



## A SYSTEMATIC REVIEW AND SINGLE-CENTRE EXPERIENCE OF URETERORENOSCOPY UNDER LOCAL ANESTHETIC: A SAFER OPTION FOR ANESTHETICALLY HIGH-RISK PATIENTS?

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### ABSTRACT

Patients are living longer with an increasing number of co-morbidities. Minimally invasive ureterorenoscopy (URS) to manage upper tract calculi or transitional cell carcinoma (TCC) can be performed under general or spinal anesthesia; however, certain co-morbid patients are not suitable for this and may benefit from a different approach. We report on URS under local anesthesia (LA) using intra-ureteric marcaine as the primary form of anesthesia. We also aimed to perform a robust systematic review of this topic.

A retrospective analysis over 6 years was undertaken on all patients who underwent URS for calculi or TCC under LA, with the use of intra-urethral lidocaine gel (2%) and intra-ureteric marcaine (0.5%, 20 mL) with sedoanalgesia as an adjunct. A systematic review and all English language articles on ureteroscopic procedures with the use of LA with or without intravenous sedoanalgesia were selected and data extracted.

In our case series, 12 patients had a total of 42 procedures. Stone size varied from 4–35 mm. Twenty-two percent of procedures (9/41) did not require any sedation or intravenous analgesia as an adjunct to the bupivacaine with a further 49% (20/41) requiring midazolam. (The anesthetic chart was not available for one procedure.) No procedures were abandoned and there were no conversions to general/spinal anesthesia. There were no complications secondary to the use of LA. Eighty-one percent of cases (34/42) were performed as a day-case or overnight stays. The complication rate was similar to that for conventional anesthesia. The systematic review yielded 1121 procedures from 11 papers and 7 countries. In 32 cases the procedure was converted to general anesthesia. Stone clearance rates were between 78–100%. The procedures were well tolerated in 80–90% of cases.

This study highlights that URS can be safely performed under LA. It is well tolerated and represents an option for carefully selected patients who have been adequately counselled, and who would be at high risk from anesthesia. Such patients may otherwise be considered “unfit” for endourological intervention.

**Keywords:** *ureteric stones, ureteroscopy, laser, renal stone*

In 1912, Hugh Hampton Young accidentally entered the dilated ureter of a child with posterior urethral valves thereby performing the first diagnostic ureteroscopy. This was published years later in 1929.<sup>1</sup> In 1977, Goodman first reported the use of an 11Fr pediatric cystoscope in adult women for ureteric pathology.<sup>2</sup> A few years later in 1980, the first ureteroscope that could reach the renal pelvis was introduced. Over the decades, ureteroscopy has become ubiquitous with the miniaturization and improved optics of semi-rigid and flexible ureterorenoscopes. These procedures have become mainstream modalities for the management of urolithiasis and increasingly upper tract malignancies.<sup>3</sup> Although many institutions perform ureterorenoscopy on a day-case basis, some co-morbid patients are not surgical candidates for ureteroscopic procedures under general or spinal anesthetic. The intent of this article is therefore twofold: (1) to report on the viability of performing ureteroscopy under local anesthetic (LA) in 12 of our patients over 6 years and (2) perform a robust systematic review of this topic.

#### **METHODS FOR SYSTEMATIC REVIEW OF THE LITERATURE**

Three of the authors (AT, SY, and TA) performed a literature search using the key words: ureteroscopy, stones, local anesthesia, regional anesthesia, flexible ureteroscopy and rigid ureteroscopy. Google Scholar, PubMed, EMBASE and Cochrane databases were searched. English language articles on ureteroscopic procedures with the use of LA with or without intravenous analgesia and/or sedation were selected. Reference lists of articles were also assessed to ensure all relevant articles were included. Where full articles were not available, abstracts were utilized if sufficient data were extractable.

Our outcome measures were: (1) Major and minor complications, (2) Stone clearance rates, (3) Patient tolerability, and (4) Length of hospital stay.

#### **CASE SERIES METHODOLOGY AND PATIENT SELECTION**

A retrospective analysis was made of all patients who underwent ureteroscopy/flexible ureterorenoscopy (URS/FURS) for calculi or upper tract transitional cell carcinoma (TCC) under LA with the use of

intra-ureteric marcaine (0.5%, 20 mL). Marcaine was instilled under pressure into the ureter using a 5Fr ureteric catheter prior to commencing URS.

