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Original Article

Single session vs two sessions of flexible ureterosopy (FURS) for dusting of renal pelvic stones 2-3 cm in diameter: Does stone size or hardness play a role in number of sessions to be applied?"

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ABSTRACT

Objective: To evaluate the stone hardness in predicting the need for single or two sessions of retrograde intrarenal surgery (RIRS) for renal pelvis stones of 2-3 cm in size.

Material and methods: Ninety-six patients (64 male and 32 female) with only renal stones (2.5±0.3 cm) underwent RIRS using flexible 7.5 Fr ureteroscope (FURS). The stone hardness was evaluated by preoperative non-contrast computed tomography (NCCT). The patients were divided into two groups based on stone hardness: Group I (n=54) (hard stones - Hounsfield Unit (HU) >1000) and group II (n=42) (not hard stone - HU <1000). The stone- free rate, the operative time, any intra or postoperative complications and the need for second sessions of RIRS were evaluated.

Results: All stones were successfully accessed. Intraoperative complications were not reported. The initial stone- free rate was 40% in Group I and 95% in Group II after a single session (p=0.01). A second session FURS was needed in 32 cases of Group I (40%) where postoperative CT showed significant residual stone fragments of 6±2 mm, and stone-free rate up to 100 percent. On the contrary only 2 cases from Group II underwent second session FURS (p=0.01). The operative times were 75±15 minutes in Group I and 55±13 minutes in Group II (p<0.01). Six patients (4 in group I and 2 in group II) had postoperative high- grade fever (Clavien Grade II).

Conclusion: Stone hardness had a significant impact on the decision of performing single versus two sessions of FURS for renal pelvic stones of 2-3 cm rather than the stone size alone.

Keywords: Flexible ureterosopy; retrograde intrarenal surgery; stone hardness.

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Introduction

Percutaneous nephrolithotomy (PCNL) is an efficient modality in the treatment of renal stones larger than 2 cm, however, it is a morbid procedure with risk of excessive bleeding, fever, sepsis, and pneumothorax.[1-3] The use of flexible ureteroscopy (FURS) as an alternative to PCNL in the treatment of large (>2 cm) renal stones was shown to be an effective modality in previous reports.[4-6] The surgical outcomes in terms of operative time, number of sessions, and volume of energy required for disintegration depend on the size[7,8] and composition of the stones.[9] Calcium phosphate, and calcium oxalate monohydrate stones are the hardest to disintegrate.[10] Hardness of the renal stones can be assessed by non-contrast computed tomography (NCCT).[11-13] In the current study, we have investigated the impact of stone Hounsfield Units (HU) on the surgical outcomes of FURS in the treatment of large renal pelvic stones measuring 2-3 cm in size.

Material and methods

Records of adult patients who underwent FURS for the treatment of single pelvic renal stones in our center between September 2012 and September 2015 were scrutinized. Patients with previous open renal surgery, ureteropelvic junction obstruction (UPJO), pyeloplasty, ureteral stricture or multiple stones or horseshoe kidneys were excluded from the analysis. Patients' demographic characteristics, imaging assessments and surgical outcomes including operative time, complications, hospital stay, number of sessions, and stone-free rate (SFR) were analyzed. The study was conducted according to the principles of World Medical Association Declaration of Helsinki 'Ethical Principles for Medical Research Involving Human Subjects' and an informed consent forms were completed by all patients.

