ORIGINAL PAPER

UROLOGICAL ONCOLOGY

The role of preoperative ureteral stenting in retrograde intrarenal surgery outcomes for renal stones: a matched-pair analysis

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Introduction Ureteral stenting is not routinely recommended, but it may be performed before or after retrograde intrarenal surgery (RIRS). We aimed to investigate the effect of preoperative ureteral stenting on the success rate and intraoperative, postoperative, and infectious complications in RIRS.

Material and methods We retrospectively analysed the data of 581 patients who underwent RIRS. Demographic data, stone characteristics, presence of hydronephrosis, presence of congenital kidney anomaly and solitary kidney, duration of operation, and duration of hospitalisation were analysed. Intraoperative, postoperative, and infectious complications and the success rate of all operations were recorded. The patients were divided into 2 groups as prestented and non-prestented and matched in terms of age, sex, stone size, and number of stones. Ninety-four patients in the prestented group were matched with 282 patients in the non-prestented group with respect to age, sex, stone size, and number of stones (matched 1:3).

Results The 2 groups were similar in terms of matching parameters and all other characteristics. After matching, the success rate was 77.7% (73/94) in the prestented group and 78% (220/282) in the non-prestented group, and there was no statistically significant difference between the 2 groups (p = 0.943). The intraoperative complication rate was statistically significantly higher in the non-prestented group (19.2% vs 28.7%, p = 0.046). Postoperative complications occurred in 22.3% of patients in the prestented group and 20.7% of patients in the non-prestented group (p = 0.429).

Conclusions Preoperative ureteral stenting in RIRS was not associated with the success rate or postoperative and infectious complications. However, preoperative stenting was effective in decreasing only grade 1 intraoperative complications.

Key Words: complication ‹› preoperative ureteral stenting ‹› RIRS ‹› success

INTRODUCTION

Kidney stones comprise one of the most common urological diagnoses, and surgical treatments play an important role in the management of urinary stones. Regarding the surgical treatment of kidney stones, technological advancements contribute to a continuously evolving treatment algorithm, which at present includes the application of extracorporeal shockwave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), and stone extraction procedures, which are performed either with open or minimally invasive approaches [1]. Among available modalities, RIRS demonstrates the most rapid, technology-driven evolvement, which is reflected

in the expansion of its indication in the kidney stone surgical algorithm. Currently, the European Association of Urology (EAU) strongly recommends the application of RIRS for all patients with stones ≤2 cm, and even for larger stones in patients with contraindications for PCNL [2]. Similarly, the American Urological Association (AUA) recommends RIRS for every renal stone ≤2 cm, and additionally for patients who are not candidates for PCNL and bear larger stones [3].

Recent data from a multicentric database suggest that, under the current RIRS standards (methodology and indications), retrograde surgery for kidney stones is an effective modality for stone clearance, with only 11% of the patients undergoing additional RIRS sessions to achieve stone-free (SF) status [4]. At the same time, RIRS represents a safe endourological procedure; only 1.8% and 1.3% of the patients had complications > Clavien grade 2 in the intraoperative and postoperative setting, respectively [4]. Under the continuously increasing experience and familiarity with RIRS, several modifications are being tested with the intention of simplifying the whole process without compromising the results and the safety of the procedure. In the above patient cohort, 6.8% of the patients underwent a sheathless RIRS, while other reports describe the feasibility of performing effective and safe RIRS without the support of fluoroscopic guidance [5].

Another modification that is already applied by several urological centres is ureteral prestenting. Ureteral stents induce passive ureteral dilation in a predictable manner, but their advantage remains a topic of controversy among urologists. Both European and American guidelines recommend against routine prestenting in patients planned for RIRS on the basis of avoiding the cost of an additional procedure and the ureteral stent-related morbidity for achieving uncertain benefits [2, 3]. However, both the EAU and International Alliance of Urolithiasis recognise the possibility of improving SF rates and the safety of RIRS by placing a ureteral stent preoperatively [2, 6]. At present, there are no conclusive data relating to the decision for or against ureteral stenting before RIRS.

