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Can rigid ureteroscopic lithotripsy be an alternative to flexible ureteroscopic lithotripsy in the treatment of isolated renal pelvis stones smaller than 2 cm?

İki santimetreden küçük izole böbrek pelvis taşlarının tedavisinde rijit üreteroskopik litotripsi, fleksibl üreteroskopik litotripsiye alternatif olabilir mi?

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Abstract

Aim: Although flexible ureteroscopy (FURS) is preferred over rigid ureteroscopy in the treatment of kidney stones, rigid ureteroscopy (RURS) is also often sufficient for reaching the renal pelvis in many patients. In this study, we aimed to analyze the results of rigid (RURSL) and flexible ureteroscopic lithotripsy (FURSL) for the treatment of isolated renal pelvic stone (IRPS) <2 cm in size by evaluating stone-free rates, operation times, and associated complications.

Methods: This retrospective cohort study included patients who underwent RURSL (group 1, n=24) and FURSL (group 2, n=21) for IRPS <2 cm in size between June 2012 and May 2017. RURS was routinely performed in all patients. The stones reached by rigid ureteroscope were fragmented with holmium laser. When the stones were not reachable by rigid ureteroscope, FURS was performed, and the stone was fragmented with the same laser energy.

Results: In 24 of 45 (53.3%) patients, stones were reached by rigid ureteroscope and fragmented with holmium laser. In the remaining 21 (46.7%) patients, the stones could not be reached by rigid ureteroscope, and they were managed with FURS and fragmented with the same laser energy source. RURS was successful in reaching renal pelvic stones in 15 of 25 (60%) female patients; however, the stones were reached in 9 (45%) of 20 male patients (P=0.173). There was no significant difference between the two groups in terms of age, gender, side of stone, mean stone size, hospital stay, stone-free rates, and associated complications (P=0.298, P=0.396, P=0.775, P=0.266, P=0.742, P=0.428, P=0.186, respectively). The mean operative times were significantly lower in RURSL group than in FURSL group, and they were 66.75 (15.77) minute and 89.54 (17.71) minute, respectively (P<0.001).

Conclusions: FURSL is a more appropriate procedure for the treatment of kidney stones; however, it should be kept in mind that RURSL is an alternative procedure to FURSL with shorter operation time, similar stone-free rates and similar complication rates for IRPS in selected cases.

Keywords: Rigid, Flexible, Ureteroscopic lithotripsy, Renal pelvis stone

Öz

Amaç: Her ne kadar böbrek taşlarının tedavisinde fleksibl üreteroskopi rijit üreteroskopiye tercih edilse de, birçok hastada renal pelvise ulaşmak için rijit üreteroskopi yeterli olmaktadır. Bu çalışmada, 2 cm'den küçük izole böbrek pelvis taşı tedavisinde rijit ve fleksibl üreteroskopik litotripsi sonuçlarını taşsız oranları, operasyon süreleri ve ilişkili komplikasyonları değerlendirerek analiz etmeyi amaçladık.

Yöntemler: Bu retrospektif kohort çalışması, Haziran 2012 ile Mayıs 2017 tarihleri arasında, 2 cm'den küçük izole renal pelvis taşı için RURSL (grup 1, n=24) ve FURSL (grup 2, n=21) uygulanan hastaları kapsamaktadır. Tüm hastalara rutin olarak rijit üreteroskopi uygulandı ve rijit üreteroskop ile ulaşılan taşlar holmiyum lazer ile parçalandı. Rijit üreteroskop ile ulaşılamayan taşlara fleksibl üreteroskopi yapıldı ve aynı lazer kaynağı ile kırıldı.

Bulgular: 45 hastanın 24'ünde (%53,3) rijit üreteroskop ile taşlara ulaşıldı ve holmiyum lazer ile kırıldı. Rijid üreteroskop ile taşlara ulaşılamayan 21 (%46,7) hastada fleksibl üreteroskop ile taşlara ulaşıldı ve aynı lazer kaynağı ile parçalandı. Rijit üreteroskopi 25 kadından 15'sinde (%60) taşlara ulaşmada başarılı olurken; 20 erkek hastanın 9'unda (%45) taşlara ulaşıldı (P=0,173). İki grup arasında yaş, cinsiyet, taşın yönü, ortalama taş boyutu, hastanede kalış süresi, taşsızlık oranları ve ilişkili komplikasyonlar açısından istatistiksel olarak anlamlı bir fark yoktu (sırasıyla P=0,298, P=0,396, P=0,775, P=0,266, P=0,742, P=0,428, P=0,186). Ortalama ameliyat süreleri rijit üreteroskopik litotripsi grubunda fleksibl üreteroskopik litotripsi grubuna göre anlamlı olarak daha düşüktü ve sırasıyla 66,75 (15,77) dakika ve 89,54 (17,71) dakika idi (P<0,001).

