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Increased Number Of Encrusted D-J Stents In Our Clinic During The Covid-19 Pandemic And The Reliability Of Ureteroenoscopy (Rigid/Flexible) In Removing Encrusted D-J Stents

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ABSTRACT

Introduction: Stent encrustations that develop due to the D-J stent being forgotten or left in the body for a long time are one of the major causes of these side effects and complications.
Objective: To examine the effect of the coronavirus disease 2019 (COVID-19) pandemic on the frequency of encrusted (petrified) D-J (double j) stent cases treated during the pandemic and the effects of the encrusted D-J stent on our patients.
Methods: The data of 27 patients who underwent D-J stent removal due to encrusted stent between March 2019 and March 2021 were analyzed retrospectively. The age of the patients, duration of ureteral stenting, size and location of the encrustation were examined.
Results: The mean age of the patients was 46.56 ± 14.78 years. The mean length of stent stay in the body was 217.15 ± 472.08 days. The mean incrustation size was 386.96 ± 541.26 mm2. Eight of the patients had severe D-J stent incrustation, 3 had moderate D-J encrustation, and 16 had mild D-J encrustation. During the COVID-19 pandemic, there was a 200% increase in the number of cases. The encrusted D-J stents of all our patients were successfully removed via ureteroenoscopy by breaking the encrusted parts of the stents using a holmium laser, achieving complete stone removal.
Conclusion: Due to the Covid-19 pandemic, there has been a significant increase in the number of encrusted D-J stents. Ureterorenoscopy/flexible ureterorenoscopy is an effective treatment method for removing the encrusted D-J stent using holmium laser and achieving complete stone removal.

Keyswords: COVID-19, Encrusted D-J Stent, Üreteroenoscopy, Holmium Laser Lithotripsy, Endourology.

INTRODUCTION

In urology, ureteral stents were first applied by Zmskind et al. in 1967, and over time, it became the current D-J stent by Finney et al (1978) (1,2). D-J stent is used to facilitate urinary drainage between kidney renal pelvis and bladder. Although it is used in many cases such as genitourinary system traumas, renal transplantation, ureteral strictures, and genitourinary system reconstructive surgery, where the urine flow between these two organs is impaired, it is most routinely used in the treatment of kidney stones and ureteral Stones (3,4). With the use of D-J stents, which has become widespread in urology clinics, a significant increase has been observed in complications and side effects such as urinary tract infection, hematuria, fever, dysuria, stent migration, rupture, and encrustation due to ureteral stents (4,5). Stent encrustations that develop due to the D-J stent being forgotten or left in the body for a long time are one of the major causes of these side effects and complications. Moreover, severe problems such as urinary obstruction, hydronephrosis, loss of renal function, and urosepsis may develop due to stent encrustations (6,7). In addition to surgical treatments such as ureterorenoscopy and percutaneous nephrolithotomy (PNL), minimally invasive interventions such as electroshock wave lithotripsy (ESWL)/ultrasonic flooding or chemolytic agent application with the help of percutaneous nephrostomy tube have been described in the literature for the treatment of stent encrustations due to forgotten D-J stents (8,9).

Coronavirus disease 2019 (COVID-19) (caused by severe acute respiratory syndrome coronavirus 2) is a highly contagious type of coronavirus whose origin is unknown and has not been encountered in