In the current study, we aimed to evaluate the effect of ureteral prestenting on the results and complications in patients who underwent RIRS in our clinic. To isolate the net effect of ureteral prestenting, special attention was paid to measuring surgical outcomes and complications in patient subcohorts, which were comparable in terms of every factor that may affect the results of RIRS in a parallel manner.

MATERIAL AND METHODS

Patients and clinical data

The data of 581 patients who underwent RIRS between January 2013 and May 2019 were obtained from the hospital information database retrospectively. The patients with prior urinary stone surgery, active urinary tract infection, concomitant ureteral stone, malignancy, history of radiation therapy, unsuccessful ureteral access sheath (UAS) placement because of ureteral stenosis or difficult ureter, and inadequate data were excluded from the study.

Demographic data of the patients (age, sex), stone characteristics (stone size, stone density, number of stones and lateralisation, stone location), presence of hydronephrosis, presence of congenital kidney anomaly and solitary kidney, duration of operation, and duration of hospitalisation were analysed. Intraoperative (modified Satava classification system), postoperative (modified Clavien-Dindo classification system), infectious (fever, urinary tract infection, sepsis and septic shock) complications, and success rates of all surgeries were recorded [7, 8].

All patients were diagnosed by non-contrast computed tomography (CT). Stone size was defined as the longest diameter of the stone and the sum of the longest diameters of all stones in the case of multiple stones.

We divided the patients into 2 groups: prestented and non-prestented. According to EAU guidelines, prestenting may improve the stone-free rate of ureteroscopic treatment of renal stones [2]. Prestenting was recommended to kidney stone patients before RIRS, and 1 or 2 weeks before RIRS a 4.8 F DJ stent was preoperatively placed in patients who accepted the presenting procedure. Among 581 patients, 94 patients were included in the presented group and 487 patients were included in the non-presented group. Ninety-four patients in the presented group were matched with patients in the non-prestented group with respect to age, sex, stone size, and number of stones. The 2 groups were compared in terms of intraoperative, postoperative, and infectious complications and characteristics of patients.

Surgical technique

All patients underwent RIRS under general anaesthesia in the lithotomy position. Ureterorenoscopy was performed with a 9.5 F semi-rigid ureterorenoscope (Karl Storz, Tuttingen, Germany) before RIRS. The DJ stent was extracted at the beginning of the procedure for the prestented group. After

inserting the guidewire by semi-rigid ureterorenoscope, a 9.5–11 F UAS (Flexor® Uretheral access sheath, Cook Medical, USA) was inserted into the collecting system. A 7.5 F flexible ureterorenoscope (Karl Storz, Flex X2, GmbH, Tuttlingen, Germany) was placed into the collecting system through the access channel. The stones were fragmented using a holmium-yttrium-aluminium-garnet (Ho:YAG) laser (200–365 μm) through the working channel of the flexible ureterorenoscope. At the end of the surgery, a 4.8 F DJ stent was placed into the collecting system. Postoperatively, the DJ stent was removed 2 weeks after RIRS, and all patients underwent non-contrast CT 4 weeks after RIRS to assess the success rate. Success was defined as the absence of any residual stones or fragments >2 mm in an asymptomatic patient. All procedures were performed by surgeons with at least 10 years of RIRS experience.

Statistical analysis

Data coding and statistical analyses were carried out on a computer using SPSS 22 software (IBM SPSS Statistics, IBM Corporation, Chicago, IL). Propensity score matching was performed using 4 preoperative (age, sex, stone size, and number of stones) variables by using predicted probability values in accordance with the nearest neighbour matching method in a 1:3 ratio. The conformity of the variables to the normal distribution was analysed using Shapiro-Wilk tests. Non-categorical parameters were presented as mean ± standard deviation (SD) or median (minimum-maximum). The Mann-Whitney U test was used to compare non-categorical parameters, and χ^2 or Fisher's exact tests were used for categorical variables. A p-value <0.05 was accepted as statistically significant.

