J Turgut Ozal Med Cent
DOI: 10.5455/jtomc.2017.08.112 2018;25(1):7-11

ORIGINAL ARTICLE

Is there any relationship between ureteral DJ stent colonization and lower urinary tract symptom severity?

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Abstract

Aim: The purpose of this study is to evaluate risk factors for, and the relationship between, lower urinary tract symptoms (LUTS) and double J stent (DJS) colonization.

Material and Methods: One hundred and thirty five patients aged 18 to 77 were included in this prospective study conducted at Urology Clinic in our university hospital between July 2012 and December 2013. Patients were followed clinically; we recorded any bothersome symptoms after treatment. Stents were removed under aseptic conditions. Their distal ends were removed and placed in a culture medium for evaluation. The relationship between colonization and LUTS was evaluated.

Results: Bacteriuria and stent colonization were found in 10 (7.4%) and 35 (26%) patients, respectively. In the colonized stents, Candida spp. was the most commonly observed pathogen (40%). Mean indwelling times were different for the colonized (68.6 days) and non-colonized (46.2 days) groups. Similarly, the encrustation rate was significantly higher in colonized patients (42.8%) than in non-colonized cases (27%). In the colonized group, rates were significantly higher for irritative voiding symptoms such as polyuria (57.1% vs. 31%), nocturia (71.4% vs. 57%), and urgency (54.2% vs. 33%).

Conclusions: LUTS, especially irritative voiding symptoms including polyuria and nocturia, are more frequent in patients with stent colonization. Patients at risk of stent colonization should be followed up for the development of infections, and prophylactic treatment should be administered. In addition, indwelling time may be shortened to prevent colonization.

Keywords: Uretral Stent; Colonization; Symptom; LUTS.

INTRODUCTION

Double J stents (DJSs) are commonly used in urological practice. Made from synthetic biomaterials, their surfaces are suitable for colonization and the development of biofilm polysaccarides. While the development of softer materials has improved patient endurance, DJS still causes considerable morbidity (1). Bacterial colonization of surgical devices normally remains clinically silent, but colonized devices may be the origin of local infection, bacteremia, and sepsis, particularly in immunodeficient patients (2).

Encrustation is one of the most serious complications associated with ureteral stents (3). The real pathophysiology of symptoms caused by stents remains unknown. Flank pain is thought to be due to reflux of urine from the bladder into the kidneys (4, 5). Bladder symptoms such as dysuria, urgency, and frequency are theorized to result from irritation of nerves in the submucosal area concentrated in the bladder trigone (6).

In this study, we investigated the relationship between DJS colonization and lower urinary tract symptoms (LUTS).

MATERIAL and METHODS

In this prospective study conducted between July 2012 and December 2013 at our Urology Department, 135 patients (83 males and 52 females) were included. All patients with DJS were evaluated randomly after surgery and were divided into two groups according to DJS colonization. Ureteral stenting (8 of them bilateral) was performed for various indications; mostly for kidney and ureteral stone surgery and therefore, indwelling times varied. None of the patients was at risk of any other infection or displayed LUTS. Sterile urine samples were obtained before stent insertion and antibiotics were administered if the urine cultures were positive. All patients had a Foley catheter inserted for 1 day and were administered ciprofloxacin treatment for 5 days after surgery. All double J stents used in the study were made of polyethylene.

Received: 07.08.2017 **Accepted:** 05.10.2017
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We prospectively assessed the prevalence and bother of various urinary tract symptoms caused by indwelling ureteral catheters using validated questionnaires (International Prostatic Symptoms Score-IPSS, International Continence Society Male questionnaire, and Quality of Life questionnaire). The most common symptoms are pain and urination complaints. Therefore we have focused on bothersome symptoms such as suprapubic pain, dysuria, polyuria, urgency and incontinence.

The questionnaire was applied prior to the patient's stent extraction. DJS were removed under sterile conditions after the collection of urine samples for cultures. The stents' distal ends were removed and samples were sent to be cultured.

