Ultrasound-Guided Ureteral Stent Removal in Women

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Objectives—The purpose of this study was to develop a fast, comfortable, and safe method of ureteral stent removal in women.

Methods—From February 2014 to July 2015, a retrospective multicenter controlled study including 82 female outpatients was conducted. The control group was composed of 46 patients who underwent stent removal using a 22F cystoscope. The experimental group was composed of 36 patients who underwent stent removal under ultrasound guidance with a 15F spiral-ending device. Exclusion criteria were pelvic organ prolapse quantification stage II or higher and complicated stents (with migration or encrustation).

Results—All studied patients had successful ureteral stent removal. No complications were seen in both groups. Differences between mean visual analog pain scale scores and stent removal durations were statistically significant in favor of the experimental group ($P = .0077$ and .0075, respectively).

Conclusions—The proposed method for ureteral stent removal in women under ultrasound guidance was shown to be faster and to have lower visual analog pain scale scores, in comparison with removal by a cystoscope, which makes it an attractive option for outpatient urologic praxis in uncomplicated cases, and because it is free of the risk of ionizing radiation and more comfortable, it can be used in pregnant patients.

Key Words—device; genitourinary ultrasound; removal; ultrasound; ureteral stent

After the introduction of ureteral stents into routine clinical practice in 1967 by Zimskind et al[1] and later in 1978 by Finney,[2] they rapidly became the mainstay for management of ureteral obstruction. Nevertheless, if not removed or exchanged in a timely manner, ureteral stents are associated with complications, such as infection and encrustation,[3] for which the incidence of encrustation increases with the duration that the stent remains indwelling.[4,5] The classic way of either rigid or flexible endoscopic ureteral stent removal has been described elsewhere[6,7] and is associated with the necessity of an additional grasping device, expenditures for cystoscope sterilization, and discomfort due to cystoscope insertion. Several attempts to eliminate cystoscopic guidance have been made, but almost all of them needed fluoroscopic control, which is not without detrimental stochastic effects,[8] or were complicated, which hindered their wide application. Our aim was to develop an effective, fast, safe, and comfortable method for ureteral stent removal in women that does not require either endoscopic or fluoroscopic guidance.

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Abbreviations
VAPS, visual analog pain scale

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Materials and Methods

This study was designed as a retrospective multicenter controlled study. After local Ethical Committee approval and obtainment of informed consent, 82 consecutive female outpatients from February 2014 to July 2015 were included in the study. Stents to remove were 4.7F to 6.0F (Cook Medical, Bloomington, IN; and Urotech, GmbH, Rohrdorf, Germany). Indications for stenting are shown in Table 1. Exclusion criteria were: the presence of pelvic organ prolapse (pelvic organ prolapse quantification stage ≥II) and migrated or encrusted stents. All patients received single-dose antibacterial prophylaxis according to a local antibiogram. The control group, composed of 46 female outpatients, underwent stent removal in a classic way under endoscopic guidance via a 22F cystoscope and grasping forceps. The experimental group, composed of 36 female outpatients, underwent stent removal by means of a 15F retrieval spiral-ending device, which was hand made from a medical steel rod of 1 mm in thickness that was sterilizable by autoclaving. The prototype of our device was developed and described in detail by Alvarez-Vijande.[9]