#### **PATIENT SELECTION**

We selected adult patients who required URS and laser fragmentation for stone disease or for TCC in whom general or spinal anesthesia was high risk or contraindicated for a variety of reasons: high body-mass index, difficult airway, asbestosis-related pulmonary fibrosis, previous severe postoperative cardiorespiratory failure, and previous difficulties with intubation. Patients who expressed a desire to avoid general or spinal anesthetic were provided with the option of a procedure under sedoanalgesia with LA. Where appropriate, extra-corporeal shockwave lithotripsy (ESWL) was attempted in the first instance to avoid ureteroscopy, but was unsuccessful.

#### **PROCEDURE**

All procedures were performed in the hospital operating room. An anesthetist was involved in all cases to administer sedation, provide intravenous analgesia when required, and for patient monitoring. Patients would receive sedation and intravenous analgesia in the anesthetic room. The nature of the sedation and analgesia was determined on a case-by-case basis and by each individual anesthetist's preferences and patient tolerability (Tables 1 and 2). Prophylactic intravenous antibiotics were administered prior to commencing endoscopy. Once in theatre, patients were positioned in the lithotomy position and prepared and draped as for cystoscopy.

Intra-urethral lidocaine gel (2%, 11 mL Instillagel®) was instilled prior to performing cystoscopy using a 17Fr Olympus® rigid cystoscope. A Sensor® guide wire (Boston Scientific®) was used to cannulate the ureteric orifice and the wire passed to the kidney under image intensifier guidance followed by a dual-lumen catheter over this. Through this 20 mL 0.5% marcaine was infused at pressure resulting in a degree of extravasation.

Following a delay of 3–5 minutes and with close attention to patient behaviour, a graduated 6.5/7.5Fr Wolf® semi-rigid ureteroscope was inserted alongside the safety Sensor® wire for ureteric pathology. For

**TABLE 1** Systematic Review of the Literature

Rittenberg <i>et al</i> USA, J Urology	1987	Prospective Non- randomised	30 patients	Male: female= 11:19	5	100%	None	Good
Chan <i>et al</i> , Hong Kong, British journal of urology	1990	Prospective Non- randomised	61 patients, 10mg diazepam orally 30 min pre- operatively and were 2% lignocaine gel instilled into the urethra for 3 minutes before instrumentation	Mean age = 43y Male: female= 20:4	61	78%	1 patient converted to general anaesthesia	score of 0 -10 (0=no pain, 10=extreme unbearable pain) Mean pain score = 6.1 (0-8)
Vogeli <i>et al</i> Germany British journal of urology	1993	Prospective Non- randomised	161 patients, 133 units, lidocaine jelly, intravenous bolus of Alfentanil (0.5mg/ single dose), Midazolam if necessary as additional analgesia	Mean age= 53.6 y Male: female= 60:73	Ureteroscopy for various procedures	X	28 patients needed general or regional anesthesia  Ureteric injuries- 11 (6.8%)	50% ureteroscopic procedures performed routinely under local anaesthesia with and without intravenous analgesia
Yalcinkaya <i>et al</i> Turkey, International Urology and Nephrology	1995	Prospective Randomised	30 patients Group 1 - IM midazolam Group 2 - 2% urethral lidocaine	43+/- 7.4 y (Group 1) 46+/- 8.7 y (Group 2)	30	83.3% (Group 2)	Minor ureteric injuries 3 patients Post-operative fever 3 patients	Minimal pain in 4 patients Moderate pain (tolerable) in 5 patients Intolerable pain in 2 patients
Hosking <i>et al</i> . USA. J Urol	1996	Prospective Non- randomised	68 patients		68	97%	Post-operative pain in 1 patient	Good tolerance- 81.4% Fair tolerance- 18.6%

TABLE 1 Systematic Review of the Literature (Continued)

