Original Article
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Predicting Factors of the Success Rate of Extracorporeal Shock Wave Lithotripsy in Ureteral Stones: A Retrospective Evaluation with Large Patient Participiant

Üreter Taşlarında Ekstrakorporeal Şok Dalga Litotripsisinin Başarısını Öngörmede Belirleyici Faktörler: Geniş Hasta Katılımlı Retrospektif Değerlendirme

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ÖZET

Amaç: Retrospektif olarak planladığımız çalışmamızda; ekstrakorporeal şok dalga litotripsisi (ESWL) yöntemi ile tedavi edilen, üreter taşı olan hastalarımızda ESWL başarısını öngören faktörleri ve güvenirliğini araştırmayı amaçladık.

Gereç ve Yöntemler: Çalışma 2008-2013 yılları arasında Atatürk Üniversitesi Üroloji Kliniği'nde üreter taşı nedeniyle tedavi edilen 489 hastayı kapsamaktadır. Hastalara en fazla üç seans ESWL uygulandı. İki seansa kadar kırılanlar başarılı kabul edildi. Üreter taşı nedeniyle ESWL uygulanan hastalar hastane kayıtlarından retrospektif olarak incelendi. ESWL başarısını öngörmede, cinsiyet, yaş, opasitesi, taraf ile komplikasyon oranları, ek prosedür gerekliliği gibi parametreler değerlendirildi. ESWL sonrası taşsız olan ya da kontrol görüntülemede 4 mm'den küçük rezidü taşı olan hastalarda ESWL başarılı olarak kabul edilip taşsızlık sağlandı olarak değerlendirildi. Sedoanaljezi sadece çocuk hastalara uygulandı.

Bulgular: Üreter taşlarından ESWL'ye alınan toplam 486 hasta çalışmaya dahil edildi. Hastalar da yaş gruplarına göre 3 gruba ayrıldı.1- 18 yaşa kadar birinci grup 20-40 arası ikinci grup ve 40 üstü üçüncü grubu oluşturuyordu. Yaş grupları ve cinsiyet parametreleri açısından taşsızlık istatiksel olarak anlamlı değildi. Komplikasyon olarak 3 hastada taş yolu, 2 hastada hematüri gelişti. Komplikasyonlar ile taşların lokalizasyonu arasında anlamlılık saptanmadı (p=0.531). Taş boyutu ile taşsızlık sağlanması ve komplikasyon gelişmesi açısından anlamlılık saptanmıştır (sırası ile p=0.016, p=0.0001).

Sonuç: ESWL'de tedavi başarısını öngörmek, hastaları gereksiz tedavi ve işlemden kaynaklanabilecek komplikasyonlardan, zaman kaybından ve morbiditeden korumak esastır. Geniş hasta katılımlı çalışmamızda ESWL'nin üreter taşlarında güvenle tercih edilebilecek bir yöntem olduğunu yüksek başarı ve düşük komplikasyon oranları ile gösterdik. Bizim çalışmamızda taş boyutu başarıyı ön görmede önemli bir prediktif değer olarak saptanmıştır.

Anahtar Kelimeler: ekstrakorporeal şok dalga litotripsisi, üreter taşı, komplikasyon, taşsızlık

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ABSTRACT

Objective: In our retrospectively planned study; treated with ESWL method; we aimed to investigate the factors that predict the success of Extracorporeal Shock Wave Lithotripsy (ESWL) and its reliability in our patients with ureteral stones.

Material and Methods: The study includes 489 patients treated for ureteral stones at Atatürk University Urology Clinic between 2008 and 2013. Patients underwent a maximum of three sessions of ESWL. Those who had fractures within two sessions were considered successful. Patients who underwent ESWL due to ureteral stones were retrospectively examined from hospital records. In predicting ESWL success, parameters such as gender, age, opacity, side and complication rates, and the need for additional procedures were evaluated. In patients who were stone-free after ESWL or had residual stones smaller than 4 mm on control imaging, ESWL was considered successful and stone-free was achieved. Sedoanalgesia was applied only to pediatric patients.