Bioethical standards

The institutional review board at Ankara City Hospital approved this study (approval number: E2.23.5862), and this study was prepared in accordance with the principles of the Declaration of Helsinki.

RESULTS

A total of 581 patients were included in the study. The mean age was 46.4 ±14.5 years, and 366 (63%) patients were male. The median stone size was 16.2 ±8.4 mm. Ninety-four (16.2%) patients were in the prestented group, and 487 (83.8%) patients were in the non-prestented group. There was no statistically significant difference between the 2 groups in terms of age (p = 0.309), sex (p = 0.113), stone size (p = 0.112), stone density (p = 0.39), number of stones (p = 0.844), stone location (p = 0.799), duration of operation (p = 0.702) and hospitalisation (p = 0.296), lateralisation (p = 0.549), presence of hydronephrosis (p = 0.381), congenital kidney anomaly (p = 0.484), and solitary kidney (p = 0.333). In the matching process, 94 patients in the prestented group were matched with 282 patients in the non-prestented group with respect to age, sex, stone size, and number of stones (matched 1:3). The two groups were similar in terms of matching parameters and all other characteristics (Table 1).

After matching, the success rate was 77.7% (73/94) in the prestented group and 78% (220/282) in the non-prestented group, and there was no statistically significant difference between the 2 groups (p = 0.943).

Eighteen (19.2%) patients had intraoperative complications (grade 1 in 9 patients, grade 2 in 9 patients) in the prestented group and 81 (28.7%) patients had intraoperative complications (grade 1 in 59 patients, grade 2 in 22 patients) in the non-prestented group. The intraoperative complication rate was statistically significantly higher in the non-prestented group (p = 0.046).

Postoperative complications occurred in 21 (22.3%) patients in the prestented group (grade 1 in 14 patients, grade 2 in 2 patients, grade 3 in 5 patients) and 57 (20.2%) patients in the non-prestented group (grade 1 in 47 patients, grade 2 in 2 patients, grade 3 in 8 patients), and the 2 groups were statistically similar in terms of postoperative complications (p = 0.429) (Table 2).

DISCUSSION

In the current study, we included 581 patients, who underwent a completed RIRS session. The surgical methodologies applied to the entire cohort were similar (ureteral sheath introduction, stone fragmentation with Ho:YAG laser, post-procedural ureteral stent placement), while a subgroup of the patient cohort was prestented to undergo RIRS with the ipsilateral ureter in a dilated state. Intraoperative and postoperative complications and success rate were evaluated in a standardised manner across the entire cohort. To minimise the effect of other factors that may interfere with the outcomes, we matched the prestented patients with non-prestented patients who had similar clinical characteristics. The comparison of the matched patient subgroups confirmed that they had no statistically significant

Table 1. *Demographic, stone-related, and clinical characteristics of the prestented and non-prestented groups, and comparative analysis before and after matching*

