REVIEW PAPER

UROLITHIASIS

Ureteroscopy for stone disease: expanding roles in the modern era

Adrian Ho[1], Piyush Sarmah[2], Ewa Bres-Niewada[3], Bhaskar K. Somani[1]

[1]University Hospital Southampton NHS Trust, United Kingdom
[2]Royal United Hospital, Bath, United Kingdom
[3]Medical University of Warsaw, Department of Urology, Warsaw, Poland

Citation: Ho A, Sarmah P, Bres-Niewada E, Somani BK. Ureteroscopy for stone disease: expanding roles in the modern era. Cent European J Urol. 2017; 70: 175-178.

Article history
Submitted: March 13, 2017
Accepted: May 13, 2017
Published online: June 11, 2017

Corresponding author
Ewa Bres-Niewada
Medical University of Warsaw
Department of Urology
4, Lindleya Street
02–005 Warsaw, Poland
ebres@medistat.pl

Introduction The prevalence of urolithiasis is increasing worldwide and is causing significant morbidity and cost to the healthcare systems. While ureteroscopy (URS) has been established as a treatment option, our review highlights the expanding role of URS for the management of more complex stones and patients in the modern era.

Material and methods Ureteroscopy has shown to have good outcomes with stone free rates (SFR) comparable to other treatment modalities. Relevant publications have been identified. Their findings were critically appraised and used to formulate clinically oriented conclusions.

Results The use of URS has increased and now includes URS management for large stones, bilateral stone disease, obesity, pregnancy, pediatrics, solitary kidney, horseshoe kidney and patients with a bleeding diathesis.

Conclusions With advances in URS technique and technology, its role has expanded to offer treatment in difficult clinical scenarios with good outcomes.

Key Words: bleeding ‹› obesity ‹› laser ‹› solitary kidney ‹› stone ‹› ureteroscopy

INTRODUCTION

The incidence of urolithiasis is increasing with an incidence of 9–14%, becoming a major burden on healthcare systems and an adverse impact on patient's lives [1, 2, 3]. In England, the incidence is closer to 14% and the number of admissions for stone disease has risen by 20% over 7 years from 2006/07 to 2013/14 [1]. This is being attributed to a number of factors including increasing rates of obesity, diabetes, dehydration and an aging population [1, 2]. Indeed, recent data from England demonstrated an increased incidence in patients over the age of 75. In this cohort of patients, there was a 51% rise in the incidence of urolithiasis from 2006/07 to 2013/14 [1]. There is also a strong association of metabolic syndrome with kidney stone disease [2, 4]. Treatments of urolithiasis have risen over the same time with 47% more procedures performed over the last decade; mainly URS, but shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PCNL) have also shown an overall increase [1]. The trend appears to be moving towards day case URS, with England seeing a threefold increase in the number of treatments from 2006/07 to 2013/14 [1]. URS is also being used increasingly in the acute setting for primary management of ureteric calculi [5]. In addition to the use of URS as a treatment option for standard ureteric and renal calculi, it has an expanding role in treating patients with more complex stone disease or with co-morbidities (Table 1). We outline the evidence for its implementation in such circumstances.

Large renal stones

Large calculi greater than 2 cm in size have traditionally been treated with PCNL, considered as the gold standard with stone-free rates (SFR) approaching 95% [6, 7]. However, the overall transfusion rates, hospital stay and complication rates are higher, especially for patients with a high BMI or comorbidities [7]. In comparison, there has been greater use of URS in patients with larger stones and evidence is emerging to demonstrate similar SFR to PCNL with a much lower

doi: 10.5173/ceju.2017.1343

risk of complications, especially Clavien ≥III complications [8]. Although recent evidence suggests the SFR with URS for stones ≥2 cm is around 91% with a complication rate of 8.1%, some patients have to have a 2-staged URS procedure to achieve this [8]. Despite this, the risks of major complications favorably support the use of URS in these patients and there is evidence that URS does not have inferior SFRs compared to PCNL [9]. However, as stone size increases to beyond 3 cm, URS is less favorable with a drop in the SFR to 85% compared to the 96% for stones between 2–3 cm [10]. Whilst these results were collected from high volume centers, the results do indicate that URS and laser stone fragmentation can match PCNL outcomes in stones up to 3 cm in size and is especially good for patients with comorbidities where PCNL might be a high-risk strategy; the European Association of Urologists (EAU) guidance supports its use in this context [7].