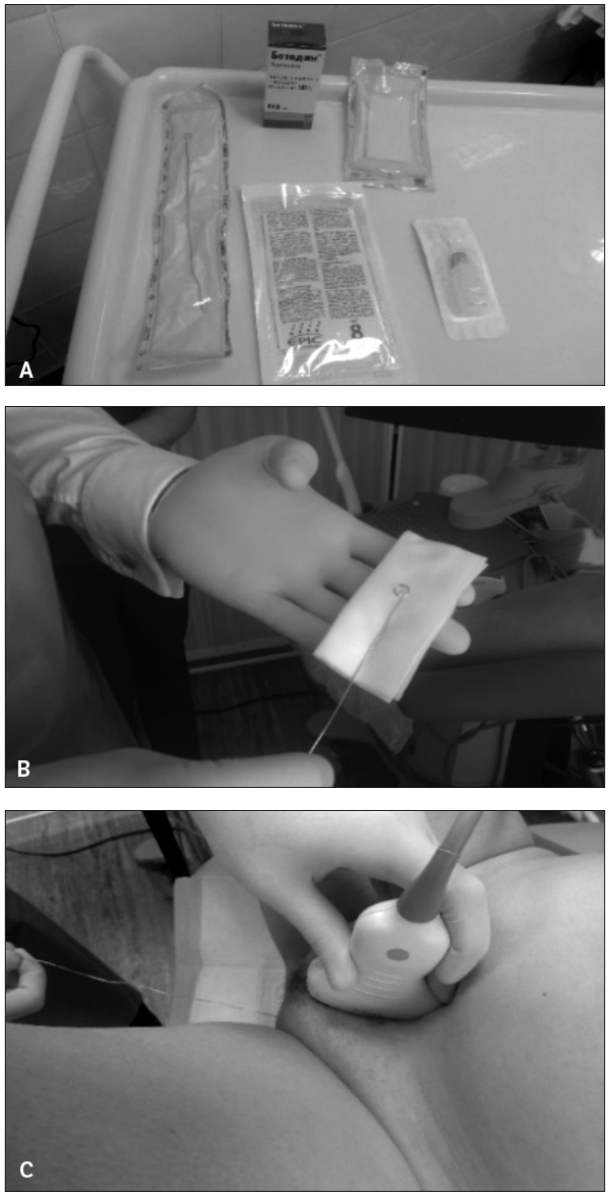
Ultrasound guidance was performed with an Acuson x150 ultrasound system equipped with a 3.5–5.0-MHz convex probe (Siemens Medical Solutions, Mountain View, CA). The patient was seated on a chair after at least 1.5 hours from the last urination, considering that the normal urine output rate is 1 mL/kg/h to have at least 90 to 100 mL in the bladder. With the patient in the lithotomy position, the retrieval device was inserted into the bladder after adequate lubrication with 2% lidocaine gel. The ultrasound transducer was placed in the midline of the suprapubic area in the sagittal plane. The spiral end of the retrieval device and the bladder end of the double-J stent should be seen in a line on the ultrasound monitor. With capturing movement from upward to downward and slight back traction, the stent was engaged in the spiral ending and drawn out by simple pulling. Equipment and main steps of the procedure are depicted in Figure 1. Schematic views of the procedure are depicted in Figure 2.

Table 1. Indications for Stenting

Indication	n
Retrograde intrarenal surgery	16
Prestenting before retrograde intrarenal surgery	23
Dismembered pyeloplasty	14
Percutaneous nephrolithotomy	17
Hydronephrosis	12

All statistical estimates (mean values and their difference) were presented with 95% lower and upper confidence limits.[10] Due to the discreetness of visual analog pain scale (VAPS) scores, they were analyzed in a contingency table using the Freeman-Halton extension of the Fisher

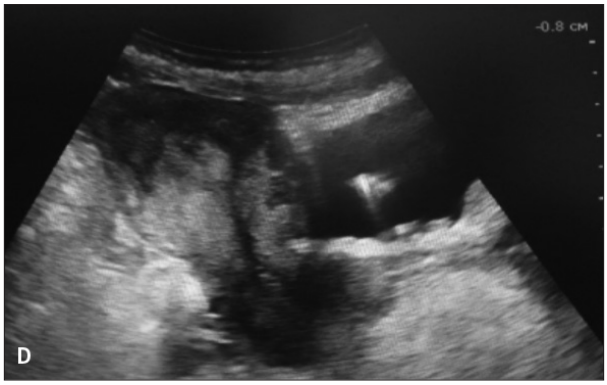
Figure 1. Equipment and main steps of ultrasound-guided stent removal. **A**, Spiral device, povidone-iodine, lidocaine gel, and gloves. **B**, Spiral device. **C**, Device in the bladder. **D** (opposite page), Sonogram showing the device and stent in a line. **E**, Stent withdrawal. **F**, Stent in the spiral.

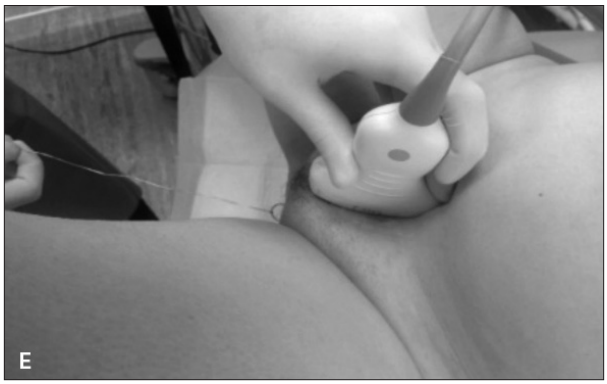


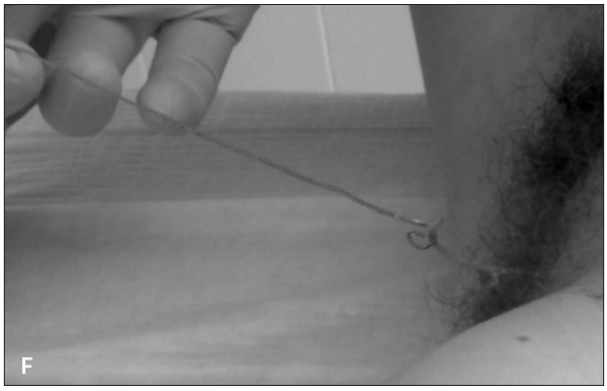
exact test. Bootstrap resampling and Monte Carlo permutations that were applied for calculations were performed with the Paleontological Statistics version 3.09 software package.[11] $P < .05$ was considered significant.

