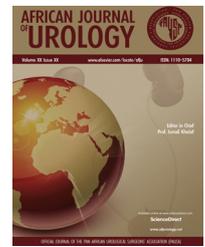




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Original article

Forgotten ureteral stents: Risk factors, complications and management



A.Y. Abdelaziz^{a,*}, W.B. Fouda^b, A.A. Mosharafa^a,
M.A. Abelrasoul^a, A. Fayyad^a, K. Fawzi^a

^a Urology department, Faculty of Medicine, Cairo University, 11562, Egypt

^b Urology department, Electricity Hospital, Egypt

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KEYWORDS

Ureteral stents;
Infection;
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Abstract

Objectives: To assess complications of neglected stents, risk factors for the occurrence of complications, and management options and outcomes.

Subjects and methods: A prospective study including patients presenting to our center with neglected polyurethane ureteral stents (indwelling for more than 6 months in the period from February 2012 to September 2015). We noted the complications of neglected stents (urinary tract infections (UTI), urinary obstruction, elevated creatinine, encrustations and stent fragmentation), management challenges (need for complex endo-urologic or open procedures). We evaluated potential risk factors for these complications (duration of stenting, lack of urinary acidification, cause of stent placement).

Results: The study included 68 patients with mean age 49.3 ± 12.6 years 80.9% were males. Mean stenting duration 17.3 ± 12.7 months. A total of 29% of patients received urine acidifier while the stent was indwelling, 92% were stone formers, 60% presented with UTI and 25% presented with elevated creatinine. Preoperative non-contrast spiral CT abdomen and pelvis showed encrustations on the stent in 23.5% of patients and fragmented stent in 13%. The stent was removed by cystoscopy only as an outpatient procedure in 26 (38.3%) cases (7 of them with encrustation) while 42 (61.7%) cases needed more than simple cystoscopy. Management challenges included need for complex endourological interventions (URS, PCNL, cystolithotripsy or even open surgery). Lack of urinary acidification was a significant risk factor for UTI and stent fragmentation (P-value = 0.038 and 0.006, respectively). Stone former patients needed complex interventions (P = 0.046). UTIs were more likely with longer duration of stenting (P = 0.027).

Conclusion: Forgotten ureteral stents are associated with significant complications. Urinary acidification is protective against complications. Patients with stones are more liable to forgotten stents complications.

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* Corresponding author.

E-mail address: dr_ahmedyehia81@yahoo.com (A.Y. Abdelaziz).

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Introduction

Ureteral stents are hollow tubes which drain the kidneys into the urinary bladder through the ureteric lumen. They were first described in 1967 and since that time there were many advances in the ureteric stent design regarding the material, shape and coating [1].

Ureteral stent placement is important to many urologic procedures such as extracorporeal shock wave lithotripsy (SWL) and ureteroscopy [2]. Ureteral stents may also be useful for many conditions such as hydronephrosis due to stone disease, pregnancy and a malignant neoplasm [3]. The indications for stent insertion have increased during the last years and ureteral stents are inserted as an almost routine procedure in patients with ureteric obstruction. Thus the complications of stents become also more frequent than before [4].

Despite their advantages, ureteral stents are not without possible morbidity. Many patients complain of symptoms related to stent placement; stents may cause complications, and certain management issues may arise from their use. Forgotten ureteral stents can cause a spectrum of complications ranging from hematuria, stent occlusion, migration, fragmentation, encrustation, and stone formation to serious complications like recurrent urinary tract infection (UTI), urinary tract obstruction, and renal failure [5,6]. Even fistula formation to the iliac arteries is known [7]. Mortality has also been reported [8].

The removal of ureteric stents is one of the most simple endourologic maneuvers, yet the removal of the neglected ureteric stent may be one of the most complicated endourological maneuvers as the loss of its tensile character due to neglect may lead to its breakage and fragmentation.