Bilateral stone disease

Patients with bilateral urolithiasis could potentially benefit from a bilateral simultaneous URS (BS-URS) to treat stones, the use of which is increasing. The potential benefit is the need for a single general anaesthetic, reduced overall length of hospital stay and reduced costs to treat bilateral stone disease compared to having planned staggered procedures. Evidence has shown good outcomes with SFR approaching 90% and in high volume centers the complication rates of BS-URS are less than that of delayed 2-staged procedures [11, 12]. With the worldwide increase in the incidence of stone disease, this will be an area of further expansion, reducing the overall number of procedures for an individual patient with bilateral stone disease, but also potentially cost and morbidity associated with treatment.

Stone disease in obese and morbidly obese

With an epidemic of obesity worldwide and the associated difficulties in managing stone disease in these patients, there is a growing uptake and use of URS for obese stone patients [4, 13]. In this population PCNL has higher complication rates and SWL lower SFRs, resulting in more URS being performed. This is favorable on both these counts, and both American Urological Association (AUA) and EAU suggest using URS in this cohort of patients [6, 7]. Obesity increases the skin-to-stone distance for SWL and makes fragmentation less efficient, leading to multiple sessions or a higher failure rate. PCNL presents anesthetic challenges during surgery due to the positioning required, and has been shown to have higher transfusion and complication rates. By contrast, URS overcomes these challenges as the SFR is not affected by the skin-to-stone distance and surgical positioning and therefore does not present higher anaesthetic risks compared to PCNL. Evidence shows that URS has an overall SFR of 83–86% with an overall complication rate of 8.5–9.3% [13, 14]. Patients with a higher BMI had lower SFR suggesting [14].

Stone disease in pregnancy

Urolithiasis in pregnancy can be a complex and challenging management dilemma. Although rare, the incidence ranges from 1 in 1,500 to 1 in 200, it is the most common cause of hospitalization in pregnant women due to non-obstetric causes [15, 16]. Conservative temporizing approaches with ureteric stenting / percutaneous nephrostomy (PCN) insertion are the only clinical options. Over the last decade, there have been more studies reporting on URS in pregnancy [15, 16], demonstrating its safety and efficacy with SFR of 85% and complication rates of 16% [15]. There were no maternal or fetal deaths reported in any of these papers. These reports do suggest that URS for urolithiasis in pregnancy is effective and safe although it should be carried out adopting a multi-disciplinary approach with the involvement of obstetricians, radiologists and urologists and only in high volume stone centers. Indeed, AUA and EAU guidance both recommend URS, should conservative treatment for urolithiasis fail [6, 7].

Paediatric stones

Pediatric stone disease is increasing in prevalence with a rise in the number of URS procedures being performed. There are multiple risk factors for stone for-

Table 1. *Summary of evidence for expanding roles of ureteroscopy*

Indication	Mean stone-free rate (%) (range)	Overall complication rate (%)	Clavien Grade >3 (%)
Stones >2 cm [8] (Large stones)	91	8.5	4.5
Bilateral stones [9]	92	17	12
Obese patients [10]	83	9 (17.5% for morbid obese)	0.2
Pregnancy [11]	85	16	ND
Paediatric stones [12, 13]	85.5–87.5	10.5–12.4	ND
Solitary kidney [14, 15]	87.2 (66.7–95.8)	28.4	5
Horseshoe kidney [17]	78 (70–88.2)	31.7	0
Bleeding diathesis [18]	87.7	11	ND

mation, the most prominent including renal tract anatomical variances and metabolic abnormalities [17]. With advances in surgical technology, URS has been used more frequently producing good results. Evidence suggests that paediatric patients who undergo URS for urolithiasis have an overall SFR of 85.5–87.5% and an overall complication rate of 10.5–12.4% [18, 19]. It is worth noting that in subgroup analysis, patients below the age of 6 had a higher complication rate (24% *vs.* 7.1%) and failure rate (4.4% *vs.* 1.7%) than children over the age of 6 [18]. To achieve best outcomes, the management should be a combined multidisciplinary approach between paediatric, renal and urology teams.

Stones in patients with solitary kidneys

Patients with stone disease in a solitary kidney are at an increase risk with obstruction and or infection related to their stones. In this cohort of patients the preservation of kidney function is paramount, and for ureteric stones, urgent treatment is recommended to prevent obstructive uropathy and permanent renal impairment. The optimal treatment option should be considered in line with the patient's other comorbidities such as age, BMI, stone location and size. Evidence for URS for stones in solitary kidney suggests an acceptable SFR of 87% [20], better than for SWL and lower complication rate than PCNL potentially making it an effective option for this cohort of patients. However, as this condition is a rare entity, URS for stones in a solitary kidney seems to be preferred and not just a standard option, especially for smaller stones.

