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Original Research / Özgün Araştırma

Is There a Relationship Between Post-ureteroscopic Lesion Scale and Irrigation Fluid Absorption in Ureteral Stone Disease Patients

Üreter Taşı Hastalarında Postüreteroskopik Lezyon Skalası ile Emilen Irrigasyon Sıvısı Arasında Bağlantı Var Mı?

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Özet

Amaç: Üreteroskopi (URS) esnasında üreter duvarında oluşan hasarı sınıflandırmak için Post-Üreteroskopik Lezyon Skalası (PULS) kullanılmaktadır. Bu çalışmada PULS derecelerine göre absorbe edilen irrigasyon sıvı hacimlerinin ön sonuçlarını sunduk.

Gereç ve Yöntemler: Bu çalışmaya üreter taşı nedeniyle 7 F semirijid üreteroskopi uygulanan 44 hasta dahil edildi. Tüm hastalara genel anestezi uygulandı. %1 etanol içeren izotonik irrigasyon sıvısı olarak kullanıldı. Venöz kan etanol konsantrasyonları irrigasyon kullanılmaya başlaması ile ölçülmeye başlandı, operasyon sonrası derlenme odasını kapsayacak şekilde 15 dakika arayla periyodik ölçüldü. Absorbe edilen sıvı hacmi kan etanol konsantrasyonları kullanılarak hesaplandı. İrrigasyon süresi, taş boyutu, PULS derecesi kaydedildi.

Bulgular: Ortalama operasyon süresi 44.2 ± 19.9 dakika olarak saptandı. Ortalama taş hacmi 12.7± 6 mm ve ortalama kullanılan irrigasyon sıvı miktarı 1371±1262 mL olarak ölçüldü. Hastaların 26'sında PULS derecesi 0 iken 18'inde 1 veya üzerindeydi. Hiçbir hastada PULS derecesi 3 veya 4 olmadı. Ortalama absorbe edilen sıvı hacmi 58 ± 50,6 mL olarak hesaplandı. PULS derecesi ile ortalama absorbe edilen sıvı miktarı arasında istatistiksel anlamlı fark saptanmadı.

Sonuç: URS esnasında oluşan PULS derecesi 1-2 olan veya düşük dereceli submukozal üreter

Abstract

Objective: Post-Ureteroscopic Lesion Scale (PULS) is used to classify ureteral wall injury that occurs during ureteroscopy. In this study we presented the preliminary results of absorbed irrigation fluid volumes according to PULS grades.

Material and Methods: Forty-four patients to whom 7F semirigid ureteroscopy was performed due to ureteral stone were included in the study. All patients received general anesthesia. Isotonic containing 1% ethanol was used as irrigation fluid. Ethanol concentration in venous blood was commenced to be measured at the start of irrigation use and was carried on at 15-minute intervals including the post-operative period in the recovery room. Absorbed fluid volume was calculated by using blood ethanol concentrations. Irrigation time, stone size and PULS grade were recorded.

Results: Mean operation time was found to be 44.2 ± 19.9 minutes. Mean stone size was measured to be 12.7± 6 mm and mean irrigation fluid amount used was 1371±1262 ml. PULS grade of 0 was seen in 26 patients and that of 1 or more was seen in 18 patients. No patient had a PULS grade of 3 or 4. Mean absorbed fluid volume was measured to be 58 ± 50,6 ml. No significant correlation was found between PULS grade and mean absorbed fluid volume.

Conclusion: Fluid absorption during URS is not correlated with the lesion severity that is PULS

The study was approved by the Ethic Committee of Istanbul Medipol University (Approval Number: 10840098-131). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

lezyonlarıyla sıvı emilimi korele bulunmamıştır. Semirijid URS, üreter taşı hastalığı tedavisinde irrigasyon sıvısının emilimi açısından güvenli bir yöntemdir.

