Case Report

First use and evaluation of a novel 6.3 Fr disposable flexible ureteroscope for stone management in duplex kidney: a case report

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Background: Flexible ureteroscopy (FURS) is increasingly used as the first-line treatment for urological procedures. Disposable digital (dd-)FURS has been developed to overcome limitations such as durability, degradation, and repair cost of reusable scopes. The diameter of commercially-available models ranges from 7.5–9.9 Fr. This study aimed to report the first clinical application of a novel 6.3 Fr HU30M HugeMed dd-FURS.

Case Description: We present the case of a 61-year-old female diagnosed with a left ureteric (8 mm × 7 mm) and two renal stones (6 mm × 5 mm and 5 mm × 3 mm) located at both moieties of her duplex kidney. She was opted for elective flexible ureteroscopic lithotripsy. The 6.3 Fr dd-FURS was preferred to overcome the challenging anatomy. No intra-/peri-operative complication was observed and the patient made an uneventful recovery. Complete stone clearance was achieved based on 2-week follow-up computed tomography (CT).

Conclusions: The application of the 6.3 Fr dd-FURS demonstrated its feasibility, safety, and efficacy in stone retrieval. However, a thin device has its limitations, including its stiffness and working space area. Adaptation to the device during procedures or further improvements may be necessitated. Yet, this scope has potential in the management of pediatric urology procedures and complex upper urinary tracts.

Keywords: Digital flexible ureteroscope; disposable; single-use; flexible ureteroscopy (FURS); case report

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Introduction

Flexible ureteroscopy (FURS) is considered the gold standard for treating urolithiasis (1). Disposable digital (dd-) FURS has gradually replaced reusable ureteroscopes as they eliminate problems such as maintenance cost, sterilization, and reprocessing, while imposing comparable results in technical specificities including deflection, optic resolution, and irrigation flow (2).

Urolithiasis is an increasingly common condition (3). While the European Association for Urology (EAU) guidelines for urolithiasis mentions management for anatomical variants of the upper urinary tract, no clear recommendation is available for patients with duplex kidney (1,4).

Duplex kidney is one of the most common congenital renal abnormalities with a 0.8% incidence (5). A complete duplex system is often unilateral and results in two collecting systems draining via two independent ureters into the bladder, which may lead to complications such

as vesicoureteric reflux and pelvic-ureteric junction obstruction (6). Patients may remain asymptomatic. Detection of the malformation is often incidental and prone to being misdiagnosed as a renal mass (7). In case of urolithiasis, FURS with holmium laser lithotripsy is reported safe and feasible (8).

In this study, we report a successful case of dd-flexible ureteroscopic lithotripsy for complete duplex kidney with concomitant ureteric and renal lithiasis using a novel 6.3 Fr scope. We further evaluate its strengths and weaknesses for stone retrieval procedures. We present this article in accordance with the CARE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-24-315/rc).

Case presentation

A 61-year-old female was diagnosed with a left ureteric stone at a local hospital and referred to our tertiary institute (The University of Hong Kong – Shenzhen Hospital) after failed medical therapy. She had persistent left flank pain for more than a week accompanied with hematuria and a sense of abdominal distention. She was neither febrile nor experienced any lower urinary tract syndrome. Physical examination found left costovertebral tenderness. Biochemical results showed hypertriglyceridemia (1.81 mmol/L; normal range <1.70 mmol/L), elevated parathyroid hormone levels (275.8 pg/mL; normal range, 12–88 pg/mL), normal renal function and inflammatory markers. She had no underlying chronic illness. Past surgical records included the resection of a benign thyroid neoplasm, left adrenal gland, bladder cyst, and stone. Computed tomography (CT) identified duplication of the left kidney, with a proximal ureteric stone [8 mm × 7 mm; 795 Hounsfield units (HU)] and mild lower moiety hydronephrosis with suspected ureteritis, an upper moiety stone at the middle calyx (6 mm × 5 mm; 780 HU) and inferior calyx (5 mm × 3 mm; 692 HU) (*Figure 1*). She was admitted for elective flexible ureteroscopic lithotripsy.

