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ARTICLE

Treatment of isolated small renal stones leads to resolution of symptoms and should be routinely offered to patients: retrospective outcomes from a university hospital

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ABSTRACT

Introduction: Treatment of smaller renal stones and the symptomatic value it offers to patients is often debated. We wanted to analyse surgical outcomes for treatment of small renal stones and whether treatment resulted in symptom resolution.

Materials and methods: All patients who underwent ureterorenoscopy (URS) for isolated symptomatic small renal stones ≤10 mm over a 7-year period were retrospectively included and subdivided into those with stones of ≤7 mm (Group A) and stones of 8–10 mm (Group B). Patients with multiple renal stones, ureteric stones, or combined renal and ureteric stones were excluded. Based on the symptoms, the patient groups were those with pain, urinary tract infection (UTI) and haematuria. Resolution of symptoms was defined as no symptoms during the follow-up period.

Results: A total of 109 patients with a single small renal stone ≤10 mm underwent URS and stone treatment, with mean age of 50 years and a male:female ratio of 1:1.2. The mean operative time was significantly longer in Group B (55.9 min vs 33.07 min, $p = 0.001$). In total, 97.2% ($n = 70$) of patients in Group A and 83.7% ($n = 31$) of patients in Group B were stone free ($p = 0.017$). Complete resolution of symptoms was seen in 63 (92.6%), 24 (85.7%) and 13 (100%) patients with pain, UTI and haematuria, respectively. There were no statistically significant differences in symptom resolution between patients with stones ≤7 mm and those with stones 8–10 mm in size.

Conclusion: Ureteroscopic treatment is a feasible option for small symptomatic stones, since it may lead to symptom resolution. Based on our study we would recommend that patients with symptomatic small renal stones are offered endoscopic treatment.

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Urolithiasis; ureteroscopy; URS; renal stone; symptomatic; UTI

Introduction

The lifetime prevalence of nephrolithiasis in the UK is estimated to be around 15%, with the figure being higher in some other countries [1]. Whilst the management of large renal stones is well established, there is some debate over the treatment of smaller renal calculi [2–4]. Surgical intervention rates for asymptomatic stones range from 7–27%, with symptom development and stone growth seen in 7–77% and 5–66%, respectively [2]. Moreover, there appears to be no correlation between the duration of surveillance and surgical intervention [2].

If renal stones become symptomatic with the onset of pain, urinary tract infection (UTI), or haematuria then active treatment is recommended [4,5]. The same applies for de novo obstruction, associated infection or stone growth [4,5]. In the early 1980s shockwave lithothripsy (SWL) revolutionized the management of small renal stones, however it soon became clear that proper patient and stone selection is required to maximize its efficacy. Over the years, a number of factors limiting the adequacy of SWL, namely stone size, skin-to-stone distance, Hounsfield unit attenuation values, pelvi-calyceal anatomy and stone composition, have been identified to affect stone-free status [6].

Ureterorenoscopy (URS) emerged as a viable alternative to SWL with the obvious advantage being direct visualization of the stone and real-time laser fragmentation or removal of stone to ensure complete stone clearance. The European Association of Urology (EAU) and American Urology Association (AUA) guidelines advise that URS and SWL are equally effective for the treatment of upper and mid-pole renal stones ≤20 mm, whilst with regards to lower pole stones between 10–20 mm URS is advisable over SWL, especially if the anatomy is unfavourable for the latter [4,5]. Moreover, several studies have since been published which show URS to be superior to SWL in the treatment of renal stones ≤20 mm with regards to stone-free rate, cost and the need for re-intervention [7].

A clinical dilemma exists on the treatment of smaller renal stones and the symptomatic value it offers to patients. We wanted to analyse retrospective surgical outcomes for treatment of small renal stones and whether treatment resulted in symptom resolution. The secondary endpoints were stone

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free rate (SFR), complication rate, operative time, day-case rate, the need for post-operative stenting and follow-up.

