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Repeat Imaging to Avoid Surgery: An Initiative to Reduce-Negative Ureteroscopy in Patients with Ureteral Stones

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What's known on the subject? and What does the study add?

Negative ureteroscopy is a clinical occurrence defined by ureteroscopy being performed for a ureteric or renal calculus identified on radiographic imaging pre-operatively, with no calculus ultimately being identified intra-operatively due to the calculus being passed prior to the procedure being performed. This occurrence has been reported in the existing literature with rates between 6.3 and 9.8% in cohorts consisting of patients with both ureteric and renal calculi. The rates of negative ureteroscopy can be reduced by having more timely operative intervention, and by utilizing repeat pre-operative imaging when indicated. Smaller and more distal calculi are more likely to pass prior to intervention and result in a negative ureteroscopy. This study provides further information regarding the rates of negative ureteroscopy in a specific cohort of patients with only ureteric calculi. These patients did have a higher rate of negative ureteroscopy than other populations in the literature. Additionally, patients who were more symptomatic from their stone undergoing more expedited intervention were actually more likely to have passed their stone prior to intervention when compared to patients undergoing delayed intervention. This highlights the need for repeat imaging when available prior to intervention.

Abstract

Objective: Negative ureteroscopy (nURS) describes the absence of ureteric stones during endoscopic visualization, despite imaging confirmation before surgery. This study aimed to identify the prevalence of, and factors predicting nURS in patients presenting with ureteral stones.

Materials and Methods: We performed a retrospective review of all uretersocopies for ureteral stones performed by three endourologists over a six-month periods. Only patients without previous intervention for the stone in question were considered for this study. nURS was investigated in relation to demographics, time from imaging to procedure, stone and procedure-specific characteristics, etc. Statistical analysis consisted of descriptive statistics and univariate and multivariate logistic regression analyses using SPSS statistical software.

Results: Eighty-two patients were reviewed, with 14.6% of those patients experiencing a nURS. The frequency of computed tomography imaging and time from imaging to procedure did not differ significantly between +URS and nURS. Stone size (7.74±3.09 vs 6.73±2.28 mm; p=0.298), and stone location (68.6% vs 75.0% distal; p=0.686) were also not significantly different. Significantly more nURS procedures were performed in the emergency (21.7% vs 50.0%; p=0.048). These emergency nURS patients also had a statistically significant shorter duration from imaging to URS (7.1 vs 20.7 days; p=0.001). nURS procedures were 3.60 times more likely to be performed as an emergency (odds ratio=3.60; 95% confidence interval=1.01-12.79; p=0.048).

Conclusion: We have identified 14% of patients undergoing ureteroscopy for ureteral stones at our center are being overtreated. Therefore, we believe that it is imperative that reimaging be considered in this patient population before surgery.

Keywords: Nephrolithiasis, ureteroscopy, negative ureteroscopy

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Introduction

With an estimated 1 in 11 North Americans developing kidney stones, many will ultimately require surgery to remove obstructing ureteral stones (1). Most kidney stones will pass spontaneously, however endoscopic stone removal is now readily performed for all anatomic regions of the upper urinary tract. Technological advancements have made ureteroscopy increasingly common as first-line treatment (2), as well as secondary treatment for failed SWL (3-5).

Despite significant progress in endoscopic stone management, there are several well-established complications. This particular study is concerned with negative ureteroscopy (nURS), defined as a surgical procedure performed for a stone on imaging where no stone is ultimately found despite its presence on imaging. In these cases, it is believed that the patient passed the stone without awareness of this fact. This results in surgical intervention in patients in whom it is no longer required, exposing them to unnecessary risks. Additionally, it represents a source of wasted operative resources in our already strained Canadian public healthcare system. Given the need to be judicious with healthcare resources, while protecting the best interests of our patients, the objective of this study was to better understand the factors contributing to nURS in patients with ureteric stones. Patients with symptomatic ureteral stones are typically motivated to undergo expedited surgery due of ongoing symptoms, and to avoid the perceived ongoing pain until spontaneous passage (if it occurs at all).

Therefore, we sought to define the incidence and any predictors of nURS at our center to create strategies to minimize future occurrences.

Materials and Methods

We performed a retrospective evaluation of all patients who underwent ureteroscopy for ureteral stones at our center over six consecutive months. Only patients with untreated ureteral stones at the time of consultation were included in this analysis. Those with indwelling ureteral stents placed before surgery were excluded. A nURS was defined as failure to endoscopically locate the ureteral stone diagnosed on pre-operative imaging. Patients were reviewed with respect to demographics, presenting characteristics, and time from consultation to surgery. Pre-operative imaging was manually reviewed, and intraoperative reports were used to assess the specifics of each procedure. Flexible and/or semi-rigid ureteroscopy was performed at the discretion of the urologist performing these procedures. Surgical technique was not standardized, due to the retrospective nature of this analysis.