Sonuç: Fleksibl üreteroskopik litotripsi böbrek taşlarının tedavisi için daha uygun bir prosedür olmakla beraber, daha kısa operasyon süresi, benzer taşsızlık ve komplikasyon oranları ile rijit üreteroskopik litotripsi 'nin seçilmiş izole böbrek pelvis taşlarında fleksibl üreteroskopik litotripsiye alternatif bir prosedür olduğu unutulmamalıdır.

Anahtar kelimeler: Rijit, Fleksibl, Üreteroskopik litotripsi, Renal pelvis taşı

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Introduction

Today, there are numerous options for the treatment of kidney stones, such as extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), ureteroscopic lithotripsy (URSL), their combinations, laparoscopic techniques, and open surgery [1]. Technological advances and more advanced equipment have increased success rates and decreased morbidity in the treatment of kidney stones. This improvement in technology has extended the indications of ureteroscopic surgery. For isolated renal pelvic stones (IRPS) <1 cm, ESWL or retrograde intrarenal surgery (RIRS) are first-line treatment options whereas for kidney stones >2 cm, PCNL is the first option. For IRPS 1-2 cm, ESWL or endourologic surgeries such as RIRS and PCNL are recommended [2].

Although it is well known that flexible ureteroscopy (FURS) permits a detailed caliceal examination and therapeutic interventions, rigid ureteroscopy (RURS) is also often sufficient for reaching the renal pelvis in many patients [3]. RURS is an applicable option for whole ureteral stones. Although RURS is not recommended in kidney stones due to limited maneuverability and difficulty in reaching the middle and lower calyces, in some patients, it can be used to reach the kidney without any difficulty. The advantages of RURS in these patients are larger working channel, thus larger working equipment and better visualization owing to higher irrigation flow [4]. Even though it can be applied in isolated renal pelvic stones, the reported data is limited.

We analyzed the results of rigid (RURSL) and flexible ureteroscopic lithotripsy (FURSL) for the treatment of IRPS <2 cm by evaluating stone-free rates, operation times, and associated complications.

Materials and methods

We retrospectively reviewed the records of 45 patients who underwent RURSL (group 1, n=24) or FURSL (group 2, n=21) for the treatment of IRPS <2 cm between June 2012 and May 2017. Approval was obtained from the Ethics Committee of Health Sciences University, Diyarbakır Gazi Yaşargil Education and Research Hospital (No. 2019/11-04, Date: 03/12/2019). The same surgeon performed all procedures. Prior to operation, all patients were evaluated by renal function tests, urinalysis, and urinary culture. Preoperative radiologic investigation consisted of kidney-ureter-bladder (KUB) plain film, intravenous pyelogram, and non-contrast spiral computed tomography (CT) in all cases. The stone size was assessed with the maximum diameter of stone shown in the CT. The patients having stones in other areas of the collecting system other than the renal pelvis and those with anatomical kidney abnormalities such as pelvic kidney, horseshoe kidney, ureteropelvic junction obstruction and rotation anomalies were excluded from the study.

Surgical technique

RURS was routinely performed in all patients to dilate the ureter and place a hydrophilic guidewire to the renal pelvis. All of the RURSL were performed with a 8/9.8 F rigid ureteroscope (Karl Storz®, Tuttlingen, Germany). Ureteral balloon dilation was not performed in any of the cases. The stones reached by rigid ureteroscope were fragmented with holmium laser with an energy setting of 0.6 to 0.8 J and a rate of 8 to 10 Hz. When the stones were not reachable, a second 0.035/0.038-inch safety guidewire was placed into the renal pelvis through a rigid ureteroscope. After removing the rigid ureteroscope, a ureteral access sheath (9.5/11.5F) was placed to allow for optimal visualization, maintain low intrarenal pressure, and facilitate the extraction of stone fragments. FURS was performed with a 7.5 F flexible ureteroscope (Karl Storz, Tutlingen, Germany). The stones were fragmented with similar laser energy settings and fibers. After lithotripsy, a 4.8 F double-J stent was routinely placed in all cases and removed 3 weeks after the operation.

All patients were evaluated with plain radiography at 3 weeks after operation. Ultrasonographic examination was performed at 3 months after surgery. CT was conducted when residual stone was detected in ultrasound or plain radiography. Success of the surgery was defined as no evidence of residual stones of >2 mm in diameter.

