Original Article
Özgün Araştırma

Endourol Bull 2021;13(2);47-55 e-ISSN:2148-0532

Is the clinical significance of double-J stent colonization following ureteroscopic lithotripsy ignored?

Üreteroskopik litotripsi sonrası yerleştirilen double-J stentteki kolonizasyonun klinik önemi göz ardı edilir mi?

Mehmet Çağlar Çakıcı[1], Ferhat Keser[1], Meftun Çulpan[1], Özgür Efiloğlu[1], Uygar Miçooğulları[2], Ahmet Tahra[1], Asıf Yıldırım[1]

1 Department of Urology, Istanbul Medeniyet University, Goztepe Training and Research Hospital, Istanbul, Turkey
2 Department of Urology, Tepecik Training and Research Hospital, Izmir, Turkey

ÖZET

Amaç: Double-J stent (DJS) üzerinde mikroorganizmaların kolonize olmasının önemini değerlendirmek ve idrar yolu enfeksiyonuna (İYE) veya kolonizasyona neden olmayacak veya daha az olmasına neden olacak en güvenli DJS kalma süresini belirlemek. Diğer bir amaç ise DJS kolonizasyonunu etkileyen faktörleri incelemekti.

Gereç ve Yöntemler: Kliniğimizde Kasım 2017-Şubat 2020 tarihleri arasında üreteroskopik litotripsi uygulanan hastaların verileri geriye dönük olarak incelendi ve DJS kültürü olan hastalar çalışmaya dahil edildi. Hastalar DJS kolonizasyonu pozitif (grup 1) ve DJS kolonizasyonu negatif (grup 2) olmak üzere iki gruba ayrıldı.

Bulgular: Ardışık 215 DJS'nin kolonizasyon oranı %31,2 idi. Özellikle 7. dekat ve sonrasında belirgin olmakla birlikte kolonizasyon yaş ilerledikçe daha fazla görüldü (p=0,013). Ortalama DJS kalma süresi grup 1'de 43,1±40,0 gün ve grup 2'de 32,0±15,6 gündü (p=0,032). 4 hafta veya daha az, 4-6 hafta ve 6 haftadan uzun süreli DJS'lerin kolonizasyon oranları sırasıyla %27,5, %26 ve %50 idi (p=0,017). DJS kolonizasyonu, İYE görülmesi ve idrar kültürü pozitifliği ile pozitif korelasyon gösterdi (sırasıyla kappa (κ) katsayısı=0,100, κ=0,216, p<0,05). Çok değişkenli regresyon analizi, İYE'ye neden olan bağımsız risk faktörlerinin stent çıkarılmadan önceki idrar kültürünün pozitif olması (OR:29,487, p<0,001) ve >6 hafta DJS bulunma süresi (OR:7,584, p=0,003) olduğunu gösterdi.

Sonuç: İdrar kültürü pozitifliği ve DJS'nin 6 haftadan uzun sürmesi, DJS'li hastalarda üreteroskopik litotripsi sonrası İYE'yi öngörebilecek faktörlerdir. Ayrıca yüksek komorbidite skoru, İYE öyküsü ve idrar kültürü pozitifliği de DJS kolonizasyonu için bağımsız risk faktörleridir.

Anahtar Kelimeler: *Kolonizasyon, double j stent, üreteroskopi, idrar kültürü, idrar yolu enfeksiyonu, ürolitiyazis*

This study was approved by the Ethic Committee of Clinical Researches of Istanbul Medeniyet University (Approval Number: 2020/0347, Date: June 10, 2020). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

Corresponding Author : Mehmet Çağlar Çakıcı, MD, FEBU, Eğitim Mahallesi, Dr. Erkin Cd., 34722 Kadıköy, Istanbul / Turkey
Tel: +90 537 610 24 38 ***e-mail:*** mcaglarcakici@hotmail.com
Received : July 10, 2021 - ***Accepted*** : July 23, 2021

ABSTRACT

Objective: To assess the significance of colonizing microorganisms in double-J stent (DJS) and determine the safest indwelling time of DJS that would cause no or less urinary tract infection (UTI) or colonization. Another objective was to examine the factors that influence DJS colonization.