Miroglu et al Turkey European Urology	1997	Prospective Non- randomised	51 units, 2% lidocaine gel, Intravenous 10mg of Diazepam and 5ml of Baralgin		34	82%	Pain 8 Hemorrhage/ laceration 2	
Park et al South Korea European Urology	2004	Retrospective	200 patients Pethidine HCl 50mg as premedication. Local 10ml of 2% lidocaine	Male: female= 94:109	200	93%	Ureteral injury- 1 Pyelonephritis- 2 Ureteral stricture- 2	Mean Pain score - 3.4 (Visual analogue score 0-10) Mean length of stay 0.58-0.96 days
Jeong et al South Korea Urological research	2005	Prospective Non- randomised	85 patients	Mean age= 51.1 y Male: female= 52:33				3.8± 2.1 on ten- point linear visual analog scale-VAS (significantly lower than SWL P<0.05)
Rao et al India International Urology and Nephrology	2005	Prospective Non- randomised	124 patients Diclofenac sodium 50-100mg and promethazine 12.5mg IM. Injection of metoclopramide 10mg Midazolam 0.03mg/ kg body weight IV. Lignocaine 2% jelly	Mean age= 33.52 y Male: female= 1.94:1	124	Distal 97.3% Mid 80% Proximal 86.7% Overall 88%	Urosepsis-2 patients	On pain intensity (PPI) (Mc Gill pain questionnaire); Mild Pain 79.0 %, Discomforting 11.3% Distressing 6.5%, Horrible 3.2%
Gupta et al India J Endourology	2006	Prospective Non- randomised	25 patients	Mean age= 30.4 y	25	92%	3 patients - converted to general anaesthesia for prolonged procedure	

Tadeusz <i>et al</i> Canada Can Urol Assoc Journal	2016	Retrospective	314 patients 0.1mg of fentanyl and 2mg of midazolam. Additional dose if required	Mea Mean age= 53.74y Male: female= 160:154	314	97%	10 patients Ureteric submucosal injury-2 False passage- 2 Ureteric perforation-1 Stricture-2 Bacterial cystitis-2 Sepsis-1	Good -263 patients Fair -44 patients Poor-7 patients
Tasleem <i>et al</i> . UK (this series)	2017	Retrospective	12 (42 procedures) patients Intraureteric Marcaine+/- non-steroidal/ paracetamol+/- Midazolam+/- fentanyl+/- propofol (See details in table 5)	Stone burden 4-35mm Mean age= 56y Male: female= 1:1	12 (42 procedures)	82% (9 patients had stones cleared out of 11 with stones)	No procedures abandoned/ converted to GA (propofol used in 6 procedures)	71% procedures (30/42) did not require sedation or IV analgesia. 81% percent of cases (34/42) were performed as day case or overnight stays.

**TABLE 2** Current Case Series

Case	Pathology	Site	Size	Scope used	Sedoanalgesia	Indication for LA
Case 1 Procedure 1	Stone	Distal ureter	5 mm	DUR-D	Paracetamol, diclofenac, midazolam, intrauretric marcaine	ESWL- stone not visualised. Failed intubation- laryngospasm. Failed spinal anesthetic.
Case 1 Procedure 2	Stone	Distal ureter	4 mm	URF-V	Paracetamol, diclofenac, midazolam, intrauretric marcaine	
Case 2 Procedure 1	Stone	Renal pelvis and + lower pole	Up to 33 mm	URF-V	Paracetamol, diclofenac, midazolam, intrauretric marcaine, fentanyl	Patient choice
Case 2 Procedure 2	Stone	Multiple: Lower pole	8–10 mm	URF-P5	Paracetamol, diclofenac, midazolam, intrauretric marcaine	
Case 2 Procedure 3	Stone	Multiple: Lower pole	10–15 mm		Paracetamol, diclofenac, midazolam, intrauretric marcaine	
Case 2 Procedure 4	Stone	Lower pole			Paracetamol, diclofenac, midazolam, intrauretric marcaine	
Case 3 Procedure 1	TCC	Distal ureter		DUR-D	Paracetamol, diclofenac, midazolam, fentanyl, propofol	Severe chronic obstructive pulmonary disease, obstructive sleep apnea Refused spinal.
Case 4 Procedure 1	Stone	Upper ureter Distal ureter	10 mm 4 mm	URF-P5	Paracetamol, diclofenac	Morbid obesity.
Case 5 Procedure 1	Stone	Renal pelvis	30 mm		Paracetamol, midazolam, intrauretric marcaine	Failed ESWL. Ischaemic heart disease, chronic obstructive pulmonary disease, kyphoscoliosis, obesity, difficult extubation in past.
Case 5 Procedure 2	Stone	Lower pole Renal pelvis	7–8 mm	DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 5 Procedure 3	Stone	Upper, middle and distal ureter		URF-V	Paracetamol, midazolam, fentanyl, propofol, intrauretric marcaine	
Case 5 Procedure 4	Stone	Multiple lower pole		DUR-D		