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humans before. After the first case was seen in Wuhan, China, in December 2019, it quickly affected the whole world and was declared a pandemic by the World Health Organization on March 11, 2020 (10). As of February 28, 2021, the number of cases and deaths worldwide has exceeded 113 million and 2.5 million, respectively (11). The most common symptoms of COVID-19 include fever, cough, shortness of breath, fatigue, and weakness. The disease is usually mild. In the elderly and those with comorbidities, it can cause pneumonia, acute respiratory distress syndrome, and multiorgan failure (12). While the most common mode of transmission is droplet and contact, the detection of severe acute respiratory syndrome coronavirus 2 RNA in the urine for up to 47 days in recent studies indicate COVID-19 risks in urinary system surgery (13,14). During the pandemic, many hospitals in the affected countries have been converted into pandemic hospitals and even daily patient examinations and elective surgeries have been completely suspended (15). Lithotripsy for ureteral/kidney stones were performed by ureteroenoscopy in patients with emergency indication having renal colic, urosepsis, or acute kidney failure (D-J stent placement is performed in the kidney at the end of the procedure); however, D-J stent removal, which is an elective surgery, performed approximately 1 month after this procedure had to be postponed, albeit for a while, and stent removal could not be performed at the required time. In many cities, hospitals were divided into pandemic and nonpandemic hospitals to better provide COVID-19 healthcare; our hospital had to fight on both fronts since it is the only public hospital in our city that provides health services. Moreover, without flexible working, all clinics (COVID-19, emergency and all other clinics) served at full capacity. However, the number of patients presenting to the hospital significantly decreased due to the fear of COVID-19. While the number of patients who applied to our daily COVID 19 outpatient clinic exceeded 1500 and all the services of our hospital were converted to full capacity (600 patients) COVID 19 services, there were periods when the number of patients who applied to our urology outpatient clinic, where we had an average of 160 patients before the pandemic, decreased to 8 patients (Figure 1). The fact that patients did not come to the hospital and the suspension of elective surgeries raised the question of whether encrusted D-J stent cases increased during this period and what kind of treatments can be used to effectively treat these patients.

METHODS

The data of 27 patients who underwent D-J stent removal due to encrusted stent between March 2019 and March 2021 were retrospectively analyzed. The age of the patients, complaints at hospital admission, duration of ureteral stenting, size and location of the encrustation, duration of the operation, and complications in accordance with the modified Clavien classification were examined. Only cases of encrusted D-J stent removals performed under spinal anesthesia, with bladder capacity measured right before the procedure were included in the study. Bladder capacity was measured with the same method, with serum irrigation to the bladder using a catheter and glass-tipped injector, and maximum bladder capacity was recorded just before surgery. Patients with insufficient preoperative imaging were excluded from the study. Patients with growth in their urine culture were admitted to the ward and consulted for infectious diseases, and they were included in the study after sterilization of urine culture was ensured following antibiotic treatment. Preoperative evaluation was made with anamnesis form recorded by the physician, urine culture, direct urinary system radiography (DUTR), and noncontrast whole abdominal computed tomography (CT). Stone load in stent encrustations was calculated with the following formula: stone load = (DUTR/CT) stone length × stone width (mm^2) (16,17). Stent encrustation load was categorized as follows: low < 100 mm^2, moderate = 100–400 mm^2, and severe > 400 mm^2 (16,18).

Statistics

Mean, standard deviation, frequency, and ratio values were used to present the descriptive statistics of the data. The distribution of variables was evaluated using the Kolmogorov–Smirnov test. The Kruskal–Wallis test was used to analyze the data. SPSS 24.0 program was used in the analysis of the data, and $P < 0.05$ was accepted as statistically significant in all analyses.

Ethics: Aksaray University ethics committee approval was obtained (65-SBKAEKA).

Table 1. Demographic Data of Patients URS: Ureterorenoscopy, FRUS: Flexible Ureterorenoscopy LUTS: Lower Urinary Tract Symptoms

Demographic	N = 27
Sex	Male :16 Female:11
Side	Right :13 Left:14
Nationality	Turkish:18 Iranian:1 Syrian:3 Fagan :5
D-J stent placement surgery	URS: 24 PNL : 1 Pregnancy hydronephrosis: 1 Before gynecological pelvic surgery: 1
Dysuria-LUTS	27
Hematuria	11
Flank pain	10
Urinary incontinence	2
Subfebrile fever	2
Escherichia coli	4
Enterococcus	1
Klebsiella	1
Mean duration of stay of the stents in the body	217.15 ± 472.08
Mean duration of surgery	37.63 ± 50.89 min
Mean encrustation	386.96 ± 541.26
Residual stone	0
Successful operation	27
FRUS	5
Stent replacement	12
Complication	Clavien 1 = 4 Clavien 2 = 3 Clavien 3a =1

URS: Ureterorenoscopy, FRUS: Flexible ureterorenoscopy LUTS: Lower urinary tract symptoms.