Statistical analysis

IBM SPSS Statistics 22.0 (IBM Corp. Released 2013, IBM SPSS Statistics for Windows, Version 22.0, IBM Corp.) program was used for statistical analysis. The normality in the distribution of the data was determined using the Kolmogorov-Smirnov test, and the normally distributed variables were presented as mean (standard deviation) (SD). The differences between the groups were analyzed with independent-samples t-tests. The categorical variables were presented as frequencies and percentages, and they were compared with the chi-square test or Fisher exact probability test. A *P*-value of <0.05 was considered statistically significant.

Results

In 24 of 45 (53.3%) patients, IRPS were reached by rigid ureteroscope and fragmented with holmium laser. In the remaining 21 (46.7%) patients, the stones were not reached by rigid ureteroscope. They were managed with FURS and fragmented with the same energy source. Rigid ureteroscopy was successful in reaching renal pelvic stones in 15 of 25 (60%) female patients; however, the stones were reached in 9 (45%) of 20 male patients (P=0.173).

The characteristics of the patients including age, gender, laterality, and size of stones are summarized in Table 1. There was no significant difference between the two groups in terms of the parameters mentioned above (P=0.298, 0.396, 0.775, 0.266, respectively).

The mean operative times were significantly lower in the RURSL group than in the FURSL group, which were 66.75 (15.77) minutes and 89.54 (17.71) minutes, respectively (P<0.001). The stone clearance rates at postoperative week 3 and month 3 were 70.8% and 76.2% in the RURSL group and 83.3% and 85.7% in the FURSL group, respectively (P=0.787 and P=0.428). The mean hospital stay times were 1.5 (1.3) days in the RURSL group and 1.5 (1.5) days in the FURSL group (P=0.742). We found no significant differences between the groups regarding stone clearance rates and hospital lengths of stay. There were no intraoperative complications in either of the groups. At postoperative day 1, three patients (12.5%) in the RURSL group and two patients (9.5%) in the FURSL group had

fever and were treated with appropriate antibiotics (P=0.186). The complication rates were similar in both groups and these complications were classified as grade 1 according to the Clavien-Dindo classification (Table 2). None of the patients required FURS during RURS due to the mobilization of the stone to the lower or other calyces.

Table 1: Demographic data of patients

Variables	RURSL group (n=24)	FURSL group (n=21)	*P*-value
Age (years)	44.70±10.80	47.05±11.05	0.298
Gender			0.396
Male	9 (37.5%)	11 (52.4%)	
Female	15 (62.5%)	10 (47.6%)	
Side			0.775
Right	14 (58.3%)	12 (57.1%)	
Left	10 (41.7%)	9 (42.9%)	
Mean stone size (mm)	14.20 (6.50)	12.90 (6.20)	0.266

RURSL: Rigid ureteroscopic lithotripsy, FURSL: Flexible ureteroscopic lithotripsy

Table 2: Operative and postoperative data of patients

Variables	RURSL group (n=24)	FURSL group (n=21)	*P*-value
Mean operative time (minute)	66.75 (15.77)	89.54 (17.71)	0.001
Stone clearance rate			
Postoperative week 3	17 (70.8%)	16 (76.2%)	0.787
Postoperative month 3	20 (83.3%)	18 (85.7%)	0.428
Mean hospital stay (day)	1.5 (1.3)	1.5 (1.5)	0.742
Complication rate	3 (12.5%)	2 (9.5%)	0.186

Discussion

With the development of endourology, in the last 3 decades, the treatment of kidney stones has dramatically changed, and minimally invasive treatments such as ESWL, PCNL, mini and ultramini-PCNL, RIRS or laparoscopic surgery, have replaced open surgery [5]. Although patients with isolated renal pelvic stones <20 mm in size have several treatment options (ESWL, RIRS or PCNL), it is still challenging to decide which treatment should be the first choice. Advancements in the flexible equipment and laser technology have made FURSL for renal calculi more popular. The high stone clearance and low retreatment rates after FURSL seem to establish FURSL as equivalent or superior to ESWL for treating kidney stones <2 cm in size [6,7]. Although FURSL is a safe and effective procedure for the treatment of kidney stones, it has some disadvantages, such as a small caliber working channel that allows only small sized stone extractors and laser fibers to pass through the ureteroscope; prolonged operation time, and impaired vision quality due to reduced irrigation during the operation [8]. Additionally, the other major disadvantages of flexible ureteroscope include less durability of the instruments compared to rigid ureteroscopes and the higher cost of repair [9,10].

