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Clinical features determining the fate of a long-term, indwelling, forgotten double J stents

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Abstract We review our experiences with forgotten stents and investigate the potential factors determining the degree of encrustation. Our series consists of nine cases of forgotten stent that had remained indwelling for more than 1 year (mean 36.1 months). We describe and compare their various clinical parameters in terms of encrustation. In addition, we briefly summarize our management schemes. All patients showed few stent related irritative symptoms. Six cases showing minimal or no encrustation shared the common feature of urine hypotonicity. Cystoscopic pullout was possible in these cases. The remaining three cases showed moderate to severe encrustation around the stent which required multiple procedures. Pyuria was observed in all cases and two patients had a history of urolithiasis. Finally, all cases were rendered stent and stone free. The fate of forgotten stents was dependent on the amount of encrustation around the stent. In our study, lithogenic history and presence of pyuria were associated with moderate to severe encrustation. Interestingly, patients showing urine hypotonicity tended to have a minimal encrustation on their stents and the stents were easily removed. Therefore, in patients with an impaired renal concentrating ability and a poor medical condition, the duration of indwelling stents might be safely prolonged if the patient has no risk factor for encrustation. As patients with forgotten stents are less likely to complain of stent related symptoms, thorough education of patients is important to prevent stent related complications.

Keywords Stents · Calcinosis · Specific gravity

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Introduction

Since the introduction of the ureteral stent by Zimskind and associates [1], stent indwelling has become an integral part of endourologic practice. However, as there is at present no completely biocompatible and biodegradable ureteral stent, all ureteral stents should be removed after they have served their purpose. If they are neglected, they may be retained in the urinary tract for a long time with or without clinical problems.

Previous reports [2, 3, 4] have stressed that stents remaining in the urinary tract can cause serious morbidity due to encrustation, fragmentation, migration and infection, and often result in the loss of the involved renal unit. Of all the disabling stent conditions, encrustation is the most common and the most serious, and the amount and the site of encrustation often determine the removal procedures required.

Often, an encrusted stent and its associated stone burden may be too much and multiply involved, necessitating a multimodal endoscopic approach that may be performed at a single or over multiple sessions. Using a combination of extracorporeal shockwave lithotripsy (ESWL), electrohydraulic lithotripsy (EHL), laser lithotripsy, ureteroscopy, percutaneous nephrolithotripsy (PCNL) and percutaneous chemolysis with Suby's solution G, clearance rates ranging from 75% to 100% have been obtained [3, 5, 6, 7].

Curiously, a forgotten stent is not always associated with severe encrustation. In some cases, the amount of encrustation was so negligible that the stents were easily removed by a simple cystoscopic pull out procedure. Though the underlying mechanisms of encrustation are

not completely elucidated, understanding the risk factor of encrustation may help to stratify the patients according to risk, and the stent indwelling time might be safely prolonged in patients with lifelong palliative ureteral stenting.

Although lithogenic history, infection, the presence of biofilm, stent material, and prolonged stenting have all been reported to contribute to an encrusted stent [3], we are still not able to accurately define the effect of individual risk factors on the encrustation.

We retrospectively reviewed our nine cases of long-term indwelling (more than 1 year) forgotten ureteral stents. As our cases did not include an episode of migration or fragmentation of stent, the amount of encrustation is the only determining factor for the required procedures. To reveal the potential inhibiting factor of encrustation, our nine cases were divided into two groups by the amount of encrustation, and their clinical parameters were compared. In addition, we briefly describe our experiences and discuss the reasons that account for the individual differences.

Patients and methods

We retrospectively collected and reviewed nine consecutive cases of forgotten stent between 2000 and 2003. Each patient was evaluated for stent encrustation, associated stone burden, obstruction and infection using various combinations of plain radiographs, urine tests, computed tomography (CT) and intravenous urography (IVU). Treatment decisions were based on the clinical presentation and imaging findings. Combined ESWL, cystolitholapaxy, retrograde ureteroscopic stone manipulation, intracorporeal lithotripsy or PCNL were performed to facilitate stent removal and to render patients stone free. Four patients received either general or spinal anesthesia at the beginning of the procedure according to the patient's and surgeon's preference, while five patients did not require anesthesia for the completion of the procedure. All patients underwent at least three repeated urinalysis and culture tests, and negative urine cultures were documented prior to endourologic procedures. Perioperative antibiotics were administered in all cases.

Successful management of these forgotten stents was defined as the confirmation of stent and stone free status in postoperative imaging.

To investigate the potential factors which influence the amount of encrustation, we investigated the following variables: age, sex, history of urolithiasis, duration of stent indwelling, urine specific gravity, presence of urinary tract infection and stent material. Also we describe the required procedures in individual patients.

