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Comparison of Efficacy of Shock Wave Lithotripsy in Different Age Groups

Şok Dalga Tedavisinin Etkinliğinin Farklı Yaş Gruplarında Karşılaştırılması

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What's known on the subject? and What does the study add?

For the management of renal stones, shock wave lithotripsy (SWL) is advised by the European Association of Urology and American Urological Association guidelines. Efficacy of SWL in the elderly population was shown to be lower in some studies. However, these studies were not published recently and SWL devices and the technique has changed remarkably in the last decade. This study compares the efficacy of SWL in different age groups and the results showed no difference in the success rates.

Abstract

Objective: Shock wave lithotripsy (SWL) is a safe and effective treatment for renal stones. The success rate of SWL has been shown to be lower in the elderly populations. However, in these previous studies, the SWL devices and techniques were not compatible with the current devices and techniques. In this study, it was aimed to compare the success rates of SWL in different age groups and evaluate the effect of age on SWL outcomes.
Materials and Methods: Data of 472 patients who have undergone SWL was evaluated. The patients were grouped into 3 age categories: 18-40 (n=159), 41-64 (n=180), and ≥65 (n=133) years. Data regarding stone location, stone size, number of SWL sessions, and success rates were recorded. The groups were compared for success rates. Additionally, logistic regression analysis was performed to evaluate the effect of age on success rates of SWL treatment.
Results: The success rates in patients in age categories 18-40 years, 41-64 years and ≥65 years were 75.4%, 75.6% and 69.1%, respectively (p=0.37). In the logistic regression analysis, age was not found to be associated with success rates. In the multivariate analysis, greater stone size [odds ratio (OR): 1.59, 95% confidence interval (CI): 1.10-4.24, p=0.04] and lower pole location (OR: 1.65, 95% CI: 1.110-5.327, p=0.04) were found to be associated with lower success rates.
Conclusion: There were no significant differences in the rate of success of SWL treatment in different age groups. In patients over 65 years of age, SWL treatment should not be avoided with the assumption of lower success rates.
Keywords: Shock wave lithotripsy, age, stone free rate

Öz

Amaç: Böbrek taşlarının tedavisinde şok dalga tedavisi (SWL) güvenli ve etkin bir tedavi olarak kullanılmaktadır. Yaşlı popülasyonda SWL etkinliğinin daha düşük olabileceği belirtilmiştir. Ancak bu çalışmalarda güncel SWL cihazları ve tekniği kullanılmamıştır. Bu çalışmada, SWL etkinliğinin farklı yaş gruplarında karşılaştırılması ve yaşın SWL etkinliği üzerine olan etkisinin değerlendirilmesi amaçlanmıştır.
Gereç ve Yöntem: SWL yapılan 472 hastanın verileri değerlendirilmiştir. Hastalar yaş gruplarına göre; 18-40 (n=159), 41-64 (n=180) ve ≥65 (n=133) yaş olmak üzere 3 gruba ayrılmıştır. Hastalara ait taş yerleşimi, boyutu, SWL seans sayısı ve SWL başarı oranları kaydedilmiştir. Gruplar başarı oranları açısından karşılaştırılmıştır. Ayrıca SWL başarısına yaşın etkisini değerlendirmek için lojistik regresyon analizi yapılmıştır.
Bulgular: SWL başarı oranları 18-40 yaş, 41-64 yaş ve ≥65 yaş gruplarında sırasıyla %75,4, %75,6 ve %69,1 olarak saptanmıştır (p=0,37). Lojistik regresyon analizinde SWL başarısı açısından hasta yaşı anlamlı bir parametre olarak bulunmamıştır. Çok değişkenli analizde taş boyutunun büyümesi [göreceli olasılıklar oranı (OR): 1,59, 95% güven aralığı (GA): 1,10-4,24, p=0,04] ve alt kaliks yerleşimli olması (OR: 1,65, 95% GA: 1,110-5,327, p=0,04) daha düşük başarı oranları ile ilişkili olarak bulunmuştur.
Sonuç: Böbrek taşı nedeniyle SWL uygulanan hastalarda yaş grupları arasında SWL başarısı açısından anlamlı fark saptanmamıştır. ≥65 yaş olan hastalarda SWL tedavisinden başarı oranlarının düşük olacağı düşünülerek kaçınılmamalıdır.
Anahtar Kelimeler: Şok dalga tedavisi, yaş, taşsızlık oranları