In this study, we evaluate the outcome of neglected ureteric stents and their complications, with a focus on the risk factors for these complications, and management options.

Subjects and methods

This was a prospective, cohort observational study conducted at the department of urology, Cairo University. Sixty eight patients were included in the period from February 2012 to September 2015. All the patients presenting to the urology outpatient clinic with polyurethane ureteral stents for more than six months, above the age of eighteen years, irrespective to the gender were included in the study. The patients with a ureteral stent in situ for a prolonged period with regular change every 6 months or with non-polyurethane ureteral stents were excluded from the study. The study was performed in compliance with the ethics principles of the 1975 Declaration of Helsinki. A written informed consent was obtained from all patients. The study protocol, as well as the suggested informed consent, were approved by the Institutional Review Board (IRB) before the start of enrolling participants.

The patients were evaluated preoperatively using a pre-designed sheet including history of previous stone formation, indications for initial stent placement, duration of stent in urinary system, the presenting complaints, the use of urine acidifier along the duration of the stent. Preoperative baseline investigations as complete blood count,

coagulation profile, kidney and liver function tests, urine analysis and culture were done. The midstream of urine was collected in all cases for urine culture. All patients were evaluated for stent complications by abdominopelvic ultrasound, plain X-ray, non-contrast spiral CT abdomen and pelvis and/or excretory urography. Treatment decisions were based on clinical and radiological findings. All patients with infected urine were treated preoperatively to have negative urine culture before intervention, and prophylactic antibiotics were given to all cases.

In cases with minimal encrustation on the stent, a gentle attempt was made to remove the stent using a grasping forceps through the cystoscope under fluoroscopic guidance. In cases with marked encrustation or stone burden on the lower coil of the stent only, we started with cystolithotripsy then tried to remove the stent. In cases with marked encrustations along the stent or failed simple traction by the cystoscope, retrograde study was done by a 6 Fr Teflon ureteral dilator then a 0.035-in. straight floppy tipped guide wire was advanced through the dilator into the renal pelvis, under fluoroscopic guidance. The guide wire was kept inside the ureter all through the whole technique. Ureteroscopy was performed by a semi-rigid (9.5 Fr or 12.5 Fr) ureteroscope ("Karl Storz" 43 cm length, angled 6-degree telescope, with 6 Fr central channel) and intracorporeal lithotripsy to the ureteric encrustations or stones using a pneumatic lithotripter or a holmium: YAG laser, then we performed a gentle trial to retrieve the stent using the ureteroscopic forceps. If the stent failed to uncoil, fragmented stent, or in cases with large renal stones around the stent coil, a ureteric catheter was placed adjacent to the stent and the patient was placed in the prone position for percutaneous nephrolithotomy (PCNL) of the upper coil or the renal stone using a rigid 24F nephroscope. The ureteral stent was replaced by another one in selected cases according to patient's situation. Cystolithotomy, ureterolithotomy or pyelolithotomy were required in certain cases with large stone burden.

Plain X-ray was performed to all patients early postoperatively to ensure that they became stent and stone free. Stone or encrustations analysis was done in all cases. After one month all patients were interviewed to confirm the absence of symptoms and exclude new symptoms. Urine analysis and culture, serum creatinine and abdominopelvic ultrasound to exclude hydronephrosis were done after one month.

We studied the effect of different risk factors (stent duration, lake of urine acidification, history of stone formation, and elevated creatinine) on the complications of forgotten ureteral stents (urinary infection, encrustation, stent fragmentation, complicated endoscopic technique and postoperative need of stent replacement).

Statistical analyses were performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY). Continuous variables were tested for normality by the Kolmogorov-Smirnov test. Normally distributed data were presented as means \pm standard deviation. The rates and proportions of discrete variables were determined using the chi-squared test. The median with data range (minimum to maximum) was used for non-normally distributed data. The independent samples Mann-Whitney U test was used for nonparametric groups. The two-sided P value of <0.05 was considered statistically significant.

