Forgotten Double-J Ureteral Stents: Prevalence, Risk factors and Complications

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ABSTRACT

Background: Ureteral JJ stents (DJS) are a common part of urological practice and are used for the management of upper urinary tract obstruction and ureteral surgery, despite their advantages; ureteral stents are not without possible morbidity.

Objective: This study aimed to record the prevalence and possible reasons behind neglected DJS and its complications. The difficulties associated with their removal and risk factors correlate with these difficulties.

Patients and Methods: A cohort study including 517 patients presented with fixed DJS presenting to Department of Urology, Al-Azhar University Hospitals; Cairo; Egypt. With neglected DJS (indwelling for more than 6 months). We noted the complications of neglected stents **(**urinary tract infection, gross hematuria, encrustation, migration and stent fragmentation), the treatment modalities and risk factors for these complications.

Results: From the entire patients, 239 (46.2%) had a neglected stent with mean stenting duration 11.11 ± 8.6 months. A total of 26.8% of patients received urine acidification, 26.4% were stone formers, 32.2% presented with urinary tract infection (UTI) and 33% had gross hematuria. Encrustations on the stent were recorded in 17.2% of patients and fragmented stent in 4.6% and 2.5% migrated stent up. The stent was removed by cystoscopy in 201 cases (84.1%). Other cases needed combined endoscopic and/or open surgical procedures. Lack of urinary acidification was a significant risk factor for UTI and complex interventions for stent removal (P = 0.013 and 0.017, respectively). Stent fragmentation were more likely with longer duration of stenting (P = > 0.001).

Conclusion: Neglected DJS are associated with significant morbidity, urine acidifications is protecting against complications.

Keywords: DJS, encrustations, Urinary acidification.

INTRODUCTION

The use of dual ring stents (DJS) has become an integral part of the practice of modern urinary tract. Indicators of inclusion in DJS include almost any surgical intervention involving ureters and a variety of renal surgeries [(1)].

By allowing urine flow through both internal and external routes, DJS provides a channel for discharge of urine from the kidney to the bladder to relieve obstruction, pain or infection associated with it. Despite the obvious advantages of DJS, its use can be associated with complications [(2)]. However, different complications may occur with short- or long-term use of indwelling stents. These complications vary from minor side effects to major complications as (hematuria, UTI, migration, fragmentation, encrustation, stone formation, urinary tract obstruction, and renal failure). Most of these complications require removal of the stent **[(3)].**

The removal of ureteric stents is one of the simplest 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, fragmentation, encrustation and stone formation.

AIM OF WORK

To record the prevalence and possible reasons behind neglected DJS and its complications. The difficulties associated with their removal will be studied and risk factors correlate with these difficulties will be assessed.

PATIENTS AND METHODS

Combined retrospective and prospective cohort study including patients with neglected DJS (indwelling for more than 6 months) presenting to Department of Urology, Al-Hussein and Sayed Galal Hospitals, Al-Azhar University, Cairo, Egypt in the period from January 2016 to February 2019.

The study included all patients with neglected DJS more than 6 month underwent stent removal. A ureteral stent in situ for a prolonged period with regular change every 6 months and long term DJS (silicon JJ) were excluded from the study.

Ethical approval:

The study was approved by the Ethics Board of Al-Azhar University. All study material were kept in separate lockers; not accessed except by study investigators. A signed consent was obtained from each patient included in this study.

Study procedures and data collection:

The medical records of all patients with neglected fixed DJS who were treated at our University Hospitals were reviewed for: Demographic and historical data (age, gender, marital status, residence,

Received:27/4/2019
Accepted:26/5/2019

occupation; education level, chronic medical diseases, regular medications), medical history and lab profile (urine analysis and urine culture). Also, operative details, biomaterial of DJS, side of DJS, double-J indwelling time (defined as the time of insertion to the time of removal), cases of stent insertion and possible cause of delayed removal as

- ✓ **Urologist** related: instruction not defined in discharge summary
- ✓ **Patient** related: patient misunderstands instructions, neglects, or could not come for assigned retrieval date.

Reported complications of neglected DJS (UTI, gross hematuria, encrustation, migration, stent breakdown and stone formation) and treatment modalities of these complications. We studied the incidence and effect of different risk factors (stent duration, lake of urine acidification and history of stone formation) on the complications of forgotten ureteral stents (UTI, gross hematuria, encrustation, stent fragmentation, stone bladder formation and complicated endoscopic technique needed for stent removal).

