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The success of extracorporeal shock wave lithotripsy at stones up to 10 mm in horseshoe kidneys

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Abstract

Aim of this study is to research retrospectively the effectiveness of extracorporeal shock wave lithotripsy (SWL) for horseshoe kidney according to the size of stones. SWL treatment applied on 27 kidney stones in 21 patients at a single center were examined retrospectively. Stones were classified according to their size, the number of shock waves applied and average session number. The mean age of the patients was 44 (18-70). Stone sizes were 16mm (7-40) X 10mm (5-30). Average of sessions was 2.55 (1-3) and shock number was 1643 (977- 2300). The success rate of SWL treatment at horseshoe kidney stones which were under 10 mm was 90% and for over 10 mm it was 30% (p=0.001). Success rates were detected 63%, 52% and 48%; respectively up to 0-15 mm, 0-20mm and for all stones. The SWL success rate with horseshoe kidney is similar to that in normal kidney. The success rate decreases as stone size increases. SWL is a safe and effective treatment option for horseshoe kidney stones. Especially for stones up to 10 mm, the rate of SWL's success rate is pretty high.

Keywords: Effectiveness of SWL, horseshoe kidney, stone, 10 mm

Introduction

Upper urinary system anomalies include not only the absence of organs, division anomalies, and normal localization but also deformity, collecting system and vascular disorders. Many of these anomalies are associated with hydronephrosis and increased stone incidence [1]. The occurrence is 33% hydronephrosis, 30% infection and 20% stones in horseshoe kidneys [1,2]. It is assumed that the main factor in stone formation in abnormal kidneys is the deterioration of urinary drainage and stasis rather than metabolic or genetic factors [3,4].

The SWL, which was introduced by Chaussy [5] in 1980, is noninvasive, highly effective and reliable treatment method for urinary system stones [5]. SWL is a treatment method also used for horseshoe kidney stones [3]. However, the number of studies on SWL treatment of horseshoe and anomalous kidney stones are few, and their success rate is variable [6-10]. In our study, we examined retrospectively the effectiveness of SWL treatment of horseshoe kidney stones in a single center

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Materials and Methods

Twenty-seven horseshoe kidneys with stones that were given SWL treatment were examined retrospectively between the years 1997-2014 in the ACK Urotas SWL Treatment Center. Patients with radiopaque stones were included in the study. We obtained the age and sex of the patients, the localization and side of the stone, number of SWL sessions, and shock wave number and complications encountered. Patients with pregnancy, whose body mass index was over 30, with non-functioning kidneys, severe hydronephrosis and apparent thinning of the parenchyma thickness, whose serum creatinine level was over 2mg/dl, who had a bleeding diathesis, who receive anticoagulant treatment, and who had severe urinary system infection were not given SWL treatment. Stone analysis was not performed for these patients.

We assumed the persistence of stone images in the radiologic examination after three sessions as failure of the treatment, while the case of spontaneous passage of the stone (parts under 4 mm) or stone-free status was assumed as a success of the treatment.

Before SWL, patients were assessed with a detailed history, full physical examination, urinalysis, urea, creatinine and blood chemical analysis. For some cases, specific tests were examined or requested (those with bleeding disorder or anticoagulant, suspected pregnancy, etc.). Patients with pacemaker or cardiac and/or respiratory disease were consulted to the relevant physicians. All patients were given intravenous urography (IVU) before the process. Routine computerized tomographic examination was not used as it did not affect the process and because of its high level of radiation [11].

Patients were informed about the SWL treatment, and informed consent was obtained before the process. Sizes of stones were calculated in two dimensions from direct X-ray and localization was assessed in IVU. Patients with urinary system infections were included after appropriate antibiotic treatment.

The SWL treatment was given to all patients as the primary treatment method. During the process, they were given diclofenac for pain. In case of failure in pain control, meperidine was given.