We calculated the percentage of patients with bothersome symptoms and compared with other studies. Pearson's chi-square tests and independent samples t-tests were used for comparison. The statistical analyses were performed using SPSS Version 14.0 software and $p<0.05$ was considered to be statistically significant.

RESULTS

A total of 135 patients (83 males and 52 females) with a mean age of 43.7±17.9 (18-77) were included in this study. The most common reason for stent insertion was ureterescopic stone surgery (69 patients, 51.2%).

Mean DJS indwelling time was 52.3 days (8-183); it was 68.6 days and 46.2 days for colonized and non-colonized groups, respectively. Similarly, the encrustation rate was significantly higher in colonized patients (42.8%) than in non-colonized patients (27%). DJS bacterial colonization was observed in 35 out of 135 patients (25.9%). The most commonly cultured microorganism was Candida spp. (14 patients). The most commonly cultured bacterial microorganisms were Pseudomonas aeruginosa (4 patients) and Enterococcus spp. (4 patients) (Table 1). Both stent and urinary cultures were positive in only 10 patients (28.5%) (Table 2). Stent colonization was not seen in those 4 of the 10 culture-positive patients who had been treated with antibiotics.There were no significant differences associated with this group of 4 patients in terms of mean age, gender, surgical procedure, or number of days of catheterization, or in terms of their history of previous LUTS or urinary tract infection.

Fifty one patients (37.7%) had significant polyuria (>10 times a day) and 82 patients (60.7%) experienced significant nocturia (>2 times a night) during the DJS treatment. All patients with significant storage LUTS (urgency, nocturia, and polyuria) had positive DJS cultures. Similarly, indwelling times were longer in DJS culture-positive patients ($P<0.0001$) (Table 3).

Table 1. Data about DJS culture positive patients and ciprofloxacin susceptibility (n=35)

DJS culture	Number of patient	Ciprofloxacin susceptibility (%)
Pseudomonas aeruginosa	4	2 patients + (50%)
Enterococcus spp.	4	3 patients + (75%)
Pseudomonas spp.	1	1 patient + (100%)
Klebsiella pneumoniae ESBL+	1	1 patient - (0%)
Staphylococcus aureus (MRSA) Coag (-)	2	1 patient + (50%)
Streptococcus spp	2	1 patient + (50%)
Acinetobacter spp.+ Enterococcus spp.	1	-*
Pseudomonas spp.+ Candida spp	1	-*
Bacillus	1	-*
Stenotrophomonas maltophilia	1	-*
Candida spp	14	-*
Candida albicans	3	-*

*No knowledge about antibiotic susceptibility

Table 2. Data about urine culture positive patients and DJS culture after treatment (n=10)

Patient No	Sex	Age	Urine culture	DJS culture after treatment
1	Male	26	Pseudomonas aeruginosa	No colonization
2	Male	36	Pseudomonas aeruginosa	Pseudomonas aeruginosa
3	Female	18	Pseudomonas aeruginosa	No colonization
4	Male	44	Pseudomonas aeruginosa	Candida spp.
5	Male	35	Candida spp.	Candida spp.
6	Female	39	Candida spp.	No colonization
7	Female	75	Candida albicans	Candida albicans
8	Male	32	E. Coli ESBL+	Candida spp.
9	Female	58	E. Coli ESBL+	No colonization
10	Female	26	Klebsiella pneumoniae	Klebsiella pneumoniae

Table 3. Demographic characteristics of the study group (n=135)

