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Categorization of ureteroscopy complications and investigation of associated factors by using the modified Clavien classification system

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Background/aim: The purpose of the present study was to review the complications of ureteroscopy (URS) by using the modified Clavien classification system (MCCS) and to investigate the factors associated with complications.

Materials and methods: Data regarding 811 patients who underwent URS for ureteral calculus were analyzed. Peroperative and postoperative complications were recorded. The patients were divided into seven groups depending on the severity of the complications. The association of sex, stone size, number, and localization with each MCCS grade was also evaluated.

Results: The average age was 45 years. The success of the procedure after one session was 93.5%. Complications were recorded in 57.9% of the patients. According to the MCCS, grade I, II, IIIa, IIIb, IVa, IVb, and V complications were documented in 29.8%, 7.1%, 8.6%, 11%, 0%, 1.2%, and 0% of the patients, respectively. The factors associated with the complications graded by MCCS were sex, stone size, number of stones, and localization. In addition, in multivariate analysis, history of previous surgeries for urolithiasis, orifice dilatation, and instrument size were associated with complications.

Conclusion: According to MCCS, sex, history of previous surgeries for urolithiasis, orifice dilatation, size of the instrument, stone size, number of stones, and localization are associated with different grades of complications in URS.

Key words: Complication, ureterorenoscopy, Clavien classification system

1. Introduction

Semirigid ureteroscopy (URS) is one of the most common treatment options for ureteral stones. Since instruments have become smaller with high imaging quality as a result of advances in technology, endourology has improved rapidly. Therefore, URS has become a common endoscopic surgery which is performed easily and successfully worldwide. The success rate of the procedure is mostly associated with the size and location of the stone (1,2), URS is considered to be a fairly safe and effective procedure. However, it may result in some morbidity and rarely, mortal complications. Categorizing these complications is also important to understand how safe the procedure is. Recently, Mandal et al. (3) modified and used the modified Clavien classification system (MCCS) to categorize postoperative URS complications for the first time in adults. The present study is the second trial that used the MCCS for postoperative complications of URS. The purpose of this study was to present our URS results and to test the feasibility of MCCS to indicate severity of postoperative complications after ureteroscopic stone removal. In addition, the possible predicting factors such as stone number, size, side, location, and gender were also evaluated.

2. Materials and methods

The medical records of 811 patients (543 male and 268 female) who underwent URS procedures due to ureteral calculus in three referral hospitals were reviewed retrospectively. All procedures were performed under spinal or general anesthesia using a semirigid ureterorenoscope (Storz 27000 L/K 6.5 Fr, Storz 27002L/K 8 Fr, or Richard Wolf 9.5 Fr), and stones were fragmented with a pneumatic lithotriptor or holmium YAG:laser until the fragments were suitable for spontaneous passage (<3 mm).

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We evaluated the success of the procedure and postoperative complications by using MCCS, as well as factors associated with complications. Since retrospective studies potentially have the risk of loss of certain data due to their natures, we evaluated the complications uniformly among centers by using a standard form. First, the patient's data required for the evaluation was determined according to MCCS as described above. Then, the patient's characteristics and operative findings, mentioned below, were documented in the institutions. Patients with unclear data were excluded from the study.

Ureteral D-J stent was inserted in patients with edema, injury, or perforation of the ureter. Patients with huge impacted stones or with residual fragments also received a ureteral D-J stent based on the surgeon's decision. Patients were evaluated by plain x-ray and ultrasonography (USG) the day after the surgery to determine stone clearance. The patients with residual fragments were called back 2 to 4 weeks after surgery for an assessment of the final outcome. They were evaluated by x-ray or intravenous urography (IVU) and USG routinely, and by computed tomography (CT) for stones with nonopaque nature. Stone-free status or residual fragments smaller than 3 mm were defined as a success. Patients without hematuria, fever, or renal colic were discharged the day following the surgery. Hematuria that self-limited in two days was defined as temporary hematuria; if it did not improve in 2 days, it was defined as persistent hematuria. Patients with persistent hematuria were evaluated by USG or CT, based on the patient's clinical findings.