Methods

All patients who underwent URS for isolated small renal stones ≤10 mm over a 7-year period between March 2012 and June 2018 were included in this database and the outcomes were analysed retrospectively. It was registered in the hospital 'Clinical effectiveness (CE) and audit office'. Outcomes were collected for consecutive patients, performed or supervised by a single surgeon (BS) and recorded in a database which was then analysed by a third party (MS), not involved in the original procedure. The inclusion criteria were the presence of a single symptomatic renal stone ≤10 mm in any location. Patients with multiple renal stones, ureteric stones or combined renal and ureteric stones were excluded. Data was collected for patient demographics and symptoms, stone parameters, stone-free rate (SFR), operative time and complications, which were classified according to the Clavien–Dindo classification [8]. Based on the symptoms, the patient groups were those with pain, urinary tract infection (UTI) and haematuria. While the UTI group were patients with symptoms associated with a proven positive urine culture within the last 6 months, the haematuria group were those with an episode or more of frank haematuria. Resolution of symptoms was defined as no symptoms during the follow-up period.

All patients had a CTKUB for confirmation of stone diagnosis. The ureteroscopy procedure was done as per protocol [9]. After cystoscopic insertion of a safety wire, a semi-rigid URS was performed over a working guidewire first to exclude a ureteric stone, passively dilate the ureter and assess the caliber of the ureter on whether a ureteric access sheath (UAS) could be safely inserted. If the ureter was too tight for UAS, the flexible URS (FURS) was inserted radiologically over the safety wire. The FURS was done using a Flex X2 (Karl Storz Endoscopy (UK) Ltd., Slough, UK) and the stone was fragmented using a Holmium YAG laser (Lumenis (UK) Ltd., Elstree, UK) with a 272-μm laser fibre (Lumenis, Inc.). The access sheath was used in selected cases (9.5 Fr/11.5 Fr or a 12 Fr/14 Fr Cook Flexor UAS (Cook Medical, Bloomington, USA) and was placed just below the pelviureteric junction (PUJ). Where feasible, all stone fragments were retrieved with a Cook Ngage® nitinol stone extractor (Cook Medical, USA) and sent for biochemistry. In patients where a 6 F ureteral stent (Cook Medical, USA) was inserted post-operatively, it was removed after 2–4 weeks. SFR was defined as being endoscopically stone free, and radiologically stone-free on follow-up imaging, which was a plain X-ray for radiopaque stones and ultrasound (USS) for radiolucent stones done 2–3 months post-operatively.

Patients were further subdivided into two groups, those with stones of ≤7 mm (Group A) and those with stones of 8–10 mm (Group B). Nominal variables were compared using the χ^2 test and Fisher's exact *T*-test (FET). The Independent *T*-test (parametric) was used for normally-distributed data with the Mann-Whitney test (non-parametric) used for skewed data. A *p*-value < 0.05 was taken to be significant. Data was analysed using the SPSS® software (IBM Corp., Armonk, NY).

Table 1. Stone demographics and pre-operative characteristics (Mann–Whitney *U*-test).

	Stone size		
$N = 109$	≤7 mm ($n = 72$)	8–10 mm ($n = 37$)	*p* value
Side (%)			–
Right	73.6% ($n = 53$)	43.2% ($n = 16$)	
Left	26.4% ($n = 19$)	56.8% ($n = 21$)	
Stone location (%)			–
Upper pole	9.7% ($n = 7$)	5.4% ($n = 2$)	
Middle pole	16.7% ($n = 12$)	8.1% ($n = 3$)	
Lower Pole	48.6% ($n = 35$)	54.1% ($n = 20$)	
Renal pelvis	25% ($n = 18$)	32.4% ($n = 12$)	
Pre-operative stenting (%)	16.7% ($n = 12$)	13.5% ($n = 5$)	0.67 (χ^2)
Pre-operative creatinine, umol/L (median)	74	78.5	0.56

Table 2. Overall symptom resolution for both groups (FET – Fishers exact test).

	Resolution of symptom			
Primary symptom	≤7 mm ($n = 72$)	8–10 mm ($n = 37$)	*p* value (FET)	Overall symptom resolution
Pain ($n = 68$)	46/50 (92.6%)	17/18 (94.4%)	1.0	92.6%
UTI ($n = 28$)	14/17 (82.4%)	10/11 (90.9%)	0.63	85.7%
Haematuria ($n = 13$)	5/5 (100%)	8/8 (100%)	1.0	100%

Results

Table 3. Outcomes of ureteroscopy for both groups.

