Randomized, multicenter trial of ureteral stent placement vs. stent omission after ureteroscopy for renal stones

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ABSTRACT

INTRODUCTION: Ureteral stent placement after ureteroscopy is a major contributor to patient morbidity. We sought to evaluate postoperative complications and quality of life (QoL) metrics comparing individuals receiving ureteral stent placement vs. stent omission after ureteroscopy.

METHODS: A multicenter, randomized controlled trial was performed among patients undergoing ureteroscopy and laser lithotripsy for non-obstructing renal stones with up to 1.5 cm in total stone diameter. Ureteral access sheath use and laser technique were at the discretion of the surgeon. At case end, if no ureteral injury was observed, patients were randomized to stent placement or stent omission. Primary outcome was the 30-day occurrence of emergency department visits, unanticipated provider visits, or hospitalization. Secondary outcomes included QoL measured by the Wisconsin Stone Quality of Life (WISQOL) and the Patient-Reported Outcomes Measurement Information System (PROMIS) pain interference surveys, opiate use, and abnormal imaging findings at followup.

RESULTS: Of 103 patients enrolled with mean (standard deviation [SD]) stone diameter 9.6 mm (4.5), 74 were randomized to stent placement (n=36) or stent omission (n=38). Ureteral access sheaths were used in 83% and 61% of patients in the stented and unstented groups, respectively. There was no difference in rate of 30-day complications between stent and stent omission cohorts (8% vs. 11%, absolute risk difference -2%, 95% confidence interval [CI] -15%, 11%, p=0.75). Stent omission showed better adjusted pre- vs. post-surgery WISQOL scaled score (16.7, 95% CI 3.1, 30.4, p=0.02) and PROMIS 6a t-score (-8.5, 95% CI -15.3, -1.6, p=0.02). No differences between groups were observed in the cumulative opiate use, ability to return to work, symptomatic urinary tract infection, or abnormal imaging findings at followup.

CONCLUSIONS: Compared to ureteral stent placement, stent omission after ureteroscopy for renal stones appears to be feasible and suggests improved short-term patient-reported outcomes in selected patients. This study was limited by small sample size, and future larger studies are needed.

INTRODUCTION

Ureteral stent placement after ureteroscopy is commonly performed to prevent obstruction and pain, and yet, is the major contributor to patient morbidity. Postoperative stent colic, urgency, and frequency can lead to unplanned healthcare, including emergency department (ED) visits and readmissions, in as many as 1/8 individuals.[1-3] While current practice guidelines state that stents can be omitted in selected cases,[4] stents are still routinely placed in 73–85% of cases.[5]

To our knowledge, there are no prospective studies focusing on unplanned stone-related healthcare utilization, patient-reported outcomes, or health-related quality of life (HRQoL) in the setting of stent use for renal stones. A recent Cochrane review found that higher-quality studies are needed.[6] We sought to determine whether stent omission after ureteroscopy specifically for renal stones carried any difference in 30-day postoperative complications and quality of life (QoL) metrics compared to stent placement.

METHODS

We performed a multicenter, randomized controlled trial among patients undergoing ureteroscopy and laser lithotripsy for non-obstructing renal stones. Patients were identified in clinic as they were scheduled for surgical treatment and enrolled by surgeons or members of the clinical research team. Written informed consent was obtained. Each site had

local institutional review board approval, and the study was registered at *clinicaltrials.gov*: NCT03855787. A CONSORT diagram (Figure 1) and checklist were completed. For study overview, see Supplementary Figure 1 (available at *cuaj.ca*).

Inclusion/exclusion criteria

Primary inclusion criteria were age ≥18 years, undergoing planned unilateral ureteroscopy and lithotripsy (acceptable to have untreated contralateral stones), and maximum renal stone diameter of ≤1.5 cm as measured on computed tomography (CT) scan (if multiple stones, total sum of maximum diameters). To broaden our inclusion criteria and more accurately reflect the heterogeneity of stone cases in real-world practice, the presence of a preoperative indwelling stent was allowed.

Exclusion criteria included the presence of a ureteral stone, percutaneous nephrostomy tube, preoperative hydronephrosis, solitary kidney or estimated glomerular filtration rate (eGFR) <60 mL/min, and variant anatomy, including horseshoe kidney, pelvic kidney, prior urinary tract reconstruction, planned bilateral ureteroscopy, and intraoperative identification of ureteral injury or infection.