**TABLE 2** Current Case Series (*Continued*)

Case 6 Procedure 1	Stone	PUJ and lower pole	4–6 mm		Paracetamol, midazolam, fentanyl, propofol	Failed ESWL. Obesity, limited neck extension and mouth opening
Case 7 Procedure 1	Stone	Renal pelvis	10–20 mm		Paracetamol, midazolam, intrauretric marcaine,	Previous prolonged intensive case unit admission following GA for percutaneous nephrolithotomy
Case 7 Procedure 2	Stone	Renal pelvis			Paracetamol, intrauretric marcaine,	
Case 7 Procedure 3	Stone	Lower and mid poles and renal pelvis			Paracetamol, intrauretric marcaine,	
Case 7 Procedure 4	Stone	Bilateral renal pelvis and left ureter	Staghorn (Right)		Paracetamol, midazolam, intrauretric marcaine,	
Case 7 Procedure 5	Stone	Renal pelvis			Paracetamol, midazolam, intrauretric marcaine,	
Case 7 Procedure 6	Stone	Lower and mid pole			Paracetamol, midazolam, intrauretric marcaine, propofol	
Case 7 Procedure 7	Stone	Staghorn			Paracetamol, midazolam, intrauretric marcaine,	
Case 7 Procedure 8	Stone	Staghorn			Paracetamol, intrauretric marcaine	
Case 7 Procedure 9	Stone	Staghorn			Paracetamol, intrauretric marcaine	
Case 8 Procedure 1	Stone	Lower pole	Partial staghorn		Paracetamol, midazolam, intrauretric marcaine, fentanyl, propofol	
Case 8 Procedure 2	Stone	Lower pole	Partial staghorn	DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 8 Procedure 3	Stone	Lower pole	Partial staghorn	DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 8 Procedure 4	Stone	Lower pole	Fragments	DUR-D	Paracetamol, midazolam, intrauretric marcaine, fentanyl, propofol	

**TABLE 2** Current Case Series (*Continued*)

Case 9 Procedure 1	Stone		Staghorn (R)	URF-V	Paracetamol, midazolam, intrauretric marcaine	Spina bifida, patient choice
Case 9 Procedure 2	Stone		Staghorn (R)	DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 9 Procedure 3	Stone		Staghorn (R)	DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 9 Procedure 4	Stone	Lower pole	12 mm		Paracetamol, intrauretric Marcaine	
Case 9 Procedure 5	Stone	Lower pole	16 mm		Paracetamol, intrauretric Marcaine	
Case 9 Procedure 6	Stone	Lower pole	16 mm		Paracetamol, intrauretric marcaine	
Case 9 Procedure 7	Stone	Upper and lower pole			Paracetamol, intrauretric marcaine	
Case 9 Procedure 8	Stone	Lower pole	15–20 mm		Paracetamol, midazolam, fentanyl, intrauretric marcaine	
Case 9 Procedure 9	Stone	Renal pelvis and calyces	Matrix stone		Paracetamol, midazolam, fentanyl, intrauretric marcaine	
Case 9 Procedure 10	Stone	Interpolar	7–8 mm		Paracetamol, midazolam, fentanyl, intrauretric marcaine	
Case 10	Stone	Distal ureter	7 mm	Rigid Scope	Paracetamol, midazolam, fentanyl	Chronic obstructive pulmonary disease, Ischaemic heart disease, spinal deformity
Case 11	Stone	Mid ureter	18 × 10 mm	Rigid Scope	Paracetamol, midazolam, propofol, intrauretric marcaine	Ischaemic heart disease, coronary artery bypass graft, pulmonary fibrosis, pleural plaques (previous asbestos exposure)