Statistical Analysis

Descriptive statistics were performed, comparing patients in which ureteroscopy identified stones (+URS) and nURS groups. Univariate, followed by multivariate regression analyses were performed to evaluate any associations with nURS.

Results

Of 245 ureteroscopies performed over a 6-month period, we identified 82 ureteroscopies matching our inclusion/exclusion criteria. There were no significant differences between age (50.9 +URS vs 47.1 y nURS, p=0.390), gender (52.9% vs 58.3% male, p=0.726), and body mass index (BMI) (30.1 vs 29.3, p=0.696) between +URS and nURS.

The overall incidence of nURS was 14.6%, (n=12). Stone size (7.74±3.09 vs 6.73±2.28 mm; p=0.298) and location were not a statistically significant different in nURS vs +URS. The majority of stones were distal (+URS 68.6% vs nURS 75%). Only 3 of 11 stones not found during ureteroscopy were proximally positioned (above the pelvic brim) on pre-operative imaging (p=0.656) (Table 1).

There was no difference in the rates of pre-op imaging modalities between +URS and nURS [computed tomography (CT) in 87.0% vs 83.3%; p=0.736], and the average time from the first imaging confirmation of ureteral stone to the date of ureteroscopy was not significantly different (18d±14 +URS vs 9d±6 -URS; p=0.08). Overall, there was no significant difference in historical stone procedures (20.0% +URS vs 25.0% nURS; p=0.694) (Table 1). There was also no difference in patients past medical history for pelvic surgery, or overall health as categorized by the American Society of Anesthesiologists Physical Status Classification (ASA score) (p>0.05).

Significantly more nURS procedures were performed as expedited cases that were performed on weekends or outside of elective operating room time (10% Routine vs 28.6% Expedited; p=0.048). Out of 81 total procedures, 25.9% (n=21) was expedited. Additionally, expedited cases had a shorter interval between imaging and ureteroscopy (7.10 days vs 20.66 days; p=0.001). Expedited vs routine cases also showed no significant differences in size (7.91 vs 6.80 mm), distal stone position (73.3% vs 61.9%), or pre-op imaging modality (CT 84.7% vs 90.5%) (p>0.05). No other differences were identified between age, gender, BMI, surgeon, or average ASA score. nURS procedures were 3.60 times more likely in those who were expedited (odds ratio=3.60; 95% confidence interval=1.01-12.79; p=0.048) (Table 2).

Table 1. Analysis of ureteral stones treated with ureteroscopy				
Variable	**+URS (n=70)**	**nURS (n=12)**	**p-value**	**OR (95% CI)**
Age (years)	50.8	47.1	0.390	1.020 (0.975-1.066)
Gender (male)	52.9%	58.3%	0.726	1.249 (0.361-4.314)
BMI	30.0	29.3	0.696	1.020 (0.923-1.128)
Avg ASA score	1.97	2.08	0.549	0.735 (0.268-2.013)
Emergency cases	21.7% (n=15)	50% (n=6)	0.048	0.278 (0.08-0.99)
Recur. stones	20.0%	25.0%	0.694	0.750 (0.179-3.140)
Stone size (mm)	7.74±3.09	6.73±2.28	0.298	1.149 (0.884-1.493)
Stone side (L)	58.6%	33.3%	0.115	2.828 (0.778-10.282)
Uteral stone location				
Distal	68.6%	75.0%	0.686	0.844 (0.156-4.570)
Middle	12.9%	16.7%		2.437 (0.283-21.029)
Proximal	18.6%	8.3%		
CT performed	87.0% (n=60)	83.3% (n=10)	0.736	1.333 (0.250-7.097)
Hydronephrosis	65.7% (n=46)	50.0% (n=6)	0.466	2.190 (0.632-7.598)
Time from first imaging to URS				
All patients	17.58	9.30	0.093	1.08 (0.99-1.18)
Emergency cases	7.57	6.00	0.469	1.09 (0.86-1.37)
Surgeon				
A (n=32)	37.1% (n=26)	50.0% (n=6)	0.264	5.53 (0.62-49.41)
B (n=25)	34.3% (n=24)	8.3% (n=1)		0.92 (0.25-3.46)
C (n=25)	28.6% (n=20)	41.7% (n=5)		

OR: Odds ratio, CI: Confidence interval, BMI: Body mass index, URS: Ureteroscopy, ASA: American Society of Anesthesiologists, CT: Computed tomography

