Urologia Internationalis

Research Article

Urol Int 2023;107:772–777
DOI: 10.1159/000531482

Received: March 19, 2023
Accepted: June 6, 2023
Published online: July 14, 2023

Optimal Dwelling Time for Ureteral Stents Placed for Passive Dilation after Impassable Ureteroscopy

Ali K. Yildiz[a] Arif Bayraktar[b] Turgay Kacan[a] Bugra B. Keseroglu[a] Berat C. Ozgur[b] Omer G. Doluoglu[b] Tolga Karakan[a]

[a]Department of Urology, Ankara City Hospital, Ankara, Turkey; [b]Department of Urology, Ankara Training and Research Hospital, Ankara, Turkey

Keywords
Dilation · Kidney · Stent · Stone · Ureter · Urolithiasis

Abstract
Introduction: The aim of the study was to determine the correlation between the dwelling time for a ureteral stent placed for passive dilation after impassable ureteroscopy and success and complications. ***Methods:*** A retrospective evaluation was made of patients who underwent stent placement after impassable ureteroscopy and a repeat ureteroscopy due to kidney stones. A total of 161 patients were included in the study between 2015 and 2022. Demographic, clinical, preoperative, and perioperative data were collected. Logistic regression analyses were performed on the data showing a significant difference in the univariate analyses performed to determine the predictive factors of ureteroscopy after the stent dwelling period in terms of stone-free status and perioperative complications. ***Results:*** Stone-free status was achieved in 110 (68.3%) of 161 patients, and perioperative complications were observed in 41 (25.4%). Factors that affected the stone-free status were determined as the dwelling time and the S-ReSC score, while factors affecting perioperative complications were the stent dwelling time and the operation time. The stone-free rates were observed to increase from 46.4% in the first 2 weeks to 72.9% after the 2nd week, an increase of 1.5-fold. Perioperative complications were determined at the rate of 17.5% during the first 5 weeks and increased 2.1-fold to 37.5% after the 5th week. ***Conclusion:*** It can be recommended that great care is taken during the stent dwelling period and ureteroscopy should be performed within 5 weeks (14–35 days) but no earlier than 2 weeks, so as not to affect the success of the procedure.

Introduction

Standard access to the ureter may be difficult for endoscopic management of stone disease due to anatomic abnormalities, narrow ureteral lumen, kinked ureter, or previous ureteral instrumentation [1]. In case of difficult access or failure of access, a double-J ureteral stent is a safe and effective approach to allow passive ureteral dilation prior to definitive treatment [2].

Stone access failure in the first ureteroscopy treatment has been reported at the rate of 11.5%, and these patients have to undergo a second ureteroscopy with a ureteral stent. The reasons for failure of the first procedure have been reported to be a narrow ureteral orifice, difficulty

karger@karger.com
www.karger.com/uin

Correspondence to:
Ali Kaan Yildiz, alikaanyildiz@gmail.com

Karger

crossing the iliac crest, poor vision due to bleeding, and a narrow ureteral lumen [3]. Passive dilation with an elective ureteral stent has been shown to be associated with better stone-free rates (SFR), shorter operative time, and fewer complications [2, 4]. However, the presence of a ureteral stent and increased dwelling time can increase the risk of septic complications, as well as flank pain, storage symptoms, hematuria, and dysuria often occur [5]. The purposes of this study were to investigate how dwelling time affects the success and complication rates in patients with a ureteral stent placed because of failed access to kidney stones and to evaluate the optimal dwelling time.

Methods

Approval for the study was granted by the Institutional Ethics Committee. All procedures of the study were performed in accordance with the principles of the Declaration of Helsinki. The hospital database was screened for the relevant patients between April 2015 and January 2022.

