Responsiveness of lower pole kidney stone less than 15 mm to extracorporeal shockwave lithotripsy (ESWL)

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DEDICATION

To My ...

Parents

Sisters

Friends

Teachers

And

to those who ever support

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ABSTRACT

Objective:The developments in the urological treatments of urinary system stone diseases led to the discussions about the first choice treatment methods. We have evaluated the results of extracorporeal shock wave treatments being applied in our clinics for the lower pole stones which has the most of the discussions.

Methods:The records of 25 stone patients who were applied ESWL according to ultrasound study(US) results between October 2018 and January 2019 to our clinics .In the controls after the procedure, who could not be evaluated with the Ultra sound(US) study or ESWL treatment not completed, were excluded from the study. 20 patients with lower pole stone in total were divided according to the success of the ESWL treatment. ESWL success or unsuccessfulgroups , and the size of the stone, was recorded by examining the US report of the patient.

Results:Of all 20 patients included in the study , 11 of them (55%) were men and 9 of them (45%) were women. The average age was 36.25 (18-60). Among the 20 patients included in the study after ESWL treatment, the stones of the 8 patients (40%) were totally broken and made ineffective and asymptomatic were accepted as response (successful). ESWL treatment was unresponsive (unsuccessful) in 12 patients (60%) in total. The stone size was 9.36 mm (7-12 mm) in average .the number of sessions was 3.6(2-5) in average.

Conclusion:The ESWL treatment is still a noninvasive and successful method for the lower pole kidney stones. While the ESWL success is being determined, the imaging method chosen is important, the use of abdominal CT provides accurate evaluation. The higher success rates of minimal invasive surgery methods is promising and might change the treatment methods in the future.

Key words: Kidney stone, lower pole stone, ESWL, response.

Introduction

Prior to the introduction of extracorporeal shockwave lithotripsy (ESWL) in 1980 [1],stone treatment in some patients has been a matter of controversy for urologists. Complex stones were traditionally removed by surgical intervention [2]. However, the surgical management of urolithiasis has now largely been replaced with a minimal invasive procedure-like extracorporeal shock wave lithotripsy (ESWL) [3]. The introduction of ESWL revolutionized urolithiasis treatment [4],Since then, ESWL has become the preferred tool in the urologist's armamentarium for the treatment of renal stones, proximal stones, and midureteral stones. Compared with open and endoscopic procedures, ESWL is minimally invasive, exposes patients to less anesthesia, and yields equivalent stone-free rates in appropriately selected patients.[1]

The efficacy of ESWL lies in its ability to pulverize calculi in vivo into smaller fragments, which the body can then expulse spontaneously. Shockwaves are generated and then focused onto a point within the body.The shockwaves propagate through the body with negligible dissipation of energy (and therefore damage) owing to the minimal difference in density of the soft tissues. At the stone-fluid interface, the relatively large difference in density, coupled with the concentration of multiple shockwaves in a small area, produces a large dissipation of energy. Via various mechanisms, this energy is then able to overcome the tensile strength of the calculi, leading to fragmentation. Repetition of this process eventually leads to pulverization of the calculi into small fragments (ideally < 1 mm) that the body can pass spontaneously and painlessly.[1]

History of the Procedure :

Evolution of shockwave lithotripters :

The Dornier HM3, originally designed to test supersonic aircraft parts, was the first shockwave lithotriptor introduced in the United States. Despite being somewhat dated, it is still one of the most effective lithotriptors and has become the standard to which other devices are compared. The design of the HM3 is based on an electrohydraulic shockwave generator; the shockwaves are focused via an ellipsoid metal water-filled tube in which both the patient and the generator are submerged. Biplanar fluoroscopy is used for localization, allowing placement of the calculi to be fragmented in the target zone.