Table 2. Analysis of emergency vs non-emergency ureteroscopies				
Variable	**ASA "E" (n=21) 25.9%**	**ASA Non-"E" (n=60) 74.1%**	**p-value**	**OR (95% CI)**
Age (years)	49	51	0.58	0.99 (0.995-1.026)
Gender (male)	52.4%	53.3%	0.94	1.04 (0.384-2.811)
BMI	28	30	0.17	0.94 (0.859-1.027)
Avg ASA score	1.90	2.02	0.46	0.73 (0.309-1.705)
Negative URS	**28.6%**	**10.0%**	**0.048**	**3.60 (1.013-12.793)**
Prev stone Tx	23.8%	20.0%	0.71	1.25 (0.381-4.096)
Stone size (mm)	6.80	7.91%	0.16	0.86 (0.705-1.060)
Stone side (L)	52.4%	55.0%	0.83	0.9 (0.332-2.437)
Ureteric location				
Distal	61.9%	73.3%	0.29	
Middle	9.5%	13.3%		0.85 (0.160-4.488)
Proximal	28.6%	13.3%		2.54 (0.745-8.651)
CT performed	90.5%	84.7%	0.52	1.71 (0.338-8.647)
Hydronephrosis	61.9%	65.0%	0.86	0.91 (0.310-2.638)
Img-URS time (days)	**7.10**	**20.66**	**0.001**	**0.822 (0.73-0.93)**
Surgeon				
A (31 cases)	28.6% (n=6)	41.7% (n=25)	0.16	
B (25 cases)	47.6% (n=10)	25.0% (n=15)	0.10	2.78 (0.839-9.200)
C (25 cases)	23.8% (n=5)	33.3% (n=20)	0.95	1.04 (0.277-3.917)

OR: Odds ratio, CI: Confidence interval, BMI: Body mass index, URS: Ureteroscopy, ASA: American Society of Anesthesiologists, CT: Computed tomography

Discussion

Our findings have illustrated a relatively high rate of negative ureteroscopies are being performed at our centre Knowing that 14% of endoscopic interventions for ureteral stones could be avoided, our goal should be to minimize nURS to enhance patient safety and the use of operative resources.

To date, this is the only series investigating negative ureteroscopies for patients undergoing ureteroscopy for ureteric stones. Several nURS reports have been published that combine renal and ureteral procedures. As our definition of nURS was the absence of the ureteric stones identified at the time of diagnosis, we sought to investigate this important sub-population of patients undergoing ureteroscopy. As they are usually symptomatic at the time of consultation, they are motivated to proceed with expedited surgery to avoid ongoing symptoms.

With this in mind, our experience is not significantly different then other reported rates. Kreshover et al. (6) reported 9.8% nURS rate from 2011 (over 256 renal+ureteric cases). Similarly, using California's administrative data, Lamberts et al. (7) found that of 19,000 ureteroscopies 6.3% were negative procedures. Again, a distinction was not made for stone presenting in the ureter. This is avoided in our analysis, as nURS was determined on the basis of intra-operative findings compared to a re-review of pre-operative imaging.

Somewhat counter-intuitively we have found that nURS disproportionately affects patients undergoing expedited ureteroscopy. Given that stone sizes and locations were similar, presumably these patients are being prioritized due to intractable pain and coping difficulties. When expedited surgery was performed within 7 days, 28.6% (6/21) of these patients presumably passed their stone before surgery compared to 10% (6/60) in those performed within 3 weeks. Why this population seems to pass stones more readily is unknown, however it does highlight the need for repeat imaging no matter how short the delay between evaluation and surgery, especially in those who are very symptomatic, as our review suggests they may be more likely to pass their stone. Parallel experiences have been reported in general surgery, where appendectomy has shown benefits of protocolized imaging and nomogram stratification. By using routine imaging to aid the clinical diagnosis of appendicitis, negative appendectomy rates decrease from 15% to 4.5% (8). The acceptable rate of negative procedures may be different for each procedure, but obviously our goal is to reduce it as much as feasibly possible.

At our center, reimaging for expedited surgery has not been used for several reasons. Firstly, before this analysis there was not a good understanding of the frequency of events. Additionally, these patients are not admitted at the time of consultation, and once in hospital for their surgery, limited accessibility to afterhours non-urgent imaging (namely ultrasonography). Difficulties also exist when arranging urgent outpatient imaging appointments with a few days notice, especially in rural communities where radiology services may not be readily available.

Therefore, with our new insight into this source of over-treatment, we have instituted a policy to reimage patients with a KUB X-ray the day before their surgery. If their stone was not visible on X-ray at the time of consultation, they be brought to our out-patient surgery center earlier in the day, and an ultrasound will be arranged with radiology. With these small steps, we hope to reduce the frequency of nURS, thereby avoiding unnecessary procedures and wasted surgical resources. Future analyses will then help to ascertain whether meaningful reductions in nURS rates can be achieved.

Conclusions

We have identified 14% of patients undergoing ureteroscopy for ureteral stones at our center are being overtreated. Therefore, we believe that it is imperative that reimaging be considered in this patient population before surgery.

Ethics

Ethics Committee Approval: This study was approved University of Alberta Research Ethics Board (approval number: Pro00057396).

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: T.W., T.S., S.D., Concept: T.W., T.S., S.D., Design: C.L., T.W., T.S., S.D., Data Collection or Processing: C.L., M.L., Analysis or Interpretation: C.L., M.L., Literature Search: C.L., M.L., Writing: C.L., S.D.

Conflict of Interest: No conflict of interest was declared by the authors.

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