RESULTS

The mean age of the patients was 46.56 ± 14.78 years. While 16 (59.3%) of the patients were male, 11 (40.7%) were female. Seventeen patients had D-J stent placed in our clinic, and the other patients were from an external center. A 6-Fr D-J stent was used or present in all patients. One patient had undergone D-J stent placement during her pregnancy, and one patient was Iranian in whom the D-J stent was placed before gynecological surgery and then forgotten. While three of the remaining patients were Syrian nationals, five were Afghan nationals. One of our patients had undergone D-J stent placement after PNL and the stent was forgotten, while all other cases were forgotten and encrusted stents after lithotripsy treatment with ureterorenoscopy. All patients had dysuria and lower urinary symptoms; 11 patients had hematüri, 2 had subfebrile fever (36.8°C–38°C), 4 had Escherichia coli growth in urine culture, 1 had enterococcus growth, 1 had Klebsiella growth, 10 had flank pain, and 2 had urinary incontinence. The mean length of stent stay in the body was 217.15 ± 472.08 days. The mean incrustation size was 386.96 ± 541.26 mm2. The mean operation time was 37.63 ± 50.89 min. Eight (29.6%) of our patients had severe D-J stent encrustation, the mean operation time of these patients was 101 ± 53 min, and the mean bladder capacity was 301 ± 89 cc. Three (11.1%) of the patients had moderate-severe D-J encrustation, the mean operation time was 29 ± 7 min, and the mean bladder capacity was 397 ± 15 cc. Sixteen (59.3%) of the patients had mild D-J encrustation, the mean operation time was 7 ± 4 min, and the mean bladder capacity was 485 ± 63 cc (P = 0.00). Encrustation was observed in 3 of the patients in the upper segment, in 14 patients in the lower segment, and in 10 patients in the entire stent (upper middle and lower). ESWL and PNL were not performed any of the patients, and ureterorenoscopy and flexible ureterorenoscopy (FURS) were performed in all patients. D-J stent was removed by breaking the stones with the help of a holmium laser. In one patient, the bladder stone was removed with open surgery because the bladder stone was too large (6 cm) and the duration of operation was prolonged. In 5 patients with D-J stents with encrustation on the upper side, rigid ureterorenoscopy failed to reach encrustation.

Flexible ureterorenoscopy was used to reach encrustation, the encrusted part of the stent was broken and it was successfully removed as a whole. While performing FURS, access sheet was not used in any case; the encrusted parts of stents were reached by entering directly from the side of the stent via the guide. Complete stone-free status was achieved in all patients. Twelve of the patients needed stent replacement during the operation, which were removed 1 month later. According to the modified Clavien classification, four patients had Grade 1, three patients had Grade 2 and one patient had Grade 3a complications (Table 1). Eight (29.6%) of the patients had stent placement before the COVID-19 pandemic and then forgot to have their D-J stent removed. However, 19 (70.4%) patients had D-J stents placed during the pandemic and then did not come to the hospital due to fear of COVID-19 transmission, but had to come later when their complaints became very severe. When the hospital data system was scanned between March 2017 and March 2019, only nine encrusted D-J stent cases were observed. However, here was a 200% increase in encrusted D-J stent cases during the COVID-19 pandemic.

Table 2. Comparison of Bladder Capacity According to Encrustation Site and Degree

Encrustation degree/site/number	Bladder capacity	Mean duration of surgery
Mild, 16 (59.3%)	485 ± 63 cc	7 ± 4 min
Moderate, 3 (11.1%)	397 ± 15 cc	29 ± 7 min
Severe, 8 (29.6%)	301 ± 89 cc; *P* = 0.00[k]	101 ± 53 min; *P* = 0.00[k]
Upper, 3 (11.1%)	497 ± 75 cc	
Lower, 14 (51.9%)	473 ± 68 cc	
Throughout, 10 (37%)	324 ± 93 cc; *P* = 0.225[k]	

K = Kruskal–Wallis.