Stones in horseshoe kidney

Patients with horseshoe kidneys are more prone to the development of urolithiasis due to abnormal drainage anatomy and associated infections. In this cohort of patients, treatment is difficult due to the anatomical variation, making PCNL and SWL technically challenging. Evidence suggests that URS gives acceptable stone-free rates of 78% with a low risk of major complications, and no significant change in the renal function or renal loss [21]. Though the evidence is sparse, these are encouraging numbers and recent EAU guidance suggests the use of URS in these patients [7].

Patients with bleeding diathesis

For patients with a bleeding diathesis or on anti-coagulant therapy, URS is now the recommended by both the AUA and EAU guidance for the treatment of kidney stone disease [6, 7]. Reversal of anti-coagulation is advised where appropriate, but in certain circumstances where this is not possible, SWL and PCNL are contraindicated due to the high risk of bleeding [6, 7, 22]. Evidence suggests URS and laser stone fragmentation provides a good SFR of 87.7% and a complication rate of 11% [23]. Only 4% of patients had minor bleeding, demonstrating that URS is a safer treatment in this situation [23].

Ureteroscopy in an acute setting

There seems to be an increasing role of primary URS for acute management of non-infective acute ureteric stone. Although temporising measures like insertion of a JJ stent or nephrostomy might be options, there is a move towards URS in an acute setting provided surgical experience and expertise is available for it [5].

Ureteroscopy in patients with urinary diversion

In patients with previous urinary diversion, identification and cannulation of the ureteric orifice might be difficult with a learning curve associated with it [24]; however, success rates of 80% have been described in patients with a neobladder [25].

Limitations of ureteroscopy

While ureteroscopy has been successfully done in patients with large renal stones, the guidelines suggest a cut-off of 2 cm beyond which a PCNL is recommended [7]. Similarly in pediatric patients and patients with urinary diversion there is a higher failure rate associated with ureteroscopy [18, 24].

Future direction for ureteroscopy

The advent of digital ureteroscopes has allowed better visual clarity in stone fragmentation and is gaining popularity worldwide [26]. This has translated into significantly reduced operative times although the overall SFR was not dissimilar to conventional ureteroscopes. Use of ureteroscopes has also allowed photodynamic diagnosis and treatment of upper urinary tract tumours leading to a conservative management approach of these cancers [27]. This is an area of growing popularity amongst urologists allowing for renal preservation and endoscopic management of these tumours. Similarly in an era of increasing antimicrobial resistance (AMR) and complex urinary tract infections, the advent of disposable ureteroscopes should prove to be a step in the right direction [28].

CONCLUSIONS

The use of URS has increased, corresponding to the rising incidence of urolithiasis, it is being performed

in more complex cases and patients than ever before. These include URS management for large stones, bilateral stone disease, obesity, pregnancy, pediatrics, solitary kidney, horseshoe kidney and patients with a bleeding diathesis. With advances in the URS technique and technology, its role has expanded to offer treatment in these difficult clinical scenarios.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