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Introduction

Stone disease is an important health problem due to its effect on renal functions and quality of life of the patients (1,2). Extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery, and percutaneous nephrolithotomy are the available treatment modalities offered by the most recent European Association of Urology and American Urological Association guidelines for the treatment of patients with a non-lower pole stone of <20 mm in diameter (3,4).

ESWL has the advantages of being less invasive and resulting in lower complication rates compared to the endourology procedures. However, main drawback of ESWL is the lower success rates with higher re-treatment rates compared to retrograde intrarenal surgery and percutaneous nephrolithotomy (5,6). Patient selection to provide highest success and lowest complication rates should be the main aim of the endourologist. Therefore, evaluation of parameters that affect outcomes of ESWL had been the subject of many studies and nomograms and scoring systems have been established (7,8,9,10,11).

Besides, factors such as stone density, stone to skin distance, stone diameter, and age were also determined as prognostic parameters for ESWL outcomes. However, conflicting results have been reported on the effect of age. In some studies, age was found to have a negative effect on ESWL outcomes (9,12,13). In a recent study, Ichiyanagi et al. (14) evaluated the effect of age on the time needed to establish stone clearance after ESWL and concluded that age had no effect on ESWL success but patients aged ≥80 years might experience delayed stone clearance within the first 12 months after ESWL.

The success of the ESWL procedure also depends on the ESWL device and applied energy and shock wave frequency. The previous studies evaluating the effect of age on ESWL success rates are mainly performed about a decade ago with older generation ESWL devices and, in this study, we aimed to identify the effect of age on ESWL success with the currently accepted ESWL methodology.

Materials and Methods

We retrospectively evaluated data of 472 patients who underwent SWL treatment for renal stones <20 mm in the largest diameter in our department from January 2011 to January 2016 and followed up for at least 12 months. Informed consent was taken from every patient prior to the treatment. Stone disease was diagnosed by use of renal ultrasonography (USG), plain abdominal radiography (KUB) and intravenous urography or non-contrast-enhanced computed tomography (NCT). In case of a positive urine culture, appropriate antibiotic therapy was prescribed and sterile urine was established. Demographic and stone-related characteristics were: age, gender, use of alpha blockers as medical expulsive therapy, size and location of the stone, and number of ESWL sessions. For medical expulsive therapy, tamsulosin, an alpha blocker, was prescribed.

Success of the procedure was evaluated using KUB and USG. In case of a radiolucent stone or a possible ancillary procedure, NCT was performed. ESWL success was defined as absence of a residual fragment >2 mm in size (15). The patients were grouped into 3 age categories: 18-40 (n=159), 41-64 (n=180), and ≥65 (n=133) years. The groups were compared for success rates.

ESWL was performed with ELMED Complit ESWL device (Elektronik ve Medikal Sanayi ve Ticaret A.Ş., Ankara, Turkiye). All patients were treated on an outpatient basis without anesthesia but sedation was applied with midazolam 0.1 mg/kg intravenously when the patient could not tolerate the procedure. All treatment sessions were limited to 3000 shocks with frequency of 60-90 shocks per minute and power ramping was applied (started at 14 kV and gradually increased to 21 kV). None of the patients were stented prior to the procedure.

Statistical Analysis

For statistical analysis, SPSS version 21 (IBM Corp, Armonk, NY, U.S.) was used. A p value of less than 0.05 was considered statistically significant. Comparisons between the groups were performed using chi-square tests for categorical variables and analysis of variance or Kruskal-Wallis H test were used for continuous variables, depending on the distribution of the data. Univariate and multivariate logistic regression analyses were conducted to identify variables predictive of success rates. Age is included as a continuous variable in the logistic regression analysis.