In order to reduce the possibility of sepsis, especially in patients with hydronephrotic kidneys, once it was observed that the infected urine flushed out after movement of the huge impacted ureteral calculus, a urine sample for culture was taken intraoperatively. The procedure was then postponed to another session by placing a ureteral J-stent. Postoperative infection was defined in patients with fever ≥38.3 °C or with a urine culture result in which a microorganism was detected. Perioperative antibacterial prophylaxis by second-generation cephalosporins in all patients was administered routinely. An empirical antibiotic was administered to the patients who had fever due to infection. The appropriate antibacterial therapy was chosen according to the knowledge of the local pathogen profile, susceptibility, and the virulence of the predominant pathogens in each center. Then, an appropriate antibiotic was administered to the patients according to urine or blood culture following surgery.

MCCS was used to categorize semirigid URS complications. According to MCCS, grade I complications included events without adverse consequences for the patient. These complications did not require surgical, endoscopic, or radiologic intervention; instead, they required analgesics, antipyretics or antiemetics intervention. Grade II complications comprised blood transfusions or urinary tract infection. Grade III were those that required intervention under local (grade IIIa) or general anesthesia (grade IIIb). Grade IV complications included single organ dysfunction, such as myocardial infarction, renal failure (grade IVa), and urosepsis or multiorgan dysfunction (grade IVb). The grade V complication was death. Related factors affecting each grade of MCCS such as stone side, size, number, location, sex, and age were also evaluated for the first time.

All statistical analyses were performed using SPSS, version 20.0. Statistical significance was assumed at $P < 0.05$. As a supplementary statistic, frequencies (percentages) were used for variables obtained by counting; mean ± standard deviation and median (minimum and maximum) values were used for variables obtained by measurement. Chi-square analysis was used for variables obtained by counting. The Mann–Whitney U test was used to compare two independent groups.

3. Results

The average age of the patients was 44.8 years (17–81 years), and the male/female ratio was about 2/1. The postoperative success rate was 93.5%. The average stone size and success rate for distal, mid-, and proximal ureter were 8.1 mm, 10.3 mm, and 11.3 mm and 98%, 91.9%, and 77.1%, respectively. Patient and operative characteristics are shown in Table 1 in detail.

The incidence of complications was 57.9%. According to MCSS, Grade I, II, IIIa, IIIb, IVa, IVb, and V complications were detected in 29.8%, 7.1%, 8.6%, 11%, 0%, 1.2%, and 0% of the cases, respectively. The complications were fever (10.2%), transient serum creatinine elevation (0.37%), transient (13.6%) and persistent hematuria (5.7%), blood transfusion (0.24%), urinary tract infection (6.9%), urinoma requiring ureteral stent insertion (2.2%), hematoma in bladder (1.4%), mild mucosal injury (5%), D-J stent migration (1.9%), stone migration (3.7%), ureteral perforation (4.6%), ureteral avulsion (0.86%), and urosepsis (1.2%) (Table 2).

Hematurias were self-limiting in all patients; however, 11 (1.4%) patients experienced hematoma in the bladder, which was treated under local anesthesia. We did not experience any intraoperative bleeding that could have caused us to terminate the procedure. Blood transfusion was necessary for two patients who required conversion to open surgery as a result of ureteral avulsion. Although the urine culture was normal in all patients before surgery, ten (1.2%) of the patients experienced sepsis. Even though they were all successfully treated with appropriate antibiotic therapy, one required a transfer to the intensive care unit. Since fever is a component of urosepsis, these patients were not included in the fever group.

Table 1. Patient and surgery characteristics.

Mean age (range)	44.8 years (17–81 years)
Sex	
Male (%)	543 (67%)
Female (%)	268 (33%)
Mean stone size (range)	9.1 mm (3–28 mm)
Location of stone	
Proximal ureter (%)	118 (14.6%)
Mid ureter (%)	185 (22.8%)
Distal ureter (%)	508 (62.6%)
Side	
Left (%)	391 (48.2%)
Right (%)	412 (50.8%)
Bilateral	8 (1%)
Lithotripsy	
Pneumatic lithotripter	790 (97.4%)
Holmium Yag:laser	21 (2.6%)
No. of postoperative double-J stents	134 (16.5%)
Success rates (%)	758 (93.5 %)
Mean postoperative hospitalization time, days (range)	1.8 days (1–10 days)
Mean surgery time, minutes (range)	37.2 min (20–100 min)

