Preoperative factors associated with failure in unstented primary ureteroscopy for nephrolithiasis

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Introduction: *Primary ureteroscopy for nephrolithiasis is often completed without prior ureteral stenting. However, failure can occur due to inability to access the stone, requiring ureteral stenting for passive dilation and a second procedure. This typically results in increased morbidity due to a prolonged period of ureteral stenting and subsequent stent related symptoms. Patient counseling preoperatively is important to discuss the risk of failure.*

Materials and methods: *We reviewed all primary ureteroscopies for nephrolithiasis performed by four urologists at our institution from November 2007 to November 2016. Univariate analysis was performed to compare groups with Chi squared analysis, Fisher's exact test, Student's t-tests and Mann-Whitney U test as appropriate. Binomial logistic regression was then performed analyzing the statistically significant univariate factors.*

Results: *Failure rate for accessing the unstented ureter was 6.04% (30/497). Thirty ureteroscopies were identified who failed without prior ureteral stenting. A total of 422 ureteroscopies were identified with successful initial attempt with records complete for analysis. Failures were more likely to have a proximal ureteral stone (46.6% versus 23.9%). This remained significant on logistic regression. There was no difference in stone size, number of stones, age, sex, history of stones, prior abdominal or retroperitoneal surgery. Failure of primary ureteroscopy in women was associated with proximal stones (50.0% versus 20.9%) and women with a prior hysterectomy and/or oophorectomy (67.0% versus 32.0%). Both remained significant on logistic regression. Men did not have any significant factors.*

Conclusion: *The vast majority of ureteroscopy is performed without prior ureteral stenting. Proximal ureteral stones appear to be the only factor associated with failure in primary ureteroscopy. Additionally, one may consider counseling women with prior hysterectomy and/or oophorectomy that they may be at increased risk of requiring a second procedure.*

Key Words: unstented ureteroscopy, nephrolithiasis, ureteral stent

Introduction

The treatment of nephro- and ureterolithiasis has undergone tremendous improvement in patient morbidity, treatment success and surgical ease in the past 20 years.[1] After transition from open surgery to shock wave therapy to endoscopic management, there are still likely further innovations to come. Currently, ureteroscopic management of stones is the technique used for the majority of calculus disease.[1] Ureteroscopy is often completed without prior ureteral stenting,[2] however, there remain instances when it is not possible to access the stone due to ureteral stricture, narrowing or tortuosity. The majority of time, a ureteral stent is placed to allow for passive dilation of the ureter and definitive second ureteroscopy.[3,4] It is important to discuss with patients preoperatively the potential for an additional surgical procedure, increased stent time and potential stent bother that may occur if we are unable to access the stone.[5,6] The ability to appropriately counsel patients preoperatively regarding certain risk factors necessitating a second procedure would potentially improve patient expectations.

Materials and methods

We retrospectively reviewed all unstented, primary ureteroscopies performed for renal or ureteral calculus disease by four urologists from November 2007-November 2016. Institutional Review Board

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approval was obtained. Patient age, gender, primary stone size, location and laterality, number of stones, prior abdominal, retroperitoneal and gynecologic surgical history and stone disease history were reviewed. The most distal stone was used for stone size when multiple stones were present as this is the stone currently causing the presenting symptoms. Procedures where purulent or cloudy urine that was concerning for infection upon passage of wires or ureteral access sheaths to the stone were not defined as failures and were not included in the study.

Flexible, rigid and semirigid ureteroscopies were included. Ureteroscopy was performed with Olympus (Tokyo, Japan) 8.5Fr digital flexible or Karl Storz (Tutlingen, Germany) 7.5Fr fiberoptic flexible, 8.5Fr digital flexible, 8Fr rigid and 7Fr semirigid ureteroscopes. All procedures were begun with placement of a safety guide wire. If possible, dilation of the orifice and distal ureter was not routinely performed unless necessary. If difficulty traversing a portion of the ureter was encountered, a variety of surgical techniques were performed at the discretion of the operating surgeon. These included dilation with a safety guide-wire introducer (Cook Medical, Bloomington, IN, USA), ureteral access sheath (Cook Medical, Bloomington, IN, USA) (entirely or only the inner core) or "train-tracking" past the narrowing between two safety wires. Balloon dilation (Boston Scientific, Marlborough, MA, USA) was performed if necessary, although only in a small portion of cases due to concern for ureteral injury or perforation. The definition of success was deemed the ability to reach and adequately treat the most distal stone present. Success rate was calculated using the total number of ureteroscopies performed for calculus disease. Stone location was identified from radiology report preoperatively.