References

1. Rukin N, Siddiqui Z, Chedgy E, Somani BK. Trends in Upper Tract Stone Disease in England: Evidence from the Hospital Episodes Statistics (HES) Database. Urol Int. 2017; 98: 391-396.
2. Scales CD, Smith AC, Hanley JM, Saigal CS, Urologic Diseases in America Project. Prevalence of Kidney Stones in the United States. Eur Urol. 2012; 62: 160-165.
3. New F, Somani BK. A Complete World Literature Review of Quality of Life (QOL) in Patients with Kidney Stone Disease (KSD). Curr Urol Rep. 2016; 17: 88.
4. Wong Y, Cook P, Roderick P, Somani B K. Metabolic syndrome and kidney stone disease: A systematic review of literature. J Endourol. 2016; 30: 246-253.
5. Makanjuola JK, Rintoul-Hoad S, Bultitude M. Evolving Guidance on Ureteric Calculi Management in the Acute Setting. Curr Urol Rep. 2016; 17: 24.
6. Assimos D, Krambeck A, Miller N, et al. Surgical management of stones: American Urological Associaition / Endourological Society Guideline. 2016. Available at: https://www.auanet.org/education/guidelines/surgical-management-of-stones.cfm (Accessed: November 2016).
7. Turk C, Knoll T, Petrik A, et al. Guidelines on Urolithiasis, 2015. Available at: http://uroweb.org/wpcontent/uploads/22-Urolithiasis_LR_full.pdf (Accessed: November 2016).
8. Geraghty R, Aboumarzouk O, Rai B, Biyani CS, Rukin N, Somani BK. Evidence for ureterorenoscopy and laser fragmentation (URSL) for large renal stones in the modern era. Curr Urol Rep. 2015;16: 54.
9. Karakoyunlu N, Goktug G, Şener NC, et al. A comparison of standard PCNL and staged retrograde FURS in pelvis stones over 2 cm in diameter: a prospective randomized study. Urolithiasis. 2015; 43: 283-287.
10. Aboumarzouk O, Monga M, Kata SG, Traxer O, Somani BK. Flexible Ureteroscopy and Laser Lithotripsy for Stones >2 cm: A Systematic Review and Meta-Analysis. J Endourol. 2012; 26: 1257-1263.
11. Rai BR, Ishii H, Jones P, Chapman RA, Stolzenburg JU, Somani BK. Bilateral simultaneous ureteroscopy for bilateral stone disease: a systematic review. Can J Urol. 2016; 23: 8220-8226.
12. Ge H, Zheng X, Na Y, et al. Bilateral Same-Session Ureteroscopy for Treatment of Ureteral Calculi: A Systematic Review and Meta-Analysis. J Endourol. 2016; 30: 1169-1179.
13. Ishii H, Couzins M, Aboumarzouk O, Biyani CS, Somani BK. Outcomes of systematic literature review of Ureteroscopy for stone disease in the Obese and Morbidly Obese Population. J Endourol. 2016; 30: 135-145.
14. Krambeck AE, Wijnstok NJ, Olbert P, et al. The influence of BMI on Outcomes in Ureteroscopy (URS): Results From the Clinical Research Office of Endourological Society URS Global Study. J Endourol. 2017; 31: 20-26.
15. Ishii H, Aboumarzouk O, Somani BK. Current status of ureteroscopy for stone disease in pregnancy. Urolithiasis. 2014; 42: 1-7.
16. Semins MJ, Matlaga BR. Management of urolithiasis in pregnancy. Int J Womens Health. 2013; 5: 599-604.
17. Sas DJ. An update on the changing epidemiology and metabolic risk factors in pediatric kidney stone disease. Clin J Am Soc Nephrol. 2011; 6: 2062-2068.
18. Ishii H, Griffin S, Somani BK. Ureteroscopy for stone disease in the paediatric population: a systematic review. BJU Int. 2015; 115: 867-873.
19. Ishii H, Griffin S, Somani BK. Flexible ureteroscopy and lasertripsy (FURSL) for paediatric renal calculi: Results from a systematic review. J Pediatric Urol. 2014; 10: 1020-1025.
20. Jones P, Rai BP, Somani BK. Outcomes of Ureteroscopy for patients with stone disease in solitary kidney: Evidence from a systematic review. Cent European J Urol. 2016; 69: 83-90.
21. Ishii H, Rai B, Traxer O, Kata S G, Somani BK. Outcome of ureteroscopy for stone disease in patients with horseshoe kidney: Review of world literature. Urol Ann. 2015; 7: 470-474.
22. Bourdoumis A, Stasinou T, Kachrilas S, Papatsoris AG, Buchholz N, Masood J. Thromboprophylaxis and bleeding diathesis in minimally invasive stone surgery. Nat Rev Urol. 2014; 11: 51-58.
23. Aboumarzouk O, Somani B K, Monga M. Flexible Ureteroscopy and Holmium:YAG laser lithotripsy for stone disease in patients with bleeding diathesis: a systematic review of the literature. Int Braz J Urol. 2012; 38: 298-305.
24. Rivera M, Krambeck A. Retrograde ureteroscopy via a continent urinary diversion: surgical techniques and common pitfalls. J Endourol. 2014; 28: 763-766.
25. Singla N, Montie JE, Lee CT, et al. Experience with 45 Consecutive Patients with Neobladders Undergoing Retrograde Ureteroscopy for Upper Tract Abnormalities. Urol Pract. 2015; 2: 244-249.
26. Somani BK, Al-Qahtani SM, Gil de Medina SD, Traxer O. Outcomes of flexible ureterorenoscopy and laser fragmentation for renal stones: comparison between digital and conventional ureteroscope. Urol. 2013; 82: 1017-1019.
27. Somani BK, Moseley H, Eljamel MS, Nabi G, Kata S G. Photodynamic diagnosis (PDD) for upper urinary tract transitional cell carcinoma (UT-TCC): evolution of a new technique. Photodiagnosis Photodyn Ther. 2010; 7: 39-43.
28. Buttice S, Sener TE, Netsch C, et al. LithoVue™: A new single-use digital flexible ureteroscope. Cent European J Urol. 2016; 69: 302-305.