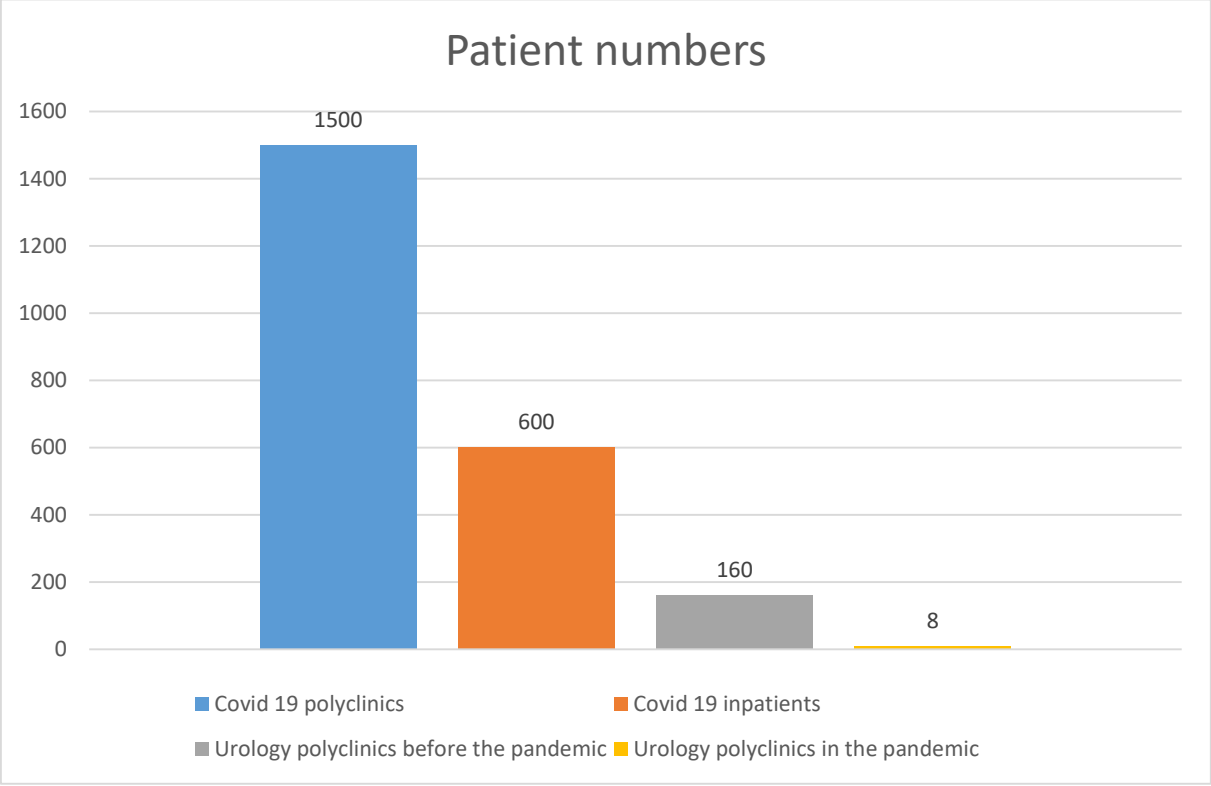

Figure 1. Patient Numbers

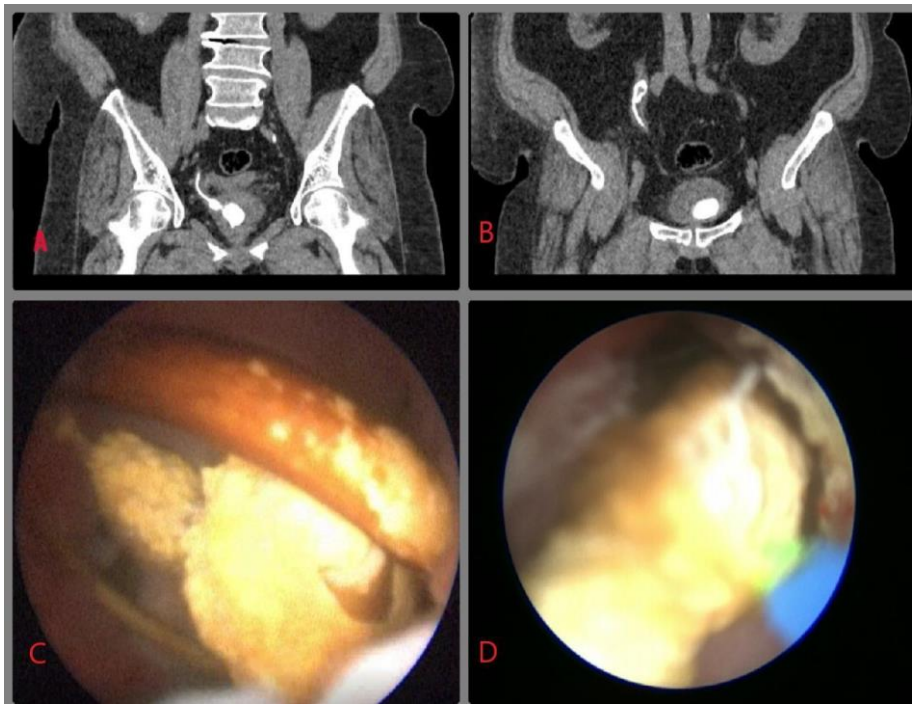

Figure 2. A: Computed tomography (CT) image of the patient with severe encrustation at the lower end of the right ureter. **B:** CT image of the patient with mild encrustation at the upper end of the right ureter and severe encrustation at the lower end **C:** Ureterorenoscopic view of the upper part of the ureter. **D:** Image captured while the stones of the encrusted D-J stent are being broken with the holmium laser, the image shows that the part of the D-J stent in the ureter is encrusted throughout.

Figure 3. A: Image of a mildly encrusted D-J stent with the encrusted parts broken off with ureterorenoscope. **B:** Severely encrusted D-J stent, encrusted throughout its length, lithotripsy was performed with ureterorenoscopy laser lithotripsy and stent was finally removed by open bladder stone surgery.

DISCUSSION

Encrustation occurs when minerals in the urine are deposited on the surface of the stent. Risk factors include duration of stent stay in the body, bacterial colonization, patient-specific factors, and physical properties of the stent. It has been shown repeatedly that the most important risk factor for the development of encrustation is the duration of stent stay in the body. El-Faqih et al. (1991) reported that 9% of stents showed signs of encrustation by 6 weeks, 48% by 6–12 weeks, and 77% by 12 weeks (19). Similarly, in a study conducted by Kawahara et al. (2012), encrustation rates of 27%, 57%, and 76% were reported at equivalent time intervals (20). Furthermore, 30% of stents removed before 12 weeks showed evidence of lumen encrustation, but only 4% of patients had clinical symptoms of stent obstruction (19). Although the ideal duration of stay for many urological procedures is not known for certain (clinicians generally do not exceed 1 month and keep the stent in the body for a maximum of 3 months), it is clear that prolonged stent stay in the body adversely affects encrustation.