	Stone size (mm)		
	≤7mm ($n = 72$)	8–10mm ($n = 37$)	*p* value (test)
Access sheath (%)	42.03%	50.0%	0.44 (χ^2)
Post-URS Stenting (%)	92.1% ($n = 67$)	100% ($n = 37$)	0.10 (χ^2)
Complications (%)	2.8% ($n = 2$)	2.7% ($n = 1$)	0.20 (χ^2)
Clavien-Dindo I	1 (stent pain)	/	
Clavien-Dindo II	1 (Urosepsis)	1 (Urosepsis)	
Clavien-Dindo III	/	/	
Clavien-Dindo IV	/	/	
Mean Operative time (mins) ± SD, range	33.07 (±15.78, 10–76)	55.91 (±21.41, 8–112)	0.001
Day-case, *n* (%)	77.8%	56.8%	0.022 (χ^2)
Stone-free rate (%)	97.2% ($n = 70$)	83.7% ($n = 31$)	0.017
Follow-up time (months)	5.17	4.94	0.34
Symptom recurrence (%)	1.4% ($n = 1$)	2.7 % ($n = 1$)	1.0

A total of 109 patients with a single small renal stone ≤10 mm underwent URS and stone treatment during the study period, with a male:female ratio of 1:1.2 and a mean age of 50 years (range = 2–91 years) (Table 1).

Stone characteristics

Patients were further subdivided into those with ≤7 mm stones (Group A) and those with stones of 8–10 mm (Group B). The table below illustrates the stone and pre-operative characteristics of each cohort. The mean stone size for groups A and B were 4.1 mm (range = 2–7 mm) and 8.2 mm (range = 8–10 mm), respectively. There were no statistically significant differences in pre-operative characteristics between the two groups.

Symptom resolution

The most common symptom pre-operatively was pain with 68 (62.4%) patients included in the study describing loin pain or renal colic as the primary symptom. Sixty-three (92.6%) patients experienced complete pain resolution following the URS (Table 2).

While 28 patients had UTI, complete resolution was seen in 24 (85.7%) patients. All 13 patients (100%) with haematuria had complete symptom resolution. There were no statistically significant differences in symptom resolution between patients with stones ≤7 mm and those with stones 8–10 mm in size.

Operative characteristics

The mean operative time was significantly longer in Group B (55.91 min vs 33.07 min, $p = 0.001$) (Table 3). This may subsequently have affected the length of hospital stay, with 77.8% of patients in Group A and only 56.8% of patients in Group B discharged the same day (day-case procedure), which was statistically significant ($p = 0.022$).

Two patients in Group A suffered a complication, namely stent-related pain requiring admission (Clavien I) and urosepsis requiring intravenous antibiotics (Clavien II). In group B only one patient suffered a complication, namely urosepsis (Clavien II). There were no statistically significant differences in complication rates ($p = 0.35$) between the two groups. In 47 patients (43.1%) included in the study an access sheath was used intraoperatively, whilst 104 patients (95.4%) had a ureteric stent inserted at the end of the procedure. There were no statistically significant differences between the two groups.

Stone-free status

The proportion of patients who were stone-free at the time of follow-up was statistically significantly higher in those patients with stones ≤7 mm ($p = 0.017$). Of patients with stones ≤7 mm, 97.2% ($n = 70$) were stone-free at the time of follow-up as compared to 83.7% ($n = 31$) of patients with stones 8–10 mm. Median follow-up was 5 months and was similar in both groups. One patient with a residual stone in Group A needed repeat intervention in the form of SWL.

Discussion

The aim of our study was to assess the symptom resolution, efficacy and safety of ureterorenoscopy in treatment of small renal stones ≤10 mm. While URS was shown to be a safe and effective technique, it also resulted in symptom resolution in the majority of patients with minimal complications. Symptom resolution was seen for all patients in Group B who were stone-free, but four of the six patients with residual stones in this group also had resolution of their symptoms. This is a strong argument for offering endoscopic treatment for all patients with symptomatic renal stones.