Under general anesthesia, she was placed in lithotomy position. A rigid 6/7.5 Fr ureteroscope was directly inserted, which revealed a normal bladder and two left ureter orifices. The 0.035" guidewire (150 cm; NiCore® Nitinol, Bard Inc., Marietta, GA, USA) was first introduced to the ureter connected to the lower moiety. Once the proximal ureteric stone was identified, it was gently pushed into the renal cavity. A 10/12 Fr tip-flexible ureteral access sheath (TF-UAS; Shenzhen Kangyibo Technology Development Co., Ltd., Shenzhen, China). Under ureteroscope guidance, the TF-UAS reached the renal cavity to identify the stone, which was pulverized by holmium laser lithotripsy (Lumenis Pulse™ 100H Holmium Laser System, Boston Scientific, Santa Clara, CA, USA). The TF-UAS was attached to the suction bottle connected to a continuous suction regulator maintained at a negative pressure of 100–150 mmHg. Stone fragments were aspirated until no visible residual stone remained. A 5 Fr Marflow ureteric stent (APR Medtech Ltd., Oxfordshire, UK) was retained and the guidewire was withdrawn.

The upper moiety stones were identified and fragmented in the same manner. Stone fragments in the middle calyx were aspired while those in the inferior calyx had to be retrieved with a stone basket (Cook Medical, Bloomington, IN, USA). The operation concluded after another 5 Fr ureteric stent and a 16 Fr Foley catheter was retained. The total operative time was 58 minutes and the total blood loss was insignificant.

The patient made an uneventful recovery. The Foley catheter was removed on day-1 post-operation and discharged on the next day. At 2 weeks follow-up, CT confirmed complete stone clearance and both the left ureteric stents were removed without complication (*Figure 2*).

All procedures performed in this study were in accordance with the ethical standards of the University of Hong Kong – Shenzhen Hospital ethics committee and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for

Highlight box

Key findings

- Flexible ureteroscopic lithotripsy with a 6.3 Fr disposable scope is a safe and feasible option for management of stones in duplex kidney.

What is known and what is new?

- Stone management in patients with urolithiasis and underlying collecting system anatomic anomaly is challenging and there is no guideline available regarding the matter.
- The 6.3 Fr disposable scope, currently one with the smallest diameter, allowed smooth navigation and laser lithotripsy management of stones in a patient with duplex kidney.

What is the implication, and what should change now?

- Disposable digital flexible ureteroscopes with a small diameter may increase convenience for the management of stones located in a hostile ureter anatomy (e.g., stenosis or tortuosity) and endoscopic procedures for pediatric urology.

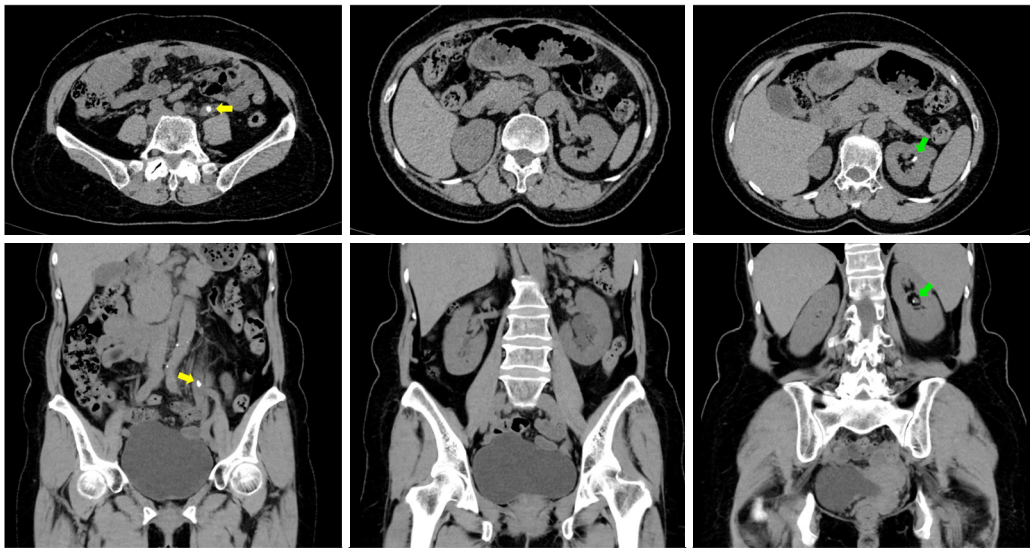

Figure 1 Preoperative computed tomography of the patient revealing a left duplex kidney with upper ureteric stone (yellow arrows) and renal stones (green arrows).