Results

Nine patients with a prolonged forgotten ureteral stent were managed between 1990 and 2003. Patient characteristics and preoperative clinical features are described in Table 1. There were four men and five women with a mean age of 46.2 years (range 21–63 years) and mean duration of stent indwelling was 36.1 months (range 14–141 months).

The initial indications for stent placement included obstructing ureteral calculus in two cases, ureteral obstruction due to nonurologic malignancy in five cases, ureteropelvic junction obstruction in one case and ureteral stricture in renal failure in one case. Only two patients complained of stent related symptoms. Symptomatic patients complained of flank pain (case 1) or recent onset urgency (case 9), while the remainder were totally asymptomatic. Typical stent related symptoms, such as frequency or urgency, were reported by only one patient (case 9).

The reasons for delayed visit fell into two categories. One was delayed referral due to treatment for concurrent disease (malignancy, renal failure) in six cases and the other involved a lapse in the patient's memory and poor compliance in three cases.

When we divided our nine cases into two groups (complicated, uncomplicated) according to the amount of encrustation, the comparison of clinical findings gave some insight into the factors influencing encrustation (Table 2). The complicated group tended to have a history of urolithiasis, longer indwelling periods and inflammation, although statistical significance was not established due to the small sample size. In the complicated group, all stents were made up of silicone, but silicone stents were also used in the uncomplicated group.

One striking observation in our cases was the association between urine specific gravity and the amount of encrustation. All patients in the uncomplicated group typically excreted hypotonic urine.

The radiological assessment of encrustation was used to determine an adequate procedure for removal. In the complicated group, three cases showed moderate to severe encrustation at either end of the stent or associated renal or bladder stone. Obstructing hydronephrosis was observed in two cases (cases 1 and 7: Fig. 1). One patient whose stent had remained in position for almost 12 years underwent simultaneous PCNL, intravesical lithotripsy and cystoscopic removal. Multi-sessioned ESWL ensued for the remaining renal stone. The other two cases showed distal curl encrustation and a bladder stone without significant proximal curl encrustation or renal stone. They were treated by intravesical lithotripsy using EHL followed by cystoscopic removal. Three encrusted stents were sent for qualitative stone analysis. All stents were positive for calcium oxalate and two of them were positive for uric acid.

Six cases showed no or minimal encrustation around the stents and most stents were easily pulled out under cystoscopic guidance. Because of insufficient encrustation, analysis of encrusted material was not performed. When initial gentle traction did not move the stent or give rise to pain, we tried to pull it out beyond the

Table 1 Clinical features of patients with forgotten stents

Case no.	Sex/age	Indication for stenting	Reason for delayed visit	Presenting symptoms	Radiological finding (encrustation/stone/hydronephrosis)
1	Male/57	After pyelo-lithotomy	Lapse in memory	Flank pain	++/+/+ (Encrusted stent and renal and bladder stone)
2	Male/21	After balloon dilation (chronic renal failure)	Delayed referral	None	±/−/− (Slight encrustation in distal curl)
3	Male/37	Pelviureteral junction obstruction	Lapse in memory	None	+/+/− (Bladder stone around stent)
4	Female/46	Malignant obstruction	Delayed referral	None	−/−/− (Remained intact)
5	Female/52	Malignant obstruction	Delayed referral	None	−/−/− (Remained intact)
6	Female/44	Malignant obstruction	Delayed referral	None	−/−/− (Remained intact)
7	Male/41	Upper ureteral calculus	Lapse in memory	None	+/+/+ (Encrustation in distal curl)
8	Female/63	Malignant obstruction	Delayed referral	None	±/−/− (Slight encrustation in distal curl)
9	Female/55	Malignant obstruction	Delayed referral	Irritative symptoms and gross hematuria	±/−/− (Slight encrustation in both curls)

urethral meatus and pass a stiff guidewire through the stent to uncoil its proximal portion.

Finally, postoperative intravenous pyelography or KUB revealed that our nine cases were successfully treated. All procedures were performed without intraoperative or postoperative complications.

Discussion

We present nine cases of forgotten stents. The clinical fates of our nine patients varied on an individual basis. In some cases, the long-term (as long as 12 years) indwelling stents followed usual courses (significant encrustation, multiple associated stones) and caused unnecessary morbidities and the possible loss of renal function. But in others, simple cystoscopic removal was possible due to no or minimal encrustation.

As the site and amount of encrustation determine subsequent procedures, any factors involved in the formation of encrustation could influence the fate of a forgotten stent. Previous studies suggest that history of calculous disease [3], infection [8], stent material [9], prolonged stenting [3] and the presence of a biofilm [10] may contribute to encrustation. Some clinical features of our cases may support the above findings, while others do not.

Two of the cases had a history of urolithiasis. As described in most previous studies [4, 6, 7], a lithogenic history appears to be an important risk factor of encrustation.