Description	All patients (100%)	DJS culture negative patients (74%)	DJS culture positive patients (26%)	P
Number of patients	135	100	35	
Age	43.7±17,9	42.86±17.7	46.12±18.5	0.36
Sex Male Female	83 (61.4%) 52 (38.6%)	66 (66%) 34 (34%)	17 (48.5%) 18 (51.5%)	0.11
Predisposing factor (DM,etc.)	20 (14.8%)	15 (15%)	5 (14.2%)	0.92
DJS encrustation	42 (31.1%)	27 (27%)	15 (42.8%)	0.015
DJS Indwelling time	52 days	46.2 days	68.6 days	0.001
DJS Indwelling time >60 days	38 (28.1%)	16 (16%)	22(62.8%)	0.0001
High fever (>37,8 °c)	15 (11.1%)	10 (10 %)	5 (14.2%)	0.7
Dysuria	55 (40.7%)	41 (%41)	14 (%40)	0.92
Incontinence	26 (19,.2%)	17 (17%)	9 (25.7%)	0.38
Significant hematuria (>10/mm2)	57 (%42)	41 (41%)	16 (45.7%)	0.77
Significant polyuria (>10 in day)	51 (37.7%)	31 (31%)	20 (57.1%)	0.0001
Significant nocturia (>2 in night)	82 (60.7%)	57 (57%)	25 (71.4%)	0.0001
Pain initially (First 3 days)	46 (34%)	34 (34%)	12 (34.2%)	0.97
Continuous Pain	43 (31.8%)	30 (30%)	13 (37.1%)	0.57
Urgency initially (First 3 days)	41 (30.3%)	31 (31%)	10 (28.5%)	0.96
Continuous urgency	52 (38.6%)	33 (33%)	19 (54.2%)	0.042
Significant leukocyturia (>10/mm2)	74 (54.8%)	51 (51%)	23 (65.7%)	0.02

DISCUSSION

It has been reported that both ureteral DJS usage and problems associated with its application have increased. Patients may experience early symptoms, such as lower abdominal pain, urgency, dysuria, fever, nocturia, and hematuria. The most serious complications in DJS patients include stent migration, stent fragmentation, flank pain, and infection. Stent-related infections are generally thought as being uncommon and asymptomatic, however they have high morbidity, such as fever, acute pyelonephritis, vesicoureteral reflux, chronic renal failure, and even death (7).

In a similar study about LUTS and DJS colonization, Bonkat et al. found a significant correlation between bacterial colonization and stent-related storage LUTS in men. The incidence of bacterial colonization was higher in male patients with storage LUTS and pyuria than in female patients. The authors recommended medical treatment for these patients with a combination of antibiotics and anti-inflammatory drugs (8).

García-Aparicio et al. reported frequent observation of bacterial colonization in DJS patients, with incidence of UTI otherwise being low (9). DJS colonization was higher in younger patients and those who underwent high-pressure balloon dilation were at increased risk of urinary tract infection related to the use of ureteral DJS (9).

Varying rates of bacterial stent colonization and bacteriuria are reported in the literature. The cause of the discrepancies is not clear. It is known that upon insertion of ureteric DJS, a conditioning film forms on its surface; bacteria can adhere to this biofilm layer and form crystals (10). Özgür et al. found that the rate of urinary tract infections associated with DJS was not very high. On the other hand, they found that bacterial colonization increased considerably with DJS indwelling time and a sterile urine culture did not rule out colonization of the DJS (11). Bacteriological evaluation showed very low rates of colonization within 6 weeks of the insertion of the DJS (11). In our study, we also observed increase in both stent colonization and resulting LUTS associated with longer indwelling times.

Riedl et al. reported that the incidence of stent colonization and bacteriuria in patients with indwelling permanent stents was 100%, with colonization in 69% of the temporary stents and associated bacteriuria in 45% (2) Farsi et al. reported a stent colonization rate of 67.9% and associated bacteriuria in 29.9% (12). Reid and Sobel reported stent colonization and bacteriuria rates as 90% and 27%, respectively (13). Akay et al. reported that lower urinary tract infections were seen in 24% and 34% of patients with proximal and distal stent segment colonization, respectively (14). As we did, Al-Ghazo et al. used ciprofloxacin as a broad spectrum antibacterial drug for 5 days as a prophylactic therapy. They found lower colonization rates than those of the other studies cited above (bacterial colonization and bacteriuria rates of 24.2% and 22.5%, respectively) (15). Although a variety of drugs were used in patients complaining of LUTS so

far, Kuyumcuoğlu et al. reported that none of the medical therapies was more effective than any other, or than the control group, in overcoming stent-related symptoms and bothersome symptoms continued for the period of indwelling stent time (16). To reduce these problems, the development of new treatment strategies and improved stent materials and designs are required, the authors concluded (16).