Surgical procedures

All procedures were carried out under general anesthesia in lithotomy position. A 10/12 access sheath was introduced over a 0.035 Fr. Guidewire, and a 7.5 Fr. flexible ureteroscope (FURS) was inserted through the sheath. Assessment of the entire pelvicalyceal system was performed under instant x-ray imaging. The stones were identified, and a 200 mm laser fiber was then introduced through the FURS to dust them at laser settings of 0.2 to 0.6 Joule/sec and 15-25 Hz frequency. Double J (JJ) stent was inserted and left in place for 1 week postoperatively, however in cases with significant residual fragments it is left *in situ* for 1 week after the second FURS. Patients were discharged home on the postoperative 1st day unless a complication was noted. Postoperative NCCT was done 1 week postoperatively. SFR was defined as absence of significant residual stones of >2 mm. Patients with significant residual stones on follow-up CT underwent a repeated FURS, 2 weeks after initial surgery. Patients who underwent a second FURS were discharged on the postoperative 1st day and another NCCT was done 1 week later to assess SFR-status. No stone analysis was done in any of the cases.

Statistical analysis

The stone HU was determined by preoperative NCCT and patients were consequently divided into two groups as Group I with renal stones ≥1000 HU (n=54 patients), and Group II with renal stones <1000 HU (n=42 patients). Stone characteristics, operative outcomes, relevant patients' characteristics, and number of FURS sessions were compared between both groups to determine the impact of stone hardness on FURS outcomes. Statistical Package for the Social Sciences (IBM SPSS Statistics, Armonk, NY, USA) version 22 was used for analysis of data. Student *t*-test and *chi*- square test were used in the analysis of numeric and categorical data, respectively. Level of significance was set at 0.05.

Table 1. Patients' demographics, stone characteristics, and surgical outcomes of the entire study group

Number of stones	96
Age (years)	36±2
Gender	
Males	64
Females	32
Side	
Right	42
Left	54
Overall stone size (cm)	2.5±0.3
Stone site:	
Renal pelvis	All
Number of stones	Single
Use of access sheath	All
Total number of sessions	130
Initial success rate	67%
Final success rate	100%

Table 2. Comparison of patients' demographics, stone characteristics, and surgical outcomes between the two groups based on stone hardness

	Group I (HU >1000) n=54 patients	Group II (HU <1000) n=42 patients	p
Gender			
Males	42	22	
Females	12	20	
Side			
Right	26	16	
Left	28	26	
Stone size (cm)	2.5±0.2	2.4±0.2	0.8
Stone site			
Renal pelvis	All	All	
Number of stones	Single	Single	
Access sheath use (n)	All	All	
Number of Sessions	86	44	0.01
Operative time (minutes)	75±15	55±13	<0.01
Initial Success rate (%)	40	95	0.01
Final success rate (%)	100	100	

HU: Hounsfield unit

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Results

A total of 96 adult patients with renal stones (64 males and 32 females) with a mean age 36±2 years were included in the study (Table 1). Renal stones were successfully accessed in all cases. Mean stone size was (2.5±0.2 cm and 2.4±0.2 cm) in Groups I and II, respectively (Table 2). No technical difference were noticed between the two groups regarding surgical approach, laser dusting specification or duration of follow-up. No basket extraction was needed in any of the cases, and no adjuvant medical expulsive therapy was prescribed for any of the patients. Preoperative NCCT was performed in all patients. Postoperative NCCT was performed one week after FURS, and the initial stone free rate was significantly lower in Group I than in Group II (40% vs. 95%, p<0.01). Postoperative NCCT scan revealed residual stones of mean size of 6±2 mm in 32 of 54 patients in Group I (60%). Second FURS session was performed in these 32 patients and they were all confirmed to be stone free by NCCT after the second session of FURS (final stone- free rate: 100%). On the contrary, only 2 of the 42 cases in Group II necessitated a second session of FURS for residual stones of 6 and 5 mm in size. No steinstrasse was noticed in any patient.

The overall mean operative time was significantly shorter in Group II than in Group I (55±13 minutes vs. 75±15 minutes, p<0.01) (Table 2). Six patients (4 in Group I and 2 in Group II) had high grade fever (Clavien Grade II) postoperatively that was controlled by IV antibiotics administered for 48 hours. Minor complications noticed were hematuria in 10, dysuria in 17 and loin pain during micturition in 12 cases.