A total of 103 patients were enrolled across eight sites in North America from 2019–2024. Preoperative and intraoperative data were collected regarding patient and clinical factors. Ureteroscopy was performed as per the standard of care. Ureteral access sheath use, scope type, and laser type and technique (dusting, fragmenting/basketing, combination) were at the discretion of the surgeon. At the time of study design and implementation, suction technology was not yet commonly used.

At case end, if no significant ureteral injury was observed during withdrawal of the ureteroscope, as deemed by the surgeon, patients were then randomized to stent placement or stent omission by opening an envelope. Stents remained in place until at least the first postoperative encounter at 5–10 days after surgery. Intraoperative data were collected, and ureters were assessed for injury according to the Post-Ureteroscopic Lesion Scale (PULS, grades 0–4) and Traxer grading scales (grades 1–4),[7,8] which provide a standardized way of describing iatrogenic ureteral lesions during ureteroscopy. Outcomes were assessed in an intention-to-treat framework.

Randomization

A two-stage block randomization process was performed. In the first stage, each clinical research site was randomly assigned to have a block containing either four or six patients. Then, in the second stage, patients were randomized within each block to have a stent or no stent. The randomization sequence was generated centrally prior to the screening of the first patient, and the sequence was provided to each site. Sites had a person not involved in the research study create the concealed opaque envelopes, which were stored securely at each site. The envelopes were opened by a person not involved in the surgery at the specified time after the ureteroscopy portion of the case was complete.

Outcomes

Primary outcome was the 30-day postoperative occurrence of ED visits, unanticipated provider visits, or hospitalizations. Secondary outcomes were collected 5–10 days after surgery and included HRQoL measured by changes from pre- to postoperative Wisconsin Stone Quality of Life (WISQOL) and the Patient-Reported Outcomes Measurement Information System (PROMIS) 6a pain interference surveys, cumulative opiate use, urinary tract infection (UTI) diagnosis, and phone calls to the office due to symptoms, as well as stone-free status and any abnormal imaging findings collected at 4–8 weeks (CT, kidney-ureter-bladder [KUB], or ultrasound [US]). At the last followup, participants were asked if they would undergo a ureteroscopy procedure again and whether they would prefer the same treatment assignment.

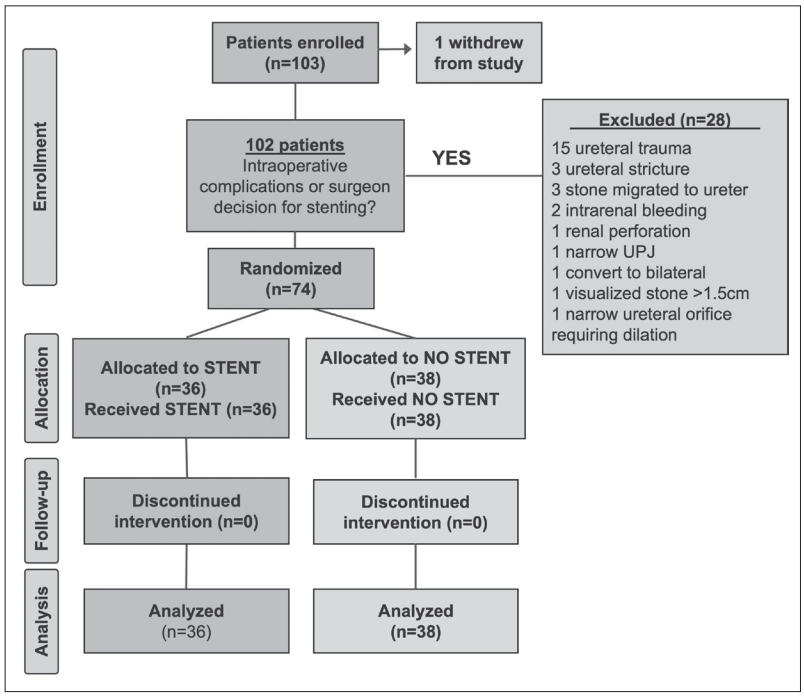

Figure 1. Consort flow diagram.

Statistical analysis

To compare the two groups, absolute differences in proportions were calculated for descriptive statistics and for the primary outcome; the absolute difference in proportions was estimated using a two-sample Wald method with continuity correction, and a two-sided 95% confidence interval (CI) was reported. Multivariable linear regression was used to model the associations between PROMIS/WISQOL scores and treatment group, with covariates of age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, maximum stone diameter, and presence of preoperative stent. Statistical significance was set at $p<0.05$.

