Arab Journal of Urology

ISSN: (Print) 2090-598X (Online) Journal homepage: https://www.tandfonline.com/loi/taju20

Complications and outcomes of JJ stenting of the ureter in urological practice: A single-centre experience

Mohammed S. Al-Marhoon, Omar Shareef & Krishna P. Venkiteswaran

To cite this article: Mohammed S. Al-Marhoon, Omar Shareef & Krishna P. Venkiteswaran (2012) Complications and outcomes of JJ stenting of the ureter in urological practice: A single-centre experience, Arab Journal of Urology, 10:4, 372-377, DOI: 10.1016/j.aju.2012.08.004

To link to this article: https://doi.org/10.1016/j.aju.2012.08.004

Arab Journal of Urology (2012) **10**, 372–377

Arab Journal of Urology
(Official Journal of the Arab Association of Urology)

www.sciencedirect.com

STONES/ENDOUROLOGY

ORIGINAL ARTICLE

Complications and outcomes of JJ stenting of the ureter in urological practice: A single-centre experience☆

Mohammed S. Al-Marhoon *, Omar Shareef, Krishna P. Venkiteswaran

Urology Division, Department of Surgery, Sultan Qaboos University Hospital, Oman

Received 10 July 2012, Received in revised form 21 August 2012, Accepted 26 August 2012
Available online 11 October 2012

KEYWORDS

Ureter;
JJ stent;
Complications;
Outcome

Abstract ***Objective:*** To determine the factors affecting the development of complications and the outcomes of JJ stenting.

Patients and methods: The study included 220 patients (133 males and 87 females, mean age 39.5 years, SD 15.4) who had self-retaining JJ ureteric stents placed while in the authors' institution. Univariate and multivariate analyses were used to identify the significant variables affecting the development of complications and outcome of stenting (condition 'improved' or 'not improved').

Results: Using a modified Clavien classification, there were grade I, II, IIIa, IIIb complications in 67 (30.4%), 39 (17.7%), two (0.9%) and 23 (10.5%) patients, respectively, and none of grades IVa, IVb and V. Loin pain (10.9%) and urinary tract infection (10.9%) were the most common complications, followed by dysuria (7.7%). There were significant complications requiring treatment in 29% of patients, and 71.4% of patients improved after stenting. On multivariate analysis the significant independent factor affecting the complication rate was the stent length

* Corresponding author. Address: Urology Division, Department of Surgery, College of Medicine & Health Sciences, Sultan Qaboos University, P.O. Box 35, Al-Khoud 123, Oman. Fax: +968 24143504.
E-mail address: msalmarhoon@gmail.com (M.S. Al-Marhoon).

☆ The abstract of the above article has been accepted for presentation in the 30th world Congress of Endurology and SWL (4-8, September 2012).

Peer review under responsibility of Arab Association of Urology.

ELSEVIER Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.aju.2012.08.004

($P = 0.016$), and the significant independent factor affecting the 'improved' outcome was age ($P = 0.014$).

Conclusion: Longer stents are associated with increased complication rates, and the older the patient the more likely they are to have a poor outcome after stenting. Future prospective multicentre studies with more patients are needed to confirm the present conclusions.

Introduction

Ureteric stents were first described by Zimskind et al. in 1967 [1]. The JJ ureteric stent has become an integral part of urological treatment options. The original indication for placing a ureteric stent was to treat a ureteric obstruction or fistula, but the current indications have expanded significantly (Table 1) [2]. The characteristics of the ideal ureteric stent [3] include: easily inserted from any access; resistant to migration; optimal flow characteristics; well tolerated by the patient; biocompatible; bio-durable; resistant to encrustation; non-refluxing; radio-opaque or visible with ultrasonography; easily exchanged and removed; versatile; and affordable. However, different complications can occur with the short- or long-term use of indwelling stents [4,5]. These complications have varied from minor side-effects such as haematuria, dysuria, frequency, flank and suprapubic pain, to major complications such as vesico-ureteric reflux, migration, malposition, encrustation, stent fracture, UTI, pyuria, incontinence, inadequate relief of obstruction, ureteric erosion or fistulation, a 'forgotten stent', necrosis and uretero-arterial fistula. Most complications require removal of the indwelling catheter.

