The New Digital Flexible Ureteroscopes: ‘Size Does Matter’ – Increased Ureteric Access Sheath Use!

C. Bach S. Nesar P. Kumar A. Goyal S. Kachrilas A. Papatsoris J. Masood
N. Buchholz

Endourology & Stone Services, Barts and the London NHS Trust, London, UK

Key Words

Flexible ureteroscopy · Digital · Fibre optic · Ureteric access sheath

Abstract

Objectives: To evaluate whether the use of sheaths to access the ureter has increased after the introduction of new digital ureterorenoscopes in patients undergoing flexible ureteroscopy. **Methods:** 140 patients with kidney stones were randomised to be scoped with either an old-generation fibre-optic flexible ureteroscope (DUR-8, Elite, ACMI; distal tip diameter = 6.75 Fr) or a new-generation digital LCD flexible ureteroscope (Invisio D-URD flexible ureteroscope; distal tip diameter = 8.7 Fr). We recorded the necessity to use a sheath to access the ureter, sheath-related and postoperative complications, and whether or not a JJ stent was left behind. **Results:** 157 (80 fibre-optic and 77 digital) ureterorenoscopies were performed. Ureteral access sheaths were used significantly more frequently with digital scopes ($p = 0.00174$). Two patients in the digital scope group had a small distal ureteric perforation from the introducer sheath compared with none in the fibre-optic scope group. **Conclusions:** A statistically significant increase in sheath use was observed in the new-generation digital flexible ureterosco-

py group. Despite the improvement in image quality, better durability and improved stone clearance, there are some potential drawbacks of these scopes. The increased distal tip diameter can result in increased use of ureteric access sheaths and this may increase morbidity and expense.

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Introduction

Flexible ureterorenoscopy (fURS) has developed into a standard diagnostic and treatment modality for upper urinary stone disease, transitional cell carcinoma and ureteral strictures [1]. Indeed, more recently fURS is becoming a minimally invasive competitor to percutaneous nephrolithotomy for larger kidney stones as well as an accepted modality for localised treatment of small upper urinary tract transitional cell carcinoma and hence significantly more of these procedures are likely to be performed in the future.

Flexible ureteroscopy has taken a major step forward recently by the introduction of a new digital chip-on-the-tip technology (d-fURS) [2] allowing for markedly increased image resolution and reducing the weight of the scopes significantly as well as allowing better durability.

Table 1. Descriptive statistics between the fibre-optic and digital ureteroscopy groups

	Analogue fURS	Digital fURS	p
Patients, n	80	77	
Male/female (%)	43/37 (54/46)	47/30 (61/39)	
Median age, years	53 (29–85)	55 (28–81)	
Need for access sheath	6 (7.5%)	19 (25%)	0.0042
Postoperative JJ stent	39%	45%	
Complications	none	2 perforations	

The literature also suggests that these new properties may result in shorter operating times and better stone clearance rates when compared to fibre-optic flexible ureteroscopy [3].

However, one drawback of these novel high-end digital instruments may be the relatively larger tip diameter (to house the ‘digital chip-on-the-tip’) compared to fibre-optic analogue ureterorenoscopes (a-fURS). This may make ureteric access more difficult requiring more frequent use of ureteric access sheaths with or without dilatation of the ureteric orifice. As a result, there is a potential for ureteric injury, increased rates of postoperative ureteric stenting, and increased cost. Indeed the rate of ureteric perforation during ureteroscopy appears directly related to the size of the ureteroscope used during the procedure varying from 15.4% perforation rate with 12.5-Fr instruments to 1% with 6- to 11.5-Fr instruments [4].

We compare the need to use introducer sheaths to gain ureteric access for fibre-optic and digital flexible ureteroscopies (fURS). We also look to see whether there is a difference in the rate of postoperative stenting and complications in the two groups as a result of using the access sheath.

Material and Methods

We recorded data on 140 patients who underwent fURS for renal stone(s) ≤ 1 cm over a 2-year period who fulfilled the inclusion criteria of our study. A total of 157 fURS were performed by two experienced consultant endourologists. Both treated a similar number of patients. During the study period, two types of fURS were used: a flexible fibre-optic ureterorenoscope (DUR-8 Elite®; Gyrus ACMI, USA) with a distal tip diameter of 6.75 Fr, and a newer generation digital flexible ureterorenoscope (Invisio DUR-D; Gyrus ACMI, USA) with a distal tip diameter of 8.7 Fr. Patients were randomised to undergo fURS either with a fibre-