Power calculation

Based on prior literature for the primary outcome of 30-day complications after stent placement, the event rate was estimated to be 15% based on administrative claims data,[3] and two randomized controlled trials (RCTs) that included patients with renal stones.[9,10] Consensus was reached that a 5% absolute difference is clinically meaningful. With 60 subjects per group, a 5% difference in the primary composite outcome could be estimated with a 95% CI width of 11.8%.

During the enrollment period, the COVID-19 pandemic limited patients' ability to obtain elective surgery, and there was a shift toward increased use of bilateral procedures to complete more surgeries in a shorter time. Patient interest in participating in research studies also decreased after COVID, and the advent of suction ureteral access sheaths led to an evolution in surgical techniques away from the original methodology of our study. All these factors resulted in recruitment delays and enrollment challenges. For these reasons, we decided to terminate the study early. With the achieved total sample size of 74, the 95% CI for the difference in proportions would have a margin of error of approximately 13–19 percentage points under plausible event rates.

RESULTS

A total of 103 patients were enrolled, and 74 were randomized to stent placement (n=36) or stent omission (n=38) (Figure 1). There were 28 (27%) excluded prior to randomization, primarily due to the ureter appearance at the end of the case. There were no significant differences between the cohorts in terms of age, gender, race, or stone size or location. In both cohorts, of the 17 stented and 24 non-stented patients for whom prior stone history details were available, more than half had previously undergone ureteroscopy and stent placement procedures (Table 1A).

The total average (standard deviation [SD]) stone diameter was 9.6 (4.5) mm. Ureteral access sheaths, primarily 11/13 Fr or 12/14 Fr, were used in 83% and 61% of patients in the stented and unstented groups, respectively (no statistically significant difference), and 14% of total patients were stented prior

Table 1A. Demographics and preoperative variables

	Stent (n=36)	Stent omission (n=38)	p
Age, mean (SD)	53.8 (17.4)	53.4 (15.5)	0.92
Gender			
Male	16 (44%)	19 (50%)	0.81
Female	20 (56%)	19 (50%)	
Race			
Asian/American Indian/Alaska Native	0 (0%)	1 (3%)	0.05
Native Hawaiian/Other Pacific Islander	0 (0%)	1 (3%)	
Black/African American	0 (0%)	2 (5%)	
White non-Hispanic	22 (61%)	28 (74%)	
Hispanic	4 (11%)	5 (13%)	
More than one race	6 (17%)	1 (3%)	
Unknown/Not reported	4 (11%)	0 (0%)	
BMI, kg/m^2 mean (SD)	28.8 (5.8)	30.8 (6.5)	0.17
Prior stone history	24 (67%)	30 (79%)	0.35
Prior ureteroscopy	9/17 (53%)	15/24 (63%)	
Prior stent	9/17 (53%)	17/24 (71%)	
Single/multiple stones?			
Single	20 (56%)	17 (45%)	0.49
Multiple	16 (44%)	21 (55%)	
Total max stone diameter, mm, mean (SD)	9.9 (5.1)	9.4 (4.2)	0.66
Total stone area, mm^3, mean (SD)	51.7 (28.7)	51.5 (32.9)	0.99
Location of largest stone			
Upper calyx	11 (31%)	3 (8%)	
Mid calyx	5 (14%)	5 (13%)	
Lower calyx	11 (31%)	15 (40%)	

SD: standard deviation; UPJ: ureteropelvic junction.