Results: A total of 486 patients who underwent ESWL for ureteral stones were included in the study. The patients were divided into 3 groups according to age groups. Ages 1-18 were the first group, ages 20-40 were the second group, and people over 40 were the third group. Stone-free status was not statistically significant in terms of age groups and gender parameters. As a complication, stone street developed in 3 patients and hematuria developed in 2 patients. No significance was found between complications and the location of the stones (p=0.531). There was a significance between stone size and stone-free status and the development of complications (p=0.016, p=0.0001, respectively).

Conclusion: It is essential to predict treatment success in ESWL and to protect patients from complications, time loss and morbidity that may arise from unnecessary treatment and procedures. In our study with large patient participation, we showed that ESWL is a method that can be safely preferred in ureteral stones with high success and low complication rates. In our study, stone size was found to be an important predictive value in predicting success.

Keywords: extracorporeal shock wave lithotripsy, ureteral stones, complication, stone free

INTRODUCTION

Extracorporeal Shock Wave Lithotripsy is based on the principle that a high-intensity low-frequency acoustic wave produced from a source called an external lithotripter focuses on the stone and fragments the stone. Since the 1980s, when ESWL was included in the treatment program, it has been a treatment modality that has been feasible, safe, effective, inexpensive, noninvasive, and non-complicated renal and ureteral stones less than 2 cm in diameter. (1,2,3) The success of ESWL is measured by fragmentation and clearance and this ratio is in the range of 46-91% (4-7). In recent years, developments in endourological and minimally invasive methods and high success rates in these methods have reduced the procedure of ESWL. The success of this technique is multifactorial. Device-related factors and patient-related parameters are significative for success. Device related factors can be listed as device type, energy level, pulse frequency, patient-matching of the device and correct placement of the patient. Patient related factors are the type of stone, the degree of hardness, the position of the stone, its size, whether it is opaque or not. As in all invasive or non-invasive interventional procedures, it is essential to predict the success of treatment in ESWL, and to protect patients from unnecessary procedure of ESWL and complications, loss of time, and morbidity that may result from the procedure.

MATERIAL AND METHODS

After the approval of the ethics committee, the patients who applied to the Atatürk University Research Hospital Urology Clinic lithotripsy unit between 2008 and 2013 and who had undergone ESWL due to ureteral stones were evaluated retrospectively from the hospital records. The location of the stones was recorded. The location of the stones was recorded as proximal above and distal below the pelvic structure. Stone size was determined by measuring from the farthest ends of stone. All treatments were done with Siemens Lithostar Modularis system (Siemens Healthcare German). All operations were performed by an experienced technician. Sedoanalgesia was applied only to pediatric patients. Pentothal sodium 3-4 mg/kg and fentanyl 1-2 µg given as pharmacological agents by anesthesiologist

physician. Adult patients were not given analgesic before and after the procedure. While planning ESWL before the procedure, the patients were evaluated by Urinary ultrasonograpy, X-Ray and if necessary Intravenous Urograpy or non-contrast abdominal CT (computed tomography) was taken. ESWL was performed for distal located ureteral stones in prone position and for proximal ureteral stones in supin position. For each pediatric patients ESWL was applied maximum 2000 shocks and for other patients 2000-3000 shocks according to patients' pain tolerance. For all the patients the operation was initiated by low energy and increased step by step according patients pain tolerance. After every 500 shocks the stone checked by flouroscopy whether the stone was fragmanted or on target. The patients were divided into three groups as age groups: 1-18 years old, second group 18-40 years old, and third group over 40 years old. Patients were evaluated for stone-free status with USG and X-ray film after each session. Stone-free status was defined as no stone fragments remaining or stone fragments less than 4 mm in size. ESWL was not performed in patients who had contraendications. Therefore, the patients with solitary kidney, urinary tract infection, stenosis distal to stone, staghorn stone, morbid obesity, cardiac pacemaker and bleeding diathesis, aortic aneurysm, and those using antiplatelet/anticoagulant agents was excluded to study naturally.
Success in ESWL was evaluated based on those who underwent up to 2 sessions.

