29.4 (23.3 – 32.8)
Stone diameter (mm)	10.0 (7.0 – 12.0)
Stone number	2 (1.0 – 2.3)
Hypertension	18 (39.1%)
Diabetes mellitus	6 (13.3%)
Preoperative pain	16 (34.8%)
Prior ESWL	22 (47.8%)
Ureteral access sheath placement	32 (69.6%)
Preoperative α-blocker use	11 (23.9%)
Pre-stenting	7 (15.2%)
Prior endourological intervention	34 (73.9%)
Tight ureter	11 (23.9%)

Data are number (%) or median (interquartile range)



POD 1.2. Figure 1. Distribution of procedure time according to intrarenal pressure ranges.

POD 1.3

Quality improvement on post-ureteroscopy opioid prescribing practices

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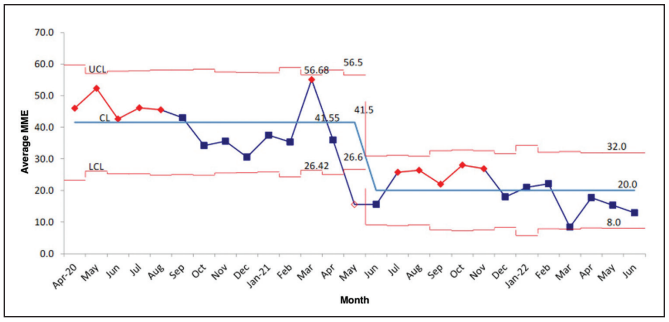
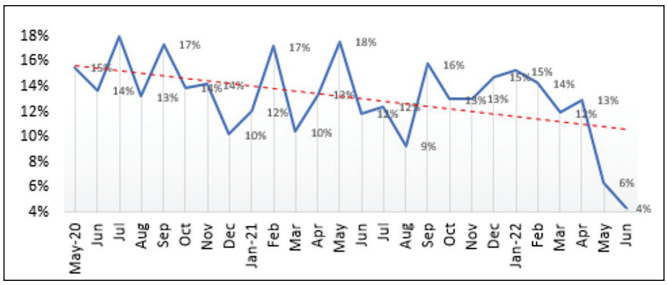
Introduction: Due to the opioid misuse crisis in North America, several studies have examined the use of minimal or opioid-free prescriptions following various surgeries in opioid-naive patients (ONPs). In May 2021, we started a quality improvement project for ureteroscopy (URS) for nephrolithiasis with opioid-free standardized prescriptions consisting only of ketorolac, acetaminophen, solifenacin, ciprofloxacin, and tamsulosin to be used by the adult urology group at their discretion.

Methods: The control consisted of ONPs who underwent URS in the 12 months prior to initiation of intervention while the opioid-free cohort consisted of ONPs who underwent URS in the 12 months after initiation of intervention. Our main outcome was the average morphine milligram equivalents (MME) of prescriptions filled for pain control within three days of hospital discharge. Balancing measures included hospital readmission within 90 days and outpatient MME prescriptions filled between 3–90 days post-discharge. Measures were compared across pre- and post-intervention groups using control charts and traditional hypothesis testing.

Results: In the current study, 3256 patients were retrospectively reviewed; the opioid-free cohort consisted of 1373 ONPs and the control consisted of 1883 ONPs. The average age was 53, with 60% males. The majority of stones were >4 mm, and most patients had multiple stones. There was a significant reduction in MME prescriptions filled in the opioid-free cohort compared to the control (19.7 vs. 41.2, $p<0.001$) (Figure 1). System stability was maintained post-intervention, with no significant increase in readmission rates in the experimental cohort (Figure 2).



POD 1.3. Figure 1. X-bar chart showing the average MME of discharge prescription in the 12 months prior to intervention (control cohort) and 12 months after initiation of standardized prescription intervention (experimental cohort). Intervention began in May of 2021. The difference in MME was found to be statistically significant between the two cohorts ($p<0.001$). Red=special cause variation, blue=common cause variation.