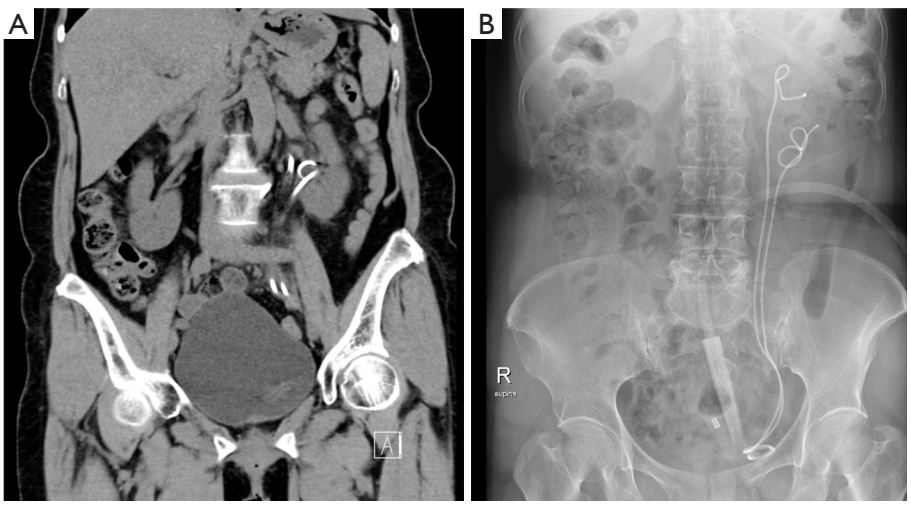

Figure 2 Postoperative follow-up (A) computed tomography image showing no residual stone and (B) X-ray showing intact double-J stents placed in the duplicated ureters.

publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

This report documents the successful stone removal in a patient with duplex kidney complicated with a ureteric and renal stones using a novel 6.3 Fr dd-FURS, which is the thinnest model commercially-available to date. For its design, the scope measures 920 mm in length and the operable segment takes up 225 mm. The shaft diameter is constantly 6.3 Fr and has a 3.0 Fr working channel. The scope also has a 270° bidirectional deflection angle (*Figure 3*). Generally, the scope offers technical features comparable to that of conventional scopes, including visualization and manipulation (*Figure 4*) (9). Although the thin diameter makes it a possibly promising endoscopic

Figure 3 Clear intraoperative image visualized with the 6.3 Fr disposable digital flexible ureteroscope.

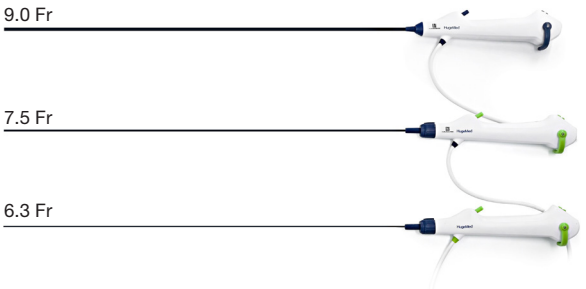

Figure 4 Comparison of different HugeMed disposable digital flexible ureteroscopes with tip diameters 9.0, 7.5, and 6.3 Fr (from top to bottom). Grip handles and ports are of similar design.

tool for the pediatric population and patients with complex upper urinary tract anatomy, certain limitations of the device ought to be discussed.

Firstly, the working channel of the 6.3 Fr scope is tapered down to 3.0 Fr and much narrower than the standard 3.6 Fr. In this case, a stone retrieval basket was required due to the difficult angle when accessing the inferior calyx of the upper moiety. The basket was 2.4 Fr, which took up approximately 14.5% of the cross-sectional area of the working channel and reduced irrigation flow speed. Without it, drainage of the irrigation fluid remained adequate. Other than minimizing the need for stone baskets, another plausible solution may be the application of small diameter baskets (i.e., 1.5 Fr) that demonstrated satisfactory perforation and radial dilation force, opening dynamics, and deflection resistance (10). However, the combination of a 6.3 Fr scope and small diameter baskets will require further research and comparison before elucidating its feasibility and efficiency. Similarly, thulium fiber laser may be more suitable given its smaller diameter compared to traditional holmium lasers (11). The better dusting technique also promoted smaller stone fragments that could be naturally eliminated and possibly obliterate the use of stone baskets (12).