optic or a digital ureteroscope. Randomisation was carried out by using cards in an envelope method. This was done by a member of staff not involved in the study. All patients had a general anaesthetic and received 20 mg butylscopolamine intravenously preoperatively to paralyse and relax the ureter to reduce the chances of using a sheath. If the ureteric orifice could not be accessed, a 12-/14-Fr (inner/outer diameter) ureteral access sheath of varying length (Flexor Ureteral Access Sheath with AQ®; Cook Urological Inc., Spencer, Ind., USA) was introduced over a guidewire for dilatation and securing access to the distal ureter. If we used an access sheath, the distal tip of the sheath was placed in the proximal ureter below the pelviureteric junction. Descriptive patient data, the use of access sheaths and postoperative JJ stents, and complications were recorded in a prospective manner. We routinely use a Holmium:YAG laser for stone disintegration in our unit. Patients with larger stones (>1 cm) where the routine use of an access sheath was felt appropriate to aid multiple passes of the scope, those with a prior JJ in situ, those with known ureteric strictures and concomitant ureteric stones were excluded. Also excluded were all patients unable to have buscopan. A JJ stent was left in at the end of the procedure at the discretion of the surgeon. There was no fixed rule as to insertion of JJ stents after use of access sheaths and was again at the discretion of the operating surgeon. Statistical analysis between the two groups was carried out using a Fisher’s exact test.

We do not report on operating times or indeed stone clearance rates between the two groups as this was not the primary aim of this study.

Results

Eighty a-fURS and 77 d-fURS were performed in 140 patients. All patients had renal stone(s) ≤ 1 cm. In the a-fURS group, there were 43 males (54%) and 37 females (46%). In the d-fURS group, there were 47 males (61%) and 30 females (39%). Median age was 53 (29–85) and 55 (28–81) years in the a-fURS and d-fURS groups, respectively. The groups were well matched in terms of weight and body mass index and stone burden. 19 out of 77 d-fURS cases required a sheath for access (25%), compared to 6 out of 80 a-fURS cases (7.5%). The Fisher’s exact test produced a significant difference between the two groups (p value 0.0042). Postoperatively, JJ stents were placed in 39% (a-fURS) and 45% (d-fURS), respectively. Table 1 summarises the descriptive statistics comparing the two groups. Although the rate of stenting was higher in the d-fURS group, this was not statistically significant. This may be related to shorter operating time as a result of improved visibility or because the study sample was relatively small. There were two sheath-related small distal ureteric perforations in the d-fURS group. They were treated with postoperative JJ stents and did not develop strictures on follow-up.

Discussion

The advent of digital technology is a milestone in the development of fURS [2]. As the image is electronically transmitted from the chip-on-the-tip to the signal processor and to the monitor, these scopes do not need conventional optics and a camera. This leads to an enhanced image resolution and quality, which translates into better intraoperative visibility and significantly shorter operating time [3, 5]. The instrument weight is reduced by about 50%, which makes handling easier and more convenient for the surgeon [1]. Due to the lack of fibre-optic fibres needed for analogue transmission, fibre breakage with consecutively steadily decreasing image quality and malfunction of the scope should become a thing of the past. Therefore, digital scopes should have a better durability bringing the overall costs of fURS down in the long term [2].

However, there is a potential drawback of these scopes in that the chip-on-the-tip technology demands a slightly larger tip diameter of the scope [3]. The increased size of the tip has been shown in our study to necessitate the use of a sheath to gain ureteric access in a significantly increased number of patients.

Every endourologist has at times experienced difficulties introducing the flexible ureteroscope into the distal ureter, especially in patients that have not been previously stented. Various 'tricks of the trade' such as using a second or a stiffer guidewire, or a 180° turn of the scope may help, but not in all cases. In such cases, a relatively atraumatic dilatation of the ureteric orifice in combination with securing ureteral access can be achieved by inserting a finely tapered ureteral access sheath. We have routinely been giving our patients 20 mg of intravenous butylscopolamine (a non-selective muscarinic antagonist) prior to ureteroscopy (unless contraindicated) to try and relax the ureteric smooth muscle and potentially reduce the need for an access sheath. Although we acknowledge the effect at low doses may be limited, there is evidence in the literature that butylscopolamine causes ureteric smooth muscle relaxation [6].

Our study suggests that the need for ureteral access sheaths to overcome resistance at the orifice level was significantly higher with d-fURS ($p = 0.00174$).

Ureteral access sheaths were first introduced in the early 1970s [7] and have undergone significant evolution since [8], making them an invaluable tool for the endourologist. Recommendations as to when to use access sheaths vary. Some authors recommend routine use [9, 10], others recommend them in difficult cases only [11].