It is generally agreed that onset of symptoms should herald active removal of renal stones, with location and size being the main determining factors for choice of surgical procedure. Both the EAU and AUA guidelines recommend that renal stones ≤20 mm located in the renal pelvis and upper/middle calyces are treated with either SWL or URS. For lower pole stones 10–20 mm in diameter, SWL is not recommended as first-line therapy due to its limited efficacy. One of the disadvantages of SWL is the variable efficacy and a residual stone rate and recurrence rates of up to 55% [4,5].

Our results show that 91.7% of patients were symptom-free following their procedure. Assessed separately, the highest success rate was achieved in the treatment of haematuria with all patients rendered asymptomatic, followed by pain with a symptom resolution rate of 92.6% and UTIs which resolved in 85.7% of patients. Moreover, the SFR for stones in group A and B reached 97.2% and 83.7%, respectively. The resolution of symptoms was not related to the location of stones and all patients with renal pelvic stones ($n = 30$) had resolution of their symptoms. This included 20, six and four patients with pain, UTI and haematuria, respectively. There were three (2.8%) complications of which there was a stent-related pain and two urosepsis needing intravenous antibiotics. This is lower than the Clinical Research Office of Endourological Society (CROES) URS Global study where the complication rate was 7.6%, although arguably this study included ureteric and renal stones of all sizes [10].

The mean operative time in group B with larger stones was significantly longer ($p = 0.001$). This is consistent with the results from a previous study which showed longer operative times for larger renal stones [11]. Our findings regarding efficacy and safety are consistent with those of Fankhauser et al. [12], who compared SWL with URS, showing that URS achieved higher SFR and lower re-intervention rates for renal stones between 5–20 mm.

The additional role of urterorenoscopic management of asymptomatic renal stones is still unclear. The National Institute for Health and Care Excellence (NICE) recommends a watchful waiting approach to asymptomatic stones <5 mm in size. A similar approach is advised in stones ≤10 mm provided that a discussion about risk and benefit of intervention versus surveillance has taken place [13]. The question arises

whether a prophylactic URS should be undertaken to limit stone-related adverse events.

Long-term follow-up studies have shown that the risk of onset of symptoms is 28.3% with the stone size over 5 mm and stone location in te non-lower pole being the strongest predictor for symptom development [14]. In another study looking at 301 renal units and a mean stone size of 10.8 mm, 39.5% had a stone related adverse event over a 5-year follow-up [15]. Similarly, for patients with post-URS asymptomatic residual fragments, the stone event rate was 44% and fragments >4 mm were more likely to grow, have complications and needed re-intervention [16].

This is a retrospective study looking at consecutive patients with renal stones under 1 cm. By subdividing the cohort into the smaller ≤7 mm and slightly larger stones 8–10 mm, it helped to assess the effect of stone size on certain clinical parameters like operative time and day-case rate. The findings confirm that URS is effective in bringing about symptom resolution and safe with minimal complications and therefore its use in the management of small symptomatic renal stones is recommended. The association of kidney stone disease and UTI is well known and this is independent of the type of stone analysis [17,18]. Hence removal of stones irrespective of the stone analysis would help with the resolution of UTI. Resolution of UTI in our study was not associated with a special stone composition.

A high percentage of our patient cohort underwent stenting at the end of the procedure and hence the need for a second outpatient procedure to remove the stent. This practice was based mainly on local experience and the paucity of high-quality evidence with regards to routine stenting following URS, with a recent Cochrane review recommending that larger trials are required for better-informed decision-making [19]. A limitation of our study was the relatively short follow-up period, with patients being discharged if their imaging at follow-up was clear and their symptoms had settled. Also, the symptom resolution was evaluated during follow-up by the clinic nurse or the surgeon, however a validated instrument was not used for this purpose. The post-op imaging was based on plain film radiography for radio-opaque stone and ultrasound for radiolucent stones. The SFR was defined as 0 U or 0 X, where no stone was seen on imaging on KUB XR or ultrasound [20]. Ideally, a follow-up CTKUB would be more sensitive for this, however this would also have implications related to cost, availability and radiation exposure. Previous papers have suggested that SFR after URS of large stones on CT evaluation might only approach 73% [21], although our patient group had smaller stones and SFR is expected to be much higher especially with retrieval of fragments.

Conclusion

Ureteroscopic treatment is a feasible option for small symptomatic stones, since it may lead to symptom resolution. Based on our study we would recommend that patients with symptomatic small renal stones are offered endoscopic treatment.