Statistical Analysis

The data were analyzed with SPSS version 25.0. The stone-free status was correlated with patient characteristics and various stone features with the aid of t-test and Pearson's chi-squared test. Factors with a significant impact on success rate were further analyzed using multivariate analysis. A p value of less than 0.05 was accepted statistically significant.

RESULTS

A total of 489 patients who were taken to ESWL for ureteral stones were included in the study. Of the patients, 367 (74.90%) were male and 122 (25.10%) were female. 48.66% of the patients underwent ESWL on the right side and 51.34% on the left side. Requiring an additional procedure after 2 sessions of ESWL or remaining a fragment larger than 4 mm was considered a failure. In terms of stone size, the patients were evaluated in three groups as less than 10 mm, 10-15 mm and over 15 mm, according to the European Urology Guideline, and in terms of stone size. Stone-free status was not statistically significant in terms of age groups and gender parameters. Stone-free rates was calculated as 93% for proximal ureteral stones, 95.1% for distal ureteral stones, and 93.7% for total (Figure 1). Proximally and distally, stone-free localization was not statistically significant (p=0.371). Likewise, whether the stones were opaque or not was not statistically significant (p=0.839) (Table1). However, there was no statistical significance between the need for an additional procedure and proximal and distal ureteral stone location and stone size (p=0.869, p=0.201, respectively). As a complication, stone street developed in 3 patients and hematuria developed in 2 patients. No significance was found between complications and the location of the stones (p=0.531). There was a significance between stone size and stone-free status and the development of complications (p=0.016, p=0.0001, respectively) (Table 2).

As additional procedures, ureterorenoscopy, Double J stent (DJS) placement, and ureterolithotomy were performed. Stone street and hematuria were reported as complications in five patients.