**TABLE 2** Current Case Series (*Continued*)

Case 12 Procedure 1	Stone	PUJ/ureteric stone+ upper pole	7–12 mm	Rigid Scope	Paracetamol, midazolam, intrauretric marcaine	High body mass index, warfarinised for atrial fibrillation, heart failure -secondary to pulmonary hypertension, asthma
Case 12 Procedure 2	Stone	PUJ/ureteric stone+upper pole	12–17 mm	Rigid Scope	Paracetamol, midazolam, intrauretric marcaine	
Case 12 Procedure 3	Stone	PUJ/ureteric stone+ upper pole	12 mm residual stone	Rigid Scope/ DUR-D	Paracetamol, midazolam, intrauretric marcaine	
Case 12 Procedure 4	Stone	PUJ/ureteric stone+ upper pole	Residual stone	DUR-D	Paracetamol, midazolam, intrauretric marcaine	

renal pathology a 35 cm or 45 cm 12/14Fr access sheath was introduced into the ureter over the in-situ Sensor® wire and FURS was performed using the Olympus® URF-P5, Olympus® URF-V and GyruS-ACMI DUR-D endoscopes. Laser fragmentation of stones or ablation of carcinoma was performed using a Holmium: YAG laser all the while with close monitoring of patients both physiologically and clinically. A double-J stent was inserted at the end of selected procedures under image intensifier guidance either on a string for removal in three days or by flexible cystoscopic removal in due course.

#### DATA COLLECTION

Data was collected retrospectively from patient notes and by reviewing radiological imaging. The indication for (F)URS and for avoiding general and spinal anesthetic was recorded. The site of pathology and stone burden was determined from operation notes and imaging. In cases where no recent imaging was available to determine stone size, this data was left missing (see Table 2). The use of sedation and analgesia was identified from the anesthetic and drug charts.

#### ETHICS

Informed consent was gained for all procedures. No further ethics approval was required as operations were performed as the standard of care and this was an audit of existing practise.

#### THE RESULTS OF THE CASE SERIES

Twelve patients had a total of 42 procedures under LA over six years from 2010 to 2016. Stone size varied from 4–35mm. Twenty-two percent of procedures (9/41) did not require any sedation or intravenous analgesia as an adjunct to the per-urethral instillagel® or intra-ureteric marcaine. The anesthetic chart could not be located for one procedure. No procedures were abandoned due to pain and there were no conversions to GA. There were no complications secondary to LA. Eighty-one percent of cases (34/42) were performed as day case or overnight stays. The overall complication rate was 14%.

#### THE RESULTS OF THE SYSTEMATIC REVIEW

The search process yielded 45 possible articles of which 34 were deemed not suitable for inclusion as the data was not available or not clear after abstract screening. In total, 11 papers generated from 7 countries, with a total of 1121 procedures were included. The mean age from the collective group was 44 years-old and the male to female ratio 0.92:1. All included studies were single centre. Eight articles were prospective,<sup>5–14</sup> one of which was a randomized controlled trial.<sup>4</sup> Two were retrospective studies.<sup>7,15</sup>

#### OUTCOME MEASURES

##### *Safety*

Out of a total 1121 procedures, 32 procedures were converted to general anesthesia (GA), mostly

for pain and inability to tolerate the procedure and also the need for a prolonged procedure. Postoperative pain was reported in 10 patients and 19 patients had a ureteric laceration or injury to the urinary tract. Two patients had false passages, two patients had ureteric strictures and nine developed postoperative urinary tract infections either cystitis or pyelonephritis

### ***Stone Clearance Rate***

In total, more than 861 patients had URS for ureteric calculi, achieving a stone-free rate of between 78% and 100%. This is comparable to procedures undertaken under conventional anesthesia.

### ***Patient Tolerability***

Few papers in this review commented on the tolerability of the procedure under LA or with some degree of sedation. Rittenberg et al. reported on the procedure being well tolerated in all patients.<sup>5</sup> Yalcincaya et al. commented on mild pain in 4/30, moderate pain in 5/30 of patients and intolerable pain in 2/30.<sup>4</sup> Hosking et al. reported good tolerance in 81.4% and fair tolerance in 18.6%.<sup>6</sup> Park et al. reported a mean pain score of 3.4 (on 10-point scale).<sup>7</sup> Rao et al. reported 79% of participants having mild pain with only 10% having severe pain.<sup>8</sup>

### ***Length of Hospital Stay***

Only one paper commented on length of stay as an outcome measure<sup>7</sup> with mean length of stay between 0.58 and 0.96 days for patients having URS with a combination of diclofenac, promethazine, metoclopramide, midazolam and urethral lidocaine.