Anahtar Kelimeler: komplikasyon, sıvı emilimi, üreteroskopi, üreter taşı, yaralanma

grade 1-2, or low grade submucosal. Semirigid URS is a safe treatment option for ureteral stone disease in terms of the level of irrigation fluid being absorbed**.**

Keywords: complication, fluid absorption, injury, ureteroscopy, ureteral stone

INTRODUCTION

The management of ureteral stone disease has dramatically evolved during the last two decades related to technical developments in ureteroscope design and production (1). Besides instrument miniaturization and enhanced optical quality, introduction of auxiliary equipments together with the growing experience of surgeons have led to increased success and decreased complication rates after ureteroscopic procedures (1). Notwithstanding all these improvements in the surgical management of ureteral stone disease, complications of varying type and severity still occur in around 9 - 25 % of the patients undergoing ureterorenoscopic stone extraction (2,3). Despite being rare (1-4% in modern series), ureteral perforation is one of the most important of these complications (4-8).

To evaluate and stratify ureteral wall injuries occurring during ureteroscopy (URS), a simple classification system was published in 2012 (9). According to this scale, post-ureteroscopic lesions are divided in to six grades depending on the severity and depth of the ureteral wall damage, which the first three were limited to submucosa and subcategorized as uncomplicated and the last three as complicated URS. Thereafter, inter-rater reliability of post-ureteroscopic lesion scale (PULS) was proven in a multicenter study (10). One of the most concerning outcomes of ureteral wall injury is systemic absorption of the irrigation fluid, which may lead volume overload.

In the present study, we aimed to evaluate the amount of fluid absorption that occurs during URS for ureteral stone(s) and its relationship with ureteral wall injury degree (PULS grade).

MATERIAL AND METHODS

This prospective study was conducted between November 2014 and October 2015 (Approval Number: 10840098-131). Following Institutional Review Board (IRB) approval, a total of 44 patients were included into the study to whom semirigid URS was employed due to ureteral stone. During the preoperative period; urine analysis, urine culture with antibiotic sensitivity testing and routine blood biochemistry tests were performed for all patients. In the presence of a urinary tract infection, preoperative antibiotic treatment was administered to ensure urine sterility. Radiological evaluation consisted of non-enhanced computed tomography (CT) of the abdomen and pelvis. Stone size was calculated either as the largest dimension of a stone or the sum of them (if multiple).

Pediatric age group, patients with a history of ethanol abuse or habitual alcohol intake, those with significant cardiovascular, hepatic, renal or psychiatric disorders, routine consumption of acetylsalicylic acid or anticoagulant agents, debilitating pulmonary disease and simultaneous kidney and ureteral stone disease necessitating the use of ureteral access sheath were excluded. Additionally, patients whose American Society of Anesthesiologists (ASA) score was ≥3 were excluded due to the risk of multi-organ dysfunction as well. Demographic characteristics of the patients were recorded. Additionally, data related to stones (size, number and location of stones) and the surgical procedures (duration of the surgery, infused volume of normal saline irrigation solution enriched with ethanol, total ethanol absorption amount and PULS grade) were assessed. Finally, stone-free rate (SFR) (no residual fragment by kidney-ureter and bladder + ultrasound at 1st month postoperatively was assessed stone-free) and postoperative surgical complications according to Dindo modification of the Clavien grading system were evaluated(1[1]).

Ureteroscopy

All of the procedures were performed in a modified lithotomy position under general anesthesia. A 7 Fr.

semirigid ureteroscope (Karl Storz, Tuttlingen, Germany) was used to inspect the urethra and bladder. After visualization of the orifice, a 0.035-inch 145 cm safety guidewire (Cook, Bloomington, IN) was introduced gently into the ureter to by-pass the ureteral stone and move up to the involved kidney. Thereafter, a second guidewire was inserted to apply the 'railroad' technique and once the stone was seen, holmium: yttrium-aluminum-garnet laser (Sphinx, LISA, Katlenburg-Lindau, Germany) was utilized for fragmentation with the settings of 0.6 J (energy) and 10Hz (frequency) and reformed these settings depending on the stone characteristics and surgeon preference, if necessary. Manuel pump irrigation system was used to increase the vision quality. All of the stone fragments were extracted using a basket catheter (Cook, Bloomington, IN) and PULS grade was determined by the surgeon as described by Schoenthaler et al. in 2012.(10) Afterwards, double J ureteral stent was placed depending on the PULS grade and surgeon preference.