Bacterial colonization (bacterial biofilm) on the stent has been shown to be effective in D-J stent encrustation. In the study by Tunney et al., colonized pathogens were observed in 90% of the encrusted D-J stents removed from the patients, whereas 55% had an adhesive biofilm layer (21). Shabeena et al. conducted a bacterial colonization analysis and found that the time of catheter insertion was directly proportional to the colonization rates, with 90% of the stents colonized by 120 days (22). In addition, it is unclear how biofilm formation on the surface of the stent precipitates minerals and triggers encrustation. Major pathogens include E. coli, Streptococcus, and Pseudomonas. However, the clinical significance of bacterial colonization and biofilm formation on ureteral stents is poorly understood, and there is no consensus on which specific pathogens, if any, increase the risk of encrustation. Recurrent chronic stone diseases, excess stone load, residual stone, and chronic kidney failure are conditions that can increase urinary bacterial load and increase the risk of stent encrustation (23). None of the patients in the present study had chronic stone disease, chronic renal failure, or residual stones. However, D-J stent was placed in most of the patients after stone surgery (ureterorenoscopy and PNL). In the present study, we did not examine bacterial colonization on all D-J stents, but we found that 6 of 27 patients had growth in the urine culture. In a patient who received D-J stent at the 30th week of pregnancy, we observed that the stent was encrusted in the postpartum period. Although hypercalciuria and hyperuricosuria are well defined during pregnancy, the incidence of symptomatic urinary stones in this population is not higher than in the control group of the same age (24-26). The reason for this is the increase in urinary stone formation inhibitors and urine volume in pregnant women (27). There is insufficient data on the incidence of urinary stone formation or D-J stent encrustation in pregnant patients in the literature.