Results

A total of 82 female patients (82 ureteral stents) underwent stent removal. The demographics, clinical characteristics, and results for the study groups are shown in Table 2. All stent removals were successful. Differences between mean VAPS scores and stent removal durations were statistically significant in favor of the experimental group. No complications, such as gross hematuria and lower urinary tract infection symptoms, were seen in both groups.







Discussion

After the first ureteral stent introduction, different techniques for ureteral stent removal in women in addition to the classic cystoscopic way have been reported. Among them, several are worth mentioning: stent removal with a spiral-ending retrieval device under fluoroscopic guidance[9]; the crochet hook technique, which needs neither endoscopic nor fluoroscopic guidance but has moderate efficacy of 83.9% and is blind in nature[12]; the lasso ureteral stent removal technique under fluoroscopic guidance, which requires practice and special skills[13]; and a magnetic tip catheter, initially described by Macaluso et al[14] in 1989, which can be used in women without cystoscopic or x-ray guidance,[15] but expenditures for magnetic tip stents are a matter of consideration. Due to the unpredictability of stent degradation, bioabsorbable stents[16] unfortunately did not gain widespread popularity.[17] Dangling sutures[18] are attractive options, but because of the high rate of incidental stent expulsion, they cannot be used with a great deal of confidence. A special stent with a removal catheter that is designed for easy and safe stent removal seems quite attractive[19] but still too complicated and expensive.

In our study, all ureteral stents were removed successfully, whereas the efficacy of cystoscopic stent removal in a study conducted by Kawahara et al[12] was only 90%. This difference presumably can be explained by exclusion of complicated cases, such as migrated or encrusted stents, in our study.

The proposed method of stent removal under ultrasound guidance is easy to learn and perform, although we did not collect difficulty scores for the procedure. It requires no special skills and was successfully performed by 2 different urologists, with relatively similar competent levels of experience in endourology but without special training in ultrasound, indicating the simplicity of the procedure. The average time for stent removal via the retrieval device was 20 seconds, in which the start point was inser-

tion of the instrument (be it the cystoscope or spiral retrieval device) into the urethra, and the end point was stent appearance at the urethral meatus. Equipment required for the procedure includes the 15F spiral retrieval device and an ultrasound machine with a regular convex transducer, which is present almost in every urologic facility. In our study, all cases were successful with no need for additional procedures, such as cystoscopic or fluoroscopic assistance. Moreover, the VAPS scores in our study were much the same, as stated in the existing literature.[12]

Nevertheless, our study was not without limitations. It was a retrospective study, had no randomized control, and had no complicated cases, such as patients with pelvic organ prolapse, and there were no patients with migrated or encrusted stents, which could have spoiled the results. Further studies are needed to confirm the efficacy of this method.

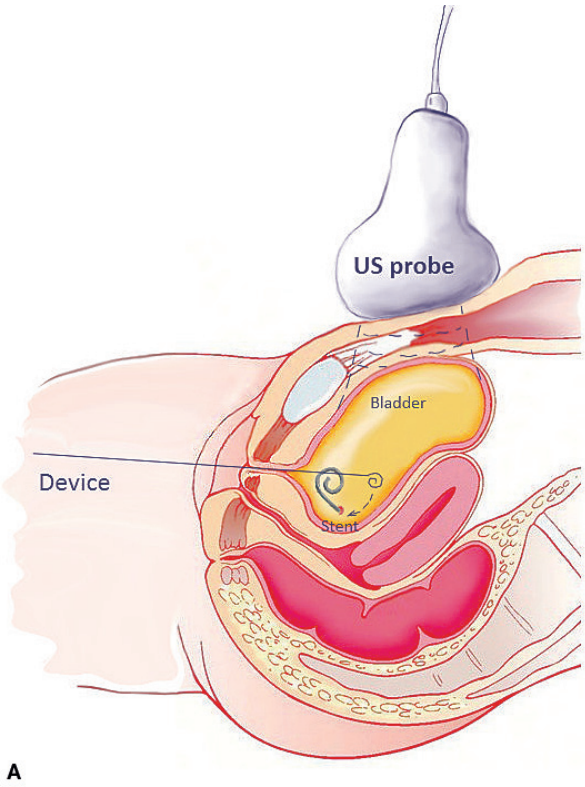


Figure 2. Schematic views of the procedure. **A**, Insertion of the retrieval device into the bladder. **B**, Capturing movement from upward to downward with slight back traction. **C**, Stent engaged in the spiral ending and drawn out by simple pulling. US indicates ultrasound.