Determination of Ethanol Absorption

Isotonic solution containing 1% ethanol was used as the irrigation fluid. Absorbed fluid volumes were measured using blood ethanol concentrations. Blood samples were drawn from patients before starting the operation and at 15-minute intervals. Alcohol concentration in blood was measured by using Ethanol Gen.2 Kit (Roche Diagnostics, Mannheim, Germany) with an automated analyzer (COBAS Integra, Roche Diagnostics, Mannheim, Germany). Alcohol concentration in whole body blood was calculated by multiplying alcohol concentration (mg/L) with total body blood concentration. Total blood volume of each patient was calculated by using Nadler's Formula (for males = 0.3669 x height in m3 + 0.03219 x weight in kg + 0.6041; for females = 0.3561 x Height in m3 + 0.03308 x Weight in kg + 0.1833).(12) Alcohol concentration in the absorbed irrigation fluid was proportional to the total alcohol concentration of whole blood. Irrigated fluid volume and preoperative hydronephrosis grade were also recorded.

Statistical Analysis

Mean, standard deviation, median, lowest and highest quantiles, frequency and ratio values were used in the descriptive statistics of the data. The distribution of variables was measured by the Kolmogrov Simirnov test. Kruskal-wallis and Mann-Whitney u tests were used in the analysis of quantitative data. Spearman correlation analysis was chosen among the correlation analysis methods and all the analyzes performed in SPSS 22.0.

RESULTS

A total of 44 patients underwent semirigid URS due to ureteral stone during the prespecified time frame. Demographic variables are summarized in Table 1. Double J ureteral stent was placed in 29 patients while the remaining 15 patients were discharged without any stent.

PULS distribution and the amount of ethanol absorption are showed in the Table 2.

Absorbed fluid amount did not differ significantly between females and males and between right and left sides ($p > 0.05$). Absorbed fluid amount according to stone location in ureter did not either differ significantly ($p > 0.05$).

There was no significant correlation between absorbed fluid and age, BMI, stone size, duration of anesthesia, operation time, ethanol irrigation time, ethanol irrigation amount, first access URS pulse amount, operation final pulse due to the ureteroscopy amount and blood v value ($p > 0.05$) (Table 2). Subgroup analysis comparing fluid absorption with PULS 0 + 1 vs. PULS 2 showed no difference ($p > 0.05$), which may show the safety of URS regardless of PULS lesion grade.

DISCUSSION

Irrigation fluid is one of the most important requirements of endourological procedures and it provides vision improvement by expanding the operating field and cleaning tissue fragments, debris and blood. Sterile water was utilized initially during transurethral resection of the prostate (TURP), which may lead to significant hemolysis once absorbed in to the circulation in case of vascular damage. Thereafter, non-electrolyte solutions containing glycine, mannitol or sorbitol were introduced to prevent this potentially fatal complication. However, these electrolyte-avid solutions are not without harm and several authors have re-

Table 1. Demographic and perioperative outcomes

		Min-Max	Mean.±s.d./n-%
Age		22,0 - 82,0	46,1 ± 15,3
Gender	Female		8 18,2%
	Male		36 81,8%
BMI (kg/m²)		21,4 - 36,3	28,2 ± 3,8
Dilation	Grade 0		1 2,3%
	Grade I		11 25,0%
	Grade II		17 38,6%
	Grade III		14 31,8%
	Grade IV		1 2,3%
Surgical side	Right		22 50,0%
	Left		22 50,0%
Location	Distal Ureter		18 40,9%
	Mid-ureter		15 34,1%
	Proximal ureter		11 25,0%
Initial URS Access PULS	Absent		31 70,5%
	Present		13 29,5%
Initial URS Access PULS		0,0 - 6,0	0,8 ± 1,6
Final PULS	Absent		26 59,1%
	Present		18 40,9%
Final PULS		0,0 - 6,0	1,3 ± 2,0
Absorbed fluid amount (ml)		0,0 - 267,0	58,0 ± 50,6
Stone size (mm)		5,0 - 30,0	12,7 ± 6,0
Duration of anesthesia (min)		20,0 - 125,0	56,1 ± 22,8
Operation time (min)		15,0 - 102,0	44,2 ± 19,9
Irrigation period (min)		8,0 - 90,0	36,3 ± 17,0
Irrigation fluid volume (min)		300 - 7000	1371 ± 1262
Body blood volume (L)		3,7 - 6,4	5,0 ± 0,7