Second-generation lithotriptors typically use piezoelectric or electromagnetic generators as the energy source. When coupled with the appropriate focusing device, these shockwave generators commonly have a smaller focal zone. Although a smaller focal zone may minimize damage to the surrounding tissue, this comes at a price. During respiratory excursion, the stone may move in and out of the focal zone; this may compromise fragmentation rates. The coupling device in a second-generation lithotriptor is a silicone-encased water cushion that coapts to the patient, a design that greatly simplifies the positioning of patients.

The newest-generation lithotriptors have been designed to offer greater portability and adaptability. These systems often provide imaging with both fluoroscopy and ultrasonography. The ability to alternate between imaging modalities allows the urologist to compensate for the deficiencies of either system.

Most current lithotriptors are powered by an electromagnetic generator. Electromagnetic generators and their focusing units are capable of delivering shockwaves that are similar in intensity to those of the HM3, but usually to a smaller focal zone. As mentioned above, this has the theoretical advantage of minimizing damage to surrounding soft tissue. However, because of the smaller focal zone, respiration may cause the stone to move out of the target zone for portions of the treatment. Although improved localization techniques and anesthetic manipulation can be used to account for this, the shockwaves applied while the stones are out of the target zone do not cause fragmentation. Thus, certain second- and third-generation machines are associated with higher failure rates, incomplete treatment, and the need for retreatment. [1]

Technical Aspects

All lithotripsy machines share 4 basic components: (1) a shockwave generator, (2) a focusing system, (3) a coupling mechanism, and (4) an imaging/localization unit.

1.Shockwave generator:

Shockwaves can be generated in 1 of 3 ways, as follows:

1.Electrohydraulic: The original method of shockwave generation was electrohydraulic, meaning that the shockwave is produced via spark-gap technology. In an electrohydraulic generator, a high-voltage electrical current passes across a spark-gap electrode located within a water-filled container. The discharge of energy produces a vaporization bubble, which expands and immediately collapses, thus generating a high-energy pressure wave.

2. Piezoelectric: The piezoelectric effect produces electricity via application of mechanical stress. The piezoelectric generator takes advantage of this effect. Piezoelectric ceramics or crystals, set in a water-filled container, are stimulated via high-frequency electrical pulses. The alternating stress/strain changes in the material create ultrasonic vibrations, resulting in the production of a shockwave.

3. Electromagnetic: In an electromagnetic generator, a high voltage is applied to an electromagnetic coil, similar to the effect in a stereo loudspeaker. This coil, either directly or via a secondary coil, induces high-frequency vibration in an adjacent metallic membrane. This vibration is then transferred to a wave-propagating medium (ie, water) to produce shockwaves

2.Focusing systems :

The focusing system is used to direct the generator-produced shockwaves at a focal volume in a synchronous fashion. The basic geometric principle used in most lithotriptors is that of an ellipse. Shockwaves are created at one focal point (F1) and converge at the second focal point (F2). The target zone, or blast path, is the 3-dimensional area at F2, where the shockwaves are concentrated and fragmentation occurs.

Focusing systems differ, depending on the shockwave generator used. Electrohydraulic systems used the principle of the ellipse; a metal ellipsoid directs the energy created from the spark-gap electrode. In piezoelectric systems, ceramic crystals arranged within a hemispherical dish direct the produced energy toward a focal point. In electromagnetic systems, the shockwaves are focused with either an acoustic lens (Siemens system) or a cylindrical reflector (Storz system).

3.Coupling mechanisms :

In the propagation and transmission of a wave, energy is lost at interfaces with differing densities. As such, a coupling system is needed to minimize the dissipation of energy of a shockwave as it traverses the skin surface. The usual medium used is water, as this has a density similar to that of soft tissue and is readily available. In first-generation lithotriptors (Dornier HM3), the patient was placed in a water bath. However, with second- and third-generation lithotriptors, small water-filled drums or cushions with a silicone membrane are used instead of large water baths to provide air-free contact with the patient's skin. This innovation facilitates the treatment of calculi in the kidney or the ureter, often with less anesthesia than that required with the first-generation devices.