POD 1.3. Figure 2. Patients readmitted following ureteroscopy between May 2020 and June 2022. Standardized prescription intervention was initiated in May 2021. Though there is downward trend in readmission in recent months, there was no significant difference in readmissions between the opioid-free cohort and the control.

Conclusions: Using a simple, standardized prescription intervention following URS in large series of over 3000 patients, there was a significant reduction of 50% in opioids prescribed at discharge, with no significant increase in outpatient prescriptions or readmissions. This intervention provides evidence for opioid-free discharges in ONPs undergoing URS.

Acknowledgements: This work was selected as a podium presentation at AUA 2023.

POD 1.4

A machine learning model to determine calcium vs. non-calcium stone composition

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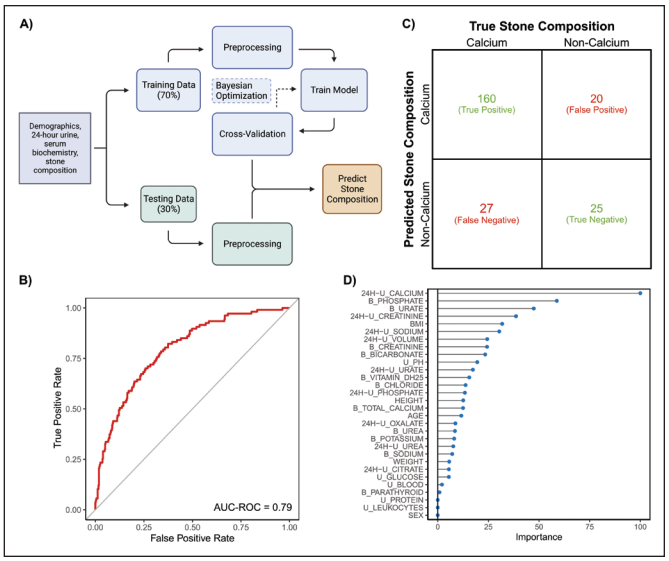
Introduction: Both surgical treatment modalities and dietary and medical prevention strategies for urolithiasis depend on stone composition; however, stone composition is often unknown until the stone is passed. Stone composition also reflects specific physiological parameters during its formation and may lead to an improved understanding of the pathophysiology of stone disease. Given this, we sought to develop a machine learning model to predict calcium vs. non-calcium stones based on the clinical and demographic data of stone formers.

Methods: Stone composition, 24-hour urine results, serum biochemistry, and demographics were prospectively collected from calcium (n=625) and non-calcium (n=152) stone patients at a tertiary care center metabolic stone clinic. Binary classification of calcium vs. non-calcium composition was performed using a gradient-boosted tree algorithm (Figure 1A). This algorithm converts multiple weak learners to strong learners to better classify stone types. Class imbalance was addressed by upsampling the minority class and hyperparameters were tuned using Bayesian optimization.

Results: Our model showed acceptable performance, with an area under the receiver operator characteristics (AUC-ROC) curve of 0.79 (Figure 1B). The model had a good degree of sensitivity of 0.86 and a moderate degree of sensitivity of 0.56 (Figure 1C). The model demonstrated that 24-hour urine calcium and creatinine, blood phosphate and urate, and BMI were the most significant predictors of classification (Figure 1D). Sex, urine dipstick results, and blood parathyroid levels were the least important predictors in the model (Figure 1D).

Conclusions: We have demonstrated that patient demographic and clinical data can be used to predict stone composition. This model may help urologists determine whether a patient has calcium or non-calcium stones and guide their management plan. Moreover, the model provides a better understanding of key clinical features of stone disease, which sheds light on the underlying pathophysiology. By extending machine learning algorithms, it will be possible to determine specific compositions of stones and ultimately improve medical therapy for stone formers.



POD 1.4. Figure 1.