Table 1B. Intraoperative variables

	Stent (n=36)	Stent omission (n=38)	p
ASA			
1	10 (28%)	3 (8%)	0.08
2	16 (44%)	20 (53%)	
3	10 (28%)	15 (40%)	
4	0 (0%)	0 (0%)	
Preoperative stent present	6 (17%)	4 (11%)	0.67
Reason: Pain	2 (33%)	3 (75%)	
Reason: Sepsis	2 (33%)	1 (25%)	
Reason: Recent ureteroscopy	2 (33%)	0 (0%)	
Preoperative tamsulosin	24 (67%)	16 (42%)	0.06
Ureteral access sheath used	30 (83%)	23 (61%)	0.06
10/12 Fr	3 (10%)	2 (9%)	0.77
11/13 Fr	14 (47%)	13 (57%)	
12/14 Fr	13 (43%)	8 (35%)	
Stone treatment method			
Pure dusting	11 (31%)	8 (21%)	0.27
Fragmentation with basketing	5 (14%)	11 (29%)	
Dusting, fragmenting, and basketing	13 (36%)	16 (42%)	
Basket only (no laser)	6 (17%)	3 (8%)	
Popcorning/popdusting?			
Yes	18 (50%)	15 (40%)	0.20
Post-treatment stone status			
Nothing	14 (39%)	13 (34%)	0.38
Only dust	8 (22%)	8 (21%)	
0.5 mm maximal fragments	7 (19%)	6 (16%)	
1 mm maximal fragments	4 (11%)	11 (29%)	
2 mm maximal fragments	0 (0%)	0 (0%)	
Inaccessible corner stone	1 (3%)	0 (0%)	
Mean operative time, mins (SD)	43.19 (17.4)	36.47 (16.4)	0.09

to surgery, primarily for sepsis and stone-related pain (Table 1B).

There were no significant differences between cohorts in terms of treatment methods, and at the end of each case, the majority of surgeons reported visualizing only sub-mm stone fragments or smaller. The operative time for the stent omission group was an average of 6.7 minutes shorter (95% CI -14.5, 1.1, p=0.092).

Table 2. Perioperative pain management

	Stent (n=36)	Stent omission (n=38)	p
Perioperative ketorolac use	25 (69%)	28 (74%)	1
Postoperative Rx ketorolac/NSAIDS	30 (83%)	34 (90%)	0.67
Postoperative Rx phenoazopyridine	28 (78%)	25 (66%)	0.38
Postoperative Rx anticholinergic	17 (47%)	8 (21%)	0.03
Postoperative Rx tamsulosin	36 (100%)	34 (90%)	0.14
Postoperative Rx benzodiazepines	1 (3%)	0 (0%)	0.98
Postoperative Rx opiate	7 (19%)	15 (40%)	0.10

NSAIDS: non-steroidal anti-inflammatory drugs; Rx: prescription.

Supplementary Table 1 (available at *cuaj.ca*) describes the specific equipment types used for each case.

At the end of the case, when inspecting the ureter, superficial mucosal lesions (PULS score 2) and ureteral mucosal erosion without smooth muscle injury (Traxer grade 2) were observed in 39% and 28% of the stented cohort and 45% and 26% of the stentless cohort, respectively, with no significant difference (Table 2). Intraoperative ketorolac was used in the majority of cases (72%).

Regarding the primary outcome, there was no difference in risk of 30-day complications between stent and stent omission cohorts (8% vs. 11%, with an absolute risk difference of -2%, 95% CI -15%, 11%, p=0.75) (Table 3A). No secondary procedures were performed in either cohort, with most complications being related to flank pain or sepsis. In a subanalysis comparing patients who received a sheath vs. not, the use of a ureteral access sheath was not associated with a significant difference in postoperative complications (8%, 4/53 vs. 14%, 3/21), respectively, with an absolute risk difference of -7% (95% CI -23%, 10%, p=0.43). In another subanalysis, the presence of a preoperative stent was not associated with a change in outcomes (Table 3B). Further multivariate analysis was unable to be performed due to the low numbers in the cohorts.

For secondary outcomes, stent omission was associated with improved postoperative PROMIS 6a t-scores (-7.6, 95% CI -13.2, -2.1, p=0.008) and greater improvements in pre- to postoperative PROMIS score differences (-8.5, 95% CI -15.3, -1.6, p=0.02) (Figure 2A) compared to the cohort with stent placement. Stent omission was also associated with improved postoperative WISQOL scaled scores (19.3, 95% CI

Table 3A. Postoperative outcomes

	Stent (n=36)	Stent omission (n=38)	p
ER/unanticipated provider visits or hospitalization within 30 days	3 (8%)	4 (11%)	0.75
Unanticipated ER visits	3	4	
Unanticipated provider visits	2	0	
Hospitalization	0	2	
Number of phone calls due to symptoms			
0	26 (72%)	28 (74%)	0.12
1	7 (19%)	4 (11%)	
2	0 (0%)	4 (11%)	
≥3	1 (3%)	0 (0%)	
Returned to work or would have returned to work if working	29 (81%)	33 (87%)	0.31
Total opiates used post-surgery (morphine equivalents), mean (SD)	6.3 (18.8)	7.4 (13.8)	0.79
Number of patients who did not use opiates	5 (14%)	5 (13%)	
Early stent dislodged/removal	6 (17%)	N/A	N/A

ER: emergency room; SD: standard deviation.