Results

The mean age of the population was 44.8±8.7 years. The age groups were similar for the parameters of sex, mean stone size, stone location, use of alpha blockers, and number of ESWL sessions (Table 1).

The success rates in the 18-40 years, 41-64 years and ≥65 years groups were 75.4%, 75.6% and 69.2%, respectively and the difference between the groups was not statistically significant (p=0.37). In case of ESWL failure, retrograde intrarenal surgery was the most common treatment modality for all groups. The number of cases with success and ancillary procedures are summarized in Table 2.

In the logistic regression analysis, age, sex, stone laterality, and use of medical expulsive therapy were not found to be associated with success rates. Stone size, stone location and number of ESWL sessions were found to be associated with success rates in

Table 1. Characteristics of the patients in different age groups

Parameters	Age 18-40 (n=159)	Age 41-64 (n=180)	Age ≥65 (n=133)	p
Male gender, n (%)	95 (59.7)	105 (58.3)	82 (61.6)	0.83
Stone size (mm), mean ± SD	14.8±4.9	14.1±4.2	13.8±3.9	0.72
Stone laterality, n (%)				0.52
Right	75 (47.2)	96 (53.3)	67 (50.4)	
Left	84 (52.8)	84 (46.7)	66 (49.6)	
Stone location, n (%)				0.99
Pelvis	61 (38.4)	70 (38.9)	54 (40.6)	
Upper pole	29 (18.2)	34 (18.9)	24 (18)	
Middle pole	36 (22.6)	35 (19.4)	28 (21.1)	
Lower pole	33 (20.8)	41 (22.8)	27 (20.3)	
Number of SWL sessions, median (range)	2 (1-3)	2 (1-3)	2 (1-3)	0.77
Use of medical expulsive therapy		46 (25.6)	32 (24.1)	0.88
	37 (23.3)			

SD: Standard deviation, SWL: Shock wave lithotripsy

Table 2. Summary of success rates and ancillary procedures in different age groups

Treatment outcome	Age 18-40 (n=159)	Age 41-64 (n=180)	Age ≥65 (n=133)	p
Success, n (%)	120 (75.4)	136 (75.6)	92 (69.2)	0.37
Failure, n (%)	39 (24.6)	44 (24.4)	41 (30.8)	
Ancillary procedures				
Observation, n (%)	6 (15.4)	6 (13.6)	8 (19.5)	0.67
Retrograde intrarenal surgery, n (%)	27 (69.2)	35 (79.5)	29 (70.8)	
Percutaneous nephrolithotomy, n (%)	6 (15.4)	3 (6.9)	4 (9.7)	

the univariate analysis and the results are summarized in Table 3. In the multivariate analysis, greater stone size (odds ratio (OR): 1.59, 95% confidence interval (CI): 1.10-4.24, p=0.04) and lower pole location (OR: 1.65, 95% CI: 1.110-5.327, p=0.04) were found to be associated with lower success rates.

Regarding the complication rates, macroscopic hematuria was the most common complication and detected in 30 (18.9%), 41 (22.8%), and 39 (29.3) patients in the 18-40 years, 41-64 years and ≥65 years groups, respectively (p=0.106). Perirenal hematoma was detected in 3 patients in the entire population (one patient in the 18-40 years group and the other 2 in the ≥65 years group).

Discussion

ESWL is one of the main treatment options for the management of renal stones with a diameter <20 mm in diameter and our results indicate that outcomes of ESWL are not affected by age. Treatment of stone disease in elderly patients can be complicated by presence of comorbidities and, ESWL is a good option in this population as it does not necessitate general anesthesia.

