Comparison of Two Different Scoring Systems in Encrusted Ureteral Stent Management: A Single-Center Experience

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Purpose: To report our single-center experience in encrusted ureteral stent management and to compare the utility of two different scoring systems, KUB (Kidney, Ureter, Bladder) versus FECal (forgotten, encrusted, calcified), in patient management.

Materials and Methods: We retrospectively analyzed the medical records of all patients who were found to have encrusted/retained ureteral stent and underwent various procedures to remove encrusted ureteral stent in our clinic between May 2014 and December 2018. Encrusted stent grading was performed using KUB and FECal grading systems. KUB system score is the sum of the stone burden scores of 3 different parts of an encrusted stent within the kidney, ureter and bladder determined using a scale from 1 to 5 according to the maximal diameter of encrustation. FECal grading system is based on the stone size, location and degree of stent encrustation and scored from Grade 1 to Grade 5.

Results: A total of 39 patients (29 males and 10 females) were included the study. The mean age of the patients was 46.4 ± 14.5 years, ranging from 13 to 71 years. The mean time from ureteral stent insertion to encrustation was 13.7 ± 26.4 months, varying between 2 and 120 months. The mean KUB score was 6.4 ± 2.4. According to FECal system, 53.8% of the patients were classified as Grade 1 and 15.4% as Grade 2. The encrusted ureteral stents of eight patients (20.5%) could be removed with the aid of a foreign body forceps inserted through a cystoscope. Fourteen patients (35.9%) underwent cystolithotripsy, seven (17.9%) underwent flexible ureterorenoscopy (URS), six (15.4%) underwent rigid URS, and three (7.7%) underwent combined percutaneous nephrolithotomy and URS beside stent removal. In multivariate regression analysis, largest encrustation diameter, FECal system grade and KUB score were found to be significant predictors of stone- and stent-free status ($p < 0.001$ for all). Also, KUB score was found to be associated with the number of required procedures (r= .506, $p = .001$).

Conclusion: KUB encrusted stent scoring system might be useful in predicting the number of required procedures to achieve stone- and stent-free status. Pure intracorporeal endourologic procedures, percutaneous interventions or open surgery might be preferred according to the patient's situation and the surgeon's experience and preference.

Keywords: ureteral stent; encrusted; calcified; score; KUB; FECal

INTRODUCTION

Ureteral stent has been a widely and routinely used device in urological procedures since it was first described in 1967. Ureteral stent placement is a main part of either open or endoscopic urologic operations performed for ureteral stones, retroperitoneal fibrosis, ureteropelvic junction obstruction, ureteral strictures, etc[1,2]. Besides being a safe and usually well-tolerated material obtaining urinary drainage from kidney to urinary bladder, ureteral stents are not without complications. These complications include dysuria, hematuria, flank pain, suprapubic discomfort, vesicoureteral reflux, migration, encrustation, urinary tract infection, etc[3,4].

Encrustation of ureteral stent depends on various factors such as indwelling time, urinary tract infection, stent material, history or presence of concomitant stone disease and metabolic or congenital abnormalities[5]. Encrusted ureteral stents might also lead to significant complications like urinary obstruction, persistent urinary infection, stent fracture and even injuries of the urinary tract and renal function loss[6,7]. Two different scoring systems were proposed for encrusted stent grading: 1. KUB score; 2. FECal grading.

Management of encrusted ureteral stents may be challenging for urologists. Several procedures have been suggested such as extracorporeal shock wave lithotripsy, endourological procedures including rigid and flexible ureteroscopy (URS), percutaneous nephrolithotomy (PNL) and open and laparoscopic surgeries[5,8-10].

In the present study, we aimed to report our single-center experience in encrusted ureteral stent management and to compare the utility of two different scoring systems in patient management.

MATERIALS AND METHODS

After the approval of the study by the local ethics com-

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Table 1. Patient Demographics and Characteristics of Encrustation.

Variables		
Number of Patients		39
Mean Age (years)		46.4 ± 14.5
Male/Female		29/10
Indication of Stent Insertion	URS for ureteral stone	28 (71.8%)
	PNL	3 (7.7%)
	Hydronephrosis	2 (5.1%)
	Pyeloplasty	2 (5.1%)
	Ureteral obstruction	4 (10.3%)
Stent retaining time (months)		13.7 ± 26.4
Grade of Encrustation KUB score		6.4 ± 2.4
FECal grade	Grade 1	21 (53.8%)
	Grade 2	6 (15.4%)
	Grade 3	3 (7.7%)
	Grade 4	4 (10.3%)
	Grade 5	5 (12.8%)
Average number of procedures		1.18 ± 0.45
Type of Procedures	Stent removal	8 (20.5%)
	Flexible URS + Stent removal	7 (17.9%)
	Rigid URS + Stent removal	6 (15.4%)
	PNL+ URS + Stent removal	3 (7.7%)
	Cystolithotripsy + Stent removal	14 (35.9%)
	Nephrectomy+ Stent removal	1 (2.6%)
Stone- and Stent-Free	Yes	36 (92.3%)
	No	3 (7.7%)