Ureteral perforation was experienced in 37 (4.6%) patients, and while 33 (4.1%) of them were treated by placement of ureteral DJ stent successfully, 4 (0.5%) of them required open surgery (1 ureteroneocystostomy and 3 ureteral repairs). All total avulsions occurred with a 9.5 Fr instrument. Total ureteral avulsion was experienced in 7 (0.86%) patients. Five (0.62%) of them had an avulsion from the distal ureter, of which 4 patients underwent a Boari flap and psoas hitch procedure, and 1 patient was treated by end to end anastomosis successfully. Two (0.24%) of the 7 patients had the avulsion from midureter, of which one was treated by end to end anastomosis, and the other was treated by a Boari flap and psoas hitch procedure. Long-term follow up results were favorable, and no stricture or renal failure was detected in any patient. Nephrectomy was not required after any complication of avulsion. Two (0.24%) patients who underwent ureteroneocystostomy required blood transfusion postoperatively. Fortunately, death (Grade V) was not experienced in either the pre- or postoperative periods of the procedures.

When we evaluated the factors associated with complications by using MCCS, sex was detected as an important entity only in grade I complications. Grade I complications were seen more in men than in women (21.5% vs. 13.4%, respectively) ($P = 0.005$). Patients with multiple ureteral stones had greater complications of grade I, II, and III b classifications ($P < 0.001$) (Table 3). In addition, all complication grades increased from the lower to the upper ureter ($P < 0.05$) (Table 4). According to our results, patients with complications in all grades had larger stone burden than patients without complications ($P < 0.05$) (Table 5). Orifice balloon dilatation before accessing the ureter was associated with grade II and IIIb complications ($P < 0.05$). Forty five (5.5%) of the patients had history of previous stone intervention (29 (3.57%) had ureterorenoscopy, 10 (1.23%) had percutaneous nephrolithotomy, and 6 (0.74%) had open surgery). According to the univariate analysis, such history was associated with grade I, II, and III complications ($P < 0.05$) (not shown in the tables).

When the risk factors were evaluated by multivariate analysis, logistic regression analysis revealed that grade I complications increased 6.9-fold with the insertion of a ureteral D-J stent, 44.8-fold with the existence of preoperative urinoma or perirenal edema, 6.9-fold with impact stones, 3.8-fold with history of surgery for urolithiasis, and 2.4-fold with the increased size semirigid ureteroscope.

According to the results of the logistic regression analysis, 1 mm increase in stone length increased the risk

Table 2. Complications of URS classified according to the modified Clavien classification system (n: 811).

Degree	Complication	Number (n)
I	Fever	83 (10.2%)
	Transient serum creatinine elevation	3 (0.37%)
	Transient hematuria	110 (13.6%)
	Persistent hematuria	46 (5.7%)
	All	242 (29.8%)
II	Blood transfusion	2 (0.24%)
	Urinary tract infection	56 (6.9%)
	All	58 (7.1%)
IIIa	Urinoma required ureteral stent insertion	18 (2.2%)
	Hematoma in bladder	11 (1.4%)
	Mild mucosal injury	41 (5.0%)
	All	70 (8.6%)
IIIb	DJ stent migration	16 (1.9%)
	Stone migration	30 (3.7%)
	Ureteral perforation	37 (4.6%)
	Ureteral avulsion	7 (0.86%)
	Ureteral stricture	0 (0%)
	All	90 (11%)
IVa	Myocardial infarction	0 (0.0%)
	Renal failure	0 (0.0%)
	All	0 (0%)
IVb	Urosepsis	10 (1.2%)
	Multi organ dysfunction	0 (0.0%)
	All	10 (1.2%)
V	Death	0 (0.0%)
All		470 (57.9%)

for grade II complications 1.16-fold. The risk for grade II complications increased 23.6-fold with the existence of preoperative urinoma or perirenal edema; 6.7-fold with impact stones; 4.1-fold with history of surgery for urolithiasis; and 3.36-fold with the increased size semirigid ureteroscope.

The increase in stone length increased the risk for grade III complications 1.098-fold. The risk for grade III complications increased 26.5-fold with the existence of preoperative urinoma or perirenal edema; 6.4-fold with the history of surgery for urolithiasis; and 2.5-fold with the presence of orifice dilatation.