Table 2. Demographic Characteristics and Results for the Study Groups

Characteristic	Control Group (n = 46)	Experimental Group (n = 36)	Difference	*P*
Age, y	43 (39, 48)	47 (43, 51)	3.8 (–2.5, 10.1)	.27
Stents, n	46	36	10	.28
Body mass index, kg/m^2	26 (25, 27)	27 (26, 29)	1.3 (–0.5, 3.1)	.16
Laterality, n				
Right	29	23	6	
Left	17	13	6	.94
Duration of stent removal, s	26 (22, 29)	20 (17, 29)	5.9 (1.6, 10.1)	.0075
Sessions, n	1	1	0	NA
Complications, n				
Lower urinary tract infection	0	0	0	NA
Gross hematuria	0	0	0	NA
VAPS score	2.3 (2.0, 2.6)	1.6 (1.4, 1.8)	0.7 (0.4, 1.1)	.0077

Data are presented as mean (95% confidence interval) where applicable. NA indicates not applicable.

Thus, the proposed method of ultrasound-guided ureteral stent removal in women was shown to be effective, fast, and free of ionizing radiation exposure, with low VAPS scores, which were probably due to diameter differences between the studied 15F retrieval device and the rigid 22F cystoscope, making it an attractive option for outpatient urologic praxis.

References

1. Zimskind PD, Fetter TR, Wilkerson JL. Clinical use of long-term indwelling silicone rubber ureteral splints inserted cystoscopically. *J Urol* 1967; 97:840–844.
2. Finney RP. Experience with new double J ureteral catheter stent, 1978. *J Urol* 2002; 167:1135–1139.
3. Chew BH, Knudsen BE, Denstedt JD. The use of stents in contemporary urology. *Curr Opin Urol* 2004; 14:111–115.
4. Borboroglu PG, Kane CJ. Current management of severely encrusted ureteral stents with a large associated stone burden. *J Urol* 2000; 164:648–650.
5. Kawahara T, Ito H, Terao H, Yoshida M, Matsuzaki J. Ureteral stent encrustation, incrustation, and coloring: morbidity related to indwelling times. *J Endourol* 2012; 26:178–182.
6. Smith AD. Retrieval of ureteral stents. *Urol Clin North Am* 1982; 9:109–112.
7. Evans JWH, Ralph DJ. Removal of ureteric stents with a flexible cystoscope. *Br J Urol* 1991; 67:109.
8. Leenhouts HP, Chadwick KH. The molecular basis of stochastic and nonstochastic effects. *Health Phys* 1989; 57(suppl 1):343–348.
9. Alvarez-Vijande R. Removal of ureteric stents in women without cystoscope. *Br J Urol* 1993; 72:388–389.
10. Louis TA, Zeger SL. Effective communication of standard errors and confidence intervals. *Biostatistics* 2009; 10:1–2.
11. Hammer Ø, Harper DAT, Ryan PD. Paleontological Statistics software package for education and data analysis. *Paleontol Electron* 2001; 4:9–18.
12. Kawahara T, Ito H, Terao H, et al. Ureteral stent retrieval using the crochet hook technique in females. *PLoS One* 2012; 7:e29292.
13. Park SW, Cha IH, Hong SJ, et al. Fluoroscopy-guided transurethral removal and exchange of ureteral stents in female patients: technical notes. *J Vasc Interv Radiol* 2007; 18:251–256.
14. Macaluso JN Jr, Deutsch JS, Goodman JR, Appell RA, Prats LJ Jr, Wahl P. The use of the Magnetip double-J ureteral stent in urological practice. *J Urol* 1989; 142:701–703.
15. Taylor WN, McDougall IT. Minimally invasive ureteral stent retrieval. *J Urol* 2002; 168:2020–2023.
16. Olweny EO, Landman J, Andreoni C, et al. Evaluation of the use of a biodegradable ureteral stent after retrograde endopyelotomy in a porcine model. *J Urol* 2002; 167:2198–2202.
17. Lange D, Chew B, Elwood C. Biomaterials in urology—beyond drug eluting and degradable: a rational approach to ureteral stent design. Intech website; 2011. http://www.intechopen.com/source/pdfs/22937/InTech-Biomaterials_in_urology_beyond_drug_eluting_and_degradable_a_rational_approach_to_ureteral_stent_design.pdf.
18. Siegel A, Altadonna V, Ellis D, Hulbert W, Elder J, Duckett J. Simplified method of indwelling ureteral stent removal. *Urology* 1986; 28:429.
19. Wang J, Feng J, Hu W, et al. Preclinical evaluation of a newly designed ureteral stent and magnetic retrieval catheter for minimally invasive stent removal. *Urology* 2014; 84:960–966.