Table 3B. Postoperative outcomes stratified by ureteral access sheath use

	Sheath (n=53)	No sheath (n=21)	p
ER/unanticipated provider visits or hospitalization within 30 days	4 (8%)	3 (14%)	0.43
Number of phone calls due to symptoms			
0	42 (79%)	12 (57%)	0.04
1	7 (13%)	4 (19%)	
2	1 (2%)	3 (14%)	
≥3	0 (0%)	1 (5%)	
Returned to work or would have returned to work if working	46 (87%)	16 (76%)	0.24
PROMIS 6a transformed t-score difference, mean (SD)	-0.38 (15.79)	1.74 (14.59)	0.60
Median [Q1, Q3]	0.00 [-9.98, 7.52]	-0.80 [-6.17, 12.20]	
WISQOL scaled score difference, mean (SD)	2.66 (32.02)	5.30 (23.79)	0.71
Median [Q1, Q3]	2.33 [-6.47, 20.09]	4.01 [-9.82, 24.11]	

ER: emergency room; SD: standard deviation; WISQOL: Wisconsin Stone Quality of Life questionnaire.

5.4, 33.2, p=0.007) and pre- vs. post- surgery scaled score differences (16.7, 95% CI 3.1, 30.4, p=0.02) (Figure 2B).

On multivariate analysis, there were no other significant predictors of improved HRQoL scores besides stent omission. There was no difference in postoperative need for opiates, but the stented patients were more often prescribed postoperative anticholinergics (47% vs. 21%, risk difference 26%, 95% CI 5%, 47%, p=0.03).

When surveyed about their preferences for surgery, patients without a stent definitely preferred to repeat surgery with the same treatment assignment of stent omission (53% vs. 19%, risk difference 33%, 95% CI 13%, 54%, p=0.02). When analyzing whether the subgroup who were pre-stented would prefer the same treatment assignment, 0% would definitely and 10% would probably prefer the same treatment compared to 42% definitely and 9% probably in the non-pre-stented group (p=0.009).

No differences were observed in cumulative opiate use, ability to return to work, symptomatic UTI, or abnormal imaging findings at followup (Table 3C). Stone-free rate, defined as no residual stone fragments seen on a variety of postoperative imaging modalities, was 58% (stent) vs. 40% (stent omission), with the absolute risk difference of 19% (95% CI -4%, 41%, p=0.27). Among the 28 patients with postoperative CT scans, 5/11 (46%) stented patients and 3/17 (18%) non-stented patients were completely stone-free, with an absolute risk difference of 28% (95% CI -7%, 62%, p=0.29) (Supplementary Table 2; available at *cuaj.ca)*.

DISCUSSION

The question of whether to stent or not to stent after ureteroscopy is commonly considered. The American Urological Association and European Association of Urology's guidelines recommend stent omission in uncomplicated ureteroscopy cases,[4,11] yet urologists still place stents in 73–85% of all cases.[2] Many factors play into the decision to leave a stent, such as patient age, stone size/location, use of ureteral access sheath, whether the stone is impacted, and day of the week of surgery;[12] however, stent placement also carries morbidity for the patients and has been shown in some studies to lead to increased unplanned health care utilization and up to 25% more ED visits after surgery.[1] There exists a need for more high-quality data in this area, focused not only on complication rates but also on patient-reported outcomes.

We report a multicenter, prospective, RCT focusing on stent omission after ureteroscopy for renal

stones in a select group of patients, with the surgeon ultimately determining whether each patient remains in the trial after the lithotripsy. We found that omission of a stent after uncomplicated ureteroscopy resulted in no changes in 30-day complication rates or unplanned healthcare utilization. Indeed, stent omission even led to improvements in some HRQoL and patient-reported outcome metrics. Of note, these findings should be interpreted as inconclusive due to imprecision from lower recruitment numbers. The small sample size limits the ability to draw significant conclusions from the data.