Parameters	Before matching			After matching		
	Prestented group (n = 94, 16.2%)	Non-prestented group (n = 487, 83.8%)	p	Prestented group (n = 94, 33.3%)	Non-prestented group (n = 282, 66.7%)	p
Age (years)	45.0 ±14.4	46.6 ±14.5	0.309*	45 ±14.4	45 ±14	0.931*
Sex						
Male, n (%)	66 (70.2)	300 (61.6)	0.113**	66 (70.2)	199 (70.6)	0.948**
Female, n (%)	28 (29.8)	187 (38.4)		28 (29.8)	83 (29.4)	
Stone size (mm), Mean ±SD	15.1 ±6.2	16.4 ±8.1	0.112*	15.1 ±6.2	15 ±6.2	0.193*
Stone density (HU), Mean ±SD	989.6 ±298.5	956.8 ±332.5	0.39*	989.6 ±298.5	941 ±339.6	0.179*
Number of stones						
Single, n (%)	60 (63.8)	316 (64.9)	0.844**	60 (63.8)	179 (63.5)	0.951**
Multiple, n (%)	34 (36.2)	171 (35.1)		34 (36.2)	103 (36.5)	
Stone location						
Pelvis, n (%)	27 (28.7)	249 (42.9)	0.799**	27 (28.7)	123 (43.7)	0.519**
Upper, n (%)	4 (4.3)	36 (6.2)		4 (4.3)	19 (6.7)	
Middle, n (%)	10 (10.6)	51 (8.8)		10 (10.6)	31 (11)	
Lower, n (%)	37 (39.4)	159 (27.4)		37 (39.4)	79 (28)	
>1 calyx, n (%)	16 (17)	86 (14.8)		16 (17)	30 (10.6)	
Duration of operation (min) (Mean ±SD)	50.2 ±15.7	55.1 ±18.7	0.702*	50.2 ±15.7	50.9 ±17.1	0.758*
Duration of hospitalisation (days) (Median) (min-max)	1 (1–17)	1 (1–75)	0.296*	1 (1–17)	1 (1–75)	0.921*
Lateralisation						
Right, n (%)	42 (44.7)	234 (48)	0.549**	42 (44.7)	127 (45)	0.952**
Left, n (%)	52 (55.3)	253 (52)		52 (55.3)	155 (55)	
Presence of hydronephrosis						
Yes, n (%)	59 (62.8)	282 (57.9)	0.381**	59 (62.8)	165 (58.5)	0.467**
No, n (%)	35 (37.2)	205 (42.1)		35 (37.2)	117 (41.5)	
Presence of congenital kidney anomaly						
Yes, n (%)	2 (2.1)	12 (2.5)	0.484**	2 (2.1)	12 (2.5)	0.602***
No, n (%)	92 (97.9)	475 (97.5)		92 (97.9)	475 (97.5)	
Presence of solitary kidney						
Yes, n (%)	5 (5.3)	16 (3.3)	0.333**	5 (5.3)	8 (2.8)	0.325***
No, n (%)	89 (94.7)	471 (96.7)		89 (94.7)	274 (97.2)	

* Mann-Whitney U Test
** χ^2 test
*** Fisher's exact
HU – Hounsfield units; SD – standard deviation

difference in any clinical parameter. More importantly, ureteral prestenting did not affect stone clearance, because 78% of both groups were stone-free on week 4 postoperatively. Regarding intraoperative complications, prestented patients had significantly fewer events (19.2% vs 28.7% in the non-prestented group). This difference was more obvious in grade 1 complications, which manifested at a doubled rate in non-prestented patients. Postoperatively, both groups developed complication events at similar rates. In summary, the dilated ureter in the prestented patients was advantageous only in terms of minor intraoperative complications.

To compare our results with previous reports, we conducted a literature search and found that most studies demonstrate only slight or no superiority of ureteral prestenting. In 2018, Lee et al. [9] investigated the influence of the duration of ureteral prestenting on RIRS results and reported that prestenting did not affect RIRS outcomes, while it was beneficial only in reducing the necessity for intraoperative ureteral balloon dilation. However, Chen et al. [10] pooled the results of 11 studies and found that ureteral prestenting contributed significantly to stone clearance rates, while no difference was detected in terms of operative times and complication rates. Another report supporting ureteral prestenting was published by Giulioni et al. [11], who investigated the decisive factors determining stone clearance and complications in a cohort of 2,946 patients who underwent RIRS for lower pole stones. The report concluded that ureteral prestenting was among the factors independently affecting the stone clearance rate. In 2023, Assantachai et al. [12] compared

Table 2. *Intraoperative, postoperative, and infectious complications and success rates of prestented and non-prestented groups in retrograde intrarenal surgery*