Populations were grouped into success and failure and compared. Analysis including Chi-squared, Fisher's exact test, student's t-test, rank-sum test was performed between the two groups. Significant variables were then analyzed with binomial logistic regression and odds ratios (OR) calculated. All analysis was performed with SPSS (IBM, Armonk, NY, USA). An alpha level of 0.05 was determined to be statistically significant.

Results

A total of 497 primary unstented ureteroscopies were identified without prior ureteral stenting and 422 (84.9%) ureteroscopies were identified that had patient data complete for analysis. All 497 procedures had detailed operative reports available. Failure rate was 6.04% (30/497). Comparative data is shown in Table 1. There was no difference in average age, sex or stone

TABLE 1. **Comparison of unstented primary ureteroscopy for entire cohort**

	Failed	**Success**	**UVA p value**	**MVA p value**	**Odds ratio (95% CI)**
All (n)	30	422			
Age (years)	55.2 ± 15.8	54.2 ± 15.0	0.737	-	
Male	58%	60%	0.835	-	
Female	42%	40%			
Right	53%	41%	0.186	-	
Left	47%	59%			
Distal ureter	20%	29%	0.306	-	
Mid ureter	10%	10%	1.000	-	
Proximal ureter	**47%**	**24%**	**0.006**	**0.008**	**2.79 (1.31-5.90)**
Renal pelvis	23%	36%	0.171	-	
Prior abdominal surgery	40%	39%	0.963	-	
Prior RP surgery	20%	15%	0.429	-	
History of stones	33%	35%	0.635	-	
Stone size (mm)	8.20 ± 4.68	8.53 ± 4.60	0.707	-	
Number of stones	1.93 ± 1.4	1.95 ± 2.0	0.219	-	

UVA = univariate analysis; MVA = multivariate analysis; RP = retroperitoneal

TABLE 2. **Comparison of unstented primary ureteroscopy for men**

	Failed	Success	UVA p value
Male (n)	18	245	
Age (years)	52.6 ± 16.3	56.4 ± 14.6	0.666
Right	56%	43%	0.350
Left	44%	57%	
Distal ureter	17%	32%	0.198
Mid ureter	17%	11%	0.442
Proximal ureter	44%	26%	0.104
Renal pelvis	30%	22%	0.599
Prior abdominal surgery	11%	27%	0.169
Prior RP surgery	16%	17%	1.000
History of stones	33%	34%	0.991
Stone size (mm)	7.83 ± 5.26	8.31 ± 4.43	0.666
Number of stones	1.83 ± 1.7	2.22 ± 1.6	0.127

UVA = univariate analysis; RP = retroperitoneal

laterality. Failed primary ureteroscopy was associated with a proximal ureteral location (47% versus 24%, p = 0.006). This was the only factor associated with failure in the entire cohort. This remained significant on multivariate analysis (MVA) (OR 2.79 (1.31-5.90), p = 0.008). There was no difference in stone size, number of stones or history of calculus disease. Subset analysis of men shown in Table 2 did not reveal any additional factors associated with failure. Although a proximal ureteral location was more often associated with failure (44% versus 26%, p = 0.104), this did not reach significance. Subset analysis of women shown in Table 3 did reveal

