ENDOUROLOGY

Original Article

Flouroscopy-free technique is safe and feasible in retrograde intrarenal surgery for renal stones

Floroskopisiz retrograt intrarenal cerrahi tekniği böbrek taşı tedavisinde güvenli ve uygulanabilir bir yöntemdir

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ABSTRACT

Objective: The aim of this study was to present outcomes of our patients who had undergone retrograde intrarenal surgery (RIRS) with fluoroscopy-free technique and evaluate the efficacy and safety of the technique.

Material and methods: Between January 2013 and June 2015 the outcomes of 93 patients who had undergone RIRS with fluoroscopy-free technique were retrospectively evaluated. Our RIRS technique involved preoperative assessment of ureter by semi-rigid ureteroscope, inserting guidewire through semi-rigid ureteroscope, inserting ureteral access sheath over the guidewire with the visiual guidance of semi-rigid ureteroscope, passing flexible ureteroscope through the sheath, dusting the stone with holmium laser, rechecking the ureter with semi-rigid ureteroscope and inserting double J stent through semi-rigid ureteroscope. Low-dose computerized tomography scan was performed to all patients in postoperative first month and the results were classified as stone-free (absence of any fragment), clinically insignificant residual fragments (CIRF) (≤4 mm) and residual stone.

Results: Study population consisted of 62 (66.6%) male and 31 (33.3%) female patients with a mean age of 47.8±14 (range 14-93) years. Mean stone size was 14.7±5 (7-32) mm. Median operative time was 72 (30-125) minutes. Stone-free rate was achieved in 65 (69.9%) patients while CIRF was achieved in 13 (13.9%) and residual stones were detected in 15 (16.1%) patients. Five patients (5.37%) had minor complications, including hematuria and fever. No major complications were observed.

Conclusion: Fluoroscopy-free technique is effective and safe technique in management of renal stone. Furthermore fluoroscopy-free technique can protect the surgeon from the negative effects of radiation.

Keywords: Flexible ureterorenoscopy; fluoroscopy; nephrolithiasis.

ÖZ

Amaç: Çalışmanın amacı floroskopisiz teknikle retrograt intrarenal cerrahi (RIRC) uygulanan hastaların sonuçlarını sunmak ve bu tekniğin etkinliğini ve güvenliğini değerlendirmektir.

Gereç ve yöntemler: Ocak 2013 ile Temmuz 2015 yılları arasında böbrek taşı nedeniyle floroskopisiz teknik ile RIRC uygulanan 93 hastanın sonuçları retrospektif olarak değerlendirildi. RIRC tekniğimiz sırasıyla semi-rijit üreterorenoskop ile üreterlerin değerlendirilmesi, üreterorenoskop içinden kılavuz telin gönderilmesi, bu telin üzerinden çalışma kılıfının semi rijit üreteroskopla gözlemlenerek gönderilmesi, fleksible üreteroskopun çalışma kılıfının içinden yerleştirilmesi, holmium laserle taşların parçalanması, semi-rijit üreteroskop ile üreterin tekrar gözlemlenmesi ve semi-rijt üreteroskop içinden double J stent yerleştirilmesinden oluşmaktaydı. Düşük doz bilgisayarlı tomografi postoperatif 1. ayda tüm hastalara uygulandı ve sonuçlar taşsızlık (hiç fragmanın olmaması), klinik olarak önemsiz rezidü fragman (KÖRF) (≤4 mm) ve rezidü taş olarak değerlendirildi.

Bulgular: Çalışma grubu ortalama hasta yaşı 47,8±14 yıl olan 62 (%66,6) erkek ve 31 (%33,3) kadın hastadan oluşmaktaydı. Ortalama taş boyutu 4,7±5 (7-32) mm, medyan operasyon zamanı 72 (30-125) dakikaydı. Altmış beş (%69,9) hastada taşsızlık, 13 (%13,9) hastada KÖRF ve 15 (%16,1) hastada rezidü taş tespit edildi. Beş (%5,37) hastada hematüri ve ateşi içeren minor komplikasyon görüldü. Herhangi bir major komplikasyon görülmedi.

Sonuç: Böbrek taşı tedavisinde floroskopisiz teknik etkili ve güvenli bir yöntemdir. Buna ek olarak floroskopisiz teknik cerrahi radyasyonun olumsuz etkilerinde koruyabilir.

Anahtar Kelimeler: Fleksible üreterorenoskopi; floroskopi; nefrolitiazis.

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Introduction

Retrograde intrarenal surgery (RIRS) is an alternative treatment method for kidney stones. Use of RIRS has increased with technical improvements, including miniaturisation of endoscope, improved deflection mechanism and enhanced optical quality.[1] Conventionally, fluoroscopy is used for initial ureteral access, assistance in reaching the stone and monitoring the placement of stents and wires.[2,3] The risk of radiation exposure has become a clinical concern for both patients and urologists with the widespread use of endoscopic treatment. Genetic mutations and secondary malignancies are the potential risks of the radiation exposure.[4,5] Therefore, fluoroscopy-free techniques and radiation exposure-minimising techniques have become popular in the field of urology.[6-10] The present study aimed to determine the outcomes of our fluoroscopy-free RIRS technique and evaluate its safety and efficacy.