Table 1 Reasons for ureteral stents fixation.

The reason	SWL	Ureteroscopy	PCNL	Open surgeries
Number (%)	30 (44%)	22 (32%)	2 (3%)	14 (20%)

SWL: Extracorporeal shock wave lithotripsy, PCNL: Percutaneous nephrolithotomy.

Table 2 Different procedures needed for forgotten stents removal.

Procedure	Cystoscopy	URS	PCNL	Cystolitholapaxy	Open surgery
Number	68 (100%)	26 (38.2%)	20 (29.4%)	8 (11.7%)	8 (11.7%)

URS: Ureteroscopy. PCNL: Percutaneous nephrolithotomy.

Table 3 Correlations between the risk factors and the complications (urinary infection, encrustations and fragmentation).

	Cases with infection	P Value	Cases with encrustations	P Value	Number of fragmented stents	P Value
Stent duration		0.027*		0.44		0.186
Lack of urine acidification	34	0.006*	11	0.85	9	0.038*
History of stone formation	36	0.059	15	0.03*	8	0.21
Elevated creatinine	13	0.11	4	1.0	4	0.14

* P Value \leq 0.05 is significant.

Results

A total of 68 patients with forgotten ureteral stents for more than six months were enrolled in the study. Fifty five were males and thirteen females with a male to female ratio of 4.2:1. The age distribution was 21–70 years (mean 49.3 ± 12.6 years) with no patients in the pediatric age group. The duration of indwelling stent ranged from 6 months to as long as 96 months (mean 17.3 ± 12.6 months).

We studied the reasons for primary ureteral stents insertion whether prior to extracorporeal shock wave lithotripsy (SWL), after ureteroscopy, after PCNL, or after open surgery (pyeloplasty, pyelolithotomy and ureter-vesical reimplantation) (Table 1). Sixty three (92%) cases were stone formers. All patients presented with dysuria, 32 (47%) patients presented with recurrent attacks of haematuria on top of dysuria, and two patients presented with recurrent attacks of fever.

Forty one (60%) cases had infected urine with significant pyuria and positive urine culture on presentation. Urine cultures showed growth of *Escherichia coli* in 15 cases, *Klebsiella* in 6 cases, both *E. coli* and *Klebsiella* in 5 cases, *Pseudomonas* in 3 cases, *Pseudomonas* and *Klebsiella* in 4 cases, *Streptococci* in 2 cases, *Candida* in 5 cases and multidrug resistance *Streptococci* (MRSA) in one case. Elevated serum creatinine was found in 17 (25%) cases while 51 (75%) cases had normal serum creatinine. Twenty (29.4%) cases had history of receiving urine acidifier in the form of oral vitamin C while the ureteral stents were indwelling.

Preoperative non-contrast spiral CT abdomen and pelvis or IVP were done for all cases. Imaging showed upper tract obstruction in 36 (53%) patients, fragmented stent in 9 (13%) patients and encrustations on the stent in 16 (23.5%) patients. Four patients had encrustations around the renal pelvic coil only, 3 patients had encrustations around the body of stent only, 7 had encrustations around the bladder coil, one patient had encrustations around the whole stent and one had encrustations around the body and the bladder coil.

The stent was removed by cystoscopy only as an outpatient procedure in 26 (38.3%) cases (7 of them with encrustation) while 42 (61.7%) cases needed more than simple cystoscopy. Management challenges included need for complex endourological interventions (cystolitholapaxy, URS, PCNL, open surgery or multiple maneuvers) to render the cases stone and stent free. Open surgery was performed in 8 cases due to failed endourologic maneuvers or large stone burden and multiple sessions (2–4) to remove the retained stent in 9 (13%) cases. (Table 2).

Different correlations were studied between risk factors (stent duration, lake of urine acidification, history of stone formation, and elevated creatinine) and the complications of forgotten ureteral stents (urinary infection, encrustation, stent fragmentation, complicated endoscopic technique and postoperative need of stent replacement). Tables 3 and 4 show the correlations between risk factors and different complications.