Stones were checked by direct X-ray24 hours after the SWL session. Ultrasonography was performed for patients when needed. A 2ndsession was planned for ten days later. Before the 2nd session, patients were assessed again by direct X-ray. Three sessions of SWL were applied at most.

A Multimed 9200 Lithotripter Spark Gap (Elmed Medical System, Turkey) device was used for the SWL process. The device was used under fluoroscopy, and the table was movable, whereas the shock generator was fixed.

The SWL was generally applied in the supine position, but in case of difficulty in localization of the stone, a modified prone position was used, as defined by Kose et al. [12]., and which has been used successfully and safely in prevesical lower ureteral stones [12].SWL treatment was applied to all patients by an experienced urology expert (ACK). Each SWL session was begun at a low dose (12 kV) and was gradually increased to20kV.

Statistical analysis

In this study, SPSS (Statistical Package for the Social Sciences, Version 18.0 SPSS Inc. Illinois, USA) was used for statistical analysis. Student's t test and Pearson's Chi-Square tests were also used. A significant p value was assumed as lower than 0.05.

Results

Sixteen of the patients were male, and five were female, and SWL was applied to 27 kidneys. The average age was 44±12,8(18—70). All of the stones were radio-opaque (Table 1)

Table 1. Distribution of patients according to their ages, gender and side

Age		44 (18-70)
Gender	Male	16(76%)
	Female	5(24%)
Side	Right	15(55%)
	Left	12(45%)

The mean number of sessions per patient was 2.55 (1-3), and the number of shocks was 1643±360 (977- 2300).

The average length of the stones was 16 mm±9,1 (7-40), and the average width was 10mm ±5(5-30) . 15(55%) of the stones were located in the kidney pelvis, 8 (29%) in the lower calyx and 4(16%) in the upper pole. SWL failed in 14 kidneys, and they were referred to surgery. Nine kidneys were purified from stones, and there were minimal fragments in 4 of them, meaning it was successful.

The rate of stone-free kidneys or kidneys with sufficient fragmentation among all horseshoe kidneys in the controls one month after three sessions of SWL was 48% (13 patients; p=0.17).There was no statistical relation between successful treatment and age, gender and side.

Total rate of success in analysis after SWL on 27 horseshoe kidneys in all locations was 48% (27 kidneys).Average number of sessions applied was 2.55(1-3), number of shocks was 1643±360 (977-2300), and stone size was 16mm±9,1 (7-40).

Size of the stones and success rates are given in Table 2. There was a 90% success rate for size smaller than 10 mm.

Table 2. Stone sizes and success rates in horseshoe kidney

Size		Size mm (min-max)	Success number (%)	Failure number (%)	p value
	Smaller than 10mm	8.3(7-10)	***9(90%)***	1(10%)	0.001
	Bigger than 10mm	21(11-40)	4(30%)	13(70%)	0.001

The success rate was 90% for stones smaller than 10 mm, the success rate for sizes smaller than 15 mm was 63%, and it was 52% for stones smaller than 20 mm. When the size of the stone is getting bigger, the rate of success will decrease (Table 3).

Table 3. Association of success rates of the SWL with stone sizes

Stone size	Success	Failure
Smaller than 10mm	*9(%90)*	1(%10)
0-15 mm	10(%63)	6(%37)
0-20 mm	11(%52)	10(%48)
0 - bigger than 20 mm	13(%48)	14(%52

The SWL success rate on stones smaller than 10 mm located in 27 horseshoe kidneys was 90% (10 kidneys) while the success rate of stones larger than 10 mm was 30%(17 kidneys). The size, sessions and shock average of the group under 10 mm were, respectively, 8.3 ±1,3 mm (7-10), 2.55 sessions (1-3), and 1543±444 shocks (977-2000). Size, sessions and shock averages for stones larger than 10 mm were, respectively, 20,5±8,9mm (11-40), 2.88 sessions (1-3), and 1702±300 shocks (1240-2300) (for all groups p=0.001).