Table 2. PULS distribution and the amount of ethanol absorption

Absorbed Fluid Volume				
		Mean.±s.d.	**Min-Max**	**p**
Gender	Female	56.3 ± 23.4	24.2-88	0.503
	Male	58.4 ± 55.1	0-267	
Surgical side	Right	67.8 ± 60.3	0-267	0.213
	Left	48.2 ± 37.6	0-170	
Location	Distal Ureter	59.7 ± 48.1	0-170	
	Mid-ureter	47.9 ± 31.9	3-92	0.835
	Proximal ureter	69.0 ± 73.2	0-267	

Initial URS Access PULS	Absent	55.7 ± 50.9	0-267	0.681
Initial URS Access PULS	Present	63.5 ± 51.6	3-170	
Final PULS	Absent	50.3 ± 33.9	0-144	0.676
Final PULS	Present	69.1 ± 67.6	3-267	

Statistical significance (p <0.05)

ported a life-threatening complication associated with their use; namely the TUR syndrome, which affects the cardiovascular and central nervous system. Nowadays, physiological saline solution is preferred for irrigation purposes especially for procedures that are expected to last long and when periprocedural bleeding is probable such as; TURP of a bulky gland, transurethral resection of large, multifocal bladder tumors (TURBT) and percutaneous nephrolithotomy (PNL).

Urinary stone disease within the ureter has a reported global prevalence of 5–10%.(13) Several surgical treatment options are available for ureteral stones, mainly shockwave lithotripsy (SWL), URS and, less commonly, laparoscopic, percutaneous or open surgery, with varying success as well as recurrence and complications rates. (14) Despite the fact that URS has a higher complication rate when compared to SWL, the greater chance of achieving stone-free status after a single procedure has made URS the most popular and commonly employed surgical treatment alternative for ureteral stones. (9,14) Although the level of irrigation fluid absorption during endourological procedures (TURP, TURBT, PNL, laser prostatectomy and transurethral bipolar plasma vaporisation of the prostate) was determined by several studies, URS has not been evaluated in this context yet.

Cybulski et al. claimed the safety of sterile water and physiologic saline as possible irrigation solutions during URS. (15) However, their study population was inhomogeneous (therapeutic approach for urolithiasis or diagnostic URS for hydronephrosis, hematuria etc.) and ureteral access sheath was used in some of the cases, which may decrease intraureteral/intrarenal pressure and also the level of fluid absorption. Besides all of these biases, the method that was used to calculate volumetric fluid balance was also controversial. Nonetheless, the amount of mean systemic fluid absorption of 54 mL is compatible with our results, which revealed 58 mL irrespective of the PULS. From another perspective, we can state the fluid absorption per minute during URS was 1.59 ml in our whole cohort.

According to our hypothesis, it was anticipated to document a positive correlation between the PULS grade and fluid absorption level. However, our results depicted just the opposite, as fluid absorption level did not differ with higher PULS grade.

This controversy can be explained by our small cohort size, especially the low number of Grade 2 and higher level of ureteral lesions, which are more likely to cause urinary extravasation and hence systemic fluid absorption. Multi-institutional studies enrolling higher number of patients from each PULS grade might reveal findings that are supportive of our presumption.

Another weak point of our study is the fact that changes in the serum electrolyte levels have not been assessed. However, the lack of symptoms of both fluid overload and infection suggests and confirms that fluid absorption during URS is clinically insignificant.

CONCLUSION

Significant ureteral wall injury rarely occurred in this cohort. Fluid absorption during URS is not correlated with the PULS grade. Semirigid URS is a safe treatment option for ureteral stone disease in terms of the level of irrigation fluid being absorbed.

Conflict of interest

All authors declare no conflict of interest.

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Ethical Approval

The study was approved by the Ethic Committee of Istanbul Medipol University (Approval number: 10840098-131). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

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