Decreased success rates in ESWL have been reported in previous studies. Abe et al. (16) evaluated the results of 2844 patients treated with ESWL in a 13-year period. The patients were evaluated 3 months after treatment. Stone-free rate in patients >60 years of age was detected to be 57% and this was significantly lower than in the younger age groups of <19, 20-39, 40-59 which were 93%, 74%, and 61%, respectively (16). In another study, Kimura and Sasagawa (17) also compared age groups of ≤39, 40-49, 50-59, 60-69, and >70 years in 601 patients. Stone-free rates were 87.4%, 84.4%, 75%, 71.1%, and 66.3%, respectively. The underlying mechanisms for the decreased success rates in the elderly population are not clear. Increased acoustic impedance due to age-related sclerosis in the renal parenchyma was blamed for decreased rate of fragmentation. Another factor hypothesized was the decreased expulsion rate of the fragments in the elderly population (14).

In a recent study, Ichiyanagi et al. (14) compared the success rates in SWL together with time to stone clearance in different

Table 3. Results of univariate analysis for success rate following shock wave lithotripsy

Parameter	OR	95% CI	p
Age	1.107	0.685-1.139	0.914
Sex (male vs. female)	1.131	0.617-1.487	0.812
Stone laterality	1.006	0.481-1.119	0.995
Stone size	2.155	1.348-5.170	0.008
Stone location (lower pole vs. other locations)	2.004	1.226-4.398	0.011
Number of SWL sessions	1.664	1.212-2.714	0.044
Use of medical expulsive therapy	1.280	0.804-1.994	0.772

OR: Odds ratio, CI: Confidence interval, SWL: Shock wave lithotripsy

age groups. The authors evaluated the results of 247 patients and classified patients into 10-year age groups. The stone-free rate at 3 months was 74.9% and increased over 90% in each age group after 18 months. The stone free-rate did not differ between the age groups, however, patients older than 80 years of age were proposed to have a delay for reaching the stone-free status (14). Similarly, we did not detect a significant difference in success rates between the age groups. The stone free rates in the elderly populations in studies by Abe et al. (16) and Kimura and Sasagawa (17) were lower than our results (57% and 66.3% vs. 69.2%). This may be due to longer follow-up (at least 12 months) of patients in our study which condones the delayed stone expulsion in the elderly population.

Complications following ESWL have been shown to be higher in the elderly population. Dhar et al. (18) evaluated the results of 317 patients to determine the factors that affect the rate of subcapsular hematoma. Subcapsular hematoma was observed in 4.1% of the cases. The authors identified patient age as a factor associated with increased rate of subcapsular hematoma (18). Subcapsular hematoma was observed in only three patients in the current study which is significantly lower than the results of Dhar et al. (18). We believe that this is mainly due to the different ESWL techniques.

Study Limitations

Our study has important drawbacks. First of all, this is a retrospective study and the treatment success was evaluated with KUB or USG, which are not the gold standard imaging methods, in most of the patients. Also, we grouped the patients into three age groups. This is not a standardized method of age grouping but due to the relatively low number of patients, we could not make grouping with 10-year increments, which was the methodology in most of the studies on this subject. Another important drawback is the lack of information on stone to skin distance and stone attenuation which are the parameters associated with success of the procedure. We could not get information on these parameters since an important portion of the patients did not undergo NCT before treatment.

Conclusion

Our results reveal that SWL outcomes are not affected by aging. Success rates were shown to be affected by stone size and location in our study. These two parameters should be taken into account while deciding the treatment options in renal stone patients of all age groups. We believe that with the equivocal success rate and acceptable complication rates, ESWL should not be underestimated as a treatment alternative in elderly renal stone patients.

Ethics

Ethics Committee Approval: Ethics committee approval was not applied because of retrospective design.

Informed Consent: This was a retrospective study and informed consent was not performed.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.İ.G., E.S., Concept: M.İ.G., Ç.A., Design: M.İ.G., A.S., E.S., Data Collection or Processing: M.İ.G., V.T.S., Analysis or Interpretation: M.İ.G., A.S., Literature Search: M.İ.G., A.A., Writing: M.İ.G., E.S.

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