Material And Methods: The data of patients that underwent ureteroscopic lithotripsy in our clinic from November 2017 till February 2020 were retrospectively reviewed and patients with DJS culture were included in the study. The patients were divided into two groups: DJS colonization positive (group 1) and DJS colonization negative (group 2).

Results: The colonization rate of 215 consecutive DJSs was 31.2%. Colonization increased with increasing age, especially in the 7th decade and later (p=0.013). The mean duration of DJS indwelling was 43.1±40.0 days in group 1 and 32.0 ± 15.6 days in group 2 (p=0.032). The colonization rates of DJS indwelling for 4 week or less, 4-6 weeks, and more than 6 weeks were 27.5%, 26.0% and 50.0%, respectively (p=0.017). DJS colonization positively correlated with development of UTI and urine culture positivity (kappa (κ) coefficient=0.100, κ=0.216, respectively, p<0,05). The multivariate regression analysis showed that the independent risk factors associated with UTI were urine culture positivity before stent removal (OR:29.487, p<0.001) and >6 weeks DJS indwelling time (OR:7.584, p=0.003).

Conclusion: Urine culture positivity and DJS indwelling longer than 6 weeks were the factors that could predict UTI in patients with DJS after ureteroscopic lithotripsy. In addition, high comorbidity score, UTI history and urine culture positivity were independent risk factors for DJS colonization.

Keywords: *Colonization, double j stent, ureteroscopy, urine culture, urinary tract infection, urolithiasis.*

INTRODUCTION

The double-J stent (DJS) is frequently used for urinary drainage after endourological stone surgery. Despite its therapeutic benefits, DJS may be associated with troublesome urinary symptoms such as dysuria, hematuria, flank pain or minor complications such as urinary tract infection (UTI), migration, breakage, and encrustation. All DJSs can form a biofilm with certain proportions of bacterial adherence irrespective of the stent indwelling time. Almost all DJSs can encrust if left in urinary tract for a sufficiently long period (1).

The colonization on the DJS plays an important role in the pathogenesis of DJS-related infection (2). Publications reporting no correlation between colonization and UTI are also available in the literature (3). Therefore, we aimed to evaluate the significance of colonizing microorganisms in DJS and determine DJS's safest indwelling time with no or less UTI or colonization. In addition, we also aimed to examine the factors that influence DJS colonization.

MATERIAL AND METHODS

After the approval of the local ethics committee (approval date is 10.06.2020 and decision number is 2020/0347), the records of patients that underwent ureteroscopic lithotripsy in our clinic between November 2017 and February 2020 were retrospectively reviewed. Among the patients that underwent DJS insertion at the end of the operation those that had cultures in their DJS were included in the study. All DJSs were produced from polyurethane material. Patients younger than 18 years of age, patients that underwent bilateral stenting or nephrostomy during surgery, immune-compromised patients and the ones with urethral or ureteral obstructions, uncontrolled coagulopathies, and non-sterile urine culture were excluded from the study. All patients received antibiotic prophylaxis administration half an hour before the surgery with 2nd or 3rd generation cephalosporin by a single dose. Preoperative urine cultures were sterile in all patients. Antibiotic therapy was not administered to any patient in the postoperative period.

The stents were removed under aseptic conditions, and a urine culture was obtained within 1 week before the stents removal. After DJS was removed, it was sent to microbiology laboratory as a whole in a sterile container for culture. All of the samples were inoculated on eosin methylene blue (EMB) agar and blood

agar for cultures as whole stent. Positive cultures were described as the growth of >105 colony-forming units (cfu)/ml of a single pathogen. UTI that occurred until DJS were removed were recorded. The patients were divided into two groups based on whether they had colonization on the ureteral DJS in the postoperative period: colonization positive (group 1) and colonization negative (group 2).