Kawahara et al. evaluated 330 D-J stents placed in a single institution and found that stent length and patency were not associated with the risk of encrustation. Those with stent diameters of <6 Fr had more encrustation, whereas those with stent diameters of ≥7 Fr had less encrustation.(20) The materials used in the construction of the D-J stent also affect the encrustation time. Most of the stents used are made of polymer (polyurethane) mixtures with encrustation-reducing properties coated with bioactive compounds, and these are called short-term stents and generally stay in the body for a month. Carbon-coated, hydrophilic, and silicone-coated, encrustation-resistant D-J stents are used long-term and kept in the body for a maximum of 12 months (28). We recommend the use of long-term DJ stents to reduce the incidence of encrusted DJ stent during the pandemic period. However, we did not use long-term stents in any of our patients.

Other well-known patient-specific risk factors include urolithiasis, diet, malabsorption, and a history of cancer, all of which exert anti-encrustation effects by increasing urinary calcium, oxalate, and uric acid concentrations (20). Finally, low health literacy and poor patient compliance increase the risk of a naturally encrusted D-J stents (23). Nine patients in the study were immigrants from different Middle Eastern countries and had poor literacy in Turkish.

Most stents can be removed without prior imaging, but patients suspected for encrustation or patients with risk factors require imaging to visualize the encrustation and to assess the severity and location of the encrustation along the stent (Figure 2). Standard DURT is usually sufficient to diagnose encrustation size. However, in some cases encrustation cannot be seen on the x-ray and CT may be required. Various

grading systems have been defined that predict which surgical procedures should be performed on patients by grading the stone load of the encrusted D-J stent by imaging. These are FECal ("Forgotten, Encrusted, Calcified") system; Visual-Grading for Ureteral Encrusted Stents Classification (V-GUES); Kidney, ureter, and bladder (KUB) scoring system and its variants (29-32). In a series of 110 patients in which the KUB (0–15) system was used, it was found that those who scored 9 and above required further surgery in their treatment (31). In order to make this distinction, the authors emphasized two important points: to separate patients as mild/moderate or severe, and stent encrustation of 50% with encrustation diameter exceeding the limit of 5 mm (Table 2). If the encrustation load does not exceed 5 mm and covers less than 50% of the stent, the load is classified as mild and cystoscopic stent removal should be attempted first in these patients. If the encrustation load is ≥5 mm anywhere along the stent and/or the encrustation coverage exceeds 50%, it is classified as severe (Figure 3) and surgical treatment should be performed following the recommended algorithm at this point (18).

Eswl is the first method that comes to mind in cases of encrusted DJ stents, but it cannot be applied to every patient and it is very difficult to achieve success in a single session. In addition, during the pandemic period, the most appropriate method to minimize patient entry and exit to the hospital is to treat patients in a single session. The biggest advantage of encrusted DJ stent removal with ureterorenoscopy with holmium laser is that the procedure can be completed in a single session (33).

6.0/7.5 Fr ureterorenoscopy was used in all of our patients; 16 of the patients were male, and 5 of them had to undergo FURS. Ureterorenoscopy/FURS usage and efficiency are high in the removal of encrusted D-J stents (34,35). In a study of 89 patients with low stone load, Manzo et al. found effectiveness of FRUS alone to be 77.7%. They found the effectiveness to be 100% in combined treatments with PNL (32). We did not use fluoroscopy during the procedure in all patients, the necessity of using fluoroscopy is debatable (36). During FURS, access sheets were not used in any patients (37). FURS was not used in any of the 11 female patients. The reason for this is that the female urethra is short and while the rigid ureterorenoscopy breaks the upper encrusted parts, the lower end of the D-J stent can be pulled from the female urethra by holding (by forceps or hand) and thus the encrusted part becomes visible in front of the rigid ureterorenoscope. In the present study, the fact that stent incrustations were predominantly distal, proximal stones had a lower stone load than the distal, the ureterorenoscopy we used had a low thickness in line with advanced technology, and we had FURS in our clinic contributed to the successful results of ureterorenoscopic holmium laser lithotripsy surgery.