- **Urinary infection** occurred in 41(60%) cases. The presence of infection was significantly associated with a lack of acidification ($p=0.006$) and a longer duration of stent indwelling ($p=0.027$), but there was no significant effect of other risk factors.
- **Stents encrustation** was found in 16 (23.5%). History of stone formation is the only significant risk factor to stent encrustation at the time of stent removal ($p=0.037$).
- **Stents fragmentation** occurred in 9 cases whether the ureteric stents appeared fragmented in pre-operative imaging or they were fragmented during the removal. Stent fragmentation was only significantly associated with the lack of acidification ($p=0.038$).
- **Complicated procedures:** twenty six patients had their stents removed via cystoscopy alone, whereas 42 patients required additional maneuvers. History of stone formation was the only significant risk factor for requiring complicated procedures during stent removal ($p=0.046$).
- **Refixation of new stent** was needed in 12 cases with no significant effect of different risk factors.

Table 4 Correlations between the risk factors and the complications (complicated procedures more than cystoscopy and stent replacement).

	More than cystoscopy	P Value	Stent replacement	P Value
Stent duration		0.172		0.942
Lack of urine acidification	29	0.72	9	0.71
History of stone formation	41	0.046*	12	0.28
Elevated creatinine	11	0.77	4	0.46

* P Value \leq 0.05 is significant.

Discussion

The ureteral stent has become an important part of contemporary urologic practice. It allows urinary drainage from the kidney to the bladder and is considered generally safe and well-tolerated. However there are different complications that may occur with short- or long-term use of the stents [9].

Our study was conducted in the Urology department, Cairo University hospitals in the period from February 2012 to September 2015. The data were collected from 68 patients that presented with polyurethane ureteric stents placed for more than 6 months for various causes.

The presentation of forgotten stent varies. Damiano et al. observed flank pain in 25.3%, irritative bladder symptoms in 18.8%, hematuria in 18.1%, and fever in 12.3%, of the patients [7]. In our study, flank pain was relatively less while irritative bladder symptoms and hematuria were the predominant presentations. Other symptoms such as gross haematuria, loin pain, suprapubic pain, urethral pain were minimal as the patients handled these symptoms for more than 6 months. Also recurrent fever was reported in 2 patients that indicated ascending infection due to blocked stent.

It is believed that the asymptomatic patients are more prone to neglect or to forget their stent and therefore develop serious complications that are time-related, such as encrustation, fragmentation and obstruction [10].

Although some studies reported migration and spontaneous fragmentation is an uncommon complication [11,12]. In our study, stent migration occurred with pre- and intraoperative fragmentation of the stent in 9 cases and was significantly associated with the lack of urine acidification. This may be due to the effect of urine acidification on the stent tensile action and it needs to be studied furthermore.

Our study showed that out of 68 patients 16 patients presented with encrustations around the ureteral stents on imaging. The severely encrusted stent is a challenge, requiring a multimodal endourological approach. The treatment was tailored according to the site and size of stone burden. We used maximum diameter of the encrustation on non-contrast spiral CT to guide the treatment decisions. In case of minimal encrustations, cystoscopic stent removal is successful in most of the cases. If difficulty or resistance is felt, the procedure should be abandoned. In our study seven cases with stent encrustation were treated successfully by simple cystoscopic stent removal. The cases with large and proximal encrustations needed multimodal approach. It has been approved by Ecke et al. that distal part of the stone burden should be removed first and PCNL would then be used for the stone on the proximal end of the stent. We recommend the same approach for complete stone and stent removal [13].