A serious limitation of previous studies that assessed the complications of JJ stenting was the inclusion of too few patients. In the present study we retrospectively reviewed our experience with JJ stenting to determine factors affecting the development of complications and the outcome of stenting.

Table 1 Indications for placing a JJ ureteric stent.

Indications
Relief of benign or malignant obstruction
Adjunct to stone therapy
For obstruction
For ESWL
For intraluminal lithotripsy
For ureteric instrumentation
For stone visualisation
Perioperative placement
Alignment of drainage elements
Maintenance of luminal calibre
After ureteric intervention
Identification of ureter(s)
Management of urinary leakage
Leak from trauma or surgery
Leak due to ureteric fistula

Patients and methods

Between April 2005 and May 2009, 220 patients (133 males and 87 females; mean age 39.5 years, SD 15.4, range 4–86) had self-retaining ureteric JJ stents placed at our centre, and were retrospectively included in the study with the approval of the hospital ethics committee.

Procedure

The JJ stent was placed with the patient under general anaesthesia and in the lithotomy position, the size and length of the stent being selected by the surgeon, depending on the patient's body size and the calibre of the ureter. Using a 22 F cystoscope the stent was placed in position over a guidewire under fluoroscopy monitoring and its position confirmed. A plain film of the abdomen was taken as needed, to confirm the position of the stent. Patients were followed up in the clinic at 2–4 weeks and depending on the indication for stent placement, the stent was removed by flexible cystoscopy under local anaesthesia.

Statistical analysis

Univariate (chi-square or *t*-test) and multivariate (logistic regression) analyses were used to identify significant variables affecting the development of complications and the outcomes of stenting. The latter can be interpreted in terms of success and complication rates. Success was defined as achieving the indication for stent insertion (e.g. less pain, less obstruction) and if the stent was well positioned, as confirmed by fluoroscopy or an abdominal plain film. The tested variables were patients' age, sex, indication for stenting, side of the stent, pre-stenting urine culture, the use of prophylactic antibiotics at the time of stent insertion, and the development of UTI. Stent characteristics were also tested, i.e. the material, length, diameter and duration of stenting. The site of the upper coil (whether in the renal pelvis or calyx), as well as the site of the lower coil (whether on the same side or crossing the midline) and the shape of the lower coil (whether a complete circle or not), were also assessed.

The stents used were made of soft polyurethane (Cook double pigtail stent set, Cook Ireland Ltd., Eire) in all the patients so this was not included in the analysis.

Results

In the present study, the most common indication for inserting a self-retaining JJ ureteric stent was after ureteroscopy (44%). Stenting of the left ureter (52.7%) was slightly more common than of the right ureter (47.3%). The most common stent length and size used were 26 cm (48%) and 4.7 F (56%), respectively. The median (range) duration of stenting was 41.5 (4–990) days. The rate of changing the stent once was 4% and changing it twice was 0.5%. The most frequent position of the upper coil was in the renal pelvis (82.7%). The shape of the lower coil assumed a complete circle in 93% of the patients and crossed the midline in 33.6%. Prophylactic antibiotics, as one dose of ceftriaxone or gentamicin before the procedure, were given in 82% of patients. The documented rate of UTI before stenting was 12% and afterwards was 11.8% (Table 2).

In the present study, 131 of the 220 patients (59.5%) developed complications due to the JJ stent. According to the modified Clavien classification [6], there were grades I, II, IIIa, IIIb complications in 67 (30.4%), 39 (17.7%), two (0.9%) and 23 (10.5%) patients, respectively, and none of IVa, IVb and V. Loin pain (10.9%)

Table 2 Factors affecting complication rate and improved outcome in 220 patients, assessed by univariate analysis.