Surgical Methods

The study included patients who underwent retrograde intrarenal surgery (RIRS) for kidney stones after passive dilation with a ureteral stent after impassable ureteroscopy. If the semirigid ureteroscope (6.5 Fr, Richard Wolf, Knittlingen, Germany) did not pass through the ureter in the first ureteroscopy, the operation was postponed by placing a double-J ureteral 6 Fr stent. Balloon or serial dilation was not performed in any patient where the ureter could not be passed. All RIRSs were planned to be performed in the first 4 weeks after stenting for passive dilatation. The patients were called to the outpatient department 3 days later for preparation for the second operation. Then RIRS was planned as soon as possible at the appropriate time according to the patient appointment time, waiting list, and urine culture results. However, the RIRS of some patients was performed after the first 4 weeks due to extended patient appointment time, recurrent urinary tract infection, or the COVID-19 pandemic conditions. After passive dilation, RIRS was performed using a standard technique. The ureteral stent was removed, and then a guidewire was advanced to the renal pelvis. The presence of stones in the ureter was checked by advancing the semirigid ureteroscope (6.5 Fr) up to the pelvis. If the semirigid ureteroscope did not pass through the ureter, the operation was postponed by placing a 6 Fr double-J stent, as safety is the priority in our clinical protocol. If no stone was detected in the ureter, an access sheath (inner diameter 9 Fr, outer diameter 11 Fr) was sent over the guidewire. A flexible ureteroscope (7.5 Fr, Flex X2S, Karl-Storz, Tuttlingen, Germany) was advanced through the access sheath and laser lithotripsy was performed. In cases where the access sheath could not be placed, lithotripsy was performed by advancing the flexible ureteroscope up to the pelvis over the guidewire without the access sheath. No lithotripsy was performed with a semirigid ureteroscope. Stone disintegration was performed using a 273 micron Holmium:yttrium-aluminium-garnet laser. Laser lithotripsy was performed with fragmentation settings (1.5–2.0 J and 10 Hz). In case of residual fragments within the kidney, popcorn lithotripsy with 1.0–1.5 J and 20 Hz was also performed to decrease the size of the fragments. At the end of the procedure, a 6 F double-J ureteral stent was placed to remain for 3 weeks postoperatively and was applied by the same group surgeons.

Urine culture was taken 1 week before RIRS in all cases with placement of a ureteral stent and urine culture was checked during hospitalization on the day before surgery. All the patients who were operated on had sterile urine culture results in the last week. Preoperatively, a single dose of prophylactic iv antibiotic was administered containing 2 g of ceftriaxone depending on the patient's renal function.

Data and Clinical Diagnostic Methods. The double-J stent was removed in all patients 3 weeks after the operation and the SFR was evaluated on non-contrast computed tomography at 4 weeks postoperatively. Stone-free status was defined as the absence of residual stones or the presence of clinically insignificant residual stones <2 mm in total. Cases of failure to advance the ureteroscope in RIRS performed after passive dilation were not considered stone-free. Mild complications were defined as postoperative fever >38.2°C in 48 h, transient serum creatinine increase, temporary or permanent hematuria (<24 h or >24 h), blood transfusion, urinary tract infection (Clavien-Dindo grade 1–2), or the need for an additional intervention due to urinoma and stent migration (Clavien-Dindo grade 3a). Serious complications were defined as ureteral perforation, ureteral avulsion (Clavien-Dindo grade 3b), acute renal failure, or urosepsis (Clavien-Dindo grade 4). Patients with urinary tract infection as a result of urine culture taken due to postoperative fever were accepted as urinary tract infection, and patients without infection were evaluated as postoperative fever.

Variables obtained from the database included sex, age, body mass index, side of the stone, stone volume, density, operation time, and stent dwelling time. Stone volume was calculated by multiplying the lengths of the stones in millimeters in three axes, and the total of the volumes of the stones was defined as the cumulative stone volume. Peak HU of the stone was calculated on non-contrast computed tomography. The stones were evaluated in respect of location in the kidney and a modified Seoul National University Renal Stone Complexity (S-ReSC) score was determined for each patient [6]. The aim of the study was to evaluate the SFR on the imaging performed 4 weeks after the operation and perioperative complications. Data were analyzed to identify potential risk factors that affect SFR and perioperative complications.

Statistical Analysis

Pearson's χ^2 test and Fischer's exact test were used to compare categorical data between groups, and the Mann-Whitney U test and the *t* test were used to compare continuous data. Data were presented as mean ± standard deviation and median and interquartile range values. Univariate analysis was performed to determine all potential predictive factors. All the factors determined to be significant in univariate analysis were then tested in multivariate analysis (logistic regression analysis). A p value of <0.05 was considered statistically significant.