Discussion

Although PCNL has been considered the optimal treatment modality for patients with renal stones of >2 cm in size, PCNL can be associated with significant morbidities such as significant bleeding that necessitates blood transfusion in some occasions.[1,4,5] It has been postulated previously that FURS can be associated with lower SFR, and need for multiple treatment sessions, and shorter fluoroscopy times.[14] However, development in endoscopic technology and introduction of new generations of flexible scopes in addition to existing comorbidities in some patients who cannot tolerate PCNL made FURS a more appealing surgical option.[15] Moreover, FURS is more advantageous than PCNL in terms of lesser intraoperative bleeding and lower need for blood transfusion[16] and its use in the treatment of renal stones of >2 cm is gaining popularity.

Stone burden has been reported as the most important factor in predicting the surgical outcome of FURS in the treatment of renal stones.[7,8] However, Xue et al.[9] has proved that stone composition is another important factor in predicting the outcome of FURS in patients with renal stones, especially that laser is the only energy source that can be used during FURS for stone fragmentation. Calcium phosphate, and calcium oxalate monohydrate stones are more demanding in terms of time and energy source used for fragmentation when compared with uric acid, and magnesium-ammonium-phosphate stones.[10] In the current study we tried to neutralize the impact of stone size in both groups by unifying the size or at least making the difference statistically insignificant between the two groups.

The use of NCCT scan in preoperative assessment of patients with renal stones has enabled physicians to predict the composition of the stone using either HU values or HU density.[11-13] Pure uric acid stones demonstrate a low HU on NCCT (average 426 HU), cystine stones show an average of 540 HU, while calcium oxalate stone can show up to 1345 HU.[17,18] Moreover, Ito et al.[19] found that HU has a higher potential in predicting stone hardness than stone composition.

In the current study, as a primary outcome we tried to determine the surgical outcomes of FURS in the treatment of large renal pelvic stones of 2-3 cm, and the secondary outcome was to determine the effect of stone HU on the surgical outcomes of FURS. The mean operative time for patients with higher HU was significantly longer than in patients with renal stones of lower HU. The initial success rate of FURS for patients in Group I was significantly lower than in Group II, and in Group I, 32 (total n=54), and in Group II, 2 (total n=42) patients required a second session of FURS. These findings indicate that, not only stone size, but also stone hardness plays a major role in determining the surgical outcomes of FURS in the treatment of renal stones. This is in keeping with previous report by Xue et al.[9] In their study, the authors performed stone analyses. They reported 52.9% stone clearance rate for FURS in the treatment of stones of >2 cm with harder composition versus 72.7% clearance rate for easy to crush-stones of >2 cm. In the current study the initial SFR was 67% and reached 100% after second FURS. Akman et al.[20] compared the outcome of PCNL and FURS in 34 patients with renal stones up to 4 cm. The authors found that SFR after a single session of FURS was 73% compared to 91% for a single session of PCNL. After a second session of FURS the SFR reached to 88 percent. Riley et al.[6] reported 80% SFR for stones of >3.5 cm after an average of 1.8 sessions. Breda et al.[21] reviewed 324 clinical studies, and investigated the outcomes of FURS for stones of >2 cm in size. The authors reported SFR of 89% with an average of 1.6 FURS sessions in 441 patients with an average mean stone size of 2.9 cm. However, all aforementioned studies considered the stone size only to be the leading factor in determining the surgical outcomes. In our study, we achieved comparable surgical outcomes of FURS in relatively larger stones. Moreover, we have proved that stone hardness represented by HU is an important influential factor in determining outcomes of FURS including operative time, number of sessions and SFR.

As an important outcome of this study, we couldn't detect any correlation between composition of the stone fragments and HU on NCCT.

In conclusion, our study showed that after unifying stone size, stone hardness had a significant impact on the need of single versus two sessions of FURS for renal pelvic stone of 2-3 cm.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

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

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