Statistical Analysis

The analysis of data was performed by using the Statistical Package for the Social Sciences version 22 for Windows (SPSS Inc., IBM, NY, USA). One-Sample Kolmogorov-Smirnov test was applied to the variables with quantitative values. The t-test was used for the variables of quantitative data that had a normal distribution and the Mann-Whitney test was utilized for the others. The Pearson chi-square, Fisher's exact tests or Z-test were used for the comparison of independent categorical variables. Pearson correlation analysis was performed to determine the compatibility between the colonization and urine culture or UTI. Binary logistic regression analysis was used to assign independent risk factors associated with DJS colonization. Multivariate analysis was performed with parameters that were found to be significant in univariate analysis. The level of statistical significance was defined as $p<0.05$.

RESULTS

A total of 215 consecutive patients that underwent ureteroscopic lithotripsy and DJS insertion were enrolled in the study. Among the all patients, colonization of the stent was found in 67 (31.2%) DJSs. The mean age of group 1, which contained 36 male (53.7%) and 31 female patients (46.3%), was 53.0 ± 15.1 years. The mean age of group 2 was 48.9 ± 14.0 ($p=0.058$), with 98 (66.2%) male and 50 (33.8%) female patients ($p=0.080$). Colonization also increased with increasing age. This difference was statistically significant in the 7th decade and later ($p=0.013$). Among the patients in group 1, 26 (38.8%) had hypertension (HT), 23 (34.3%) had diabetes mellitus (DM), 6 (9.0%) had chronic renal disease (CRD), 5 (7.5%) had chronic heart disease (CHD), and 5 (7.5%) had malignancy. In group 2, 28 (18.9%) patients had DM and 2 (1.4%) had CRD ($p<0.05$). Charlson comorbidity index (CCI) value was 2.3 ± 2.0 in group 1 and 1.5 ± 1.8 in group 2 ($p=0.004$). Preoperative UTI history was higher in group 1 than in group 2 (43.3% vs 11.5%, respectively, $p<0.001$). The frequency of preoperative catheterization such as DJS and percutaneous nephrostomy was higher in group 1 compared to group 2 (40.3% and 20.9%, respectively, $p<0.001$). While retrograde intrarenal surgery (RIRS) indication was higher in group 1, ureteroscopy (URS) indication was higher in group 2 (62.7% and 52.0%, respectively, $p=0.045$).

The mean duration of DJS indwelling was 43.1 ± 40.0 days in group 1 and 32.0 ± 15.6 days in group 2 ($p=0.032$). The colonization rates of DJS indwelling for 4 week or less, 4-6 weeks, and more than 6 weeks were 27.5%, 26.0%, and 50.0%, respectively ($p=0.017$). Febrile UTI was higher in group 1 than group 2 (10.4% vs 2.7%, respectively, $p=0.038$). Overall, 22.4% of the patients had positive urine culture in group 1 and 4.7% in group 2 before DJS removal ($p<0.001$, Table 1). In group 1, febrile UTI developed in 5 (33.3%) of 15 patients with positive urine culture and in 2 patients with negative urine culture. In group 2, UTI developed in 3 (42.9%) of 7 patients with positive urine culture and in one patient with negative urine culture. The most commonly isolated pathogen in the urine culture were Escherichia coli (31.8%), followed by Enterococcus faecalis (22.7%) and Klebsiella pneumoniae (18.2%). In the DJS culture, the most frequently isolated microorganisms were determined as Enterococcus faecalis (26.9%), Escherichia coli (19.4%), and Candida albicans (14.9%) ($p<0.001$, Table 2).

There was a positive correlation between DJS colonization and urine culture before DJS removal (kappa (κ) coefficient = 0.216, $p<0.001$). The sensitivity of DJS colonization for urine culture positivity was 68.2%, specificity was 73.1%, positive predictive value was 22.4%, and negative predictive value was 95.3%. Similarly, DJS colonization was positively correlated with development of UTI ($\kappa = 0.100$, $p=0.017$). The sensitivity of DJS colonization for febrile UTI was 63.6%, specificity was 70.6%, positive predictive value was 10.4%, and negative predictive value was 97.3%. Univariate regression analyses showed that CCI, DM, CRD, preoperative catheterization, surgery type, DJS indwelling time, and urine culture positivity before DJS removal significantly increased the possibility of DJS colonization ($p<0.05$).

Table 1. Comparison of patients with and without colonization in terms of clinical characteristics.