Table 1. Univariate and multivariate analysis of effective factors for stone free in patients undergoing retrograde intrarenal surgery

	Stone-free patients (*n* = 110)	Non-stone-free patients (*n* = 51)	Univariate *p* value	Multivariate *p* value
Sex				
Female	50 (45.5)	26 (51.0)	0.5	
Male	60 (54.5)	25 (49.0)		
Stone location				
Right	59 (53.6)	28 (54.9)	0.8	
Left	51 (46.4)	23 (45.1)		
Age, years	48 (37–54)	46 (34–57)	0.3	
BMI, kg/m^2	27.6 (24.2–32.1)	27.3 (23.2–31.3)	0.5	
Stent dwelling time, weak	5 (3–8)	4 (2–6)	**0.01***	**0.003***
Cumulative stone volume, mm^3	753 (678–831)	950 (862–1,034)	**0.046***	0.1
S-ReSC score	5 (3–7)	6 (4–8)	**0.044***	**0.018***
Stone density HU, peak	952±270	1,028±268	**0.018***	0.1

Data are shown as *n* (%) and mean ± SD or median (interquartile range). BMI, body mass index; S-ReSC, the Seoul National University Renal Stone Complexity; HU, Hounsfield unit; SD, standard deviation. *A statistically significant difference.

Results

A total of 1,016 ureteroscopy procedures were performed for kidney stones in our clinic between April 2015 and January 2022. In 855 of 1,016 (84.2%) patients, the renal pelvis could be reached by passing the ureterorenoscope through the ureter and passive dilatation was not needed. Of these 1,016 patients, 161 (15.8%) were included in the study group as a double-J ureteral stent for passive dilation was placed due to the failure of the ureterorenoscope to progress during the operation. Access sheath could not be placed in 17 of 161 (10.5%) patients and lithotripsy was performed by advancing the flexible ureteroscope over the guidewire. Stone-free status was achieved in 110 (68.3%) of these patients who underwent RIRS for kidney stones after the passive dilation period. The stent dwelling time was significantly longer in patients who were stone-free ($p = 0.01$), as median (interquartile range) 5 (3–8) weeks in patients who were stone-free, and 4 (2–6) weeks in patients who were not stone-free. The total stone volume ($p = 0.046$), the S-ReSC score ($p = 0.044$), and stone density value ($p = 0.018$) were significantly lower in patients who were stone-free (Table 1.). In the multivariate logistic regression analysis with these significantly different factors, the dwelling time (odds ratio [OR] 0.82, 95% CI: 0.71–0.93; $p = 0.003$) and the S-ReSC score (OR 1.23, 95% CI: 1.03) −1.45; $p = 0.018$) were associated with stone-free status (Table 1).

Perioperative complications were observed in 41 (25.4%) of 161 patients who underwent RIRS after the passive dilation period. Of these, 17 (41.0%) had postoperative fever, 5 (12.1%) had postoperative transient elevated creatinine, 16 (39.0%) had temporary or permanent hematuria, and 3 (7.3%) had urinary tract infections (Clavien-Dindo grade 1–2). No patient required blood transfusion, or additional intervention due to urinoma and stent migration, or had ureteral perforation or avulsion, acute renal failure, or urosepsis (Clavien-Dindo grade 3–4). The dwelling time was significantly longer in patients with complications ($p = 0.003$), at median 6 (4–9) weeks in patients with complications, and 4 (3–7) weeks in patients without complications. The total stone volume ($p = 0.048$), S-ReSC score ($p = 0.035$), and operation time ($p = 0.014$) were significantly higher in patients with complications (Table 2). In the multivariate logistic regression analysis with these significantly different factors, the dwelling time (OR 0.84, 95% CI: 0.74–0.95; $p = 0.008$) and the operation time (OR 0.97, 95% CI: 0.95–0.99); $p = 0.033$) were associated with complications (Table 2). The SFRs and complication rates at weekly intervals according to stent dwelling times are shown in Figure 1.

Discussion

In this study, the correlations between stent dwelling time and success and complications were evaluated in patients with double-J ureteral stent implantation due to inaccessibility to kidney stones. The study results demonstrated that a short dwelling time reduces success, while a long dwelling time increases complications.

Table 2. Univariate and multivariate analysis of risk factors for the complications in patients undergoing retrograde intrarenal surgery

	Patients with complication (n = 41)	Patients without complication (n = 120)	Univariate p value	Multivariate p value
Sex				
Female	18 (43.9)	58 (48.3)	0.6	
Male	23 (56.1)	62 (51.7)		
Stone location				
Right	19 (46.3)	68 (56.7)	0.2	
Left	22 (53.7)	52 (43.3)		
Age, years	46 (34–51)	48 (37–57)	0.1	
BMI, kg/m^2	27.7 (25.6–32.6)	27.3 (24.2–31.8)	0.3	
Stent dwelling time, weak	6 (4–9)	4 (3–7)	**0.003***	**0.008***
Cumulative stone volume, mm^3	964 (882–1,066)	904 (814–1,008)	**0.048***	0.1
S-ReSC score	5 (3–7)	4 (3–5)	**0.035***	0.2
Stone density HU, peak	1,014±287	916±218	0.1	
Operation time, minute	65 (55–73)	56 (45–64)	**0.014***	**0.033***

Data are shown as n (%) and mean ± SD or median (interquartile range). BMI, body mass index; S-ReSC, the Seoul National University Renal Stone Complexity, HU, Hounsfield unit; SD, standard deviation. *A statistically significant difference.