TABLE 3. **Comparison of unstented primary ureteroscopy for women**

	Failed	Success	UVA p value	MVA p value	Odds ratio (95% CI)
Female (n)	12	177			
Age	59.2 ± 14.7	51.2 ± 15.1	0.079	-	
Right	38%	50%	0.542	-	
Left	62%	50%			
Distal ureter	25%	25%	1.000	-	
Mid ureter	0%	9%	0.604	-	
Proximal ureter	**50%**	**21%**	**0.031**	**0.010**	**5.13 (1.45-18.11)**
Renal pelvis	25%	44%	0.236	-	
Prior abdominal surgery	83%	56%	0.075	-	
Prior hysterectomy and/or oophorectomy	**67%**	**32%**	**0.025**	**0.010**	**5.50 (1.49-20.25)**
Prior RP surgery	25%	13%	0.218	-	
History of stones	33%	44%	0.560	-	
Stone size (mm)	8.75 ± 3.79	8.83 ± 4.82	0.954	-	
Number of stones	1.5 ± 0.5	2.1 ± 2.4	0.925	-	

UVA = univariate analysis; MVA = multivariate analysis; RP = retroperitoneal

TABLE 4. **Comparison of unstented primary ureteroscopy for ureteral stones**

	Failed	Success	UVA p value	MVA p value	Odds ratio (95% CI)
Ureteral stones	23	269			
Age	53.3 ± 16.6	53.7 ± 15.5	0.901	-	
Male	61%	64%	0.797	-	
Female	39%	36%			
Right	53%	38%	0.191	-	
Left	47%	62%			
Distal ureter	26%	46%	0.064	-	
Mid ureter	13%	16%	1.000	-	
Proximal ureter	**61%**	**38%**	**0.028**	**0.033**	**2.59 (1.08-6.20)**
Prior abdominal surgery	35%	38%	0.793	-	
Prior RP surgery	17%	15%	0.592	-	
Stone size (mm)	6.4 ± 3.1	7.1 ± 3.3	0.380	-	

UVA = univariate analysis; MVA = multivariate analysis; RP = retroperitoneal

that proximal location was more associated with failure (50% versus 21%, p = 0.031) and prior hysterectomy and/or oophorectomy (67% versus 32%, p = 0.025). Both proximal stone location (OR 5.13 (1.45-18.11), p = 0.010) and prior hysterectomy and/or oophorectomy (OR 5.50 (1.49-20.25), p = 0.010) remained significant on MVA. A total of 292 procedures treated ureteral stones. Data is shown in Table 4. When examining these, again only proximal location was associated with failure (61% versus 38%, p = 0.028) and this remained significant on logistic regression (OR 2.59 (CI 1.08-6.20), p = 0.033).

Discussion

Treatment of ureteral stones remains an evolving field and is likely to continue to see changes and improvements of treatment success and patient morbidity in the coming years. The vast majority of ureteroscopy can be performed without prior ureteral stenting.[2] However, as demonstrated here, there still remains a small, yet real portion of patients (6.04%) that fail initial, unstented primary ureteroscopy. This is comparable to a recent cohort of patients published from a multi-institutional study of similar size where a 7.7% failure rate was reported[7] and superior to a single institution study who reported a 16% failure rate.[8] Other historical studies reported success rates 8%-11%.[4,9] In our cohort, proximal location was the only factor associated with failure in the entire cohort. This intuitively makes sense as a stone that presents in the proximal ureter may have a narrower ureter to traverse than a similar sized stone that is able to make it to the mid or distal ureter. When examining only ureteral stones, although failure or primary ureteroscopies did have smaller stones compared to successful ureteroscopies (6.4 ± 3.1 versus 7.1 ± 3.3 mm, p = 0.380), this did not reach significance. Prior studies have shown large proximal ureteral or renal stones that appear impacted may benefit from prestenting to reduce reoperation rates. Prestenting has been shown to have improved stone free rates,[10,11] however, it is associated with of increased risk of UTI and postoperative sepsis.[12] These risks and the additional stent bother symptoms must be balanced appropriately when prestenting is considered. Initial failure to access the stone during ureteroscopy with placement of a ureteral stent for ureteral dilation and return for a second procedure results in 98% successful stone access in contemporary studies.[3] Similarly, the ability to place a ureteral access sheath was shown to be associated with indwelling ureteral stent and previous ipsilateral ureteroscopy.[13] Those patients who failed initial ureteroscopy in our cohort all underwent ureteral stenting with successful access of the stone on second attempt.