Table 1. Success rates according to stone location and opacity

	opaque	nonopaque	p
Successful	93.7%	92.3%	0.839
Unsuccessful	6%	7.7%	

	proximal	distal	p
Successful	93%	95.1%	0.371
Unsuccessful	7%	4.9%	

Table 2. Success and complication rates according to stone size

	<10	10 20	15>	p
Complication	0.4%	0.9%	25%	0.0001
Noncomplicated	99.6%	99.1%	75%	

	<10	10 15	15>	p
Successful	95.8%	91.7%	75%	0.016
Unsuccessful	4.2%	8.3%	25%	

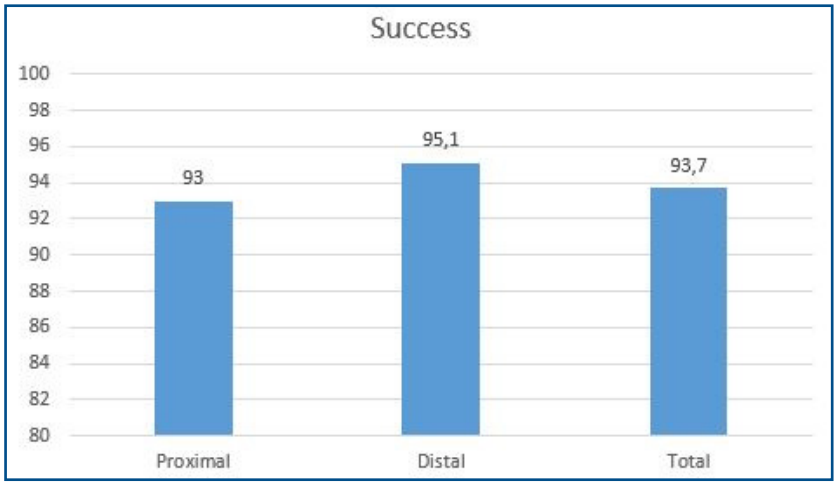

Figure 1. Success rate of localizations

DISCUSSION

Although optimal treatment planning for proximal ureteral stones is still a controversial issue due to advances in minimally invasive treatments, current guidelines still consider ESWL as the first treatment option. Because ESWL is a non-invasive and practical technique that is mostly applied without anesthesia (8). In our study, we showed that ESWL is still current procedure with its high success and low complication rates, the reason is, success in ESWL was evaluated based on those who underwent up to 2 sessions. In literature Alsmadi et al. underwent up to 2 sessions as our study (9). In distal ureteral stones, the success of the procedure decreases due to the inability to focus and effectively break due to the bone pelvis where the stone is located. However, in our study, although only one-third of the stones were distal ureteral stones, high success was achieved. Because we think that the reasons for this are every package program allowed contain up to maxiumum three sessions, high experience and equipment success due to the dense patient population. The success of emergency stone breaking and delayed breaking is similar in studies (8).

Antibiotic prophylaxis was not applied to the patients before the procedure. Studies have shown that antibiotic prophylaxis does not reduce fever and infection. In the guidelines, prophylactic antibiotics are not recommended (Recommendation A) (10).

In addition, DJS was not inserted in the patients before the procedure. In the guidelines, it is stated that DJS insertion does not affect stone-free and does not decrease complication rates. While there are studies showing low complication rates of URS (ureterorenoscopy), Lee et al. found a higher complication rate in the study of URS (11). Likewise, while there are studies showing high rates of hematuria after ESWL, there are also studies showing less hematuria after ESWL (12). In another study, voiding symptoms after treatment were higher in URS than in the ESWL group (13). Pain

rates were found to be significantly higher after URS in two studies (11,13). Studies have shown that ESWL is cost-effective (14). Although high stone-free rates are reported for URS, ESWL remains current due to low morbidity and complication rates (15,16). According to the Cochrane meta-analysis conducted in 2012, all complication rates were found to be lower in ESWL than URS (17). In studies, generally, evaluations with quality-of-life score and lower urinary system symptoms are not performed. However, lower urinary system symptoms are lower in ESWL and the quality-of-life score is higher in ESWL (13). Low complication rates were also reported in our study.

The most important factors in predicting the success of treatment are the size of the stone, stone location, density, obesity (stone-skin distance), congenital anomalies, and kidney failure. In their study, Perk et al. evaluated the three most important predictive factors as skin stone distance, stone composition, attenuation, and other factors as BMI (body mass), stone size, and stone location (18). In the study of Wiesenthal et al. to determine the success of treatment, found 60.3% success in ureteral stones in a single session. They evaluated BMI and stone size as predictive factors in predicting stone success (19). In the study of Kanao et al. found that the number of stones was a predictive factor in the success of ESWL (20). They also found that the highest success was in a single proximal ureteral stone less than 5 mm. In a few prospective studies, it was determined that BMI and stone density were effective in predicting treatment success (21).

Efiloğlu et al found the overall success rate of ESWL in ureteric stones 75%. They determined that the factors affecting the success of ESWL in ureteric stones were age and stone size (22).

According to the meta-analysis, the success rate in patients who underwent emergency ESWL was 78% (75-82%), success in proximal ureter stones was 79% (61-95), 78% (69-88) in the middle ureter and 79% (74-84) in the distal ureter they found (23).

The limitations of our study are that we counted the treatment package up to 2 sessions as success and did not consider patients who underwent ESWL for more than 2 sessions as unsuccessful because they required an additional procedure, which led to a high success rate. Most of patients include in our study had not CT scan those we could not study this parameter.

CONCLUSION

Despite the developments in the technology of endoscopic interventions in ureteral stones, ESWL is still the first treatment method for proximal ureteral stones according to the current European Urology guideline. In our study with large patient participation, we showed that ESWL is a method that can be safely preferred in ureteral stones with high success and low complication rates, and in our study, stone size was found to be an important predictive value in predicting success.

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