Technique of DJS retrieval:

All DJS in our study were stents without threads and removed using endoscope. With the patient in lithotomy position and under general, spinal or urethral topical anesthesia (lidocaine or xylocaine), the DJS were removed using rigid cystoscope and cold-cup biopsy or dormia basket. In children, cystoscope 11 fr or mini-URS, and foreign body forceps or dormia basket were used for stent removal. In case with upward stent migration, the procedure was performed using the rigid URS and foreign body forceps after a straight floppy tipped guide wire 0.035-in was advanced through the ureteric catheter into the renal pelvis, under fluoroscopic guidance. The stent was grasped from its lower end and gently extracted. After removal, the stent was carefully inspected to be sure that the stent was extracted completely without any retained fragment. The procedures were performed under antibiotic coverage and patient discharged in the same or first day post-operative.

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 ureteric catheter 4 or 6 Fr then a 0.035-in. straight floppy tipped guide wire was advanced through the catheter into the renal pelvis, under fluoroscopic guidance. The guide wire was kept inside the ureter through the whole technique. Ureteroscopy was performed by a semi-rigid (9.5 Fr or 12.5 Fr) URS ("Karl Storz" 43 cm length, angled 6-degree telescope, with 6 Fr central channels) and SWL 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 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.

Plan for Data Analysis:

The collected data were organized, tabulated and statistically analyzed using statistical package for social science (SPSS) version 22 software (SPSS Inc, USA). Descriptive statistics were performed for all study variables with a normality test for all quantitative variables. Data were explored for normality using Kolmogrov-Smirnov test and Shapiro-Wilk test. Numerical data were summarized using means and standard deviations or medians, ranges and interquartile range (IQR). Categorical data were summarized as numbers (percentages). Comparisons between the 2 groups with respect to normally distributed numeric variables were done using the independent t-test. None normally distributed numeric variables were compared by Mann-Whitney test. For categorical variables, differences were analyzed with $\chi 2$ (chi square). The results of data analysis were presented in the text, tables or figures as appropriate. Differences have been considered significant when probability (p) value < 0.05.

RESULTS

A total of 517 patients presented DJS during the study period with mean duration of stenting was 6.58 ± 7.29 (median: 4.9, range: 0.1 to 96.5 month). There were 312 (60.3%) males and 205 (39.7%) females with mean age of patients was 39.39 ± 18.17 years (range: 0.2 to 80 years). From the entire patients, 239 (46.2%) had a stent duration for more than 6 months (forgotten stent), with mean age 36.81 ± 19.93 years and mean neglected stenting duration 11.11 ± 8.6 months **(**figure 1).

Table (1): Cases of DJS insertion among patients with forgotten and those with non-forgotten JJ ureteral stent

Causes of stent insertion	Patients with forgotten JJ ureteral stent (n = 239)	Patients with non-forgotten JJ ureteral stent (n = 278)	p value
URS	(n = 64)	(n = 129)	< 0.001
insufficient data	29 (54.3)	44 (34.1)	
false passage	5 (7.8)	21 (16.3)	
laser dusting	3 (4.7)	21 (16.3)	
stricture ureter	4 (6.3)	9 (7.0)	
edematous ureter	1 (1.6)	11 (8.5)	
Bil stones	8 (12.5)	2 (1.6)	
mucosal injury	2 (3.1)	8 (6.2)	
solitary kidney	6 (9.4)	2 (1.6)	
other causes	6 (9.4)	11 (8.5)	
SWL	(n = 83)	(n = 22)	< 0.001
large stone burden	31(37.3)	6 (27.3)	
solitary kidney	18 (21.7)	8 (36.4)	
Bil stones	17 (20.5)	4 (18.2)	
Impacted ureteral stone	12 (14.5)	3 (13.6)	
insufficient data	5 (6.0)	1 (4.5)	
PCNL	(n = 36)	(n = 30)	0.187
residual stones for SWL	15 (41.7)	4 (13.3)	
insufficient data	7 (19.4)	10 (33.3)	
pelvic injury	4 (11.1)	5 (16.7)	
persistent leakage	1 (2.8)	5 (16.7)	
solitary kidney	4 (11.1)	2 (6.7)	
Bil stones	3 (8.3)	2 (6.7)	
residual stones for 2nd stage	2 (5.6)	2 (6.7)	
obstructive uropathy	(n = 19)	(n = 8)	0.017
Bil stones	17 (89.5)	7 (87.5)	
solitary kidney	1 (5.3)	1 (12.5)	
insufficient data	1 (5.3)	0 (0.0)	
Other causes	(n = 37)	(n = 89)	<0.001
open surgery	12 (32.4)	57 (64.1)	
endoscopic surgery	20 (53.1)	31 (34.8)	
before hysterectomy	3 (8.1)	1 (1.1)	
before chymolysis	2 (5.4)	0 (0.0)	