The presence of urinary tract infection has been associated with an increased tendency to stent encrustation. In our study, compared to the uncomplicated group, all cases in the complicated group showed evidence of pyuria despite negative urine culture. Therefore, it is probable that stent induced inflammation may be involved in the formation of encrustation.

Although the duration of stenting was longer in the complicated group, the effect of duration does not seem to be important. Two cases in the uncomplicated group and one case in complicated group retained their stent for 26 months.

Stent material does not seem to play an important role in our study. The silicone stent was used in both the complicated and uncomplicated groups.

Six cases showed no or minimal encrustation and were easily removed with gentle traction. What prevented them from forming an encrustation is not understood, but a review of previous reports gives some insight into the phenomenon. Kehinde and associates [11] described two patients with hypotonic urine due to moderate renal failure, which showed a minimally encrusted stent that was easily removed despite long-term indwelling (40–60 months). In addition, Persky and associates [12] reported a similar experience of minimal encrustation in patients with renal insufficiency, although the stent had been forgotten for more than 7 years. In their experience, there was a common feature

Table 2 Relevant clinical parameters of encrustation and applied management in nine cases of a forgotten stent. The complicated and uncomplicated group is divided by a dotted line. PCNL percutaneous nephrolithotomy, URS ureterorenoscopy, ESWL extracorporeal shockwave lithotripsy, * Boston Scientific Korea, Seoul, Korea

Case no.	Sex/age	Duration of stenting (months)	Stent material	Urinalysis and urine culture (mean specific gravity/pyuria/culture)	Required procedures (*n*)
1	Male/57	141	Silicone	1.015/+/−	PCNL (2), URS (1) Cystolitholapaxy (1) ESWL (2) for renal stone
3	Male/37	31	Silicone	1.012/+/−	Cystolitholapaxy (1)
7	Male/41	26	Silicone	1.015/+/−	Cystolitholapaxy (1)
2	Male/21	26	Silicone	1.005/−/−	Cystoscopic pullout (1)
4	Female/46	20	Silicone	1.001/−/−	Cystoscopic pullout (1)
5	Female/52	22	Percuflex*	1.005/−/−	Cystoscopic pullout (1)
6	Female/44	21	Silicone	1.002/−/−	Cystoscopic pullout (1)
8	Female/63	26	Percuflex*	1.005/−/−	Cystoscopic pullout (1) after straightening by stiff guidewire
9	Female/55	14	Percuflex*	1.005/−/−	Cystoscopic pullout (1)