Stone-free status and perioperative complications were associated with stent dwelling times. There was a 2.1-fold increase in complication rate at >35 days compared to ≤35 days, and a 1.5-fold increase in SFR at >14 days compared to ≤14 days. Furthermore, the S-ReSC score was an independent predictor of SFR, and the operating time was an independent predictor of perioperative complications.

Although widely applied, it is not yet known whether dwelling time before ureteroscopy significantly affects the results of stone treatment. Theoretically, as the dwelling time for the ureteral stent increases, ureteral dilatation, which allows ureteroscopic access, should increase and there should then be successful results that will ensure stone-free status, but there is currently no literature on this subject. Studies on stent dwelling time in the literature have focused on complications rather than operation success. In 1990, it was first reported that a ureteral stent placed before ureteroscopy was associated with increased operative success [7]. In a later experimental animal study, ureteral stent placed before ureteroscopy was shown to cause reversible passive dilation [8]. Ureteral dilation allows for easy advancement of the ureteral access sheath, resulting in better irrigation, better visualization, and the removal of larger stone fragments, with the outcomes of a better SFR and shorter operating time [9–11]. In addition, placement of a ureteral stent after unsuccessful access in ureteroscopy has been found to relieve obstruction and increase success in the second operation [7]. In terms of complications, different studies have shown that ureteral stents placed before ureteroscopy increase, do not change, or decrease perioperative complications. In a study of pediatric patients, stent placement before ureteroscopy did not affect side effects or the need for additional stent-related treatment [9]. In another study, stent placement was reported to reduce complications, with a complication rate of 17.2% in the stent-free group and 7.2% in the stent-treated group [11]. No intraoperative complications were observed in patients with stent implantation before ureteroscopy in another study, and this was attributed to the reduction of ureteral injuries due to passive dilatation of the ureter [12]. In contrast to those studies, it has also been shown that patients with ureteral stent placement before ureteroscopy have a higher risk of infectious complications than patients treated with primary ureteroscopy [13]. Pre-ureteroscopy placement of ureteral stents has been reported to be significantly associated with febrile complications occurring within 1 month of surgical treatment [14]. Furthermore, ureteral stents often have a negative impact on the patient's quality of life and are associated with various urinary tract symptoms, including flank pain, urinary frequency, and dysuria [15, 16]. Therefore, it is important to evaluate stent dwelling time in the ureter in ureteroscopic procedures, as it may contribute to patient morbidity. With increasing stent dwelling time, complications increase, and most importantly, with increased bacterial colonization, there is a risk of urinary