		Complications, *n* (%)		Improved outcome	
Variable	*N*	*n* (%)	*P*	*n* (%)	*P*
Side					
Right	104	61 (58.7)	0.653	76 (73)	0.281
Left	116	71 (61.2)		81 (69.8)	
Sex					
Male	133	67 (50.4)	<0.001	103	0.009
Female	87	65 (74.7)		(77.4) 54 (62)	
Pre-stenting urine culture					
Unknown	25	18 (72)	0.198	17 (85)	0.016
Negative	168	97 (57.7)		128 (58.3)	
Positive	27	17 (63)		12 (57)	
Urine culture during stenting					
Unknown	86	34 (39.5)	<0.001	65 (90.3)	0.013
Negative	108	73 (67.6)		79 (80.6)	
Positive	26	25 (69.2)		13 (61.9)	
Stent length (cm)					
22	39	20 (51.3)	0.046	36 (92.3)	0.02
24	68	35 (51.5)		51 (75)	
26	106	77 (72.6)		92 (86.8)	
28	7	4		1	
Stent diameter (F)					
4.7	123	78 (63.4)	0.514	111 (90.2)	0.002
6.0	87	50 (57.5)		68 (78.2)	
8.0	10	8		2	
Site of the upper coil					
Pelvis	182	117 (64.3)	0.387	157 (86.3)	0.095
Calyx	32	18 (56.3)		21 (65.6)	
Ureter	6	1		3	
Site of the lower coil					
Same side	146	88 (60.3)	0.091	126 (80.8)	0.229
Crossing midline	74	48 (64.9)		55 (74.3)	
Lower coil shape					
Complete circle	205	130 (63.4)	0.053	165 (80.5)	0.841
Incomplete circle	15	6		15	
Antibiotic prophylaxis					
Yes	180	110 (61)	0.635	152 (84.4)	0.898
No	40	26 (65)		29 (72.5)	
Number of stent changes					
0	210	128 (61)	0.362	172 (81.9)	0.219
1	9	7		9	
2	1	1		0	
Stent duration interval (days)					
⩽90	155	84 (54)	0.035	137 (88.4)	0.002
>90	65	56 (86)		33 (50.8)	

Table 3 Factors affecting patient's complications and effect on improved outcome in 220 patients assessed by multivariate analysis.

Variable	Regression coefficient	SEM	Relative risk (95% CI)	*P*
Complication rate				
Stent length (cm)	0.413	0.172	1.511 (1.079–2.117)	0.016
Outcome				
Age (years)	−0.149	0.061	0.862 (0.765–0.971)	0.014

and UTI (10.9%) were the most common complications, followed by dysuria (7.7%). Significant complications requiring treatment occurred in 29.1% of patients. In young patients (aged $\leqslant$20 years) three of 11 had a 'forgotten' stent, while in patients aged 21–49 years loin pain was the most common complication, at 78% (32/41). However, in patients aged $\geqslant$50 years UTI was more prominent, at 37.5% (nine of 24). The most common complication in males was loin pain (71%, 17/24) while in females UTI was the most common complication (63%, 14/24). Loin pain increased with an increase in stent diameter ($P = 0.047$). A positive urine culture after stenting was significantly associated with UTI and a forgotten stent ($P < 0.001$). A stent duration of $<$90 days was significantly associated with a lower complication rate in males ($P = 0.046$) and females ($P = 0.01$). In middle-aged patients the lower coil shape of an incomplete circle was associated with migration of the stent ($P = 0.045$). There were complications requiring hospital admission in 13 of the 220 patients (5.9%; four for ESWL, seven for ureteroscopy and two for percutaneous surgery). Acute pyelonephritis was managed with intravenous antibiotics, according to the urine culture results, and with antipyretics, without exchanging the stent. There was encrustation around the stent in five patients (2.3%) with a mean (range) stenting duration of 71.4 (30–131) days, and the encrustations were broken up at the time of stent removal.

The outcomes of ureteric stenting were 'improved' in 71.4% of patients (157/220), not improved in 16% (35/220), with 8.6% who died from their disease or from other comorbidities (19/220), and in 4% of patients the outcome was unknown (nine of 220).

On univariate analysis the significant factors affecting the complication rate were gender ($P < 0.001$), stenting duration ($P = 0.035$), stent length ($P = 0.046$), and a positive urine culture after stenting ($P < 0.001$; Table 2), while significant factors affecting the outcome after stenting (improved or not) were patient age ($P = 0.002$), gender ($P = 0.009$), stenting duration ($P = 0.002$), stent length ($P = 0.02$), stent diameter ($P = 0.002$), and a positive urine culture before ($P = 0.016$) and after ($P = 0.013$) stenting (Table 2).

On multivariate analysis the only significant independent factor affecting the complication rate was the stent length ($P = 0.016$), with a relative risk (95% CI) of 1.5 (1.1–2.1) (Table 3). However, the only significant independent factor affecting the (improved) outcome was age ($P = 0.014$), with a relative risk of decreasing the outcome by 0.86 (0.765–0.971) for each year (Table 3).