Material and methods

Patients who had undergone RIRS for the management of renal stones with a fluoroscopy-free technique between January 2013 and June 2015 were retrospectively evaluated. The diagnosis of urolithiasis was based on a preoperative low-dose computed tomography (CT). Preoperative CT was also used for estimating location, laterality and size of the stone. Stone size was defined as the maximal diameter of the stone in either the coronal, transverse or sagittal plane. Stone size was not used an exclusion criterion; however, patients with preoperatively inserted double-j stent, bilateral stones or who had undergone bilateral RIRS were excluded from study. Patients' demographic characteristics and size, location and laterality of the stones were recorded.

Informed consent was obtained from all patients. A single preoperative dose of 1 g ceftriaxone was routinely administered. The main outcomes that were assessed were stone-free and complication rates at 1 month after a single procedure. All patients underwent kidney, ureter and bladder (KUB) radiography on the first day, and low-dose CT 1 month postoperatively. The results were classified as stone-free, clinically insignificant residual fragments (CIRF) and residual stones. Stone-free status was defined as the absence of any fragment. CIRFs were defined as ≤4 mm, non-obstructing, non-infectious and asymptomatic residual fragments.[11] Residual stones were defined as >4 mm or symptomatic stones.

Operation technique

All procedures were performed under general anaesthesia with the patient in the lithotomy position. Before the procedure, diagnostic ureterorenoscopy (URS) using a 9.5 Fr semi-rigid ureteroscope (Storz, Tuttlingen, Germany) was performed to define the ureteral abnormalities that may cause difficulty during the insertion of a ureteral access sheath (UAS). Diagnostic URS also allows ureter dilatation that may aid in UAS insertion. A working guidewire (0.038-inch hydrophilic material coated flexible tip guidewire, Cook Medical, Limerick, Ireland) was inserted through ureteroscope up to the ureteropelvic junction to ensure that the guidewire was stable in the renal pelvis. Subsequently, the ureteroscope was withdrawn and reinserted into the bladder nearby guidewire for visiual guidance during the course of UAS insertion. UAS (9.5 Fr, Cook Medical, Bloomington, USA) was introduced over the guidewire with the aid of the ureteroscope until resistance was encountered or any deflection in the UAS was observed. A 7.5 Fr flexible ureteroscope (Storz Flex-X2, Tuttlingen, Germany) was passed through the UAS. A Litho (Quanta System, Italy) Ho:YAG laser generator and 272 µm laser fibre were used in all patients for stone dusting. High frequency (10-15 Hz) and low power (0.8-1.0 J) was applied for stone dusting. At the end of the procedure, UAS was removed and a semi-rigid ureteroscope was inserted to check whether any ureteral injury occurred. Finally, a 4.7 Fr 26 cm double-J stent was inserted through the ureteroscope.

Statistical analysis

Descriptive analysis was performed by using the Statistical Package for the Social Sciences, (IBM SPSS Statistics; Armonk, NY, USA) version 22.0.

Results

The present study population comprised 62 (66.6%) male and 31 (33.3%) female patients with a mean age of 47.8±14 years. The mean stone size was 14.7±5 (range, 7-32) mm, and 42 (45.1%) patients had a lower pole calyceal stone. Stone characteristics are presented in Table 1. The surgery was performed after a negative preoperative urine culture was obtained in all patients.

Comorbidities included hypertension in eight, diabetes mellitus in four, and obstructive lung disease in three patients.

Table 1. Demographic and clinical data

Variable		No.cases (%)	Mean±SD (range)
Age, years			47.8±14 (14-83)
Sex			
	Male	62 (66.6)	
	Female	31 (33.3)	
Laterality			
	Left	45 (48.4)	
	Right	48 (51.6)	
Stone size, mm			14.7±5 (7-32)
Stone location			
	Pelvis	42 (45.1)	
	Lower calyx	42 (45.1)	
	Middle calyx	5 (5.4)	
	Upper calyx	4 (4.3)	

Table 2. Perioperative outcomes

Variable	No. cases (%)	Mean±SD (range)
Operative time (min)		72.1±14.6 (30-125)
Stone- free rate	65 (69.9)	
CIRF	13 (14)	
Residual stone	15 (16.1)	
Complication		
Fever	3 (3.2)	
Hematuria	2 (2.2)	

CIRF: clinically insignificant residual fragments; SD: standard deviation

Table 3. Success rates according to stone location

	Stone- free (%)	CIRF (%)	Residual stone (%)	Total (%)
Renal pelvis	35 (83.4)	4 (9.5)	3 (7.1)	42 (45.2)
Lower pole	22 (52.4)	9 (21.4)	11 (26.2)	42 (45.2)
Middle pole	5 (100)	-	-	5 (5.4)
Upper pole	3 (75)	-	1 (25)	4 (4.3)
Total (%)	65 (69.9)	13 (14)	15 (16.1)	93 (100)