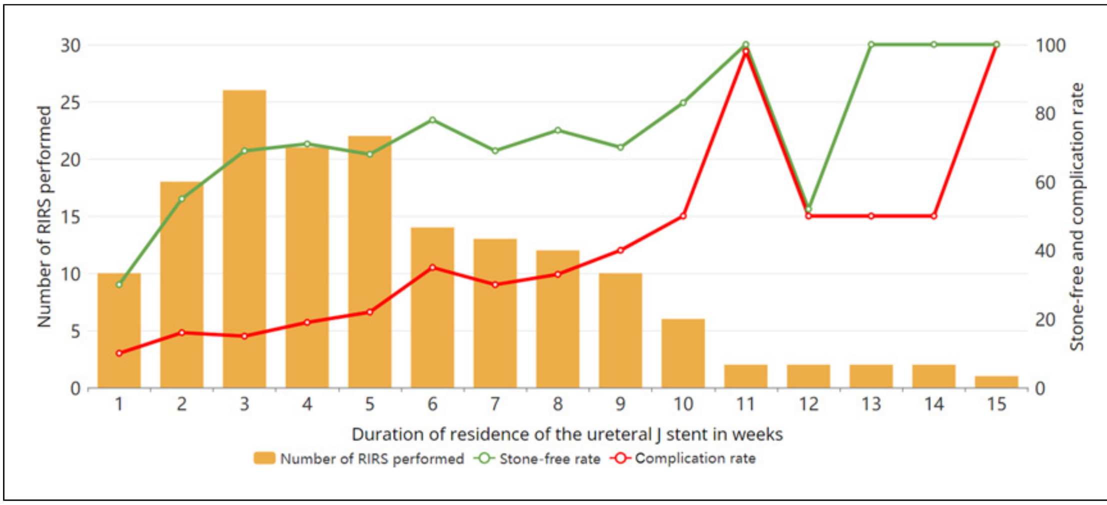

Fig. 1. Stone-free and complication rates according to the stent dwelling time. The horizontal axis represents dwelling time in weekly intervals, e.g., 0–7 days are shown in the 1st week, 7–14 days in the 2nd week, and 14–21 days in the 3rd week. Bars represent the number of ureteroscopies performed each week, the green line indicates the stone-free rate and the red line indicates the complication rate in the corresponding intervals.

tract infection and infectious complications [10, 11]. The risk of bacterial colonization and septic complications can occur in the presence of a ureteral stent and this has been shown to increase with prolonged dwelling time [17]. Bacterial spread from colonized stents during manipulation of stents during surgery may be responsible for the increased risk of septic complications in patients [18, 19]. A direct correlation has been found between stent dwelling time and bacteriuria and stent colonization [20]. In one study, the risk of sepsis increased cumulatively with stent dwelling time from 2.2% at 30 days to 4.9% at 60 days, 5.5% at 90 days, and 9.2% for >90 days. Postoperative urinary tract infection rates increased from 1% for less than 1 month to 9.2% at ≥3 months. Furthermore, in this study, similar to stent-free patients, patients with a stent dwelling time of less than 1 month had a 5-fold lower risk of urinary tract infection compared to those with a longer dwelling time. The conclusion reached in that study was to keep the stent dwelling time as short as possible [5].

In the current study, the access sheath could not be placed in 6 of 28 (21.4%) patients in the first 2 weeks and in 11 of 133 (8.2%) patients after the 2nd week. SFRs were 46.4% in the first 2 weeks and increased to 72.9% after the 2nd week. The rates of perioperative complications were determined to be 17.5% during the first 5 weeks and increased to 37.5% after the 5th week. Thus, it can be recommended to keep dwelling time as short as possible to avoid infectious complications, but when success is considered, ureteroscopies performed earlier than 2 weeks are less likely to be successful. Therefore, the dwelling time should preferably be between 3 and 5 weeks (14–35 days) prior to ureteroscopy.

The present study had several limitations, primarily the retrospective study design. A study of a larger population with longer follow-up would be able to obtain more conclusive results. The sample size of this study was small for multivariate analysis. More studies are needed to standardize dwelling times. Furthermore, not all patients had stone composition and stone culture, so the higher prevalence of infection stones or patients with infection in stone culture despite the absence of infection stones may have affected the incidence of postoperative infection complications. In the current study, dwelling times were relatively long and variable due to waiting lists in the public healthcare system. Despite these limitations, the relationship between stent dwelling time and both ureteroscopy success and perioperative complications has been newly defined. If validated by larger, prospective, and long-term studies, it may provide a guide to optimal dwelling time for passive dilation-induced ureteral stents placed after impassable ureteroscopy.

Conclusion

The risk of perioperative complications increases with prolonged stent dwelling time in patients with ureteral stent implantation after impassable ureteroscopy. In the light of these results, it can be recommended that care is taken during the dwelling period and that ureteroscopy is performed within 5 weeks (35 days), but no earlier than 2 weeks (14 days), so as not to affect the success of the procedure.

Statement of Ethics

This study was conducted in accordance with the Declaration of Helsinki and its amendments and with approval of the University of Health Sciences, Ankara Training and Research Hospital Local Ethics Committee (Approval No. E-22/907). Due to the retrospective design of the study, the Ethics Committee waived the requirement for written informed consent.

Conflict of Interest Statement

The authors have no conflict of interest to declare.

Funding Sources

The authors have received no external funding.