In most of these studies, E. coli was the most commonly isolated pathogen. In our study, however, after the treatment protocol was completed, Candida spp. was the most commonly found pathogen, isolated from 14 out of 35 patients (40%). We also observed lower rates of colonization than those of the cited studies. Urine culture positivity was 7.4% and the DJS culture positivity rate was 26%. We believe that the patients with indwelling ureteral stents and sterile urine cultures may benefit from prophylactic antibiotic treatment prior to endourologic procedures. Some of the studies report that the risk of bacteriuria and ureteric stent colonization with DJS insertion is more common in immune-compromised patients (12,14) and in female patients with urinary infections (12, 15). On the contrary, we found no significant difference in bacteriuria and DJS colonization in female patients and immune-compromised patients.

Regarding stent retention, Riedl et al. and Akay et al. reported no difference in the mean indwelling times between patients with sterile and colonized stents (2,14). On the other hand, Kehinde et al. found a direct association between duration of stent retention and risk of bacteriuria; colonization of DJS was significantly increased with longer periods of stent retention (17). They reported bacteriuria rates of 4.2% for stents removed within 30 days and 34% for stents removed after 90 days (17). Farsi et al. showed that the longer the stenting period, the higher the rate of colonization (58.6% for stents left for <1 month vs. 75.1% for those left for >3 months) (12). Similarly, we found that the rates of stent colonization (mean time was 68.7 days for culture-positive stents) and lower urinary tract infection increased with stent indwelling time. Indwelling time of more than 60 days was especially significant for colonization.

Factors contributing to the rate of DJS encrustation were: the material from which the stent or catheter was made, urine composition, and the duration of usage (18). The ideal ureteral stent biomaterial that prevents infection and encrustation has yet to be discovered. In all our patients, we used ureteric stents made from the same material. We found encrusted stents in 15 out of 35 patients with positive cultures (42.8%) and in 27 out of 100 patients with no colonization (27%). Therefore, 42 out of 135 DJS patients were encrusted (31.1%), of whom 15 were DJS culture-positive (35.7%). We believe that encrustation should be considered as a risk factor for DJS colonization, though it is not significant for all patients.

Irritative symptoms are major clinical problems for patients with an indwelling ureteral stent. Joshi at al. examined the prevalence of symptoms associated with ureteral stents and their impact on health-related quality of life, including a utility analysis based on validation studies of the new Ureteral Stent Symptom Questionnaire (19). Their results demonstrated that 78% of 85 patients reported bothersome urinary symptoms including storage symptoms, incontinence, and hematuria. More than 80% of patients experienced stent-related pain affecting daily activities, 32% reported sexual dysfunction, and 58% reported reduced work capacity and negative economic impact.

In our study, pain (31.8%) and dysuria (40%) were observed more often than reported in the literature and other symptoms like incontinence (19.2%) and hematuria (42%) were observed similar to the other studies' results. We compared the symptoms experienced by DJS patients with and without colonizations and found that irritative voiding symptoms including frequency (polyuria, nocturia, and continuous urgency) occurred significantly more often in bacterially colonized DJS patients, and observed a somewhat higher frequency of leukocyturia in non-colonized DJS patients.

CONCLUSIONS

LUTS, especially irritative voiding symptoms such as polyuria and nocturia, are more frequent in DJS patients with colonization. DJS indwelling time and encrustation are the main predisposing factors for stent colonization. Patients at risk of stent colonization should be followed up for infections; prophylactic treatment that also includes anti-fungal drugs should be administered. In addition, indwelling time may be shortened to prevent colonization.

Acknowledgements:
Disclaimer: Abstract presented in South Eastern Urology Congress, Belgrade 2014.
Conflict of Interest: None
Funding disclosure: None

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