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

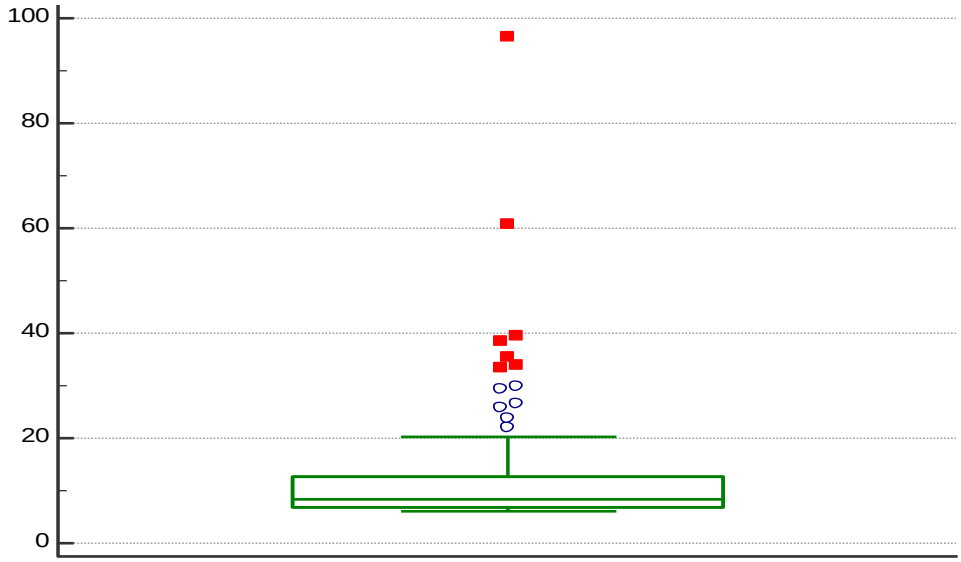

Figure (1): Box and whisker plot describing of duration of stent fixation among patients with neglected JJ ureteral stent.

A total of 26.8% of patients received urine acidifier while the stent was indwelling, 26.4% were stone formers, 32.2% presented with UTI confirmed by urine culture (table 2), 33% have gross hematuria (table 3). Preoperative non-contrast spiral CT abdomen and pelvis showed encrustations on the stent in 17.2% of patients. Seven cases (2.9%) have stone formation at upper memory of DJS, thirteen cases at lower memory and two cases at body of the stent. Fragmented stent present in 4.6% and migrated stent up in 2.5% of cases.

Table (2): prevalence of UTI among patient with neglected DJS.

UTI	Frequency	Percent	ʳalid Percent
No	110	46.0	58.8
Yes	77	32.2	41.2
Total	187	78.2	100.0
no available data	52	21.8	
Total	239	100.0	

UTI: urinary tract infection

Table (3): prevalence of gross hematuria among patient with neglected DJS.

Gross hematuria	Frequency	Percent	Valid Percent
No	144	60.3	81.4
Yes	33	13.8	18.6
Total	177	74.1	100.0
No available data	62	25.9	
Total	239	100.0	

Most of cases 127 (53.1%) have no complications which required no treatment, 57 cases (23.8%) received medical treatment of UTI, 18 cases (7.5%) conservative treatment for gross hematuria and the rest of cases needed multiple treatment modality due to combined pathology (Table 4). There were different methods needed for stent removal. Most of cases 201 (84.1%) removed by simple cystoscopy, the rest of cases needed combined endoscopic and/or open surgical procedures (table 5).