The logistic regression analysis also revealed that the risk for grade IV complications increased 4.9-fold by inserting a ureteral D-J stent at the end of the surgery and 62.1-fold with the existence of preoperative urinoma or perirenal edema. In addition, stone localization from distal to proximal ureter and bigger instrument size increased the risk for grade IV complications 1.7-fold and 2.8-fold, respectively.

4. Discussion

Semirigid URS is a common treatment option which is performed easily and successfully worldwide for ureteral stones. The success rate of the procedure is mostly associated with the size and location of the stone. It is mostly preferred for the treatment of distal and midureteral stones (1). The success of the procedure is significantly better than SWL for distal ureteral stones and for proximal ureteral stones bigger than 10 mm (2). URS is considered a safe procedure with success rates of 81%–94% (3). However, it may result in morbidity and rarely in mortal complications.

Table 3. Association of the number of stones with complications.

		Multiple		Single		All		Statistical analysis	
		n	%	n	%	n	%	Chi-square	P
MCCS Gr I	Absent	51	62.96	607	83.15	658	81.13	18.116	**0.000**
	Existence	30	37.04	123	16.85	153	18.87		
	All	81	100.00	730	100.00	811	100.00		
MCSS Gr II	Absent	67	82.72	686	93.97	753	92.85	12.269	**0.000**
	Existence	14	17.28	44	6.03	58	7.15		
	All	81	100.00	730	100.00	811	100.00		
MCSS Gr IIIa	Absent	71	87.65	678	92.88	749	92.36	2.125	0.145
	Existence	10	12.35	52	7.12	62	7.64		
	All	81	100.00	730	100.00	811	100.00		
MCSS Gr IIIb	Absent	64	79.01	681	93.29	745	91.86	18.011	**0.000**
	Existence	17	20.99	49	6.71	66	8.14		
	All	81	100.00	730	100.00	811	100.00		
MCSS Gr IVa	Absent	81	100.00	730	100.00	811	100.00	-	-
	Existence	0	0.00	0	0.00	0	0.00		
	All	81	100.00	730	100.00	811	100.00		
MCSS Gr IVb	Absent	79	97.53	722	98.90	801	98.77	Fisher's Exact	0.263
	Existence	2	2.47	8	1.10	10	1.23		
	All	81	100.00	730	100.00	811	100.00		
MCSS GrV	Absent	81	100.00	730	100.00	811	100.00	-	-
	Existence	0	0.00	0	0.00	0	0.00		
	All	81	100.00	730	100.00	811	100.00		

Values in bold are significant.

The most important and dreaded complications of URS are ureteral injuries, such as ureteral perforation and avulsion. The complication reports have mostly focused on these dreaded complications (4–7). However, after describing the first classification systems, the complication reports of institutions have changed, and an international language for complications was developed (8,9). The Clavien and Satava classification systems are widely used for postoperative and intraoperative adverse events of different endourological procedures (8–12). Recently, Tepeler et al. (1) and Oguz et al. (13) modified and used the Satava classification system for semirigid and flexible URS for the first time. Dogan et al. (14) used the Satava and Clavien classification systems for semirigid URS in children in 2011. The following year, Mandal et al. (3) modified and used the MCCS to define peroperative and postoperative complications of semirigid URS prospectively in 120 adults for the first time. The present study is the second trial that used the MCCS for peroperative and postoperative complications of URS in adults in the international literature. We aimed to present our results of URS and the feasibility of MCCS and to indicate the severity of postoperative complications after ureteroscopic stone removal. In addition, the possible predicting factors for MCCS such as sex, number of stones, size, side, and location were also evaluated.

In our series, the overall incidence of complications was 57.9%. Although this rate seems high, there was a dominance of grade I and II complications with rates of 29.8% and 7.1%, respectively. Grade IIIa complications were reported at 8.6% and grade IIIb complications, the most dreaded ones, were detected in 11% of patients. Grade IVa complications, including myocardial infarction and renal failure, were not detected in any patient. Urosepsis (grade IVb) was reported in 1.2% of the patients. Death (grade V) was not experienced in our series.

Infection related complications ranged from clinically insignificant fever to urosepsis. Fever was defined as temperature ≥38.3 °C in the present study and as described in the literature (15,16). The range of fever varied from

Table 4. Association of stone localization with complications.