POD 1.5

Hospital admission and disposition to long-term care following surgical intervention for nephrolithiasis in the elderly: A population-based study

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Introduction: Urolithiasis is a common condition of all ages; however, elderly patients have a higher risk of complications from surgical intervention due to increased comorbidities, frailty, and chance of atypical presentation. This results in increased burden to the healthcare system and increased morbidity for patients. This retrospective study aimed to investigate clinically meaningful outcomes, including readmission to hospital and discharge to long-term care (LTC) or an alternate level of care (ALC).

Methods: This is a population-based study of elderly patients (>65 years) with renal colic and receiving surgical management in Ontario between 2003 and 2019 using administrative data. The primary outcomes were readmission to hospital within three months of surgery and discharge to ALC or LTC facility. Multivariable regression models were performed to explore risk factors for the co-primary outcomes.

Results: A total of 34 275 patients met the inclusion criteria. Compared to a control arm that had extracorporeal shockwave lithotripsy (ESWL), elderly patients receiving surgical management had an increased risk of both readmission within three months (19.4% vs. 4.8%, p<0.0001) and transition to LTC or ALC (1.9% vs. 1.3%, p<0.001). Significant risk factors for readmission included increasing age, sex, septic stone, surgery type, and Charlson Index (p<0.001). Independent risk factors for disposition to LTC or ALC were age (odds ratio [OR] 1.11, 95% CI 1.10–1.12), Charlson Index (OR 3.24, 95% CI 2.69–3.91), and more complex surgery (OR 1.81, 95% CI 1.12–2.92).

Conclusions: Elderly patients are at a meaningful risk of readmission to hospital and need for LTC or ALC following surgical intervention for urolithiasis. This study may change the approach to how urologist's council elderly patients with renal stones requiring intervention, especially those of more extreme age and higher comorbidity.

POD 1.6

Developing an ex-vivo pig model for teaching fluoroscopic, ultrasound, and endoscopic-guided percutaneous renal access

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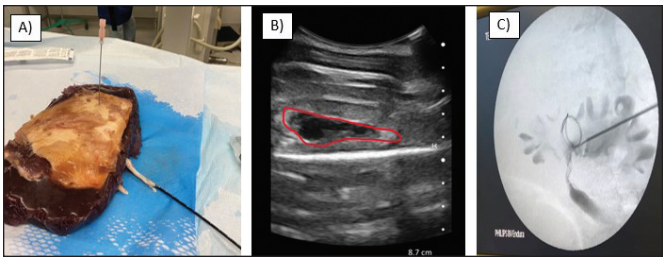
Introduction: Currently, there are no available models for use with both fluoroscopic (FL) and ultrasound (US) imaging for percutaneous renal access. Therefore, our objective was to develop a high-fidelity percutaneous renal access trainer that can be used with both FL and US guidance.

Methods: After a formal animal ethics exemption was attained, pig cadavers were harvested for flank (with shaved skin intact), kidneys, and ureters. A mold with a biosimilar gelatin matrix was cured at room temperature, then stored at -18°C. Testing was performed by an endourologist and endourology fellow for fidelity and utility, then used as a teaching tool during a hands-on residents' training session. Models were assessed for imaging (FL and US) and percutaneous access.

Results: After three iterations, the final models underwent multiple freeze/thaw cycles and did not degrade tissue integrity. US and FL (with retrograde pyelogram) were used successfully to achieve percutaneous access in multiple calyces. Hydro-distention of the collecting system via retrograde saline instillation adjusted difficulty during ultrasound (Figure 1). All (100%) of trainees found the model to simulate human anatomy and agreed/strongly agreed that the model improved their understanding of gaining access, and would use it in the future. The total cost of the model was $25.



POD 1.6. Figure 1. Porcine training model: (A) needle and ureteroscope in place; (B) ultrasound visualization; (C) fluoroscopic-guided access.

Conclusions: We developed a high-fidelity, low-cost, ex-vivo pig model to address challenges associated with learning renal access. By employing a single model to simulate ultrasound, fluoroscopic, and endoscopic-guided access, we can provide a varied yet streamlined learning experience.