4.Localization systems :

Imaging systems are used to localize the stone and to direct the shockwaves onto the calculus, as well as to track the progress of treatment and to make alterations as the stone fragments. The 2 methods commonly used to localize stones include fluoroscopy and ultrasonography.

Fluoroscopy, which is familiar to most urologists, involves ionizing radiation to visualize calculi. As such, fluoroscopy is excellent for detecting and tracking calcified and otherwise radio-opaque stones, both in the kidney and the ureter.

Conversely, it is usually poor for localizing radiolucent stones (eg, uric acid stones). To compensate for this shortcoming, intravenous contrast can be introduced or (more commonly) cannulation of the ureter with a catheter and retrograde instillation of contrast (ie retrograde pyelography) can be performed.

Ultrasonographic localization allows for visualization of both radiopaque and radiolucent renal stones and the real-time monitoring of lithotripsy. Most second-generation lithotriptors can use this imaging modality, which is much less expensive to use than radiographic systems. Although ultrasonography has the advantage of preventing exposure to ionizing radiation, it is technically limited by its ability to visualize ureteral calculi, typically due to interposed air-filled intestinal loops. In particular, smaller stones may be difficult to localize accurately.[1]

Preoperative Details

Several factors related to the stone, including stone burden (size and number), composition, and location, affect the outcome of extracorporeal shockwave lithotripsy (ESWL).

Stone size

As stone size approaches 2 cm, the likelihood of success with ESWL decreases, and the need for retreatment and adjunctive therapy increases. ESWL has also been found to be most efficacious in treating nonobstructing renal calculi. In patients with a large stone burden, pre-ESWL stenting may secure drainage and prevent obstructive urosepsis. A study where stone volume was calculated based on a 3D rendered image corroborated that smaller stones are more likely to fragment than larger stones, with 500 microL as the cutoff.[5]

Stone composition

The density and ability of a stone to resist ESWL is based in part on the composition of the stone. Stones composed of calcium oxalate dihydrate, magnesium ammonium phosphate, or uric acid tend to be softer and to fragment more easily with ESWL. Stones composed of calcium oxalate monohydrate or cystine, on the other hand, are less susceptible to ESWL. To a degree, this can be predicted with CT scanning by measuring the radio-opacity of stones. A recent retrospective study showed that ESWL monotherapy is more likely to be effective against stones with a Hounsfield units [HU] < 815 Hounsfield units [HU]) than those with a higher radio-opacity. .[6]

In addition, certain radiolucent stones (uric acid, indinavir [Crixivan]) are difficult to visualize on fluoroscopy and therefore require either ultrasonography-guided localization or the addition of retrograde or intravenous contr-ast to localize a calculus.

Stone location

Lower-pole calculi: Although ESWL can fragment stones in the lower pole of the kidney, the resulting stone-free rate is decreased because of the difficulty in passing stones from this location. Recent studies have delineated renal morphology associated with improved stone-free rates (eg, lower infundibular length–to–diameter ratio of < 7, lower-pole infundibular diameter of >4 mm, single minor calyx), as well as factors associated with decreased stone-free rates (infundibulopelvic angle of < 70°, an infundibular length of >3 cm, an infundibular width of < 5 mm). Regardless of anatomy, ESWL tends to yield better results in patients with smaller stone burdens.

Calyceal diverticula with infundibular stenosis: In patients with diverticula caused by or related to infundibular stenosis, fragmented stones cannot easily bypass the obstruction, with resultant retained stone fragments. These patients are best served by more invasive techniques that allow the surgeon to address the obstruction and the stones simultaneously, either with retrograde ureteroscopy or in an antegrade percutaneous fashion.