Patients who had dysuria, mild hematuria, or mild or moderate renal colic complaints after SWL were given appropriate medical treatment (diclofenac Na) and conservative approaches were recommended (hydration, etc.). We did not face a more severe case. There were no stone streets in the follow-up of patients

Discussion

Obstruction and urinary stasis are a frequent situation in abnormal kidneys [2]. High allocation of ureter and isthmus in horseshoe kidney is a cause of partial obstruction and stasis; moreover, arterial and venous anomalies can accompany this situation, which increase the possibility of infection and stones in horseshoe kidney [3]. There are studies that argue that metabolic factors contribute to stone formation in horseshoe kidney [13]. However, it is thought that the main reason is obstruction and stasis. Mechanisms such as abnormal localization and anomalies that hinder passage in the ureter in pelvic kidney, crossed ectopic and polycystic kidneys increase stone formation. Before the SWL treatment option period described by Chaussy in 1980[5], treatment of abnormal kidney stones was only a matter of open surgery or active following. After SWL, stones in abnormal kidneys started to be treated mainly with this method [6-10]. With developing technology, treatments such as percutaneous nephrolithotomy (PCNL) [14], minimal PCNL [15], flexible URS [16] and laparoscopic approaches [17] started to be applied to abnormal kidneys.

According to EAU criteria, the priority treatment recommended for normal kidney stones smaller than 20 mm is SWL [18]. The success rate of SWL on abnormal kidneys varies between 28-78% [19]. The reason for this is related to size, localization and composition of the stones. Similarly, these criteria determine the treatment option. The fact that SWL is noninvasive, and its success rate is relatively high with appropriate criteria is seen in treatment of stone disease in anomalous kidneys. In a study in which Sheir et al. [9] transfer their experience of 11 years, SWL is put forth as the primary option for stones smaller than 20mm. In the study of Adel R et al. [10], they conclude that SWL should be the first option for anomalous kidneys.

In the literature, the lowest level of success is 28%, reported by Kirkali et al. [6], but the stone size in this study was larger than 11 mm [6]. Sheir et al. [9] achieved a success level of 71.4% and Adel R et al. [10] had 76.9% success for horseshoe kidney. Kupeli et al. [8] reported their success rate for stones smaller than 20 mm in horseshoe kidney as 68%. The success rate in our study was 52% for stones smaller than 20 mm, and this seems relatively low. But success rates increased as the size of the stones decreased. In our study, the success rate for sizes smaller than 15 mm was 63%.

Among our results, a 90% success rate for size smaller than 10 mm is quite striking. The size, session and shock average in this subgroup were, respectively, 8.3 mm (7-10), 2.55 sessions (1-3), and 1543 shocks (977-2000). Among the main factors affecting the success are application of SWL by an experienced urologist, use of special position [12] and small size stones.

In our study, pelvis stones of 27 and 20 mm in horseshoe kidney were removed after 3and 2 sessions of SWL with 5100 and 2700 shocks. This successful result was beyond expectations, and we think that this may be associated with the composition of the stone. However, we did not have a stone analysis of these two patients. Similarly, we cannot explain the fact that there were no fragments of a pelvis stone of 20 mm from a patient with horseshoe kidney despite SWL application of 3 sessions and 6900 shocks with this stone composition.

The success rate of SWL applied to horseshoe kidney lower calyx stones in this study was 50% (6 kidneys). Two of the horseshoe kidney lower pole stones that were removed after three months were smaller than 10 mm, and another was 15 mm.

The study had begun in 1997. At that time, cut point of 2 cm was not widely acknowledged. More than this there were some publications on SWL treatment in staghorn stones. Upper limits of stone sizes were higher in the present study, so success rates were lower compared to actual results in the literature.

In conclusion, SWL is an efficient and safe treatment method in horseshoe kidney stones. The success rate decreases as the size of the stone increases. However, SWL with its quite high success level and low morbidity should be chosen as the first treatment option for horseshoe kidney stones 10 mm or smaller in size.

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