Discussion

The softness of silicone material continues to be the standard against which modern stents are judged, but due to the high coefficient of friction of silicone, placing silicone stents is often difficult. This led to the use of polyethylene in the construction of stents, to provide stiffness as an aid for insertion. This material proved to be unstable in the urinary environment, which made polyethylene stents prone to early fracture. Polyurethane was then substituted, and it continues to be used in stent construction, either alone or combined with other materials. More recently, copolymers such as C-Flex (Concept Polymer Technologies, Clearwater, FL, USA), Percuflex (Boston Scientific, Natick, MA, USA), and Flexima (Boston Scientific) have been used in the construction of JJ or double-pigtail catheters. Hydrophilic gel coatings have been added to assist in placement, and to potentially reduce the prevalence of encrustation and complicating infection. Stents made of biodegradable materials and metal are also under investigation [7]. The ureteric thermo-expandable metal segmental stent (Memokath, Engineers & Doctors A/S, Hornbaek, Denmark) is a promising, safe and efficient treatment option for the minimally invasive management of both benign and malignant ureteric strictures. Compared to conventional JJ stents there were improvements in general health and other quality-of-life variables, and there was a tendency in favour of the Memokath [8–10].

Indwelling times can range from a few days for the relief of ureteric oedema to the duration of the patient's life when maintaining ureteric patency to avoid obstruction from malignant disease [11]. Regardless of the stent composition, manufacturers usually recommend exchanging the stents at 3–6-month intervals, and studies have shown that the prevalence of complications increases with longer indwelling times [12]. In the present study a stent duration of $<$90 days was significantly associated with reduced complication rates in both males ($P = 0.046$) and females ($P = 0.01$). In the present study there were 20 patients who had stents left in

place for >180 days, due to forgotten stents (11), and encrustation or loss to follow-up (nine patients).

EL-Nahas et al. [13], in a study of 100 patients to determine the significant factors affecting patients' discomfort during the period of temporary ureteric stenting, found that a positive urine culture, crossing of the lower end of the stent to the opposite side, calyceal position of the upper coil, and longer stenting duration were significant factors. On multivariate analysis in the present study, with more patients (220), the significant independent factor affecting the complication rate was stent length ($P = 0.016$), while the significant independent factor affecting the improved outcome was patient age ($P = 0.014$). The significant effect of stent length on the complication rate can be explained by the extra length of the intravesical part of the stent causing trigonal irritation, whereas the effect of age on the outcome can be attributed to increased comorbidities and less tolerance in the elderly population. The causes are not completely understood, but a high pressure transmitted to the renal pelvis with urination, and trigonal irritation by the intravesical part of the stent, are regarded as influencing factors [14]. The shape of the lower coil (either a complete circle or not) and its position (either crossing the midline or not) are considered as other factors leading to discomfort [15]. It was reported that larger-diameter stents are associated with more discomfort [16]. In the present univariate analysis the stent diameter had a negative effect on the outcome ($P = 0.002$, regression coefficient – 0.756). Also on univariate analysis, the stent diameter had no effect on the complication rate ($P = 0.514$). Thus larger stents were not associated with better outcomes or an increased complication rate. However, on univariate analysis, stent length had a positive effect on the complication rate ($P = 0.046$, regression coefficient 0.230) and a negative effect on the outcome ($P = 0.02$, regression coefficient – 0.468). Thus longer stents were associated with an increased complication rate. Nevertheless, on multivariate analysis, stent length had a significant positive effect only on the complication rate ($P = 0.016$, regression coefficient 0.413). This could be explained by longer stents causing more irritation to the urinary urothelium. Interestingly, our data showed that increasing age is associated with a poor outcome after stenting ($P = 0.014$, regression coefficient – 0.149). Akay et al. [17] investigated the potential risk factors for lower UTI and bacterial stent colonisation in patients with JJ stents. They found that *Escherichia coli* was the most common pathogen, and diabetes mellitus, chronic renal failure, and pregnancy were associated with a higher risk of lower UTI in patients with stents. In the present study, the significant factors affecting the complication rate were patient gender, UTI after stenting, stenting duration and stent length, while significant factors affecting the outcome after stenting (improved or not) were patient age, sex, stenting duration, stent length, stent diameter, and a positive urine culture before and after stenting. However when confounding factors are considered, the only significant factor affecting the complication rate was the stent length and the only significant factor affecting the improved outcome was age.

