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Üreteral Yaralanma, İmpakte Taşlara Üreteroskopik Litotripsi Sırasında Üreter Duvar Kalınlığı ile Artmaktadır

Ureteral Injury Increases with Ureteral Wall Thickness During the Ureteroscopic Lithotripsy of Impacted Stones

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ÖZET

Amaç: Bu çalışmada, üreter taşları için üreteroskopi uygulanan hastalarda üreter duvar kalınlığı ile üreter yaralanmasının taşsızlık oranları ile olası ilişkisini değerlendirdik.

Gereç ve Yöntemler: Ekim 2014-Kasım 2015 tarihleri arasında üreteroskopik lazer litotripsi uygulanan 120 olgu (% 71.7, erkek) çalışmaya dahil edildi. Tüm hastalarda impakte taş, ameliyat öncesi, ameliyat sırası ve sonrası hasta özellikleri değerlendirildi. BT görüntülerinin yardımıyla taşın bulunduğu bölgede üreteral duvar kalınlığı hesaplandı. Üreteral lezyonlar Postüreteroskopik Lezyon Ölçeğine (PULS) göre derecelendirildi. Clavien sınıflandırma sistemine göre hastanede yatış süresi, taş yükü, taşsızlık ve komplikasyonlar kaydedildi.

Bulgular: 120 hastadan 38'inde impakte üreter taşı mevcuttu. Taşların büyük çoğunluğu alt üreterde (% 75.8) bulundu. Ortalama üreter duvar kalınlığı 2.75 ± 0.97 mm idi. 64 hastada (% 53.3) derece 1 lezyon ve 2 hastada (% 1.7) derece 2 lezyon görüldü. Taş boyutu ile üreter duvar kalınlığı arasında zayıf bir ilişki bulunurken ($p = 0.011$), taş lokasyonu veya hidronefroz derecesi ile üreter duvar kalınlığı arasında ilişki yoktu. Üreteral duvar kalınlaşması ile üreteral lezyonlar artmaktaydı ($p = 0.044$). Üreteral duvar kalınlığı impakte taş hastalarında artamaktaydı ve PULS derecesi de daha yüksekti.

Sonuç: Üreteroskopik litotripsi sırasında gelişen ureter yaralanmaları PULS ile standardize edilebilir ve sınıflandırılabilir. Taş ve hastayla ilişkili faktörler arasında üreter duvar kalınlığı ve impakte taş ile üreter lezyonu anlamlı korelasyon göstermektedir. Ameliyat öncesi planlamada bu faktörlerin dikkate alınması üreteroskopi sürecinin güvenliğini artırabilir.

Anahtar Kelimeler: *Üreter yaralanması, impakte taş, üreteroskopi*

ABSTRACT

Aim: In this study, along with the patient and stone related features, we evaluated the possible relation of ureteral wall thickness and ureteral injury with stone free rates in patients who had undergone ureteroscopy for ureteral stones.

Material and Methods: 120 cases (71.7%, male) who underwent ureteroscopic laser lithotripsy between October 2014 and November 2015 was enrolled to this study. Pre-, intra- and postoperative patient characteristics, including impacted stoneevaluation was done in all patients. Ureteral wall thickness was calculated at the stone site with the help of CT images. Ureteral lesions were graded according to Postureteroscopic Lesion Scale (PULS). Hospitalization time stone burden, stone clearance, and complications according to Clavien classification system were recorded,

This study was studied retrospectively. All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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Results: 38 patients among 120 patients had impacted ureteral stones. Vast majority of the stones were located in the lower ureter (%75.8). Mean ureteral wall thickness was 2.75±0.97 mm. A grade 1 lesion was seen in 64 (53.3%) and grade 2 lesion in 2 patients (1.7%). While there was weak relation between stone size and ureteral wall thickness (p=0.011), either location or hydronephrosis degree did not show relation with ureteral wall thickness. Ureteral lesions was increasing with ureteral wall thickening (p=0.044). Ureteral wall thickness was larger in impacted stone patients and PULS grade was higher as well.