Skin to stone distance

Skin to stone distance, which can be easily measured on CT scan, appears to predict the success of ESWL. Distances reaching greater than 10cm appears to have a negative effect on successful stone treatment. [7,8]

Renal stone disease

Kidney stones (renal lithiasis, nephrolithiasis) are hard deposits made of minerals and salts that form inside your kidneys.[9]

Kidney stones have many causes and can affect any part of your urinary tract — from your kidneys to your bladder. Often, stones form when the urine becomes concentrated, allowing minerals to crystallize and stick together.[9]

Globally, kidney stone disease prevalence and recurrence rates are increasing [10], with limited options of effective drugs. Urolithiasis affects about 12% of the world population at some stage in their lifetime [11].It affects all ages, sexes, and races [12,13]. but occurs more frequently in men than in women within the age of 20–49 years [14].If patients do not apply metaphylaxis, the relapsing rate of secondary stone formations is estimated to be 10–23% per year, 50% in 5–10 years, and 75% in 20 years of the patient [12].However, lifetime recurrence rate is higher in males, although the incidence of nephrolithiasis is growing among females [15].Therefore, prophylactic management is of great importance to manage urolithiasis.

The prevention of renal stone recurrence remains to be a serious problem in human health [16].The prevention of stone recurrence requires better understanding of the mechanisms involved in stone formation [17].Kidney stones have been associated with an increased risk of chronic kidney diseases [18],end-stage renal failure [16,19], cardiovascular diseases [20,21], diabetes, and hypertension [22]. It has been suggested that kidney stone may be a systemic disorder linked to the metabolic syndrome. Nephrolithiasis is responsible for 2 to 3% of end-stage renal cases if it is associated with nephrocalcinosis[23].

The symptoms of kidney stone are related to their location whether it is in the kidney, ureter, or urinary bladder [24].Initially, stone formation does not cause any symptom. Later, signs and symptoms of the stone disease consist of renal colic (intense cramping pain), flank pain (pain in the back side), hematuria (bloody urine), obstructive uropathy (urinary tract disease), urinary tract infections, blockage of urine flow, and hydronephrosis (dilation of the kidney). These conditions may result in nausea and vomiting with associated suffering from the stone event [25].Thus, the treatment and time lost from work involves substantial cost imposing an impact on the quality of life and nation's economy.

Risk factors for having kidney stone include crystallurea, dehydration, family or personal history, climate, certain diet(that contain high salts, protein and sugar), being obese ,digestive disease and surgery(gastric bypass surgery, inflammatory bowel disease and chronic diarrhea), and other medical conditions such as renal tubular acidosis , cystinuria, hyperparathyroidism and some urinary tract infections. [9,26].

Types of kidney stones include:

- Calcium stones. Most kidney stones are calcium stones, usually in the form of calcium oxalate. Oxalate is a naturally occurring substance found in food and is also made daily by your liver. Some fruits and vegetables, as well as nuts and chocolate, have high oxalate content.

  Dietary factors, high doses of vitamin D, intestinal bypass surgery and several metabolic disorders can increase the concentration of calcium or oxalate in urine.

  Calcium stones may also occur in the form of calcium phosphate. This type of stone is more common in metabolic conditions, such as renal tubular acidosis. It may also be associated with certain migraine headaches or with taking certain seizure medications, such as topiramate (Topamax).

- Struvite stones. (ammonium magnesium phosphate stone). Struvite stones form in response to an infection, such as a urinary tract infection. These stones can grow quickly and become quite large, sometimes with few symptoms or little warning.
- Uric acid stones. Uric acid stones can form in people who don't drink enough fluids or who lose too much fluid, those who eat a high-protein diet, and those who have gout. Certain genetic factors also may increase your risk of uric acid stones.
- Cystine stones. These stones form in people with a hereditary disorder that causes the kidneys to excrete too much of certain amino acids (cystinuria). [9]

Management of kidney stone:

Management of stone disease needs individualization. Clinical presentation, proper history, and laboratory tests help to identify whether one needs urgent surgical or medical treatment.

1. Medical management : is indicated for clinically stable patients with non-obstructive urinary stones, recurrent stone formers, and the patients with underlying systemic diseases.