Arenas et al. developed a new KUB grading system for encrusted ureteral stents. This system grades the encrustations according to the size of the calcification in or around the stent in the kidney (K), ureter (U) or bladder (B). They noted that the K score was associated with multiple surgeries, multimodal surgery, operative time >180 min, and lower stone-free rate, while the U score was only associated with longer operative time and the B score was associated with a lower stone-free rate [14]. These results agree with our findings that larger and the more proximal the stone burden, the more challenging it is to treat.

There was a significant relation between history of stone formation and the stent encrustations. Ahallal et al. found in their study that long indwelling time, urinary sepsis, history of stone disease, chronic renal failure, and congenital abnormalities were common risk factors for stent encrustation [15].

As with any foreign body continuously exposed to urine, stents become covered with a bacterial biofilm that subsequently calcifies, leading to encrustation and frank stone formation. This, in turn, leads to stent entrapment [16]. Encrustation plays a significant role in the complications and morbidity of ureteral stents [17].

In 2010 Murthy, presented his experience in managing of 14 patients with encrusted neglected ureteric stents with the average indwelling time 4.9 years. In 11 out of the 14, the stent was placed for ureteric stone disease. All patients required 2–6 endo-urological approaches [18].

In our conducted study, we evaluated the possible correlations between the various risk factors such as, elevated serum creatinine, lack of acidification, history of stones and duration of indwelling stent, and the different outcomes such as infection, encrustations, simple removal by cystoscopy or complicated needing ureteroscopy, nephroscopy or even open surgery.

In this research, we found that the lack of acidification was a risk factor for infection. This is probably due to the acidified medium that reduces the ability of bacteria to proliferate.

The acidification of urine had no significant correlations with the encrustations around the ureteric stents but the non-acidified urine may affect the polyurethane ureteric stent tensile property as it was found to increase the possibility of polyurethane ureteric stents fragmentation. Our study showed that stent fragmentation was associated significantly with non-acidified urine and urine acidification was protective against stent fragmentation. This may need further research on different types of ureteric stents.

Although there was no significant correlation between history of stone formation and infection yet there was significant correlation found between history of stone formation and stent encrustation.

Cases with history of stone formation were more liable to need complicated procedures to be stent and stone free.

Singh et al. found that renal failure is a risk factor if associated with prolonged indwelling times, poor compliance, and pyelonephritis [19]. Aron et al. recommended temporizing nephrostomy and definite operation 2–4 weeks later [20]. Our study showed that elevated serum creatinine showed no significant correlation with any of the studied outcomes. The indwelling time was found to affect the infection as more the time more the liability to infection but it did not show any significant correlation with stent encrustation nor fragmentation.

Some studies showed the same results as Kehinde et al. found that the risk of bacteriuria enhanced significantly by a longer duration of stent retention, and systemic diseases [21].

Polat et al., found significant relation between indwelling time and required treatment approaches [22]. Adanur and Ozkaya concluded that forgotten ureteral stents may lead to many complications, but they can be safely and successfully removed by endourologic techniques [23].

A limitation of our study is the small number of cases included. This may need further study on larger number of cases.

Conclusion

Forgotten ureteral stents are associated with significant complications and management challenges. Urinary acidification is protective against infection and stent fragmentation. Patients with history of stones are more liable to stents encrustations and management difficulties.

Author contribution

Design of the study: Ashraf Mosharafa.

Acquisition of data: Wael B. Fouda.

Analysis of data: Mohammed Abelasoul.

Interpretation of data and drafting the article: Ahmed Yehia Abdelaziz.

Article revision: Wael B. Fouda, Ashraf Mosharafa, Mohammed Abelasoul, Amr Fayyad, Khaled Fawzi.

Final approval of the version: Ashraf Mosharafa.

Article submission: Ahmed Yehia Abdelaziz.

Consent from the patient

A written informed consent was taken from all participants.

Ethical committee approval

Ethical committee approval of Urology Department, Faculty of Medicine, Cairo University.

Conflict of interests

All included authors declare absence of any financial or personal relationships with other people or organizations that could inappropriately influence and bias the work.

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