	Group 1 (n=67)	Group 2 (n=148)	P value
Age, years; mean ± SD	53.0±15.1	48.9±14.0	0.058
Age groups, n (%)			
≤40	17 (27.0)	46 (73.0)	0.490
>40	50 (32.9)	102 (67.1)	
≤50	28 (25.5)	82 (74.5)	0.089
>50	39 (37.1)	66 (62.9)	
≤60	42 (26.3)	118 (73.7)	0.013
>60	25 (45.5)	30 (54.5)	
Gender, n (%)			0.080
Male	36 (53.7)	98 (66.2)	
Female	31 (46.3)	50 (33.8)	
Co-morbidity			
Hypertension	26 (38.8)	40 (27.0)	0.083
Diabetes Mellitus	23 (34.3)	28 (18.9)	0.014
Chronic Renal Failure	6 (9.0)	2 (1.4)	0.012[F-E]
Chronic Heart Disease	5 (7.5)	7 (4.7)	0.522[F-E]
Hypothyroidism	2 (3.0)	10 (6.8)	0.349[F-E]
Malignancy	5 (7.5)	8 (5.4)	0.549[F-E]
Charlson Co-morbidity Index	2.3±2.0	1.5±1.8	0.004
Renal anomaly, n (%)	2 (3.0)	6 (4.1)	0.521[F-E]
Intervention history, n (%)			0.580
Primary	28 (41.8)	51 (34.5)	
Shockwave Lithotripsy	9 (13.4)	30 (20.3)	
Stone surgery	16 (23.9)	38 (25.7)	
Shockwave Lithotripsy & Surgery	14 (20.9)	29 (19.6)	
UTI history, n (%)	29 (43.3)	17 (11.5)	<0.001
Stone size, mm	15.8±8.7	13.9±6.7	0.094
Preoperative hydronephrosis, n (%)	36 (53.7)	82 (55.4)	0.819
Preoperative catheterization, n (%)			<0.001
Absent	40 (59.7)	117 (79.0)	
DJS	20 (29.9)	30 (20.3)	
Percutaneous Nephrostomy	7 (10.4)	1 (0.7)	
Indications for stent insertion, n (%)			0.045
Ureteroscopy	25 (37.3)	77 (52.0)	
Retrograde Intrarenal Surgery	42 (62.7)	71 (48.0)	
Residual stone, n (%)	11 (16.4)	32 (21.6)	0.377
DJS indwelling time, day	43.1±40.0	32.0±15.6	0.032
DJS indwelling time			0.017[Z]
0-4 weeks	28 (27.5)	74 (72.5)	102
4-6 weeks	19 (26.0)	54 (74.0)	73
>6 weeks	20 (50.0)	20 (50.0)	40
Urine culture positivity, n (%)	15 (22.4)	7 (4.7)	<0.001
Postoperative UTI, n (%)	7 (10.4)	4 (2.7)	0.038[F-E]

UTI: *Urinary tract infection* ***DJS:*** *Double-J stent* [F-E]***:*** *Fisher's exact test* [Z]***:*** *Z-test*

Table 2. Pathogens cultured from urine and DJS.

Microorganism, n (%)	DJS	Urine culture	P value
Sterile	148 (68.8)	193 (89.8)	<0.001
Non-sterile	67 (31.2)	22 (10.2)	
Escherichia coli	13 (19.4)	7 (31.8)	
Enterococcus faecalis	18 (26.9)	5 (22.7)	
Klebsiella pneumoniae	2 (3.0)	4 (18.2)	
Pseudomonas aeruginosa	6 (9.0)	3 (13.6)	
Candida albicans	10 (14.9)	1 (4.5)	
Staphylococcus epidermidis	6 (9.0)	1 (4.5)	
Streptococcus agalactiae	2 (3.0)	1 (4.5)	
Staphylococcus hemolyticus	3 (4.5)	-	
Corynebacterium	3 (4.5)	-	
Serratia marcescans	1 (1.5)	-	
Lactobacillus	1 (1.5)	-	
Streptococcus mitis	1 (1.5)	-	
Staphylococcus lugdunensis	1 (1.5)	-	
Staphylococcus aureus	-	-	
Proteus mirabilis	-	-	

DJS: *Double-J stent*

Table 3. Univariate and multivariate logistic regression analysis of predicting factors for DJS colonization.