Conclusion: Ureteral wall injuries may happen during ureteroscopic stone management which can be standardized and classified with PULS. Among the stone and patient related factors ureteral wall thickness and impacted stones had significant correlation with ureteral lesion. Considering these factors in the preoperative planning may increase the safety of the ureteroscopy process.

Keywords: Ureteral injury, Impacted Stones, Ureteroscopy

INTRODUCTION

Ureteroscopy which is used widely, inherently associated with ureteral lesions. In order to evaluate ureteral injuries objectively, ureteral wall injury classifications have been proposed and subsequently studies looking for standardization of some technical details during procedure and reporting patient outcomes have given results along with these classification systems [1-4]. It has been reported that almost half of cases who undergone ureteroscopy have mild to severe ureteral injury [1,2]. The severity of ureteral lesion affects the success of the procedure and a wide range of decisions regarding technical details during procedure and post procedural process. Beyond stone and equipment related factors, patient related factors could contribute to ureteral injury. Ureteral wall thickness is one of the limited parameters that we can utilize before the intervention. There is scarce data in the literature, recently two papers evaluating predictive value of ureteral wall thickness for medical expulsive therapy and SWL have been published. It has been reported that the diameter of the ureteric wall at the stone site is highly predictive for both SWL and medical expulsive therapy. The altered nature of ureteral wall with inflammation near the stone site is important here and along with treatment success, providing ureteral wall thickness preoperatively may enable us to predict ureteral injury. Due to its simple and practical usage it is suggested to use this parameter for treatment selection between ureteroscopy and SWL [5,6].

In this study, along with the patient and stone related features, the possible relation of ureteral wall thickness and ureteral injury with stone free rates in patients who had undergone ureteroscopy for ureteral stones will be evaluated.

MATERIAL AND METHODS

120 cases (71.7%, male) who underwent ureteroscopic laser lithotripsy between October 2014 and November 2015 was enrolled to this study. Pediatric patients, patients with positive urine cultures, anatomic anomalies, those with a history of ipsilateral previous stone surgery and preoperatively stented patients were excluded. Preoperative patient characteristics, stone size and location, urine analysis and culture, serum creatinine, hemoglobin (Hb), abdominal and pelvic ultrasound and computerized tomography (CT) evaluation were done in all patients. Ureteral wall thickness was calculated at the stone site from CT images. Impacted stone was defined as a stone that could not be bypassed either by a wire, or a stone stayed at the same localization for at least 1 month, and/or that does not move when forceful irrigation is applied during ureteroscopy [7, 8]. Perioperative prophylactic antibiotic was given to all patients. Ureteroscopy was performed using a 7 F semirigid ureteroscope under general anesthesia, in lithotomic position. A hydrophilic guide-wire (0.038 inch, 145 cm Roadrunner, Cook, Bloomington, USA) was used in all cases. For stone fragmentation, Holmium: YAG laser was used. Double-J stent was inserted in patients who had mild to severe ureteral lesion. Ureteral lesions were graded according to Postureteroscopic Lesion Scale (PULS) by the operating surgeon and recorded in all patients along with perioperative data. (Table 1) Hospitalization time, stone burden, stone clearance, and complications according to Clavien classification system were recorded.