The idea that stent omission leads to improvements in morbidity is not new. Studies and meta-analyses have shown that stent omission, and at least use of smaller-diameter stents, after treatment of ureteral stones leads to decreased complications, such as hematuria, dysuria, and pain, while not affecting ureteral stricture formation rate;[6,13-17] however, studies specifically assessing renal stones are less well-defined.

Our study followed a pragmatic design in which ureteroscopy and lithotripsy were performed by a variety of surgeons using diverse techniques with respect to laser type, settings, and technique. Importantly and unique to this study, ureteral access sheaths could be used at the discretion of the surgeon, regardless of whether the patient was pre-stented, and 11/13 Fr and 12/14 Fr sheaths were used in over 70% of cases. In addition, with the growth of suction technology, there will likely be a shift toward increasing use of sheaths. Our findings suggest that even with sheath use, urologists may often be able to consider omitting stent placement.

These data challenge the notion that ureteral access sheaths necessitate postoperative stent placement. Sheath use has traditionally been felt to increase the risk of ureteral injury, such as urothelial abrasion, ischemia, or even avulsion.[8] In these cases, management with a stent has been shown to eliminate any additional risk of long-term stricture formation;[18] however, when no ureteral injury is seen upon direct inspection at the end of the case, the requirement for a stent is less defined.

In our study, 15 patients of 103 were excluded due to submucosal (PULS grade 2) ureteral trauma upon direct inspection at the end of the case, but of the 74 patients who tolerated sheath placement that were randomized, 55% of cases had no injury, and 42% had a superficial mucosal lesion (PULS grade 1). Thus, mucosal erosions after sheath placement are not uncommon, but PULS 1 lesions alone should not prevent consideration for stent omission. Even with visible PULS 1 lesions at the end of a case, patients could still be considered for stent omission without an increased risk of complications. Nevertheless, surgeons should continue to counsel patients that stents may be required despite the best efforts of the surgeon to omit a stent. Certainly, other factors, such as the presence of a solitary functioning kidney, chronic kidney disease, bleeding complication, early termination of the case, or large residual stone burden and/or plan for second-stage procedure, would be compelling reasons to leave a stent.

This is one of the first series to report improved patient-reported outcomes and HRQoL specifically related to the treatment of renal stones. In a multicenter analysis from the SMART study group, patients without postoperative stent placement scored significantly

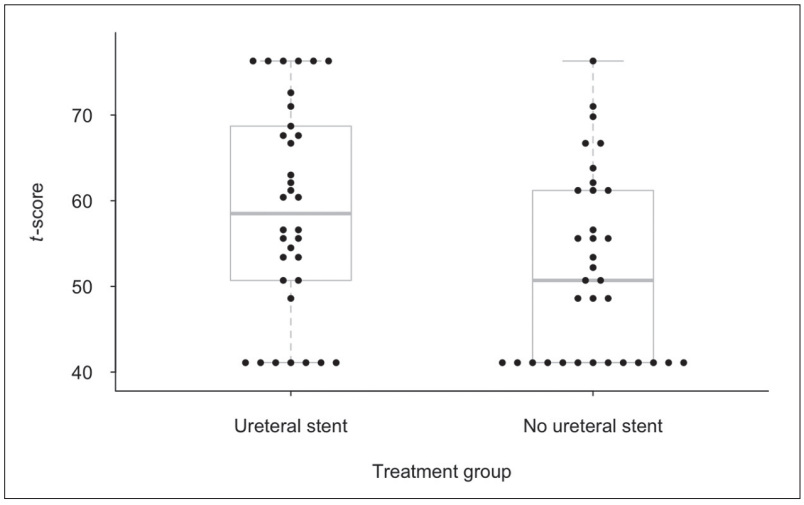

Figure 2A. Distribution plots of postoperative PROMIS t-scores (p=0.017).