mittee of Istanbul Bakirkoy Dr. Sadi Konuk Training and Research Hospital (Approval Number: 2019/40), we retrospectively analyzed the medical records of all patients who had encrusted/retained ureteral stent and underwent various procedures for encrusted ureteral stent removal in our clinic between May 2014 and December 2018. Both male and female patients at any age with available data were included the study. Patients whose encrusted/retained stent could be removed at first attempt on an outpatient basis were excluded from the study. Patients with an encrusted ureteral stent in the transplanted kidney were also excluded. The studied parameters included patient demographics, indication of stent insertion, preoperative and postoperative imaging results, urinalysis results, serum biochemical test results and the type of surgery performed for encrusted stent removal. Encrusted stent grading was performed using KUB (Kidney, Ureter, Bladder)[11] and FECal (forgotten, encrusted, calcified) [7] grading systems as described previously. KUB system score is the sum of the stone burden scores of 3 different parts of an encrusted stent within the kidney, ureter and bladder determined by using a scale from 1 to 5 according to the maximal diameter of encrustation [11]. FECal grading system is based on the stone size, location and degree of stent encrustation and scored from Grade 1 to Grade 5 [7]. Negative urine culture was obtained prior to each surgery.

Statistical analysis was performed using IBM SPSS Statistics for Mac v.21.0 (IBM Corp., Armonk, NY). Quantitative values are shown as mean ± SD (range), and qualitative values are shown as number and percentage. Pearson correlation analysis was used to investigate the linear correlation between two continuous variables. Multivariate logistic regression analysis was used to determine the effect of potentially significant variables on stent- and stone-free status. The level of statistical significance was set at $P < .05$.

RESULTS

A total of 39 patients (29 males and 10 females) were included the study. The mean age of the patients was 46.4 ± 14.5 years, ranging from 13 to 71 years. The indwelling ureteral stent insertion indication was ureterorenoscopy (URS) for stone disease in 28 patients, obstruction due to renal stone in four, hydronephrosis in two, PNL in three and pyeloplasty in two. The mean time from ureteral stent insertion to encrustation was 13.7 ± 26.4 months, varying between 2 and 120 months. The mean KUB score was 6.4 ± 2.4. According to FECal system, 53.8% of the patients were classified as Grade 1 and 15.4% as Grade 2. The encrusted ureteral stents of eight patients (20.5%) could be removed with the aid of a foreign body forceps inserted through a cystoscope. Fourteen patients (35.9%) underwent cystolithotripsy, seven (17.9%) underwent flexible URS, six (15.4%) underwent rigid URS, and three (7.7%) underwent combined PNL and URS beside stent removal. One patient underwent nephrectomy and stent removal due to massive stone formation and a non-functioning kidney. Stone- and stent-free status was achieved in 36 (92.3%) patients (**Table 1**). In multivariate regression analysis, largest encrustation diameter, FECal system grade and KUB score were found to be significant predictors of stone- and stent-free status ($p < .001$ for all) (**Table 2**). Gender and ureteral stent insertion indication had no predictive value on stone- and stent-free status ($p = .751$ and $p = .99$, respectively). In correlation analysis, FECal system grade and KUB score were found to be significantly correlated ($r = .652$, $p < .001$). Also, KUB score was found to be associated with the number of required procedures ($r = .482$, $p = .002$). However, FECal grading was not correlated with the number of procedures ($r = .239$, $p = .143$). KUB score and FECal grade were also found to be positively correlated with stent indwelling time ($r = .513$, $p = .001$; $r = .456$, $p = .004$, respectively).

Table 2. Multivariate Logistic Regression Analysis for predicting Stone-Free Status.

Variables	Score	*P*-value
Age	1.639	.200
Gender	.101	.751
Encrustation Diameter	14.589	<.001
FECal Classification	22.100	<.001
KUB Grading system	19.725	<.001
Ureteral Stent Placement indication	7.815	.099

DISCUSSION

Ureteral stents, especially double-J stents, also named as pigtail stents, are widely used in urological clinical practice. Ureteral stents allow urine passage from kidney to bladder in case of a ureteral obstruction due to intrinsic and extrinsic causes like urinary stones, iatrogenic trauma or injuries, strictures, retroperitoneal fibrosis or malignancies. Ureteral stents are also utilized in complex abdominal and gynecological procedures to identify and preserve ureters[8]. Encrustation of ureteral stents may lead serious complications, and the management of this situation might be challenging for urologists.