### ***Discussion***

This review has demonstrated that although not a popular technique, ureteroscopy under sedoanalgesia is viable and safe. This corroborates the finding of our own series whereby in high-risk surgical candidates this approach can be a useful tool. The patients in our series demonstrate this with three of the 12 having had previous intensive care unit (ITU) admissions following GA and a further five deemed at very high risk of ITU admission or death if they were to be given a GA. For this reason, operating under LA is advantageous, if not essential, for a number of patients.

Our systematic review has shown that FURS has been described with intra-urethral LA and sedation. This has been shown to be well tolerated and successful.<sup>4-14</sup>

There are, however, no reports of the use of intra-ureteric LA as an adjunct to this, which has allowed the treatment of larger renal stones including staghorn calculi through a multi-phased approach in our series. The treatment of such stones has not been described with intra-urethral LA, sedation and analgesia alone.

Often, the arguments against the use of LA are the perceived poor patient tolerability and risk of ureteric injury from patient movement. However, two studies have compared subjective pain scores of various urological procedures, including rigid cystoscopy, ESWL and FURS and not shown FURS to be more painful.<sup>7,12</sup> In our series of 42 procedures there were no abandoned procedures due to pain. Furthermore, 43% of procedures were successfully performed with only paracetamol and/ or a non-steroidal anti-inflammatory drug (NSAID) as an adjunct to the LA. In six procedures, a dose of propofol was required to maintain anesthesia. There was one case of ureteric perforation in our cohort, which resulted from damage caused by the guide wire. This was not associated with any patient movement and cannot be attributed to LA. This patient was successfully managed conservatively with a double-J stent and on subsequent imaging and follow up was not found to have hydronephrosis or impaired drainage on the affected side.

Rittenberg et al. were the first to report ureteroscopy under LA.<sup>5</sup> In this cohort of 30 patients, 18 patients had flexible ureterorenoscopy, seven patients had rigid ureteroscopy, and five had both. Of these procedures, 25 ureteroscopies were performed for diagnostic purposes and five for ureteric calculi; in one case for a mid-ureteric stone, and four were in the distal ureter. All the procedures were performed using 2% lidocaine per urethra. Twenty-eight out of 30 patients had intravenous midazolam in addition. There were no reported complications and stone clearance was found to be 100%.

Chan et al. demonstrated the feasibility of trans-urethral ureteroscopic lithotripsy under LA and sedation, in a prospective study of 61 patients using 10mg of diazepam orally.<sup>8</sup> The stone clearance rate was 78% with no major complications reported and one conversion to GA to achieve stone clearance. This study also demonstrated reasonable tolerance to the procedure with a mean pain score of 6 on a pain scale

of 0 to 10 (0= no pain; 10= extreme unbearable pain). Importantly, it showed no difference in the duration of treatment between successful and unsuccessful procedures.

In 1993 Vogeli et al., in their prospective study, reported on 133 patients who successfully completed ureteroscopic procedures without the need for general or regional anesthesia from a total of 161 patients.<sup>9</sup> Interestingly, the study highlighted that time required to perform the treatment was a major factor, unlike the findings of Chan et al. In the same year, Abdel-Razzak et al. performed a retrospective study using 6.9F ureteroscopes in 65 procedures in 57 patients.<sup>10</sup> Out of these, 42 patients were treated with intraurethral topical anesthesia and intravenous sedation.

In 1995, Yalcinkaya et al. conducted a prospective randomized study of 35 patients divided into two groups depending on stone position.<sup>4</sup> The study concluded that there was no significant difference in the stone-free rate of ureteroscopy when comparing cases performed under GA versus those under LA with sedation. Similarly, there were no additional major complications. Just one year later, Hosking et al. reported the results of 70 patients' data that underwent ureteroscopy with intravenous sedation.<sup>6</sup> They reported a stone clearance rate of 95.7% in 67 patients and failed procedures in three patients due to a larger stone burden and needing manipulation under GA. This study highlighted the overall tolerance as "good" in 81.4% and "fair" in 18.6% of patients. Miroglu et al. in 1997 reported 51 procedures under LA and intravenous analgesia for varying pathologies.<sup>11</sup> This study presented 34 procedures performed for ureteric stones and reported stone clearance in 83%.