Potentially, they may contribute to a better stone-free rate, reduce operating time [12] and protect against elevated intrarenal pressure with pyelovenous and pyelolymphatic backflow [13]. However, a risk of ureteric ischemia after long procedures and ureteric injury during sheath insertion with potential later stricture formation has been postulated. However, several studies have proven the safety of these devices [9, 14]. We experienced two ureteric perforations with access sheath, which however were dealt with in a simple and lasting way. There were no strictures on follow-up.

The postoperative ureteric stenting rate was higher after d-fURS (45%) than after a-fURS (39%). This was not statistically significant and there was no correlation between use of an access sheath and consecutive insertion of a JJ stent. This may be as a result of shorter operating time due to improved image quality in the digital ureteroscopy group but may also reflect the relatively small sample size in our study. This issue needs larger size studies to evaluate further.

Conclusion

A statistically significant increase in sheath use simply to gain access to the ureter was observed when using the new-generation digital flexible ureteroscope with an increase in the tip diameter of 1.95 Fr (8.7 vs. 6.75 Fr) for the digital scope. The tip of the digital scope houses the 'chip-on-the-tip technology', hence the larger size of the tip diameter. This fact should of course apply to the fibre-optic and digital versions of other types of flexible ureteroscopes on the market. Despite the obvious improvement in the images obtained resulting in likely better stone clearance rates and their likely better durability, the increased use of ureteric access sheaths may increase morbidity and expense. There is also a potential for increased rates of postoperative double-J stenting with its inherent morbidity, although this was not significant in our study. Clinicians need to be aware of these drawbacks.

Disclosure Statement

The authors have no conflicts of interest to disclose.

References

- 1 Andonian S, Okeke Z, Smith AD: Digital ureteroscopy: the next step. *J Endourol* 2008; 22:603–606.
- 2 Papatsoris A, Kachrilas S, El Howairis M, Masood J, Buchholz N: Novel technologies in flexible ureterorenoscopy. *Arab J Urol* 2011; 9:41–46.
- 3 Binbay M, Yuruk E, Akman T, et al: Is there a difference in outcomes between digital and fiberoptic flexible ureterorenoscopy procedures? *J Endourol* 2010;24:1929–1934.
- 4 D'Addessi A, Bassi P: Ureterorenoscopy: avoiding and managing complications. *Urol Int* 2011;87:251–259.
- 5 Paffen ML, Keizer JG, de Winter GV, Arends AJ, Hendrikx AJ: A comparison of the physical properties of four new-generation flexible ureteroscopes: (de)flexion, flow properties, torsion stiffness, and optical characteristics. *J Endourol* 2008;22:2227–2234.
- 6 Wanajo I, Tomiyami Y, Tadachi M, Kobayashi M, Yamazaki Y, Kojima M, Shibata N: The potency of KUL-7211, a selective ureteral relaxant, in isolated canine ureter: comparison with various spasmolytics. *Urol Res* 2005;33:409–414.
- 7 Takayasu H, Aso Y: Recent development for pyeloureteroscopy: guide tube method for its introduction into the ureter. *J Urol* 1974;112: 176–178.
- 8 Monga M, Bhayani S, Landman J, Conradie M, Sundaram CP, Clayman RV: Ureteral access for upper urinary tract disease: the access sheath. *J Endourol* 2001;15:831–834.
- 9 Delvecchio FC, Auge BK, Brizuela RM, et al: Assessment of stricture formation with the ureteral access sheath. *Urology* 2003;61:518–522.
- 10 Kourambas J, Byrne RR, Preminger GM: Does a ureteral access sheath facilitate ureteroscopy? *J Urol* 2001;165:789–793.
- 11 Abrahams HM, Stoller ML: The argument against the routine use of ureteral access sheaths. *Urol Clin North Am* 2004;31:83–87.
- 12 L'esperance JO, Ekeruo WO, Scales CDJ, et al: Effect of ureteral access sheath on stone-free rates in patients undergoing ureteroscopic management of renal calculi. *Urology* 2005;66:252–255.
- 13 Auge BK, Pietrow PK, Lallas CD, Raj GV, Santa-Cruz RW, Preminger GM: Ureteral access sheath provides protection against elevated renal pressures during routine flexible ureteroscopic stone manipulation. *J Endourol* 2004;18:33–36.
- 14 Vanlangendonck R, Landman J: Ureteral access strategies: pro-access sheath. *Urol Clin North Am* 2004;31:71–81.