		Localization								Statistical analysis	
		Diastal ureter		Mid ureter		Proximal ureter		All			
		n	%	n	%	n	%	n	%	Chi-square	P
MCCS Gr I	Absent	431	84.84	147	79.46	80	67.80	658	81.13	18.617	**0.000**
	Existence	77	15.16	38	20.54	38	32.20	153	18.87		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS Gr II	Absent	481	94.69	174	94.05	98	83.05	753	92.85	20.044	**0.000**
	Existence	27	5.31	11	5.95	20	16.95	58	7.15		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS Gr IIIa	Absent	478	94.09	170	91.89	101	85.59	749	92.36	9.875	**0.007**
	Existence	30	5.91	15	8.11	17	14.41	62	7.64		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS Gr IIIb	Absent	486	95.67	169	91.35	90	76.27	745	91.86	48.282	**0.000**
	Existence	22	4.33	16	8.65	28	23.73	66	8.14		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS Gr IVa	Absent	508	100.00	185	100.00	118	100.00	811	100.00	-	-
	Existence	0	0.00	0	0.00	0	0.00	0	0.00		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS Gr IVb	Absent	503	99.02	184	99.46	114	96.61	801	98.77	-	-
	Existence	5	0.98	1	0.54	4	3.39	10	1.23		
	All	508	100.00	185	100.00	118	100.00	811	100.00		
MCSS GrV	Absent	508	100.00	185	100.00	118	100.00	811	100.00	-	-
	Existence	0	0.00	0	0.00	0	0.00	0	0.00		
	All	508	100.00	185	100.00	118	100.00	811	100.00		

Values in bold are significant.

1% to 20% in the literature (2,3,17–20) and was 10.2% in our series. European Association of Urology Guidelines reported fever or urosepsis at the rate of 1.1% (2). Mandal et al. (3) reported a urosepsis rate of 0.8%, and it was detected in 1.2% of the patients in our series. All complications associated with infection had no consequences for the patients; only 1 (0.1%) patient experienced sepsis and had to be transferred to the intensive care unit during his stay.

Hematuria mostly occurs because of mucosal injury in the urethra, bladder, or ureter. The size of the instrument is an important factor that affects the degree and rate of hematuria (3,21). The bleeding complications were mostly self-limiting. According to EAU guidelines, persistent hematuria was detected with a rate of 2% (2). Transient hematuria was detected in 19.1% and 13.5% of the patients, persistent hematuria was detected in 2.5% and 5.6% of the patients, and hematoma in the bladder was detected in 1.6% and 1.3% of the patients in Mandal et al. (3) and our series, respectively.

Ureteral perforation and avulsion (grade IIIb) are the most dreaded complications of transureteral procedures. The range of ureteral perforation varied from 0.16% to 1.7% in the literature (1–3). It was detected in 4.5% of our patients with varying severities and only 0.5% of the patients required immediate open surgery to repair the ureter. Others who experienced perforation were treated by placing a D-J stent successfully.

Total ureteral avulsion can occur in up to 0.5% of the patients (1–3,22,23). Although ureteral total avulsion is a rare complication, it may result in nephrectomy. As such, dealing with this complication requires a high level of experience from a surgeon. In our series, 7 (0.86%) patients experienced total ureteral avulsion. We detected that avulsions occurred after operations by both less experienced residents and highly experienced surgeons. One surgeon did not encounter another avulsion in the following procedures because care was taken with the ureteroscope in the ureter. Complicated cases are mostly

Table 5. Association of stone length with complications.

		Stone length (mm)						Mann–Whitney U		
		n	Mean	Median	Min	Max	SS	Mean Rank.	U	P
MCCS Gr I	Absent	658	8.84	8.00	4.00	26.00	3.56	395.93	43710.5	**0.011**
	Existence	153	10.20	9.00	3.00	28.00	5.06	449.31		
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS Gr II	Absent	753	8.89	8.00	3.00	28.00	3.72	396.26	14502.5	**0.000**
	Existence	58	11.83	10.00	4.00	27.00	5.31	532.46		
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS Gr IIIa	Absent	749	8.89	8.00	3.00	26.00	3.67	397.26	16674	**0.000**
	Existence	62	11.60	10.00	4.00	28.00	5.65	511.56		
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS Gr IIIb	Absent	745	8.89	8.00	3.00	28.00	3.75	394.92	16331.5	**0.000**
	Existence	66	11.52	10.00	5.00	27.00	4.94	531.05		
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS Gr IVa	Absent	811	9.10	8.00	3.00	28.00	3.92	-		
	Existence	0	.	.	.	.	.			
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS Gr IVb	Absent	801	9.06	8.00	3.00	28.00	3.88	404.17	2539.5	**0.045**
	Existence	10	12.60	12.50	5.00	21.00	5.83	552.55		
	All	811	9.10	8.00	3.00	28.00	3.92			
MCSS GrV	Absent	811	9.10	8.00	3.00	28.00	3.92	-		
	Existence	0	.	.	.	.	.			
	All	811	9.10	8.00	3.00	28.00	3.92			

