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Success of Extracorporeal Shock Wave Lithotripsy in Patients with Lower Caliceal Stone and Favorable Anatomy

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Aim: We assessed the efficacy of extracorporeal shock wave lithotripsy (ESWL) monotherapy for isolated lower pole nephrolithiasis with favorable anatomy and compared treatment efficacy with regard to different stone sizes.

Materials and Methods: From February 1999 to December 2002, adult patients with simple, radiopaque lower pole kidney stones were treated using a Stonelith V3 Lithotriptor (PCK, Turkey). Patients were stratified into four groups based on stone diameter. These groups included stone diameters of ≤5 mm, 6-10 mm, 11-15 mm and 16-20 mm. The energy, number of shock waves, number of treatment sessions, auxiliary measures and complications were noted. All of the patients had intravenous pyelograms (IVPs) available for review. Infundibular length (IL), infundibular width (IW) and infundibulopelvic angle (IPA) were measured. The patients who were considered to have a favorable anatomy (IPA≥70°, IL≤30 mm and IW>5 mm) were included in the study.

Results: The overall stone-free rate was 84.5%. The stone-free rates in patient groups according to stone size were 90%, 84%, 57%, and 50%, respectively. The difference in success between stone groups was statistically significant. The success rates in the first (≤5 mm) and second (6-10 mm) stone size groups were especially higher than in the other groups ($P < 0.05$).

Conclusions: ESWL appears to be successful for management of isolated lower caliceal stone disease with favorable anatomy. In this study, we have shown that stone size in favorable anatomy may also have an effect on stone clearance in ESWL.

Key Words: ESWL, kidney, calculi, calix

Alt Kalis Taşı ve Uygun Anatomisi olan Hastalarda Beden Dışı Şok Dalgasıyla Taş Kırmanın Başarısı

Amaç: Uygun anatomisi olan izole alt kalis taşlarında ESWL (extracorporeal shock wave lithotripsy) etkinliği değerlendirildi ve değişik taş boyutları için karşılaştırıldı.

Yöntem ve Gereç: Şubat 1999 ve Aralık 2002 tarihleri arasında, basit radyoopak alt pol taşı olan erişkin hastalar Stonelith V3 lithotripter (PCK, Türkiye) kullanılarak tedavi edildi. Hastalar taş çaplarına göre 4 gruba ayrıldılar. Enerji, şok dalga sayısı, anestezi çeşidi, tedavi seansı sayısı, gerekli ölçüler ve komplikasyonlar kayıt edildi. İnfindibular uzunluk (IL), infindibular genişlik (IW), ve infindibulopelvik açı (IPA) ölçüldü. Uygun anatomisi olan (IPA≥70 derece, IL≤30 mm ve IW>5mm) hastalar çalışmaya dahil edildi.

Bulgular: Ortalama taşsızlık oranı % 84,5'dı. Taş boyutlarına göre oluşturulmuş hasta gruplarında taşsızlık oranları sırasıyla %90, %84, %57, %50 bulundu. Taş grupları arasındaki başarı oranlarında istatistiksel olarak anlamlı fark vardı. Özellikle birinci (≤5 mm) ve ikinci (6-10 mm) gruptaki başarı oranları diğer gruplardan yüksek bulundu ($P < 0.05$).

Sonuç: ESWL uygun anatomiye sahip izole alt kalis taşlarında başarılı bir tedavi olarak gözükmektedir. Bu çalışmada uygun anatomide taş boyutunda ESWL başarısında tedavi başarısını etkileyebileceğini gösterdik.

Anahtar Sözcükler: ESWL, böbrek, taş, kalis

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Introduction

Extracorporeal shock wave lithotripsy (ESWL) has become the first-line treatment for most urinary tract calculi because of its efficacy and low morbidity (1,2). The low stone-free rate for lower pole calculi has become a problem that is related to low clearance of stone fragments rather than stone disintegration. This was shown to be largely dependent on lower pole anatomy in the adult patients (3,4). Sampaio et al. (3,5) reported the adverse factors of lower pole stone clearance as an acute lower infundibulopelvic angle (IPA), small lower infundibulum diameter, complex caliceal anatomy and a long caliceal length.