Park et al. in 2004 reported their retrospective series of 200 cases of LA ureteroscopic procedures, primarily performed for ureteric calculi. The authors compared pain during cystoscopy and LA ureteroscopic lithotripsy using a visual analog scale in a total of 55 patients who underwent LA ureteroscopic lithotripsy and 226 patients who underwent cystoscopy. This study reported an overall stone-free rate of 93% (185/200). One patient had a ureteric injury, two had pyelonephritis and two had ureteric strictures. The mean pain score after LA ureteroscopic lithotripsy was 3.4, compared with 3.1 after cystoscopy alone.

The difference between these groups was reported as being statistically insignificant.

Jeong et al. in 2005, investigated subjective pain generated during extra-corporeal shockwave lithotripsy (ESWL) and endoscopic procedures such as ureteroscopic lithotripsy, cystoscopy, retrograde ureteric stenting and retrograde pyelography (RGP) performed as a day case procedure.<sup>12</sup> In this prospective study, subjective pain was evaluated using a 10-point linear visual analog scale (VAS). They concluded that ureteroscopic lithotripsy along with other endoscopic procedures had a pain score significantly lower than ESWL which is traditionally performed with relatively mild analgesia and rarely sedation. In a prospective study of 124 patients with ureteric calculi, Rao et al. reported on ureteroscopic lithotripsy under sedoanalgesia with the use of 2% lidocaine as LA.<sup>12</sup> The authors concluded that the procedure was well tolerated by patients with no reported complications or technical difficulties. In two patients, the procedure was abandoned because of intolerable pain. The patients with the worst pain in both the assessments had mid-ureteric calculi.

In 2006, Gupta et al. described treating patients with ureteric calculi with LA alone or with sedation. Several patients had "monitored anesthesia" with propofol or ketamine.<sup>14</sup> No complications during or after the procedure were reported, with no patients had postoperative pain. The author reports stone clearance in 23 out of 25 patients.

Recently, one of the biggest retrospective studies of 10 years by Krocak et al. reviewed data from 314 ureteroscopic procedures performed for distal ureteric calculi.<sup>15</sup> The mean age of patients in this cohort was 53.7 years, with 160 males and 154 females. Procedures were performed with initial doses of 100µg of fentanyl and 2 mg of midazolam administered prior to the start of the procedure. An additional dose of fentanyl was given in 25–50 µg increments and midazolam in 1mg doses. The author reported a success rate of 97% and a 3.2% complication rate. A total of 263 patients (83.7%) tolerated the procedure well, with seven (2.2%) having poor tolerability.

The differences in the varying complication and success rates could be explained in part by the considerable variants in endourological equipment with

older series using larger calibre scopes. The oldest papers in the review are over 30 years-old and this may be responsible for differences in results between series. Table 3 displays the different complications noted in the systematic review.

In our series, flexible ureteroscopy was been performed using intra-ureteric marcaine as the primary form of anesthesia. Using intra-ureteric marcaine (0.5%, 20 mL) via a ureteric catheter, 12 patients had a total of 42 procedures under LA. Twenty-two percent of these did not require any sedation or intravenous analgesia as an adjunct to the marcaine. Table 4 displays the sedoanalgesia used. No procedures were abandoned due to pain, there were no conversions to GA and no complications secondary to LA. In one patient, who had pain every time the pathfinder irrigation bulb was compressed by the surgeon had a further 20 mL 0.25% marcaine infused under pressure into the renal pelvis. Within a few minutes the patient was pain free with irrigation.

Four of our patients had staghorn/ partial staghorn stones. Three patients had large renal stone burdens and in two, additional ureteric and renal stones, four had ureteric stones only and one had ureteric TCC. One patient’s operative time was limited to 30 minutes

due to a previous episode of decompensated heart failure precipitated by anesthesia. At the follow-up procedure, they developed pyelonephritis accompanied by pain and were managed conservatively. Three other procedures resulted in postoperative pyrexia which was again managed conservatively with intravenous antibiotics and fluid resuscitation. These patients had large stone burdens with all having (partial) staghorn stones. One patient developed a perinephric abscess, presenting four weeks after their fourth and final procedure for an initial large 35-mm staghorn calculus and had this drained percutaneously by the radiologist making a good recovery clinically and radiologically.