Table (4): treatment modality of complication

	Frequency	Percent
No Treatment	127	53.1
Medical	57	23.8
Conservative	18	7.5
URS	8	3.3
Conservative & URS	1	0.4
Cystolithotripsy	4	1.7
Cystolithotripsy & URS & medical **treatment**	3	1.2
cystolithotripsy & medical	1	0.4
Cystolithotripsy & URS	2	0.8
pyelo-ureterolithotomy	1	0.4
SWL	1	0.4
SWL & cystolithotripsy & URS	1	0.4
Ureterolithotomy	1	0.4
ureterolithotomy & cystolithotomy & **pcnl**	1	0.4
pcnl & cytolithotripsy	1	0.4
Pcnl & Medical treatment	4	1.7
URS & Medical treatment	5	2.1
URS & pcnl & medical treatment	1	0.4
Total	239	100.0

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

Table (5): Different procedures needed for forgotten stents removal.

Method of removal	**Frequency**	**Percent**
cystoscopy	201	84.1
URS	16	6.7
Cystolithotripsy	5	2.1
PCNL	6	2.5
URS & PCNL	1	0.4
PCNL & cystolithotripsy	1	0.4
URS & cystolithotripsy	6	2.5
Ureterolithotomy	1	0.4
Pyelo-ureterolithotomy	1	0.4
PCNL & cystolithotripsy & ureterolithotomy	1	0.4
Total	239	100.0

PCNL: Percutaneous nephrolithotomy, URS: Ureteroscopy.

Different correlations were studied between risk factors (stent duration, lake of urine acidification and history of stone formation) and the complications of forgotten ureteral stents (urinary infection, gross hematuria, stent fragmentation, encrustation, stone bladder formation and techniques need for stent removal more than cystoscopy). Sixty-four cases (26.8%) had a history of administrating urinary acidification in the form of oral vitamin C. Lack of urinary acidification was significantly associated with the presence of UTI ($p = 0.013$) and complicated procedures requiring during stent removal ($p = 0.017$), but there was no significant correlations with other complications. Duration of indwelling DJS was significantly associated with stent fragmentation ($p = 0.001$) and complicated procedures needed for stent removal more than cystoscopy (p value=0.036). There was no significant correlations with other complications (Table 6).

Table (6): Correlations between the risk factors and the complications.

	Lack of urine acidification	**p value**	**history of stone formation**	**p value**	**stent duration (p value)**
Cases with UTI	57	0.013	23	0.598	0.204
Cases with Gross hematuria	24	0.238	7	0.397	0.195
Cases with Fragmentation	9	0.193	5	0.141	>0.001
Cases with Encrustation	33	0.025	11	0.940	0.096
Cases with stone bladder formation	10	0.366	3	1.0	0.146
DJS removal More Than cystoscopy	31	0.017	13	0.231	0.036

UTI: urinary tract infection, DJS: double-J ureteral stent.

DISCUSSION

Ureteral JJ stents are designed to drain the kidney or bypass a renal or ureteric obstruction to drain the kidneys or following open or endoscopic ureteral surgery [4]. And may also be inserted following iatrogenic injuries of the ureters or to protect and define the ureter in complex abdomenopelvic procedures in a preoperative period [5]. In our study, complications post uretroscopic lithotripsy was the most common indication of DJS placement in all entire patients (n = 517) (37.3%), while stenting prior SWL was the most common cause among patient with forgotten DJS (n= 239) (34.7%). In comparison, urolithiasis leading to obstructive uropathy was the most common indication of DJS placement that has been narrated by **Ali *et al.*** [6] **and Memon *et al.*** [7].

The presentation of forgotten stent varies. **Damiano *et al.*** [8] observed flank pain in 25.3%, irritative bladder symptoms in 18.8%, hematuria in 18.1%, and fever in 12.3% of the patients. While **Abdelaziz *et al.*** [9] observe that flank pain was relatively less while irritative bladder symptoms and hematuria was the predominant presentations. Also, recurrent fever was reported in 2 patients that indicated ascending infection due to blocked stent [9]. In comparison to our study, prevalence of gross hematuria 33%, UTI confirmed by urine culture was 32.2%. Other symptoms such as, loin pain, suprapubic pain, urethral pain was minimal as the patients handled these symptoms for more than 6 months.