	Binary Logistic Regression (n=215)									
	Univariate Model					Multivariate Model				
	OR	95% CI			P value	OR	95% CI			P value
Age	1.021	1.000	-	1.042	0.051	1.007	0.965	-	1.051	0.745
Gender	0.592	0.329	-	1.068	0.081	1.211	0.574	-	2.552	0.615
CCI	1.244	1.065	-	1.453	**0.006**	1.218	1.026	-	1.447	**0.025**
DM	2.240	1.169		4.295	**0.015**	1.517	0.573	-	4.022	0.402
HT	1.712	0.930	-	3.154	0.084					
CRF	7.180	1.410	-	36.573	**0.018**	3.237	0.389	-	26.918	0.277
CHD	1.624	0.496	-	5.318	0.423					
Hypothyroidism	0.425	0.090	-	1.994	0.278					
Malignancy	1.411	0.444	-	4.487	0.559					
Renal anomaly	0.728	0.143	-	3.706	0.702					
Stone size	1.033	0.994	-	1.073	0.097					
Surgery history	0.732	0.405	-	1.324	0.302					
UTI history	5.881	2.923	-	11.833	**<0.001**	5.187	2.475	-	10.871	**<0.001**
Preoperative catheterization	2.548	1.359	-	4.776	**0.004**	2.026	0.953	-	4.309	0.067
Surgery type	1.822	1.009	-	3.290	**0.047**	1.412	0.661	-	3.020	0.373
Residual fragment	0.712	0.334	-	1.516	0.378					
DJS indwelling time	1.018	1.004	-	1.033	**0.014**	1.001	0.986	-	1.017	0.851
Urine culture positivity	5.810	2.243	-	15.052	**<0.001**	3.200	1.109	-	9.235	**0.031**

OR: *Odds ratio*, ***CI:*** *Confidence interval,* ***CCI:*** *Charlson co-morbidity index,* ***DM:*** *Diabetes mellitus,* ***HT:*** *Hypertension,* ***CRD:*** *Chronic renal failure,* ***CHD:*** *Chronic heart disease,* ***UTI:*** *Urinary tract infection,* ***DJS:*** *Double-J stent*

Table 4. Univariate and multivariate logistic regression analysis of predicting factors for UTI that underwent DJS insertion.

	Binary Logistic Regression (n=215)									
	Univariate Model					Multivariate Model				
	OR	95% CI			P value	OR	95% CI			P value
Age	0.986	0.945	-	1.029	0.521					
Gender	0.209	0.054	-	0.812	**0.024**	0.282	0.040	-	1.986	0.204
CCI	1.122	0.833	-	1.511	0.448					
DM	2.862	0.835		9.806	0.094					
HT	0.839	0.215	-	3.269	0.801					
CRF	14.925	3.024	-	73.653	**0.001**	9.501	0.528	-	171.049	0.127
CHD	1.755	0.206	-	14.965	0.607					
Hypothyroidism	1.755	0.206	-	14.965	0.607					
Malignancy	7.275	1.671	-	31.681	**0.008**	0.966	0.044	-	21.455	0.983
Renal anomaly	2.814	0.315	-	25.134	0.354					
Stone size	0.990	0.909	-	1.079	0.822					
Surgery history	1.065	0.632	-	1.794	0.814					
UTI history	4.920	1.429	-	16.936	**0.012**	1.661	0.292	-	9.445	0.567
Preoperative catheterization	2.374	0.696	-	8.101	0.167					
Surgery type	4.327	0.912	-	20.521	0.065					
DJS indwelling time	1.008	0.994	-	1.023	0.277					
>6 weeks DJS	10.687	3.037	-	37.610	**<0.001**	7.584	2.023	-	28.436	**0.003**
DJS colonization	4.200	1.186	-	14.879	**0.026**	1.955	0.357	-	10.702	0.440
Urine culture positivity	36.190	8.629	-	151.778	**<0.001**	29.487	5.033	-	172.763	**<0.001**