Values in bold are significant.

referred to experienced surgeons, which could explain why two of the avulsions were also caused by experienced surgeons in our series. Nephrectomy was not required in patients. Five (0.62%) of the patients underwent a Boari flap and psoas hitch procedure, and 2 (0.24%) of them were treated by end to end anastomosis, successfully. Ureteral stricture or renal failure was not detected in the follow-up period.

The incidence of all complications was 57.9% in our series. According to MCCS, grade I, II, IIIa, IIIb, IVa, IVb, and V complications were detected in 29.8%, 7.1%, 8.6%, 11%, 0%, 1.2%, and 0% of the cases, respectively. Although the complication rates decrease with advancing technology and improving instruments, the complication rates seem to be higher with classification systems like Satava or Clavien. Insignificant events included in grade I and II of our series could be the cause of the higher complications rates. These insignificant events were not considered a complication in the previous series, perhaps because they were rather subjective.

On the other hand, we evaluated the associated factors with complications by using MCCS for the first time. Sex was detected as an important entity only in grade I complications. In the previous literature, sex-associated complications were not reported according to the grade of the MCCS and there were no significant differences between sex and complication rates (3,24,25). Moreover, the association of sex with hematuria after URS was not investigated before. In the present study, grade I complications were seen more in men (21.5% vs 13.4%) than in women as they are more prone to hematuria due to a more complicated infravesical path (P = 0.005). As expected, the stone size, the number of stones, and localization were associated with all grades of MCCS.

According to the results of the logistic regression analysis, our study demonstrated that a 1-mm increase in stone length increased the risk for grade II and III complications 1.16- and 1.098-fold, respectively. The increased size of the semirigid ureteroscope also increased the risk for grade I, II, and IV complications 2.4-, 3.36-

, and 2.8-fold, respectively. Inserting a ureteral D-J stent increased the risk for grade I and IV complications 6.9- and 4.9-fold, respectively. The existence of preoperative urinoma or perirenal edema was an important predictive factor for complications and increased the risk for grade I, II, III, and IV complications 44.8-, 23.6-, 26.5-, and 62.1-fold, respectively. Impacted stones increased the risk for grade I and II complications 6.9- and 6.7-fold, respectively. History of previous surgery for urolithiasis resulted in a 3.8-, 4.1-, and 6.4-fold increase for grade I, II, and III complications, respectively. In addition, orifice dilatation before accessing the ureter increased the risk for grade III complications 2.5-fold. Stone localization from the distal to the proximal ureter increased the risk for grade IV complications 1.7-fold.

There are several limitations of the present study. The first is that the study is retrospective. All retrospective studies potentially face the risk of loss of certain data due to their nature. As such, subjective data that were not recorded routinely, such as renal colic, could not be evaluated. In addition, some patients who were stone-free and did not experience any complications after surgery lost their follow-up procedures. As a result, we did not present the long term results of the procedures. The second limitation was that the CT was not used routinely for detecting residual fragments after surgery. Plain x-ray/IVU and USG were used for determination of final success after surgery, and CT was preferred in complicated patients with nonopaque stones and/or residual fragments.

We believe that using classification systems to categorize complications of surgical procedures is necessary to present experiences of surgeons and institutions. Thus, surgeons and institutions could have the opportunity to compare their results. According to our results, MCCS is a simple and quick method for grading the complications of URS. The most important factors associated with the complications graded by MCCS were sex, stone size, number of stones, and localization. In addition, in multivariate analysis, history of previous surgeries for urolithiasis, orifice dilatation, and instrument size were associated with complications.

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