In our study, stent migration occurred in 3.3 %. **Abdelaziz *et al*.** [9] observed that stent migration occurred in patients with pre- and intraoperative fragmentation of the stent in 9 cases and was significantly associated with the lack of urine acidification.

Our study showed that out of 239 patients 41(17.2%) 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 our study 12 (29.3%) 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.*** [10] 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.

These results agree with our findings that larger and the more proximal the stone burden, the more challenging it is to treat. Nine cases (22%) needed ureteroscopy, 5 cases (12.5%) needed cystolithotripsy, 6 cases (14.6%) needed combined URS & cystolithotripsy, 4 cases (9.8%) needed pcnl, one case (2.4%) needed URS & PCNL, one case (2.4%) needed PCNL & cystolithotripsy, one case (2.4%) needed ureterolithotomy, one case (2.4%) needed pyelo-ureterolithotomy and one case (2.4%) needed PCNL puls cystolithotomy and ureterolithotomy.

In our study, there was a significant relation between history of urine acidification and the stent encrustations (**p** .025). No correlation between stent encrustation and other risk factors (stent duration, history of recurrent stone formation). **Ahallal *et al.*** [11] 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.

Although broken stent is less commonly reported, it is most common complication seen in study of **Ray *et al.*** [12]. They found 57.89% cases with broken JJ stent. Breakage occured in those who had JJ stent for long duration ranging from 15 to 156 months. In comparison to our study we found that 11 cases (4.6%) have fragmented DJS, three of them (27.3%) removed by rigid ureteroscopy, three cases (27.3%) needed percutaneous approach for removal,

Stent migration is a recognized complication. It is related to JJ stent design and faulty technique of insertion. Double pigtails tents are less likely to migrate as opposed to J loop stent. Migration can occur either way but upward migration is more common [13]. In our study, we reported six cases (2.5%) have migrated stent up which needed rigid ureteroscopy to remove it. The incidence in our study population possibly due to incorrect positioning and improper size selection.

In the absence of clear guidelines for removal of retained stents, **Rabani** reported that 94.74% of cases were managed endoscopically with 57.89% success rate by single procedure and required multiple procedures in rest of the cases (42.11%). Open procedure was required in one case following failed attempted URS, where there was fragmentation with knotting of stent in ureter [14].

In this study, we found that most of cases 127 (53.1%) have no complications which required no treatment, 57 cases (23.8%) received medical treatment of UTI, 18 cases (7.5%) conservative treatment for gross hematuria and the rest of cases needed multiple treatment modality due to combined pathology. And we observed that there were different methods needed for stent removal. Most of cases 201 (84.1%) removed by simple cystoscopy, 16 cases

(6.7%) by URS, six cases by PCNL, five cases (2.1%) by cystolithotripsy and the rest of cases 11(4.4%) needed combined endoscopic and/or open surgical procedures.

In our conducted study, we evaluated the possible correlations between the various risk factors such as, lack of acidification, history of stones and duration of indwelling stent and the different complications. We found that the lack of acidification was a risk factor for infection and prolonged stent duration was associated significantly with stent fragmentation and the way of DJS removal

Patients who experience very little stent related symptoms or have a poor understanding that the stent is the origin of their symptoms are less likely to follow up and thus less likely to request removal [(15)].

Inadequate communication between surgeon and patient and poor compliance are main factors that are associated with DJS retention [(16)]. In our center stenting prior SWL was the most common cause of retained stent (34.7%) due to lack of SWL lithotripter machines in the government centers or high cost in private once which lead to large volume of patients in government hospitals that increases the waiting period between SWL sessions and cost of stent removal. other causes as patient misunderstanding instructions, neglection, could not come for assigned retrieval date, or missing discharge summary card. Few cases neglected duo to urologist case that instruction not defined in discharge summary card.

Many approaches have been recommended to solve this important health problem. However, this issue remains unsolved. Programs for close follow-up of patients with stents, including computerized monitoring programs, stent removal software, and follow-up by e-mail, have been recommended [(17)].

CONCLUSION AND RECOMMENDATIONS

Neglected DJS are associated with significant morbidity. Urine acidifications is protecting against complications. Complicated procedures for stent removal are more likely in patient with longer indwelling time.

Future prospective studies on different types of DJS materials separately to assess the effect of complication on each type are recommended.

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