OR: *Odds ratio,* ***CI:*** *Confidence interval,* ***CCI:*** *Charlson co-morbidity index,* ***DM:*** *Diabetes mellitus,* ***HT:*** *Hypertension,* ***CRF:*** *Chronic renal failure,* ***CHD:*** *Chronic heart disease,* ***UTI:*** *Urinary tract infection,* ***DJS:*** *Double-J stent*

Furthermore, multivariate binary logistic regression analyses of these risk factors revealed that CCI (95% confidence interval (CI)): 1.026–1.447, odds ratio (OR): 1.218, p=0.025), UTI history (95% CI: 2.475–10.871, OR: 5.187, p<0.001), and urine culture positivity (95% CI: 1.109–9.235, OR: 3.200, p=0.031) were independent risk factors for DJS colonization (Table 3). When the univariate regression analysis was performed for UTI, it was found that UTI-related risk factors were gender, CRD, malignancy, UTI history, >6 weeks indwelling time, DJS colonization, and urine culture positivity. The multivariate regression analysis showed that the independent risk factors associated with UTI were >6 weeks indwelling time (OR:7.584, p=0.003) and urine culture positivity (OR: 29.487, p<0.001, Table 4).

DISCUSSION

The use of DJS has been an important step in urological surgical procedures for more than two decades and is more comfortable for both the patient and the surgeon. However, as with any foreign object left in the body, there are some complications associated with short or long term use of indwelling DJS. There are various nomograms in which postoperative success and complications are evaluated, and urinary infections are one of the most common causes of prolonged hospital stay (4). One of the most common complications that may lead to life-threatening situations is UTI (1). Approximately 80% of nosocomial UTIs are associated with urological instrumentation, particularly the use of DJS (5). Preoperative routine urine culture and prophylactic antibiotics are administered to prevent the development of UTI. Apart from that, microorganisms colonizing the DJS can also give an idea about the clinical course, but the relationship between DJS and the occurrence of UTI is not clear. Therefore, this study aimed to address the clinical significance of the DJS culture and to examine the factors that affect DJS colonization.

It has been reported that DJS cultures differ in up to approximately half of the patients according to their urine cultures. A biofilm layer formed by protein, electrolytes and unknown molecules causing bacterial adhesion on the DJS is responsible for the microorganism colonization (6). Even if microorganisms in biofilms are not the main cause of symptomatic UTIs, they might become pathogens that cause bacteremia and urosepsis during or after endoscopic urological surgery (3). Poor correlations between preoperative urine cultures and stent cultures have previously been reported (7). This discrepancy may be explained by mechanisms and effects of biofilm formation on DJSs (8). Zumstein et al. (8) also reported that preoperative routine urine culture does not reliably detect microorganism that are present in the urinary collecting system of patients with indwelling DJSs and this might results in complications. Bacteria embedded in DJS biofilms are difficult to detect in standard urine cultures and can become a source of infection by contaminating the urinary system during surgical manipulations and intraoperative flushing.

A wide range of rates of bacterial colonization have been reported in the literature. Riedl et al. (2) reported that this rate was 100% in permanent stents and 69% in temporary stents. Some studies also reported that colonization on DJS was below 35% (9-11). In the current study, we detected microorganism colonization in 31.2% of DJSs which is similar to the previously reported studies (9,10). The reasons for difference in colonization rates may include the stent material, indwelling time, and the difference in antibiotics use. The rate of bacteriuria in the general population in our study was found to be 10.2%. This rate was 22.4% in patients with positive DJS colonization. These rates show us that not every colonization will result in bacteriuria. The most commonly identified pathogens on DJS were Enterococcus faecalis, Escherichia coli and Candida albicans, respectively. Microorganism variation and frequency were statistically different from factors grown in urine culture.

When the risk factors affecting colonization on DJS were examined, we found that colonization increased with increasing age. Unlike the literature, we saw that there was a significant difference in favor of microorganism colonization, especially after the 7th decade. While some studies reported that age is a risk factor in the development of UTI, some studies reported that it did not affect DJS colonization (11-14). As in our study, Akay et al. (9) reported that age was a risk factor for colonization. Although increasing age also increased the risk of UTI development, it was not statistically significant. Similar to the majority of the literature, we found that there is no difference in colonization in female gender, where UTI is more common (11). Although DJS colonization was relatively more frequent in female gender, it was not statistically significant. However, Akay et al. (9) mentioned that the risk of colonization increased in women.