Secondly, a smaller shaft diameter makes the scope lighter, less stiff, and less resistant to bending even when the same materials are used. Therefore, while the scope is able to pass through narrower lumens and minimize ureteral injury, the influence of a 6.3 Fr scope in controlling the flexible tip of the UAS is weaker than the conventional 7.5 Fr scope. This was a reason for the need to use a stone basket instead of proceeding with stone aspiration for the aforementioned renal stone. However, the overall process of stone retrieval was smooth and carried out within a reasonable amount of time.

The duplex kidney has a variety of anatomic phenotypes and can lead to complications including pelvicalyceal dilatation, cortical scarring, vesicoureteral reflux, hydronephrosis, and ureteroceles (13). Radiographic

Table 1 Summary of irrigation flow rate at different settings of the vacuum suctioning system during 6.3 Fr digital flexible ureteroscopic lithotripsy with tip-flexible ureteral access sheath*

Phase	Procedure	FR setting, L/min	Pressure setting, mmHg	Actual FR, mL/min
Fragmentation	–	0.3	30	56
	SlimLine SIS 200 μm reusable laser fiber[a]	0.3	30	24
	1.8 Fr Well Lead Stone Retrieval Basket[b]	0.3	30	10
	2.2 Fr Cook Stone Retrieval Basket[c]	0.3	30	5
	0.032" Zebra guide wire[d]	0.3	30	2
Suction	–	0.6	30	56
	SlimLine SIS 200 μm reusable laser fiber	0.6	30	24
	1.8 Fr Well Lead Stone Retrieval Basket	0.6	30	10
	2.2 Fr Cook Stone Retrieval Basket	0.6	30	6
	0.032" Zebra guide wire	0.6	30	3

*, results in this table were from a simulation study and not in the case of this patient. [a], manufactured by Boston Scientific, Santa Clara, CA, USA; [b], manufactured by Well Lead Medical Co., Ltd., Guangzhou, China; [c], manufactured by Cook Medical, Bloomington, IN, USA; [d], manufactured by Shenzhen Kangyibo Technology Development Co., Ltd., Shenzhen, China. FR, flow rate; SIS, Smart Identification System.

diagnosis of a duplex kidney can be easily missed or misdiagnosed due to limitations in relaying a complete diagnostic feature (14). There is no study comparing the mean ureter diameter between duplex kidney and normal anatomy. However, stenosis and tortuosity can be anticipated. The management of urolithiasis in patients with duplex kidney is not clearly detailed in the EAU guideline for urolithiasis nor under pediatric urology. Retrograde intrarenal surgery is gradually preferred over percutaneous nephrolithotomy due to its less invasiveness (15). FURS with holmium laser lithotripsy was a safe and feasible option (8). Therefore, a 6.3 Fr scope would be a promising option for the management of urolithiasis in children without or without duplex kidney given that the average widest internal ureteral diameter is 3.8 mm (16).

The 10/12 Fr TF-UAS was preferred over a larger UAS (e.g., 12/14 Fr). Other than preventing ureteral injury, the TF-UAS and 6.3 Fr ureteroscope combination resulted in a 0.63 ureteroscope-sheath diameter ratio, which met the recommended value of ≤0.75 to maintain a safe intrarenal pelvic pressure (17). Additionally, a low intrarenal pressure could enable a larger irrigation flow and higher irrigation pressure, which facilitated with stone fragment aspiration and clearing surgical vision (18). In *Table 1*, the irrigation flow was tested at settings with different procedures in a simulation and results were generally satisfactory to facilitate stone clearance.

The combination of a 6.3 Fr dd-FURS with suitable smaller-diameter adjuncts is a feasible endoscopic solution for stones associated with complex ureter anatomy. The immediate and short-term outcomes for this patient were favorable. However, this solitary case report may overestimate the benefits of the device and procedure. In order to fully elucidate the safety and efficacy of the 6.3 Fr scope and other devices, adaptation to the device and technique, further research within larger urolithiasis patient sample including children and adults ought to be conducted.

Conclusions

The novel 6.3 Fr dd flexible ureteroscope is the thinnest known scope that is commercially-available. This case documents its first application for stone retrieval in a patient with duplex kidney and has demonstrated both safety and feasibility as complete stone clearance was achieved with no postoperative complication. However, a thinner device has less strength and working space, which may require improvement in designs or adaptation along with other instruments. Larger cohorts and comparison studies are necessary to fully elucidates its performance.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-24-315/rc

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-24-315/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-24-315/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the University of Hong Kong – Shenzhen Hospital ethics committee and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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