Table 1: Postureteroscopic Lesion Scale [2]

Postureteroscopic Lesion Scale		
Grade 0	No lesion	Uncomplicated URS (no grading according to the Dindo-modified Clavien classification of surgical complications)
Grade 1	Superficial mucosal lesion and/or significant mucosal edema/hematoma	
Grade 2	Submucosal lesion	
Grade 3	Perforation with less than 50% partial transsection	Complicated URS (Grade 3a or b according to the Dindo-modified Clavien classification of surgical complications)

Table 1: Postureteroscopic Lesion Scale [2]

Postureteroscopic Lesion Scale		
Grade 4	More than 50% partial transsection	Complicated URS (Grade 3a or b according to the Dindo-modified Clavien classification of surgical complications)
Grade 5	Complete transsection	

URS= ureterorenoscopy

Statistical Analysis

Statistical packages were used for the analysis of data.Categoric evaluations were summarized as values and percentages whereas persistent ones were given as averages and standard deviations (median, minimum-maximum values depending on the data). Chi-Square and Fisher's exact tests were applied on categoric comparisons of data. Mann Whitney U test was used in the comparison of two quantitive values not having normal distribution and t test was performed on the independent normal distribution data. Quantitive comparisons of triple groups with other than normal distributions were performed with Kruskal Wallis test and One Way Anova test was used in the triple groups with normal distributions. Pearson Correlation test statistics were utilized in the comparison of constant variables. Statistical signifigance ratio of $p<0.05$ was taken into account in all of the tests.

RESULTS

38 out of 120 patients had impacted ureteral stones. The mean age of the patients was 39.08±12.8, the mean stone size 1,6±0,2.The patient and stone characteristics are seen in Table 2.

Table 2: Demographic, perioperative and postoperative outcomes

Variables	Results (n:120)
Age	39 ± 12,8
Gender (M:F)	34:86
Body mass index (kg/m2)	29,4±4,1
Stone size (mm)	1,6±0,2
Stone location (upper:mid:lower)	18:11:91
Ureteral wall thickness (mm) (UWT)	2,7±0,9
Proximal ureteral diameter (mm) (PUD)	18,5±7,6
Fluoroscopy time (second)	3±0,9
Impacted stone rate	31,7 % (38:120)
Post Ureteroscopic Lesion Scale (PULS) rate	
PULS 0	45 % (54:120)
PULS 1	55 % (66:120)
Operation time (minute)	52,2±23,1
Hospitalization (day)	0,9
Ureteral catheter indwelling period (day)	18,5±15,8
Stone clearance rate in a single session	91,7 % (110:120)
Secondary treatment requirement	2,5 % (3:120)

Vast majority of the stones were located in the lower ureter (%75.8). Mean ureteral wall thickness was 2.75±0.97 mm. Mean operation time was 52.2±23.18 min and all patients were stone free in this series. There were no PULS ≥3 ureteral injuries. A grade 1 lesion was seen in 64 (53.3%) and grade 2 lesion in 2 patients (1.7%). While there was weak relation between stone size and ureteral wall thickness (p=0.011), either location or hydronephrosis degree did not show any relation with ureteral wall thickness. Evaluation of patients' and stone characteristics' relation with ureteral lesion scale are seen in Table 3. Ureteral lesions was increasing with ureteral wall thickening (p=0.044). Ureteral wall thickness was larger in impacted stone patients and PULS grade was higher as well. Wall thickness was not different according to stone location. Double-J stent was left between 3 to 15 days in all patients who had ureteral lesions. With a mean follow-up 14 months with ureteral lesions and Double-J stent inserted patients, preoperative and postoperative hydronefrosis were not different. Univariate and multivariate tests were performed to determine statistically significant independent factors. Among the stone and patient related factors ureteral wall thickness and impacted stones had significant correlation with ureteral lesion.(Table 4)

Table 3: Effect of the patient and stone related factors on the PULS

Variables	Score	P
Age	0.3	0.579[a]
Gender (M:F)	1.0	0.296[a]
Body mass index (kg/m2)	1.6	0.202[b]
Stone size	0.1	0.722[b]
Stone location	18.3	**0.000[b]**
Presence of impacted stones	0.0	0.805[b]
Auxiliary procedures requirement	5.6	0.017[b]
Ureteral wall thickness (UWT)	1.1	**0.017[b]**
Operation time	1.1	0.290[a]
Ureteral catheter indwelling period	14.9	0.000[a]