In this study, we assessed the efficacy of ESWL monotherapy for isolated lower pole nephrolithiasis with favorable anatomy and compared treatment efficacy with respect to different stone sizes.

Materials and Methods

The study group consisted of 62 patients aged between 6 and 75 years treated with ESWL from February 1999 to December 2002, using a Stonelith V3 Lithotriptor (PCK, Turkey). Forty-two cases (67.7%) were men and 20 (32.2%) women. Before lithotripsy, all patients were evaluated routinely with renal function tests, urinalysis, urine culture, abdominal X-ray and intravenous pyelogram (IVP) and/or ultrasonography (USG). Treatment with antibiotics was administered before ESWL when the urine culture was positive. Patients with congenital anomalies of the urinary tract, a history of previous surgery for urolithiasis, apparent metabolic disorders, complete or partial staghorn calculi or multiple calculi and those treated by combined therapy with open surgery or percutaneous nephrostolithotomy were excluded from the study program.

All procedures were performed under fluoroscopic control in supine position as an outpatient procedure. The shock wave numbers ranged between 1000 and 3500 shock wave/session (mean 2750 ± 746.7). Treatment was initiated with 9 kV, and energy was gradually increased by 0.5 kV to the maximum level (23 kV) that the patient could tolerate. All patients underwent ESWL under intravenous fentanyl. Cases were designated as stone-free, clinically insignificant residual fragments that are nonobstructive and noninfectious stone fragments of 4 mm or less, and failure. Follow-up included physical examination, urinalysis and plain abdominal film. Plain abdominal film was taken on the day after ESWL and monthly in the first three months and every three to six months thereafter. The results were included one month after the last session.

The lower pole anatomy was determined on standard IVPs. All measurements were done by the same author and confirmed by another. Lower pole infundibular length (IL), infundibular width (IW) and IPA were measured as described by Elbahnasy et al. (6). Lower pole IL was measured from the most distal point at the bottom of the infundibulum to a midpoint at the lower lip of the renal pelvis. IW was measured at the narrowest point along the infundibular axis. To determine the lower pole IPA, a line was drawn connecting the central point of the pelvis opposite the margins of the superior and inferior renal sinus to the central point of the ureter opposite the lower kidney pole (ureteropelvic axis). Using an anteroposterior radiograph from the IVP, the inner angle between this line and the central axis of the lower pole infundibulum was measured (IPA).

The patients who are considered to have a favorable anatomy (IPA≥70°, IL≤30 mm and IW>5mm) were included in the study. Patients were stratified into four groups based on stone diameter. These groups included stone diameters of ≤5 mm, 6-10 mm, 11-15 mm and 16-20 mm. The energy and shock waves and number of treatment sessions were noted. ESWL was considered a failure if residual stone fragments remained after one month or if an auxiliary procedure on retreatment was required. The statistical analysis was done using the Kruskal-Wallis statistic and chi-square test.

Results

The numbers of shock wave and treatment sessions according to stone diameter group are shown in Table 1. There was no difference in shock wave numbers between the stone size groups ($p = 0.66$). There was a significant difference between number of treatment sessions depending on the stone size ($P < 0.05$).

The overall stone-free rate was 84.5%. The stone-free rates in patient groups (stone diameters of ≤5 mm, 6-10 mm, 11-15 mm and 16-20 mm) were 90%, 84%, 57%, and 50%, respectively. Differences in stone-free rates between stone size groups were statistically significant ($P < 0.05$). The success rates in the first (≤5 mm) and second (6-10 mm) stone size groups were especially higher than in the other groups.

Table 1. Treatment characteristics stratified according to stone size groups.