Author Contributions

Ali Kaan Yildiz: conception, interpretation of data, and manuscript writing and editing. Arif Bayraktar and Turgay Kacan: analysis and interpretation of data. Bugra Bilge Keseroglu and Berat Cem Ozgur: conception and interpretation of data. Omer Gokhan Doluoglu and Tolga Karakan: supervision and administrative support.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

References

1 Cetti RJ, Biers S, Keoghane SR. The difficult ureter: what is the incidence of pre-stenting? Ann R Coll Surg Engl. 2011;93(1):31–3.
2 Assimos D, Crisci A, Culkin D, Xue W, Roelofs A, Duvdevani M, et al. Preoperative JJ stent placement in ureteric and renal stone treatment: results from the Clinical Research Office of Endourological Society (CROES) ureteroscopy (URS) Global Study. BJU Int. 2016;117(4):648–54.
3 Ji C, Gan W, Guo H, Lian H, Zhang S, Yang R, et al. A prospective trial on ureteral stenting combined with secondary ureteroscopy after an initial failed procedure. Urol Res. 2012;40(5):593–8.
4 Jessen JP, Breda A, Brehmer M, Liatsikos EN, Millan Rodriguez F, Osther PJS, et al. International collaboration in endourology: multicenter evaluation of prestenting for ureterorenoscopy. J Endourol. 2016;30(3):268–73.
5 Nevo A, Mano R, Baniel J, Lifshitz DA. Ureteric stent dwelling time: a risk factor for post-ureteroscopy sepsis. BJU Int. 2017;120(1):117–22.
6 Jung JW, Lee BK, Park YH, Lee S, Jeong SJ, Lee SE, et al. Modified Seoul national university renal stone complexity score for retrograde intrarenal surgery. Urolithiasis. 2014;42(4):335–40.
7 Jones BJ, Ryan PC, Lyons O, Grainger R, McDermott TE, Butler MR. Use of the double pigtail stent in stone retrieval following unsuccessful ureteroscopy. Br J Urol. 1990;66(3):254–6.
8 Kinn AC, Lykkeskov-Andersen H. Impact on ureteral peristalsis in a stented ureter. An experimental study in the pig. Urol Res. 2002;30(4):213–8.
9 Hubert KC, Palmer JS. Passive dilation by ureteral stenting before ureteroscopy: eliminating the need for active dilation. J Urol. 2005;174(3):1079–80; discussion 1080.
10 Chu L, Sternberg KM, Averch TD. Preoperative stenting decreases operative time and reoperative rates of ureteroscopy. J Endourol. 2011;25(5):751–4.
11 Lumma PP, Schneider P, Strauss A, Plothe KD, Thelen P, Ringert RH, et al. Impact of ureteral stenting prior to ureterorenoscopy on stone-free rates and complications. World J Urol. 2013;31(4):855–9.
12 Fahmy A, Dawoud W, Badawy H, Youssif M, Kamal A, Elgebaly O. Optimum duration of ureteral prestenting dwelling time in children undergoing retrograde intrarenal surgery. J Pediatr Urol. 2021;17(6):845.e1–6.
13 Grabe M, Botto H, Cek M, Tenke P, Wagenlehner FME, Naber KG, et al. Preoperative assessment of the patient and risk factors for infectious complications and tentative classification of surgical field contamination of urological procedures. World J Urol. 2012;30(1):39–50.
14 Sohn DW, Kim SW, Hong CG, Yoon BI, Ha US, Cho YH. Risk factors of infectious complication after ureteroscopic procedures of the upper urinary tract. J Infect Chemother. 2013;19(6):1102–8.
15 Joshi HB, Stainthorpe A, MacDonagh RP, Keeley FX Jr, Timoney AG, Barry MJ. Indwelling ureteral stents: evaluation of symptoms, quality of life and utility. J Urol. 2003;169(3):1065–9; discussion 1069.
16 Lee C, Kuskowski M, Premoli J, Skemp N, Monga M. Randomized evaluation of ureteral stents using validated symptom questionnaire. J Endourol. 2005;19(8):990–3.
17 Blackmur JP, Maitra NU, Marri RR, Housami F, Malki M, McIlhenny C. Analysis of factors' association with risk of postoperative urosepsis in patients undergoing ureteroscopy for treatment of stone disease. J Endourol. 2016;30(9):963–9.
18 Lifshitz DA, Winkler HZ, Gross M, Sulkes J, Baniel J, Livne PM. Predictive value of urinary cultures in assessment of microbial colonization of ureteral stents. J Endourol. 1999;13(10):735–8.
19 Wollin TA, Tieszer C, Riddell JV, Denstedt JD, Reid G. Bacterial biofilm formation, encrustation, and antibiotic adsorption to ureteral stents indwelling in humans. J Endourol. 1998;12(2):101–11.
20 Farsi HM, Mosli HA, Al-Zemaity MF, Bahnassy AA, Alvarez M. Bacteriuria and colonization of double-pigtail ureteral stents: long-term experience with 237 patients. J Endourol. 1995;9(6):469–72.