Medical treatment of kidney stones includes dietary management, disease-specific therapies, and medical expulsion therapy (MET) of stones.

Dietary management:Fluid intake and dietary changes are important measures in preventing recurrence of kidney stones. Many trials have shown that increasing urine volume to at least 2 L/day OR 2 lit/day can reduce the recurrence of stone disease by up to 40–50%.[27],Fluid intake mainly should include water. As tea and coffee contain oxalate, milk (which binds free oxalate) should be added to them. However, increasing the urine volume has a disadvantage of reducing urinary citrate.

Stone-specific therapies:

Calcium oxalate stones

In patients with idiopathic hypercalciuria, thiazide diuretics have shown to reduce the recurrence rates by up to 70%.[27],It is the only medical therapy directed at reducing urinary calcium[28],Citrate supplements as detailed earlier are useful. Pyridoxine sometimes can be useful in patients with primary hyperoxaluria, but not in idiopathic hyperoxaluria[29],*Oxalobacterformigenes* is an oxalate degrading bacterium found in human gastrointestinal tract. It is thought that increased colonization of the gut might lead to decreased absorption of dietary oxalate and decrease in urinary oxalate excretion. Colonization with *O.*

*formigenes*showed benefit in uncontrolled studies;[30-31],however, a prospective, randomized, placebo control, double-blind trial refuted such benefits.[32]

Uric acid stones

The aim of treatment in uric acid stones is to increase the solubility of uric acid in urine. It is achieved by increasing the urine volume and by alkali therapy. Allopurinol is a useful adjunct to the therapy.

Struvite stones

Struvite stones form in alkaline urine from infection with urea-splitting microorganisms. Antibiotics are the mainstay of the therapy with occasional use of acetohydroxamic acid.[29]

Cystine stones

This is a rare stone type. The aim of treatment is to reduce the concentration of free cystine and increase its solubility in urine. A high fluid intake up to 4-5 L/day and alkalinization of urine with target urine pH >7 is desirable. Chelating agents like D-penicillamine or tiopronin are indicated when 24-hour urine cystine concentration exceeds 2000 µmol/l.[29]

2.Extracorporeal shock wave lithotripsy (ESWL):revolutionized the treatment of urolithiasis and gradually became the favorite treatment option so that today it is considered to be the first line of treatment for more than 75% of the patients with urolithiasis

The American Urological Association Stone Guidelines Panel has classified ESWL as a potential first-line treatment for ureteral and renal stones smaller than 2 cm.[1]

Indications for ESWL include the following:

1.Individuals who work in professions in which unexpected symptoms of stone passage may prompt dangerous situations (eg, pilots, military personnel, physicians) (In such individuals, definitive management is preferred to prevent adverse outcomes.)

2.Individuals with solitary kidneys in whom attempted conservative

management and spontaneous passage of the stone may lead to an anuric state

3.Patients with hypertension, diabetes, or other medical conditions that predispose to renal insufficiency .

Contraindications:

Absolute contraindications to extracorporeal shockwave lithotripsy (ESWL) include the following:

1.Acute urinary tract infection or urosepsis.

2.Uncorrected bleeding disorders or coagulopathies.

3.Pregnancy.

4.Uncorrected obstruction distal to the stone.

Relative contraindications include the following:

1.Body habitus: Morbid obesity and orthopedic or spinal deformities may complicate or prevent proper positioning.

2.Uncontrolledhypertention.

3.Renal ectopy or malformations (eg, horseshoe kidneys and pelvic kidneys)Complex intrarenal drainage (eg, infundibular stenosis).[1]

3.PercutaneousNephrolithotomy:

Percutaneous removal of renal and proximal ureteral calculiis the treatment of choice for large (>2.5 cm) calculi; thoseresistant to SWL; select lower pole calyceal stones with a narrow,long infundibulum and an acute infundibulopelvic angle; and instances with evidence of obstruction; themethod can rapidly establish a stone-free status.[26]

4. Open surgery : Open stone surgery is the historic way to remove calculi, it is rarely used today. The morbidity of the incision, the possibility of retained stone fragments, and the ease and successof less invasive techniques have made these procedures rare.[26]

Aim of this study :

To evaluate the responsiveness of lower pole kidney stone to multiple sessions of ESWL as non-invasive therapy .