Although proximal location remained significant in subset analysis of the female cohort, a history of prior hysterectomy or oophorectomy was also associated with failure, which remained significant on logistic regression. Although none of these women had known documented ureteral injury, it is possible the subclinical ureteral stenosis or narrowing developed from the close

proximity or inflammation of the previous surgery. This may result in enough narrowing to result in inability to access a stone, yet not cause any clinical problems or radiographic findings in the absence of ureteroscopy. However, it should be noted that there were very wide CI for prior hysterectomy and/or oophorectomy and these results should be taken with caution. Nonetheless, it may be mindful to counsel a patient with an extensive gynecologic surgical history that they may require multiple procedures. There was no difference in stone history when comparing ability to access the stone in failed and successful primary ureteroscopies. In our cohort, we were limited whether patients had undergone ESWL, ureteroscopy or PCNL as often times patients only knew they had undergone "lithotripsy" for stones and were often treated at multiple hospitals. As a result, we were only able to use a history of nephrolithiasis. Nonetheless, there was no difference (33% versus 35%, p = 0.635) between the two groups.

In comparison to recent studies from Fuller et al[7] and Viers et al,[8] proximal stone location appears to be the strongest driving force with failure to access the stone in the unstented ureter. However, Fuller et al also identified young women as more likely to have failure.[7] The authors were unsure of this etiology but proposed it may be due to different tissue characteristics of nonparous versus parous women. However, this is in contrast to our data where there was a trend towards older women with greater failure rates and women with prior hysterectomy and/or oophorectomy being more likely to fail. The differences may be due to inherent differences in patient population but otherwise cannot be readily explained. Prior gynecologic or other non-urologic surgical history was not reviewed by Fuller et al.[7] However, similar to Fuller et al[7] where there was no difference in success rates in those who underwent ESWL, ureteroscopy, PCNL or had prior stone passage, we did not observe any difference in failure in patients with a history of nephrolithiasis. This is in contrast to Viers et al,[8] who reported greater likelihood of requiring presenting for those who did not have prior ipsilateral ureteral stenting or ureteroscopy. The differences in these results are difficult to account for. However, the patient populations may be inherently different as patients presenting in the acute setting with renal colic were excluded by Viers et al,[8] while our study and Fuller et al[7] included those patients. Viers et al reviewed CT urogram for all patients and determined ureteral opacification <5 0% as a risk for failure, however, in our cohort, CT urogram was infrequently used.[8] In the acute setting, non-contrast CT scan is most frequently used for diagnosis for a patient presenting with renal colic. When counseling patients, it should be emphasized that there remains a small, yet real chance that accessing the stone may not be possible on first attempt. Additionally, proximal stone location carries a risk of necessitating an additional procedure as supported by ours and others data. Additional risk factors should be tailored to specific patient risk factors if present.

There are multiple limitations to our study, mainly its retrospective nature and associated biases. Additionally, there was no standardized method for navigating the "difficult ureter" and multiple techniques were employed. Additionally, this does not include patients who are stented urgently or emergently for infection or renal insufficiency. There is no reporting of stone free rate as this has been described in other studies and there was not a standardized method to postoperative imaging given the multiple urologists in the cohort.

Conclusion

The vast majority of ureteroscopy is performed without prior ureteral stenting with high success rates. Proximal ureteral stones appear to be the most significant factor associated with failed primary ureteroscopy. This is intuitively comparable to distal stones having higher spontaneous passage rates than proximal stones. Additionally, it may be considered to counsel women with prior extensive gynecologic surgical history that they may be at increased risk of requiring a second procedure. This may be due to the close proximity of the ureter to the operative field resulting in subclinical stricturing. This information can also be used to counsel patients for prestenting in highly selected cases. However, larger series are needed to confirm this. Notably, there was no difference in patients with prior stone disease between the two groups. Nonetheless, appropriate preoperative counseling is imperative to manage patient expectations. □

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