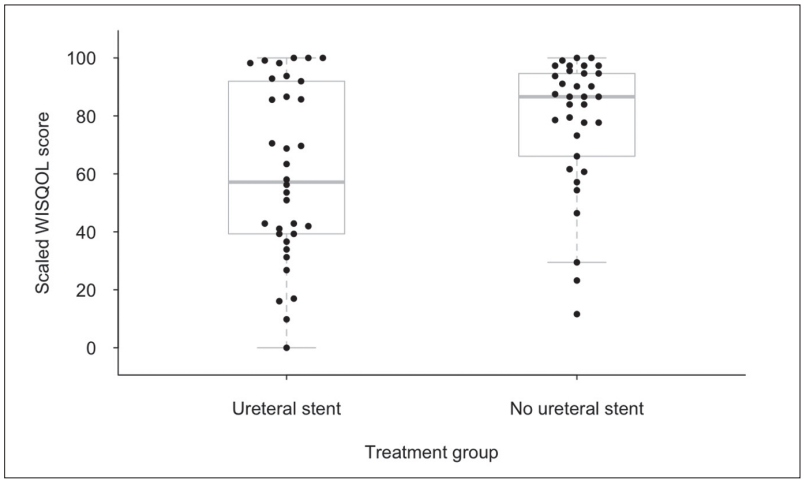

Figure 2B. Distribution plots of postoperative WISQOL scaled scores (p=0.017).

Table 3C. Postoperative outcomes stratified by presence of preoperative stent

	Stent (n=10)	No stent (n=64)	p
ER/unanticipated provider visits or hospitalization within 30 days	0 (0%)	7 (11%)	0.70
Number of phone calls due to symptoms			
0	10 (100%)	44 (69%)	0.04
1	0 (0%)	11 (17%)	
2	0 (0%)	4 (6%)	
≥3	0 (0%)	0 (0%)	
Returned to work or would have returned to work if working	8 (80%)	54 (84%)	1.0
PROMIS 6a transformed t-score difference, mean (SD)	-11.82 (15.19)	2.08 (14.67)	0.03
Median [Q1, Q3]	-13.40 [-24.60, 1.20]	0.00 [-8.85, 10.35]	
WISQOL scaled score difference, mean (SD)	23.66 (35.88)	0.36 (27.70)	0.09
Median [Q1, Q3]	21.42 [0.40, 33.04]	0.00 [-8.92, 20.09]	

ER: emergency room; SD: standard deviation; WISQOL: Wisconsin Stone Quality of Life questionnaire.

higher on social impact and disease impact domains of the Japanese WISQOL;[19] however, this study contained a mix of ureteral (72%) and renal (28%) stones undergoing various surgeries. Other studies concur that omission of a stent after ureteral stone treatment also improves HRQoL.[20]

Our secondary outcome results are exploratory but suggest significant improvement as the patient-reported outcomes effect sizes exceed the minimal clinically important difference thresholds (PROMIS -7.6 to -8.5; the literature suggests effect size of 2–6 points;[21] WISQOL 16.7 to 19.3; the literature suggests effect size of 4–10 points[22-24]). Furthermore, we feel the patient-reported attitudes toward their allocation of stent or no stent after surgery provides further insight about their personal tolerance of the procedure.

Limitations

The limitations of our study warrant consideration. We failed to meet our target recruitment due to challenges with enrollment, including a shift in practice patterns toward bilateral procedures initiated at the time of the COVID outbreak. As such, our conclusion of no significant differences in primary or some secondary outcomes is underpowered and limited by small sample size.

In addition, the inclusion of some patients with preoperative stents adds heterogeneity to our small dataset, but we sought to include a broad array of patient presentations to more accurately reflect a diverse real-world practice. Likewise, the heterogeneity in surgical approach and use of ureteral access sheaths may limit evaluating the relationship between surgical technique and outcomes.

We acknowledge a lack of standardization of preoperative and postoperative medication protocols, such as use of alpha-blockers and pain medication, which could lead to variation in patient-reported outcomes. Also, we allowed for variability in postoperative imaging. These decisions were made to better reflect the heterogeneity of typical, real-world practice patterns among urologists (for example, some postoperative imaging modality choices are driven by urologist preference or restrictions by patient insurance coverage).

Future studies involving larger cohorts with standardized preoperative and postoperative medication and imaging pathways will allow for targeted subanalyses, such as the role of ureteral access sheaths or prestenting on the operative and subjective outcomes.

CONCLUSIONS

Omission of a ureteral stent after uncomplicated ureteroscopy for renal stones, even when using a ureteral access sheath, appears to be feasible and suggests improved functional and pain-related outcome measures and increased satisfaction scores when avoiding a stent. Our study was limited by a small sample size, and larger, adequately powered studies will help elucidate the longer-term impacts on healthcare utilization and guide change in practice. With no evidence of ureteral injury after treating a renal stone up to 1.5 cm in an uncomplicated patient, surgeons should consider not placing a stent in uncomplicated cases.

COMPETING INTERESTS: The authors have no competing personal or financial interests to disclose.

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