One patient with a 10-mm upper-ureteric stone and a 4-mm vesico-ureteric junction stone on the ipsilateral side had a guide-wire related perforation of the ureter which was recognized intra-operatively and managed with a double-J stent left in-situ for four weeks post-operatively. It was not thought to be due to inadequate analgesia resulting in a sudden movement of the patient but would likely have occurred under GA in the same way.

One of our patients with TCC in their distal ureter tolerated the procedure poorly, but to completion allowing laser ablation of the tumour. Subsequent

**TABLE 3** Complications Noted in the Systematic Review

Complications	Number of Cases
Converted to general anesthesia	32
Ureteric laceration / injury	19
Ureteric false passage	2
Ureteric strictures	2
Urinary sepsis (pyelonephritis/cystitis)	9
Post-operative pain	10

**TABLE 4** Type of Sedoanalgesia Used in Current Series. (Case 5 Procedure 4 Lacked Anesthetic Chart)

Sedoanalgesia Used	Number of Cases
A: Marcaine +/- paracetamol +/- NSAID	9
B: A + midazolam	20
C: B + propofol +/- fentanyl	12

procedures were therefore performed under GA, as the choice here initially was the patient's to attempt the procedure under LA.

One of our patients had 10 procedures and continues to have planned maintenance ureteroscopies due to her history of an initial large staghorn stone with recurrent stone formation and large amounts of matrix stone between procedures. After an initial period of conservative management, she developed infections requiring antibiotics. Periodic ureteroscopies with washouts of matrix material and stone fragmentation was found to reduce the frequency of infections and was the strategy adopted moving forward. There was another patient with a large stone burden who required multiple procedures and therefore this increases the mean number of procedures per patient overall in our cohort to 3.5 which is higher than the usual re-look rate.

The majority (81%, 34/42) of our patients were discharged in less than 24 hours of their procedure. The longest stay was 6 days in the patient who developed a perinephric abscess. See Table 5 for the length of stay.

From our experience, we found some key aspects were important in order to reduce the pain and to improve tolerance. Initial counselling with a full and comprehensive description of the procedure in clinic is paramount to the patient's perception of what they are due to undergo with the provision of British Association of Urological Surgeons (BAUS) information leaflets. We believe time and effort spent explaining details to the patient affected how they went on to tolerate surgery moving forward. The operating surgeon saw the patients in clinic himself, on the morning of surgery and post-operatively. Intra-operatively, the bladder was not allowed to over-distend and the patient's voluntary urination alongside the scope, which was encouraged, helped keep the bladder empty. Distension of the

**TABLE 5** Length of Stay in Current Series

Length of Stay	Number of Cases
Daycase (admitted and discharged same day)	12
<24 hr	22
48 hr	4
>48 hr ( Range 3-6 days)	4

renal pelvis was kept to minimum using a pathfinder irrigation bulb allowing the surgeon to control flow rate tightly. We also noted that an important part of tolerability for patients was talking to them throughout the procedure, explaining what was going on and reassuring them. This was often achieved by showing them the surgery live on a slave-monitor adjacent to them and a member of theatre staff being present next to the patient at all times.

Intra-ureteric administration of marcaine, a long acting LA, has been previously reported in patients with chronic renal pain<sup>16</sup>; however, as far as we are aware this is the first report of its use as an adjunct to ureteroscopy.

Our study has limitations including absence of a control group of patients not treated with marcaine and also an objective assessment of patient's pain. However, according to the analysis of notes and from the team's experience; other than the one patient mentioned in the current series, the rest of our cohort tolerated these procedures well. The small number of patients involved also limits generalization. Conversely, the success rate reported in the literature and large number of patients who may potentially benefit warrants further investigation.

## CONCLUSION

This review article shows that URS and FURS can be safely performed under LA with or without sedation and intravenous analgesia when indicated. It is largely well tolerated and avoids the risks associated with general and spinal anesthesia in the unfit patient that might otherwise not be considered for such endourological procedures. This option is useful in those patients who may not want general or spinal anesthesia and also in those whereby a LA percutaneous nephrolithotomy may be contraindicated or high risk. Further prospective trials are required to investigate efficacy, success rates and ascertain specific criteria for its use.

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