Stone diameter group	Number of samples	Shock wave number (Mean ± SD)	Treatment sessions (Mean ± SD)
≤ 5 mm	10	2510.0 ± 1206.9*	2.7 ± 1.7**
6-10 mm	19	2584.2 ± 803.6*	3.4 ± 1.8**
11-15 mm	21	2866.6 ± 536.9*	3.9 ± 1.5**
16-20 mm	12	3008.3 ± 347.6*	4.1 ± 1.2**

- * P > 0.05
- ** P < 0.05

Discussion

Treatment outcome after lithotripsy depends on several factors. The type of lithotriptor, stone characteristics (number, size, composition and location), and renal anatomy and function are

important factors for determining treatment characteristics and outcome. Although the role of shock wave lithotripsy for management of lower pole nephrolithiasis has been questioned in some studies (7), many have suggested it as the primary treatment modality for lower pole stones of less than 2 cm (8,9). Recently, several retrospective studies have further investigated the influence of lower pole anatomy on stone clearance.

Retention of residual fragments in the lower pole calices was noted to be a major problem with ESWL not only for stones originally in the lower calices, but also when fragments of stones located elsewhere migrated there (10). For this reason, we have assessed the efficiency of ESWL monotherapy for isolated lower pole nephrolithiasis with favorable anatomy and we compared it with regard to different stone sizes.

Sampaio and Aragao (3,11) analyzed the inferior-pole collecting system anatomy in 146 three-dimensional polyester resin corrosion endocysts of the pelvicaliceal system and they described the caliceal anatomy of the lower pole and its possible impact on stone clearance with ESWL. They described three anatomical features that may have a role in stone clearance: the angle between the lower pole infundibulum and renal pelvis, the diameter of the lower pole infundibulum, and the spatial distribution of the calices. They suggested that a lower pole IPA less than 90°, lower pole infundibulum diameter less than 4 mm and multiple lower pole calices may decrease stone clearance. In a prospective trial, Sampaio et al. (12) found that 39 of 52 (72%) patients became stone-free when the lower pole IPA was greater than 90 while only 5 of 22 (23%) patients were stone-free when the angle was less than 90. Keeley et al. (4) reported on 116 patients who underwent shock wave lithotripsy for lower pole stones. The lower pole IPA was the only factor to attain significance in predicting stone-free status. The stone-free rates were 34% and 66% in patients with lower pole IPA less than or greater than 100°, respectively. Combining all three negative factors (acute angle, distorted calix and narrow infundibulum), the stone-free rate decreased to 9%. With three positive factors, the stone-free rate was 71%. Elbahnasy et al. (13) suggested an alternative method for measuring the lower pole IPA (on preoperative intravenous urography). The angle is measured between the central point of the renal pelvis and central point of the proximal ureter to determine the ureteropelvic axis and the central axis of the lower pole infundibulum. They also reported that the lower pole IPA and IW have a significant role in stone clearance after shock wave lithotripsy for lower pole stones, and added IL as another significant predictive factor. Gupta et al. (14) recently reported the results of 88 patients undergoing shock wave lithotripsy for lower pole stones. They confirmed that the lower pole IPA was the most significant factor followed by IW. However, IL was not a statistically significant factor for stone clearance.

Similar to Elbahnasy's favorable anatomy criteria, in this study we have accepted IPA≥70°, IL≤30 mm and IW>5mm as indicating favorable anatomy. The overall stone-free rate was 84.5%. The overall stone-free rates in stones <5 mm, 6-10 mm, 11-15 mm and 16-20 mm were 90%, 84%, 57%, and 50%, respectively. The difference in success between stone size groups was statistically significant (P < 0.05). The success rates in the first and second groups were especially higher than in the other groups (P < 0.05). This supports some other authors' results, with the worse results in the >10 mm group, even in favorable anatomy (15).

Extracorporeal shock wave lithotripsy appears to be successful for management of isolated lower caliceal stone disease with favorable anatomy. In this study, we have shown that stone size in favorable anatomy may also have an effect on stone clearance in ESWL.

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