It was reported that in approximately half of the patients, the renal pelvic stone was reached with rigid ureteroscope and the patients were treated with RURSL without the need for FURSL [3,4]. In our study, in 53.3% of the patients, IRPS were reached by rigid ureteroscope and fragmented.

In the literature, there are few reported studies on the RURSL for the treatment of kidney stones. Bryniarski et al. [11] analyzed the safety and efficacy of RURSL and PCNL in the treatment of kidney stones of >2 cm in diameter. They reported that, although the rate of stone clearance was superior in the PCNL group than RURSL group, RURSL offers advantages for operating times, blood loss, postoperative pain and the duration of hospital stay.

Zengin et al. [12] compared the efficacy of RURSL and ESWL in the treatment of small sized kidney stones. They reported that, in RURSL and ESWL groups, the overall stone-free rates were 91.7% and 93.9% at the third postoperative months, respectively and the difference was not statistically significant.

Süer et al. [4] performed the study of RURSL and requirement of FURSL after RURSL in kidney stones to report that the kidney stones were fragmented with RURSL in 54.5% of the patients and FURSL was required in 45.5% of the patients. In RURSL and FURSL groups, the overall stone-free rates were 83% and 87%, respectively (P>0.05).

In another study designed similarly to the above-mentioned study, the renal pelvic stones were treated with RURSL only in 25 of 47 (53%) patients and they found no significant differences among groups with regards to stone-free rates [3].

There are various major and minor complications such as ureteral wall injury or avulsion, bleeding, stone migration, fever and urosepsis in ureteroscopic procedures. Breda et al. reported that the overall complication rate for FURSL was 8% and the frequency of major complications was 1.9% [13]. Sabnis et al. [14] reported that in the 35 patients treated with FURSL, Clavien Grade I complication occurred in 11.4% of the patients, and no other Clavien Grade complication was noted. In our study, the complication rates were similar between RURSL and FURSL groups and none of our patients developed major perioperative or postoperative complications.

There are various studies in literature that have reported that prolonged operation time is an independent prognostic risk factor for postoperative fever and infection and in those studies, the operation time was reported as 60-120 minutes [15-18]. In our study, the mean operative times were significantly lower in RURSL group than in FURSL group, and compatible with the literature. The rates of infectious complications including sepsis and fever in the patients undergoing FURSL have been reported to vary from 3% to %5 and from 2% to 28%, respectively [19]. In an international multicenter study in which RURSL and FURSL were performed to patients due to kidney and ureter stones, postoperative infection rates were reported as 2.2%. This rate may be low since patients who undergo RURSL due to ureter stones are included in the study [20]. Başeskioğlu [21] reported the postoperative infection rates as 12.6% in their study, which included 111 FURSL patients. In a study comparing RURSL with FURSL in the treatment of renal pelvic stones, postoperative fever rates were reported as 16% and 9.1%, respectively [3]. In our study, we did not observe any septic complications after both of two type of surgeries. Three patients (12.5%) in the RURSL group and two patients (9.5%) in the FURSL group had fever and were treated with appropriate antibiotics.

The main objective of the present study was not to investigate and advise RURSL as the first option in the treatment of kidney stones, but rather to demonstrate that RURSL could be used in the treatment of IRPS in selected cases. In our operations, we routinely performed RURS in all patients to dilate the ureter and place the hydrophilic guidewire into the collecting system. If the pelvic stones were reachable with RURS, they were fragmented through rigid ureteroscope using a Ho:YAG laser under direct vision. When the stones were not reachable,

FURSL was performed. With this technique, the number of FURSL procedures for the treatment of renal pelvic stones decreased. We think that this practice reduces both the cost of surgery and the need for repair of flexible ureteroscope.

Limitations

Relatively few patients, lack of the other demographic characteristics of the patients such as body mass index, lack of the hydronephrosis grades and not considering the cost-effectiveness are the limitations of our study. However, it is one of the limited number of studies in the literature on the treatment of isolated renal pelvic stones with RURSL, which is its strength.

Conclusion

The results of our study indicate that RURSL has shorter operation time, similar stone-free rates and similar complication rates compared with FURSL in the treatment of isolated pelvic stones. In light of the current literature, FURSL is a more appropriate procedure for the treatment of kidney stones; however, it should be kept in mind RURSL is as an alternative procedure to FURSL for IRPS in selected cases. Further studies are needed to determine the effectiveness of RURSL on the treatment of IRPS.

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