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Stephen Griffin, Consultant Paediatric Urologist.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Disclosure statement

The authors declare that there is no conflict of interest from any of the co-authors.

References

[1] Rukin N, Siddiqui Z, Chedgy E, et al. Trends in upper tract stone disease in england: evidence from the hospital episodes statistics database. Urol Int. 2017;98(4):391–396.
[2] Han D, Cher B, Lee D, et al. The durability of active surveillance in patients with asymptomatic kidney stones: a systematic review. J Endourol. 2019;33(7):598–605.
[3] Streeper N. Asymptomatic renal stones—to treat or not to treat. Curr Urol Rep. 2018;19(5):29.
[4] Türk C, Neisius A, Petrik A, et al. EAU Guidelines for Urolithiasis. Edn. presented at the EAU Annual Congress Barcelona 2019. ISBN 978-94-92671-04-2. https://uroweb.org/guideline/urolithiasis/.
[5] Assimos D, Krambeck A, Miller N, et al. Surgical management of stones: American Urological Association/Endourological Society Guideline, PART I. J Urol. 2016;196(4):1153–1160.
[6] McClain PD, Lange JN, Assimos DG. Optimizing shock wave lithotripsy: a comprehensive review. Rev Urol. 2013;15(2):49–60.
[7] Geraghty R, Jones P, Herrmann T, et al. Ureteroscopy is more cost effective than shock wave lithotripsy for stone treatment: systematic review and meta-analysis. World J Urol. 2018;36(11):1783–1793.
[8] Dindo D, Demartines N, Clavien P. Classification of surgical complications. Ann Surg. 2004;240(2):205–213.
[9] Ghosh A, Oliver R, Way C, et al. Results of day-case ureterorenoscopy (DC-URS) for stone disease: prospective outcomes over 4.5 years. World J Urol. 2017;35(11):1757–1764.
[10] Somani B, Giusti G, Sun Y, et al. Complications associated with ureterorenoscopy (URS) related to treatment of urolithiasis: the Clinical Research Office of Endourological Society URS global study. World J Urol. 2017;35(4):675–681.
[11] Deters L, Pais V. Difference in operative time according to stone location for endoscopic management of ureteral and renal stones. Urology. 2013;81(3):522–526.
[12] Fankhauser C, Hermanns T, Lieger L, et al. Erratum: Extracorporeal shock wave lithotripsy versus flexible ureterorenoscopy in the treatment of untreated renal calculi. Clin Kidney J. 2019;12(2):309–310.
[13] NICE Guideline - renal and ureteric stones: assessment and management. BJU Int. 2019;123(2):220–232.
[14] Li X, Zhu W, Lam W, et al. Outcomes of long-term follow-up of asymptomatic renal stones and prediction of stone-related events. BJU Int. 2019;123(3):485–492.
[15] Darrad M, Yallappa S, Metcalfe J, et al. The natural history of asymptomatic calyceal stones. BJU Int. 2018;122(2):263–269.

[16] Chew B, Brotherhood H, Sur R, et al. Natural history, complications and re-intervention rates of asymptomatic residual stone fragments after ureteroscopy: a report from the EDGE research consortium. J Urol. 2016;195(4 Part 1):982–986.
[17] Yongzhi L, Shi Y, Jia L, et al. Risk factors for urinary tract infection in patients with urolithiasis-primary report of a single center cohort. BMC Urol. 2018;18(1):45.
[18] Schwaderer AL, Wolfe AJ. The association between bacteria and urinary stones. Ann Transl Med. 2017;5(2):32.
[19] Ordonez M, Borofsky M, Bakker C, et al. Ureteral stent versus no ureteral stent for ureteroscopy in the management of renal and ureteral calculi. Cochrane Database Syst Rev. 2019;2:CD012703.
[20] Somani B, Desai M, Traxer O, et al. Stone-free rate (SFR): a new proposal for defining levels of SFR. Urolithiasis. 2014;42(2):95–95.
[21] York NE, Zheng M, Rivera ME, et al. Stone-free outcomes of flexible ureteroscopy for renal calculi utilizing computed tomography imaging. Urology. 2019;124:52–56.