The exact mechanism of encrustation is not well known; however, various etiological factors such as indwelling time, stent material, urinary infection, stone disease and metabolic and congenital abnormalities[5], pregnancy and lack of health insurance have been suggested [11]. In a study, el-Faqih et al.[12] investigated the relation between stent indwelling time and encrustation. They reported that the encrustation rates of stents that were retrieved before 6 weeks, that were retrieved in 6 to 12 weeks and that were retrieved later than 12 weeks were 9.2%, 47.5% and 76.3%, respectively. They concluded that morbidity related to stent was minimal if stent indwelling time did not exceed 6 weeks.

In a study by Polat et al., ureteral stent indwelling time was found to be correlated with stone burden and hospital stay during encrusted stent removal[9]. In our study, the mean indwelling time was 13.7 months and was significantly associated with KUB score and FECal grading. In addition, most of our patients (89.8%) had a history of urinary stone disease that might have constituted the significant factor for encrustation.

Two scoring systems have been proposed for grading encrustation of stent, KUB[11] and FECal[7] scoring systems. A total KUB score of ≥ 9 was found to be associated with multiple surgeries, operation time longer than 180 minutes and lower stone-free rates[11]. In a study, KUB score was found to be associated with indwelling time. Also, a KUB score ≥ 3 was found to be related with multiple surgery requirements, multi-modal procedure requirement and lower stone-free rates. By using FECal grading system, authors proposed a clear multimodal step-wise approach in encrusted ureteral stent management[7]. In the present study, both KUB score and FECal grade were found to be correlated with indwelling time. Also, both were found to be significant predictors of stone- and stent-free status. However, while KUB score was correlated with the number of procedures required to achieve stone- and stent-free status, FECal score was not. This might be due to design of FECal grading system, as it proposes a treatment algorithm besides grading.

Achieving stent- and stone-free status while preserving maximal renal function is the main goal in encrusted stent management. Various types of operations have been suggested for encrusted stent removal including endourological, percutaneous and open procedures as well as combined approaches[8-10,13]. In a study by Thomas et al.[8], authors reported the outcomes of complete retrograde technique with holmium laser in encrusted stent management. They first inserted a safety guide-wire to the ureter beside the retained stent. Then, they fragmented the bladder curl encrustations cystoscopically. Afterwards, they used rigid URS for the middle part of the stent to reach the renal pelvis. If it was not possible to reach the renal pelvis, they cut the stent as proximal as possible and removed the distal portion of the stent using grasping forceps. Then, they inserted a ureteral access sheath and performed flexible URS to fragmentize the proximal end of the encrusted stent. The mean operative time was 110 ± 35.2 minutes, ranging between 42 and 225 minutes. The main postoperative early complication was non-obstructive pyelonephritis, which was not associated with operative time, gender or encrustation degree [8]. Bostanci et al.[10] proposed a combined endourological approach including cystolithotripsy, retrograde URS with intracorporeal lithotripsy and PNL for removing encrusted stents in a single session. The average number of required interventions was 1.9. The authors concluded that, although it was the most invasive procedure, using PNL in encrusted stent management provided higher stone-free rates and decreased the number of required procedures especially in large encrustations. In the present study, we used multimodal approaches when required. Our mean operation number for the complete removal of stents and stones was 1.18, which is relatively smaller than the numbers reported previously. This might be because most patients had encrustation on the distal part of their stent, and we think that bladder is a relatively comfortable space for stone surgery.

The main reason for unintentionally retained stents seems to be poor patient compliance. However, it is both the physician's and patient's responsibility to ensure the timely removal of the ureteral stent. To overcome the retained/forgotten stent problem, several strategies have been developed such as ureteral stent card registry, e-mail reminder and a letter of reminder based on billing information[14,15]. Recently, Ziemba et al.[15] developed a HIPAA (Health Insurance Portability and Accountability Act) complaint, a cloud based point-of-care application, to track ureteral stents. In the present study, stent indwelling time varied between 2 and 120 months. As two months is not a very long time, we think that clinicians must be alert for early encrustation of stents and might want to schedule an earlier stent removal time, especially in patients with a history of stone disease.

CONCLUSIONS

Forgotten/retained ureteral stents might lead to challenging problems for urologists. Appropriate management of this situation and deciding the feasible technique of operation(s) is vital. KUB encrusted stent scoring system might be useful in predicting the number of required procedures to achieve stone- and stent-free status. Pure intracorporeal endourologic procedures,

percutaneous interventions or open surgery might be preferred according to the patient's situation and the surgeon's experience and preference. As prevention is the best method to struggle with the disease, tracking patients with ureteral stents and providing timely removal of the ureteral stent is highly recommended.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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