Bold values indicate statistical significance (p <0.05)
a independent sample t test
b Kruskal Wallis test

Table 4: Effect of related factors seen on logistic regression test for the risk of ureteral lesion

Variables	B	S.E.	O.R.	95 % CI for OR	p
Age	0.006	0.019	1.006	0.970-1.045	0.738
Gender	0.446	0.607	0.640	0.195-2.102	0.462
Stone size	0.077	0.071	1.080	0.939-1.242	0.280
Ureteral stone localization	0.245	0.358	0.782	0.388-1.579	0.493
Presence of impacted stones	1.580	0.676	4.857	1.291-8.265	0.019
Auxiliary procedures requirement	0.955	1.537	0.385	0.161-2.639	0.535
Ureteral wall thickness (UWT)	0.276	0.308	1.317	0.721-2.407	0.370
Operation time	0.015	0.013	0.985	0.960-1.011	0.264
Ureteral catheter indwelling period	0.048	0.025	1.050	0.999-1.103	0.055

Bold values indicate statistical significance (p <0.05)

Discussion

Ureteroscopic lithotripsy has been used for several decades and has become the first treatment choice for ureteral stones in most departments. Although the safety and the success rates are quite satisfactory, urologists face some challenges during the intervention. Preoperative ureteral anatomy which is often overlooked is actually in the center of these challenges. During the whole intervention; guide wire insertion, ureteral access, stone fragmentation, and along with the surgeons' experience and equipment, the conformity of the ureteral anatomy becomes important. Even though ureteral wall thickness are ready to use with routine preoperative imaging, to date it hasn't been utilized for preoperative planning during ureteroscopy.

Recently, Sarica et al. reported that ureteral wall thickness had been shown to be the only predictive factor for SWL and medical expulsive therapy success among all the stone and patient-related parameters [5,6]. Herein, ureteral stone impaction develops local ischemia and subsequently ureteral fibrosis and edema. It should be evaluated separately, as ureteral stone management is relatively getting more challenged in impacted stone patients. It is supposed that the stone side ureteral wall tissue changes which can be associated with chronic inflammation, interstitial fibrosis and urothelial hypertrophy, is challenging during the spontaneous stone passage [9,10].Stone related histopathological changes in ureteral wall is often edematous and prone to perforation. Beyond the spontaneous stone passage, this may affect the safety of the ureteroscopy procedure itself. These adverse events may cause a challenge in stone removal which interact with inflammated (inflammatory) ureteral wall, ureteral wall frailty or direct effect of the equipment.Recently, in large CROES series, the higher incidence of ureteral perforation in midureteral stones compared to other locations has been attributed to higher incidence of impacted stones [11,12]. The altered nature of ureteral wall with inflammation is important here and ureteral wall thickness is one of the limited knowledge that we can utilize before the intervention.

PULS grading was suggested by Schoanthaler et al to set a standardized classification of ureteral lesions for postoperative ureteral stent insertion. Besides recommendations for postoperative ureteral stent insertion, this scale facilitates a concordance for ureteroscopy terminology [2]. In our study, according to PULS grading, except two patients, almost all lesions were grade 1; ≥grade 3 lesions were not seen in any patient. A grade 1 lesion was seen in 64 (53.3%) and grade 2 lesion in 2 patients (1.7%). Among the different pre- and peri-operative parameters only ureteral wall thickness and impacted stones had a significant relation with PULS grading. Along with the stone and patient related parameters those we considered preoperatively for many reasons, ureteral wall thickness and impacted stones had also predictive value in preoperative patient evaluation.

CONCLUSION

Ureteral wall injuries may be encountered during ureteroscopic stone management which can be standardized and classified with PULS. Among the stone and patient related factors, ureteral wall thickness and impacted stones had significant correlation with ureteral lesion. Considering these factors in the preoperative planning may increase the safety of the ureterocopy procedure.

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