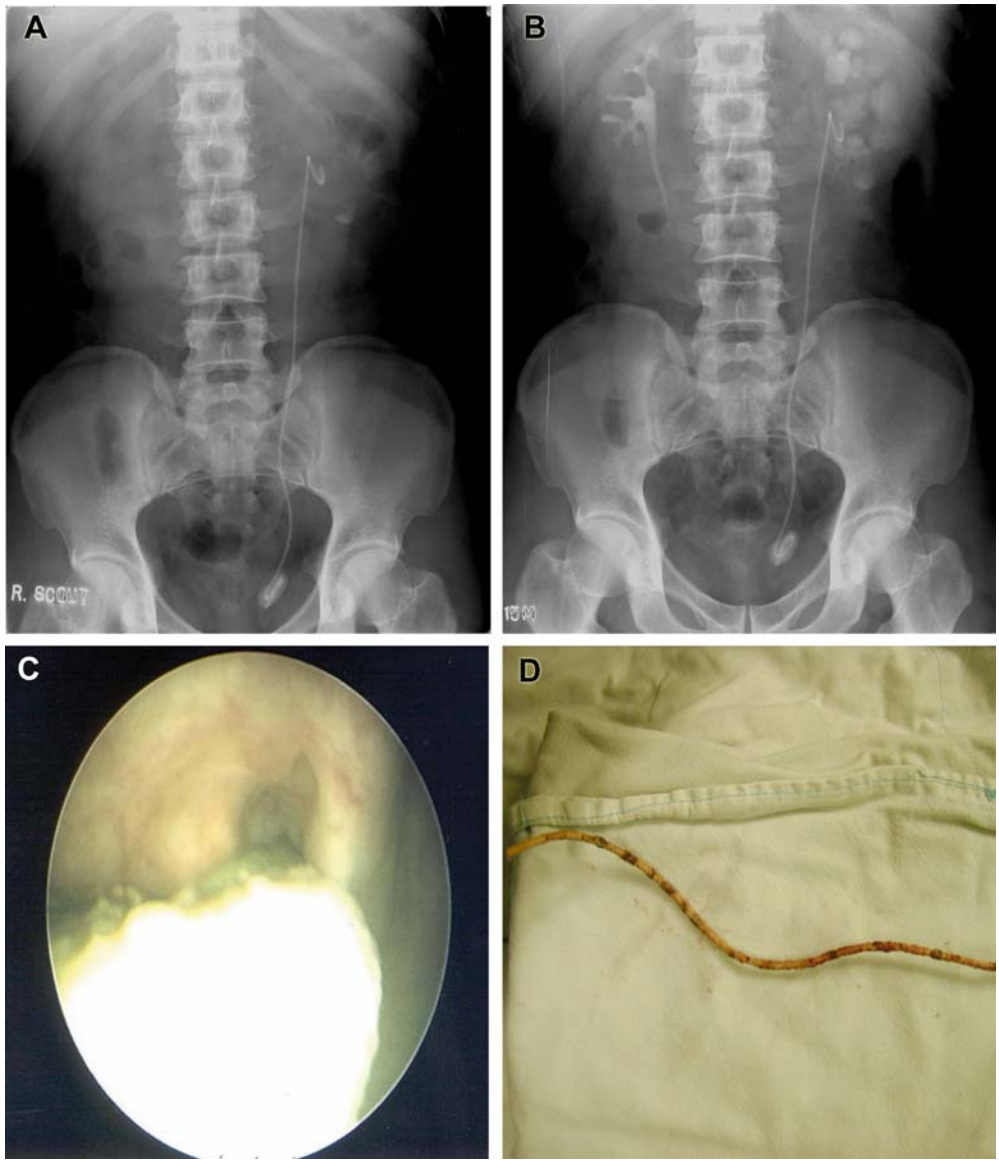

Fig. 1 Representative clinical findings with moderate to severe encrustation (case 1). The scout (**A**) and 15 min delayed view (**B**) show encrustation in the distal curl, associated renal stone and marked hydronephrosis in the left side. Endoscopic findings (**C**) reveal an obstructing bladder stone around the stent. Gross finding of the removed stent (**D**) showed widely distributed encrustation around the distal half of the stent, although this was not identified in imaging studies

of hypotonic urine bathing the forgotten stent. In our experience, one patient with overt renal impairment and five patients with malignant ureteral obstruction showed minimal encrustation, and they also shared the common feature of urinary hypotonicity, although patients with malignant ureteral obstruction did not exhibit definite renal functional impairment.

The reasons why patients with malignant ureteral obstruction excreted hypotonic urine are not clear, but relative obstructive changes due to poor urinary drainage might be involved. Although there was no hydronephrotic change, it is well known that even stents placed inside the normal ureter might impede urinary flow and reduce ureteral peristalsis. In addition, the flow is divided in two directions; peri-stent and intraluminal flow. A stent in a normal ureter was reported to have a flow ratio of about 60:40 [6]. Extrinsic compression by pelvic malignancy often obliterates important peri-stent flow and results in a relative partial obstruction. This may be the reason that internal stenting to alleviate obstruction by pelvic malignancy has not been as effective as percutaneous nephrostomy, and is associated with a high renal failure rate [13]. In our six cases, despite no identifiable hydronephrosis, the evidence of relative obstruction may be reflected by urinary hypotonicity, because the renal concentrating defect is easily impaired during the course of obstructive nephropathy.

Based on our experience, our suggestion is that the optimal interval for stent change should be individualized. Those who have a lithogenic history and evidence of infection have a high likelihood of stent encrustation and should be warned of the risk of encrustation and additional morbidity. The indwelling time should not exceed 3 months and if signs of encrustation exist, the changing interval should be reduced. If a patient has no evidence of risk factors and excretes constantly hypotonic urine, especially in cases of palliative stenting, the changing interval might be safely postponed to 9–12 months instead of 3–6 months. Therefore, when determining the follow-up interval, we recommend that criteria based on the mean urine specific gravity should be added.

In general, the ureteral stent is associated with stent related irritative symptoms, such as frequency, urgency, dysuria and flank pain, and it is estimated that the prevalence of stent related symptoms is up to 80–90% with various degree of severity [14]. Sometimes, stent related symptoms are too serious to continue with the indwelling. However, symptoms in patients with a forgotten stent did not appear to be as frequent as those in usual patients. Most did not complain of any stent related symptom, which reflects the good tolerability of stents. This may be the reason for forgetfulness and poor compliance.

Our six cases reveal that patients with a severe concurrent disease are likely to miss subsequent follow-up. Fortunately, results for delayed follow-up are not serious (i.e., cystoscopic removal) due to an inherent renal concentrating defect. However, in cases of urinary tract infection or dehydration, which frequently occur in these patients, stent encrustation may cause severe morbidity or even mortality. Therefore, the follow-up schedule should be strictly observed in these patients. To reduce the follow-up missing rate, we strongly recommend that oncologists, nephrologists and patients be fully informed of stent related problems and the proposed date for stent removal.

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