DJS colonization rates were significantly higher in patients with diabetes mellitus (DM) and chronic renal failure (CRF). Similarly, Al-Ghazo et al. (15) reported that unlike other comorbidities, DM, CRF and malignancies could be risk factors for DJS colonization and bacteriuria due to their immune suppression effect. In our study, the Charlson comorbidity index was higher in the group with positive DJS colonization. We found that DJS colonization was significantly higher in patients with a history of UTI. This made us think that patients prone to colonization are actually more susceptible to infection. Moreover, certain studies have revealed that bacteriuria is very common in patients with urolithiasis with rates ranging from 21% to 34% (16-18). In our study, we also found that DJS colonization was higher in patients with preoperative urinary catheters.

When examined in terms of surgery indications, RIRS was found to be a more risky procedure in terms of DJS colonization compared to URS. The higher rate of colonization after the procedures performed in the proximal urinary system was borderline significant. Some studies have also reported that the indication for surgery does not affect colonization (11).

As in most studies on this subject in the literature, we examined the effect of indwelling time on colonization. We found that the colonization rate was higher in patients with longer indwelling time. In one of the studies that stated that removing DJS early will reduce colonization, Ozgur et al. (10) reported that after 6 weeks, colonization increased from 2% to 25%. In our study, the colonization rate increased to 50% in DJSs

longer than 6 weeks. Many studies have reported that the probability of colonization increases especially as DJS indwelling time gets longer (12,19). Toprak et al. (13) reported DJS colonization rate of 4.4% within 15 days and 13.3% within 30 days. Unlike the literature, Aydin et al. (11) stated that significant colonization may be found in the first 3 weeks after the operation. Akay et al. (9) suggested that increasing the duration of DJS increased colonization, but this was not significant for UTI. They found that the risk factors for UTI in patients with DJS were DM, CRF, and pregnancy. In our study, DJS colonization had a negative effect on both bacteriuria and UTI. These results were statistically significant in the correlation analysis.

There are few studies examining factors predictive of DJS colonization. In one of them, only female gender (3.7 fold) was found as the predictive factor (20). Our multivariate regression analysis revealed that independent factors predicting DJS colonization were CCI, UTI history, and urine culture positivity. In predicting UTI, >6 weeks DJS indwelling time and urine culture positivity were found as independent factor. Ozgur et al. (10) stated that bacterial colonization increases significantly with indwelling time of DJS, especially after 6 weeks. However, they could not clearly demonstrate its effect on UTI due to the small number of patients. Paick et al. (14) found that DJS colonization by multiple microorganisms starts at two weeks and is followed by a UTI. Akay et al. (9) indicated that indwelling time, age, and female gender increase DJS colonization, but these factors were not significant for UTI.

This study had some limitations such as its retrospective design with a relatively limited number of patients who had UTI. Secondly, there may also have been a selection bias, as the study was planned in a tertiary referral hospital. The study contained a higher proportion of patients who were treated with multiple antibiotics and therefore had more resistant microorganisms. Another limitation is that the antibiotic given preoperatively might have changed the bacterial flora. Finally, stool culture was not evaluated even though bacteria within the stool could affect urinary colonization. Despite these limitations, the relative high number of patients compared to the studies in the literature and the single-center analysis were the strengths of the study.

CONCLUSION

We concluded that >6 weeks DJS indwelling time and urine culture positivity before stent removal were able to predict UTI in patients with DJS after urinary stone surgery. However, since DJS colonization shows correlation with urine culture and UTI, especially in patients over 60 years of age that have DM, CRF, UTI history, and preoperative catheter, evaluating DJS culture may be beneficial in terms of predicting UTI in the postoperative period. In addition, DJS indwelling time of less than 6 weeks was shown to reduce colonization and UTI in these patients.