Complications and success	After matching		p
	Prestented group (n = 94, 16.2%)	Non-prestented group (n = 282, 66.7%)	
Intraoperative complication#			
None, n (%)	76 (80.9)	201 (71.3)	0.046*
Grade 1, n (%)	9 (9.6)	59 (20.9)	
Minimal bleeding	5	33	
Minimal ureteral mucosal injury	4	26	
Grade 2, n (%)	9 (9.6)	22 (7.8)	
Bleeding requiring terminating surgery	3	12	
Ureteral mucosal injury requiring intervention	1	10	
Grade 3, n (%)	0 (0)	0 (0)	
Postoperative non-infectious complication##			
None, n (%)	73 (77.7)	225 (79.8)	0.429*
Grade 1, n (%)	14 (14.9)	47 (16.7)	
Haematuria	10	29	
Renal colic	4	18	
Grade 2, n (%)	2 (2.1)	2 (0.7)	
Blood transfusion	2	2	
Grade 3, n (%)	5 (5.3)	8 (2.8)	
Steinstrassen requiring ureterorenoscopy	4	7	
Perirenal abscess requiring drainage	1	1	
Grade 4, n (%)	0 (0)	0 (0)	
Grade 5, n (%)	0 (0)	0 (0)	
Infectious complications			0.327**
None, n (%)	87 (92.6)	257 (91.1)	
Fever, n (%)	3 (3.1)	16 (5.7)	
Urinary tract infection, n (%)	2 (2.1)	8 (2.8)	
Sepsis, n (%)	1 (1.1)	0 (0)	
Septic shock, n (%)	1 (1.1)	1 (0.4)	
Success			0.943*
Successful, n (%)	73 (77.7)	220 (78)	
Unsuccessful, n (%)	21 (22.3)	62 (22)	

* χ^2 test
** Fisher's Exact
# Modified Satava Classification System
Modified Clavien Classification System

2 patient groups that underwent RIRS and differed in the presence of a preoperative ureteral stent. The study reported no significant difference regarding stone clearance and complication rates. In line with the previous study, Jeong et al. [13] analysed the data of prestented vs non-prestented patients and concluded that ureteral prestenting was not superior in terms of stone clearance and complications. Regarding the paediatric population, Castellani et al. [14] compared prestented vs non-prestented patients and found that ureteral prestenting significantly increased the risk of postoperative infections, while no significant effect on stone clearance rates was detected.

In our opinion, the benefits of ureteral prestenting are limited and relate only to the placement of the UAS, while after the UAS introduction, there was no difference in the following procedure, stone clearance, and complication rate. Indeed, UAS placement represents a demanding step of RIRS, and its uncomplicated success depends on anatomical and functional factors [15, 16]. In 2020, Sung et al. [17] demonstrated that ureteral prestenting significantly increased the success rate of UAS placement, while primary endpoints of RIRS were not affected. Similarly, Yuk et al. [18] reported that ureteral prestenting was advantageous only in terms of UAS placement success, and it should be considered in cases that are planned to be operated through UA. Recently, a meta-analysis by Law et al. [19] demonstrated the beneficial role of ureteral prestenting in UAS placement and additionally in stone clearance. The fact that ureteral prestenting seems to aid UAS placement renders

questionable the benefit in patients who, on the basis of small stone size or surgeon's preference, are planned to undergo a sheathless RIRS.
This study has some limitations. The study was designed retrospectively, and therefore it is vulnerable to bias. Also, all surgeries were performed in a single centre. There is a lack of long-term follow-up results. In addition, data on which laser diameter was used in which case was not recorded in this retrospective study. However, we think that our study contributes to the literature on this subject, which includes conflicting results.

CONCLUSIONS

In this study, the data of prestented vs non-prestented patients who underwent RIRS after UAS placement were analysed, and no difference regarding stone clearance and postoperative complications were detected. Minor intraoperative complication rates were significantly lower in the prestented subgroup, which may be attributed to a more smooth UAS placement into the dilated ureter of these patients.

CONFLICT OF INTEREST
The authors declare no conflicts of interest.

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ETHICS APPROVAL STATEMENT
The study was approved by the institutional review board at Ankara City Hospital (approval number: E2.23.5862).

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