CIRF: clinically insignificant residual fragments

Perioperative outcomes are described in Table 2. Reaching the ureteropelvic junction was not successful using a rigid ureteroscope in four, and a deflection occurred in UAS during insertion through the ureter in three patients. In all cases, a flexible ureteroscope that could reach the ureteropelvic junction was used to evaluate the ureter beyond the resistance. No ureteral injury was observed during the second visualization of the ureter using a rigid ureteroscope. No malposition of the double-J stent was identified on the KUB radiograms on the first postoperative day. The stone- free, CIRF and residual stone rates were 69.9%, 14% and 16.1%, respectively, at 1 month postoperatively. Success rates according to stone location are provided in Table 3. The highest success rates of 100% and 83.4% were achieved in patients with middle pole and renal pelvis stones, respectively. All patients without complications were discharged on the first; whereas others on the second postoperative day. Postoperative complications occurred in five patients, including fever (Clavien grade I) in three, and haematuria (Clavien grade II) in two patients. No major complications were observed. Routinely inserted double-J stents were removed within the first postoperative month under local anesthesia in an outpatient setting after CT scan examinations.

Discussion

Fluoroscopy plays a key role and its use is recommended during endoscopic procedures to increase procedural safety.[12] Despite its several advantages, fluoroscopy is associated with potential risks to both the operation team and patients. The biological effects of radiation can be grouped as stochastic or deterministic effects.[13] Radiation induced cancer and genetic effects are stochastic, in which the probability of exposure to its effect increases with dose rather than the severity of the damage incurred. The deterministic effect is associated with the threshold radiation level. The damage becomes apparent with increasing severity as the dose increases above the threshold. Therefore, surgeons use equipment, such as lead aprons, to minimise the radiation exposure. Despite the use of protection protocols, surgeons receive the maximum radiation exposure during endourological procedures.[14] The first step that demands fluoroscopic guidance is the placement of a safety guidewire. In the present study, the guidewire was placed through the rigid ureteroscope; therefore, fluoroscopy was not required for this step. To avoid perforation or ureteral injury, fluoroscopy is used to monitor the whole process of UAS insertion. In the present study, diagnostic URS was routinely performed to detect the ureteral strictures and the whole process of UAS insertion was monitored by visual guidance using a rigid ureteroscope to avoid unnecessarily deep insertion.

The first study on URS without fluoroscopy imaging was performed in patients with distal ureteral stones.[15] The authors reported the need of fluoroscopy in 4% of their patients, with no complications observed. In the other study, in which half of the population exhibited proximal and middle ureter stones, the authors reported that fluoroscopy was required in 7.52% of the patients, and minor complications were observed in 11% of the patients.[6] The present study focused on the renal stones, and fluoroscopy was not required in any patients.

To reduce the use of fluoroscopy, some authors have reported the use of UAS insertion after diagnostic URS, with tactile cues and single-shot fluoroscopic images obtained to verify the placement of UAS.[16] Higher success rate was observed in that study than in the present study (82.9% vs. 69.9%). Patient selection may have caused this difference. The incidence of lower pole stone, for which the success rate of RIRS is lower, was higher in our study than in the previous study (45.2% vs. 22.4%, respectively). In a recently published paper, the authors evaluated a fluoroscopy-free RIRS technique for renal stones and achieved stone- free status in 95.7% of the patients.[10] In that study, the authors defined the stone- free status as the absence of any fragments or residual fragments <2 mm in diameter on plain abdominal radiography or ultrasound (US) imaging. It is well known that CT, which was used in the present study to evaluate the success rate, is more sensitive for detecting renal stones than both US and plain radiography (96.6%, 45% and 44-77%, respectively).[17-19] Furthermore, the previous study used fragmentation and stone extraction with basket forceps, which we could not perform in our study because of lack of equipment.

Many authors have emphasized RIRS as an effective and reliable treatment method for managing renal stones, with the success rates ranging from 65% to 92%.[20] The stone-free rate observed in the present study corroborates these results.

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We used a fluoroscopy-free technique to decrease the radiation dosage but maintain stone-free status by performing low dose CT. This approach may seem contradictory as the main aim of the present study was protecting tissues from radiation. However, radiation exposure from low dose CT is comparable to that from KUB radiography.[21] The present study had certain limitations. As this was a retrospective and non-comparative study, the amount of reduced radiation dose was not measured by dosimetry. Prospective randomised studies are needed to compare fluoroscopy- free techniques with conventional techniques. However, the results of the present study indicate that fluoroscopy-free RIRS is safe and feasible. Furthermore, this technique may be helpful in certain clinical situations, such as pregnancy, and may be more comfortable for the surgeons as the use of lead aprons can be avoided.

Our fluoroscopy-free RIRS technique is effective and safe in the management of renal stones. Furthermore, our fluoroscopy-free RIRS technique can protect the surgeons and staff from the negative effects of radiation exposure.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Sakarya University School of Medicine (Date: 28.08.2016/ Number: 71522473/050.01.04/121).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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