In the present study 59.5% (131/220) of patients developed complications due to ureteric stenting, but there were significant complications requiring treatment in only 29.1% of patients. Loin pain (10.9%) and UTI (10.9%) were the most common complications, followed by dysuria (7.7%). Variable degrees of stent-related discomfort and morbidity are nevertheless reported by up to 80% of patients [15].

In conclusion, a larger stent was not associated with increased complication rates or better outcomes. However, longer stents were associated with increased complication rates and the older the patient the more likely they were to have a poor outcome after stenting. Future prospective multicentre studies with more patients are needed to confirm the present conclusions.

Conflict of interest

No conflict of interest.

Funding

No funding.

References

[1] Zimskind PD, Fetter TR, Wilkerson JL. Clinical use of long-term indwelling silicone rubber ureteral splints inserted cystoscopically. *J Urol* 1967;**97**:840–4.

[2] Dyer RB, Chen MY, Zagoria RJ, Regan JD, Hood CG, Kavanagh PV. Complications of ureteral stent placement. *Radiographics* 2002;**22**:1005–22.

[3] Denstedt JD, Reid G, Sofer M. Advances in ureteral stent technology. *World J Urol* 2000;**18**:237–42.

[4] Ringel A, Richter S, Shalev M, Nissenkorn I. Late complications of ureteral stents. *Eur Urol* 2000;**38**:41–4.

[5] Joshi HB, Stainthorpe A, Keeley Jr FX, MacDonagh R, Timoney AG. Indwelling ureteral stents. Evaluation of quality of life to aid outcome analysis. *J Endourol* 2001;**15**:151–4.

[6] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;**240**:205–13.

[7] Kulkarni R, Bellamy E. Nickel–titanium shape memory alloy Memokath 051 ureteral stent for managing long-term ureteral obstruction: 4-year experience. *J Urol* 2001;**166**:1750–4.

[8] Maan Z, Patel D, Moraitis K, El-Husseiny T, Papatsoris AG, Buchholz NP, et al. Comparison of stent-related symptoms between conventional double-J stents and a new-generation thermoexpandable segmental metallic stent: a validated-questionnaire-based study. *J Endourol* 2010;**24**:589–93.

[9] Papatsoris AG, Buchholz N. A novel thermo-expandable ureteral metal stent for the minimally invasive management of ureteral strictures. *J Endourol* 2010;**24**:487–91.

[10] Masood J, Papatsoris A, Buchholz N. Dual expansion nickel–titanium alloy metal ureteric stent. Novel use of a metallic stent to

bridge the ureter in the minimally invasive management of complex ureteric and pelviureteric junction strictures. *Urol Int* 2010;**84**:477–8.

[11] Sountoulides P, Kaplan A, Kaufmann OG, Sofikitis N. Current status of metal stents for managing malignant ureteric obstruction. *BJU Int* 2010;**105**:1066–72.

[12] el-Faqih SR, Shamsuddin AB, Chakrabarti A, Atassi R, Kardar MK, Osman MK, et al. Polyurethane internal ureteral stents in treatment of stone patients: morbidity related to indwelling times. *J Urol* 1991;**146**:1487–91.

[13] El-Nahas AR, El-Assmy AM, Shoma AM, Eraky I, El-Kenawy HA, El-Kappany HA. Self-retaining ureteral stents. Analysis of factors responsible for patients' discomfort. *J Endourol* 2006;**20**:33–7.

[14] Thomas R. Indwelling ureteral stents. Impact of material and shape on patient comfort. *J Endourol* 1993;**7**:137–40.

[15] Rane A, Saleemi A, Cahill D, Sriprasad S, Shrotri N, Tiptaft R. Have stent-related symptoms anything to do with placement technique? *J Endourol* 2001;**15**:741–5.

[16] Erturk E, Sessions A, Joseph JV. Impact of ureteral stent diameter on symptoms and tolerability. *J Endourol* 2003;**17**: 59–62.

[17] Akay AF, Aflay U, Gedik A, Sahin H, Bircan MK. Risk factors for lower urinary tract infection and bacterial stent colonization in patients with a double J ureteral stent. *Int Urol Nephrol* 2007;**39**:95–8.