Financial Disclosure: The authors declared that this study has received no financial support.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical Approval: The study was approved by the Ethic Committee of Istanbul Medeniyet University, Goztepe Training and Research Hospital (Approval number: 2020/0347, Date: June 10, 2020). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

REFERENCES

1. Haleblian G, Kijvikai K, de la Rosette J, Preminger G. Ureteral stenting and urinary stone management: a systematic review. J Urol. 2008;179:424-430.
2. Riedl CR, Plas E, Hübner WA, Zimmerl H, Ulrich W, Pflüger H. Bacterial colonization of ureteral stents. Eur Urol. 1999; 36:53-59.
3. Ben-Meir D, Golan S, Ehrlich Y, Livne PM. Characteristics and clinical significance of bacterial colonization of ureteral double-J stents in children. J Pediatr Urol. 2009; 5:355-358.

4. Selmi V, Sari S, Oztekin U, Caniklioglu M, Isikay L. External Validation and Comparison of Nephrolithometric Scoring Systems Predicting Outcomes of Retrograde Intrarenal Surgery. J Endourol. 2021; 35:781-788.
5. Paz A, Amiel GE, Pick N, Moskovitz B, Nativ O, Potasman I. Febrile complications following insertion of 100 double-J ureteral stents. J Endourol. 2005; 19:147-150.
6. Habash M, Ried G. Microbial biofilms: their development and significance for medical device-related infections. J Clin Pharmacol. 1999; 39:887.
7. Nevo A, Mano R, Schreter E, Lifshitz DA. Clinical Implications of Stent Culture in Patients with Indwelling Ureteral Stents Prior to Ureteroscopy. J Urol. 2017; 198:116-121.
8. Zumstein V, Betschart P, Buhmann MT, et al. Detection of microbial colonization of the urinary tract of patients prior to secondary ureterorenoscopy is highly variable between different types of assessment: results of a prospective observational study. Biofouling. 2019; 35:1083-1092.
9. 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; 39:95-98.
10. Ozgur BC, Ekıcı M, Yuceturk CN, Bayrak O. Bacterial colonization of double J stents and bacteriuria frequency. Kaohsiung J Med Sci. 2013; 29:658-661.
11. Aydin HR, Irkilata L, Aydin M, et al. Incidence of bacterial colonisation after indwelling of double-J ureteral stent. Arch Ital Urol Androl. 2016; 87:291-294.
12. Nevo A, Golomb D, Lifshitz D, Yahav D. Predicting the risk of sepsis and causative organisms following urinary stones removal using urinary versus stone and stent cultures. Eur J Clin Microbiol Infect Dis. 2019; 38:1313-1318.
13. Toprak T, Şahin A, Kutluhan MA, et al. Does duration of stenting increase the risk of clinical infection? Arch Ital Urol Androl. 2020; 91:237-240.
14. Paick SH, Park HK, Oh SJ, Kim HH. Characteristics of bacterial colonization and urinary tract infection after indwelling of double-J ureteral stent. Urology. 2003; 62:214-217.
15. Al-Ghazo MA, Ghalayini IF, Matani YS, El-Radaideh KM, Haddad HI. The risk of bacteriuria and ureteric stent colonization in immune-compromised patients with double J stent insertion. Int Urol Nephrol. 2010; 42:343-347.
16. Roushani A, Falahatkar S, Sharifi SH, et al. Intra-operative stone culture as an independent predictor of systemic inflammatory response syndrome after percutaneous nephrolithotomy. Urolithiasis. 2014; 42:455-459.
17. Osman Y, Elshal AM, Elawdy MM, et al. Stone culture retrieved during percutaneous nephrolithotomy: is it clinically relevant? Urolithiasis. 2016; 44:327-332.
18. Shoshany O, Margel D, Finz C, et al. Percutaneous nephrolithotomy for infection stones: what is the risk for postoperative sepsis? A retrospective cohort study. Urolithiasis. 2015; 43:237-242.
19. Shabeena KS, Bhargava R, Manzoor MAP, Mujeeburahiman M. Characteristics of bacterial colonization after indwelling double-J ureteral stents for different time duration. Urol Ann. 2018; 10:71-75.
20. Kozyrakis D, Perikleous S, Chatzistamou SE, et al. Is There a Role for Double J Stent Culture in Contemporary Urology? Urol Int. 2018; 100:203-208.