When we look at the operation duration of the patients, we see that the duration increases as the stone load severity increases (P = 0.00). Considering that the breaking of stones and the collection of these stones in endoscopic cases, especially in ureterorenoscopy, are decisive in the operation time, the result can be considered logical. However, it should not be forgotten that the degree of hardness of the stones and anatomical problems related to the patient may also affect this period (38). Joshi et al. examined 40 patients and reported that irritative urinary symptoms, incontinence and hematuria were seen in 78% of patients, daily activities were affected due to catheter-related pain in more than 80% of patients, sexual dysfunction was seen in 38% and a decrease in work performance was seen in 58% of the patients (39). Many of our patients had hematuria, dysuria, and urinary incontinence caused by the encrusted D-J stent. In our series, the number of patients with encrustation from the lower end of the D-J stent together with a bladder stone was in the majority. Serious problems such as hydronephrosis and loss of renal function can develop as a result of urinary obstruction due to stent encrustations caused by D-J stents left in the body for a long time (5). However, there is no definitive study on its effect on bladder functions. Since we asked the question whether D-J stent encrustation can cause loss of bladder function, we compared the bladder capacities of our patients, which can affect bladder function and we found that the bladder capacity was less in patients with high stone load (P = 0.00) (40). However, the biggest limitation of our study was the small number of patients. In addition, there are many parameters that reduce bladder capacity. These include pelvic radical surgery (neurogenous bladder), age, radiotherapy and chemotherapy (40,41). To the best of our knowledge, none of the patients had a history of radical pelvic surgery or radiotherapy. However, we know that one Iranian patient had gynecological open surgery. In addition, we did not apply a known method (ultrasonography) while measuring the bladder capacity of the patients. Before the operation, we made calculations by inserting a classical catheter and giving the highest capacity of serum to the bladder under anesthesia. It should be considered that this calculation

also includes the stone in the encrusted stent occupying volume and may have caused us to underestimate the bladder capacity. Therefore, our results cannot be generalized to the whole population.

The most important issue in patients with D-J stent implants, the patient and their relatives should be informed about the medical problems they may experience if these stents, which are foreign materials for the body, are forgotten. For this reason, patients with D-J stent should be considered incomplete until the stent is removed and they should be followed very closely. However, this problem has not been fully resolved. In the literature, it is seen that there are many applications to prevent stent forgetting. To solve this chronic problem, many methods were used, ranging from giving a manually written stent follow-up card to patients, to sending an e-mail. A computer program has been developed that sends an automatic short message (SMS) to the mobile phones of patients with D-J stent implants. Accordingly, an SMS is sent to the patients on the date determined by the urologist who placed the stent for D-J stent removal. The initial results of this study have been shown to be quite successful (42). In addition, in new publications, it is seen that both D-J stent is forgotten and unnecessary health costs are reduced with mobile applications (Urostentz, Stent tracker, WeChat), especially during the pandemic period. However, the difficulty of accessing these applications, the language diversity problem in the applications and the education level of the patients limit the usability (43,44).

During the COVID-19 pandemic, there was a serious decrease in the number of patients admitted to the hospital and surgical treatments.(15) In addition, D-J stent removal could not be performed due to the fact that elective surgeries were stopped or patients could not come to the hospital due to fear of COVID-19 or thought that the urology outpatient clinic was closed, and an increase in the number of encrusted D-J stent cases (200%) was observed due to the prolonged stay of the stent in the body.

CONCLUSION

There was a significant increase in the number of encrusted D-J stents due to COVID-19. It was concluded that removing encrusted D-J stents and achieving stone-free status using the ureterorenoscopy/FURS technique holmium laser is an effective treatment method. It was found that increasing stone load prolongs the operation time and decreases bladder capacity. However, these results cannot be generalized to the general population, and further studies with a larger number of patients are required.

DESCRIPTIONS

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