Patients and Methods

1.Settingand duration :

The study was conducted over a period from the beginning of October 2018 to the January 2019 atAl-immamainal-kadhimain teaching hospital / Baghdad.

2. Study design and sampling technique

To achieve the aim of the present study, a cohort study was adopted. And convenient sample of the patients at Al-immamainal-kadhimain teaching hospital.

3.Thequestionnaire:

The required data were collected from the patients by the researcher through the use of semi constructed questionnaire , which included the following information:

-Demographic data (name, gender, age, residence). -

-Presenting clinical features of kidney stone

- Previous history of kidney stone disease , previous treatment with ESWL , and its response.

- Family history of kidney stone disease (hereditary one).

- Stone size.

Inclusion criteria : adults patients with lower pole kidney stone who attend Al-immamain al-kadhemian teaching hospital / ESWL unit .

Exclusion criteria

1. stone size larger than 15 mm
2. History of hereditary renal stone disease .
3. cystineor calcium carbonates stones.
4. old age people (>60 years old)
5. Contraindication for ESWL such as bleeding disorder or urinary tract congenital anomalies.

Definition of some variables :

Response : complete clearance of stone.

4. Data collection :

Data were collected depending on direct interviewing for each participants those presented with lower kidney stone , in ESWL unit , and selected according to stone size that reported in ultrasound report .

The researcher had made regular visits to ESWL unit for data collection in a system of 1-2 hours per day , 3-5 days per week , and for three months.

The records of 25 stone patients with lower kidney stone who were applied ESWL according to US results between October 2018 and January 2019 to our clinics were examined .In the controls after the procedure, who could not be evaluated with the Ultra sound(US) study or ESWL treatment not completed, were excluded from the study.20 patients with lower pole stones, who were included in the study, were divided into two groups according to the success of ESWL treatment. The stone size recorded by ultra sound report in patients included in successful and unsuccessful ESWL groups. All patients were administered with routine 75 mg diclofenac sodium(voltaren) I.M or 100 mg Tramadol HCLI.M before the procedure. Average of 3 sessions were applied for each patient, two week break was taken between each session. Before each session, the final state of the stone was reviewed with direct urinary system graphy (DUSG), DUSG was taken after the last session and the results were recorded by evaluating with ultrasound approximately after the finishing of third session.

5- statistical analysis :

Data was translate into a computerized data base structure. Statistical analysis was done by using SPSS (statistical package for social science) version 20. computer software and Microsoft office ward 2007 was used in present study.

The following measurements and percentage for studied variables.

1.Mean foe the age of patients and for stone size.

2.chi square test for the association studied qualitative variables.

A level of significance of p value < 0,05 was considered as statistically significant.

4- Ethical considerations:

1.After brief explanation of the general purpose of the study and its objectives ; oral consent was obtained from each participants.

2.Permission was obtained from center where information gathering from it.

5- Limitation of the study:

1.The sample size was small.

2.There is shortage time for data collection.

RESULTS

Totally 11 of the patients (55%) included in the study were men and 9 of them (45%) were women (figure 1). The average age was 36.25 (18-60). Among the 20 patients included in the study after ESWL treatment, the stones of the 8 patients (40%) were totally broken and made ineffective and asymptomatic were accepted as response(successful). ESWL treatment was unresponsive(unsuccessful) in 12 patients (60%) in total (figure 2). The stone size was 9.36 mm (7-12 mm) in average .the number of sessions was 3.6(2-5) in average.

We did not determine any statistically significance neither between age and response (table 1) nor between stone size and response (table 2).

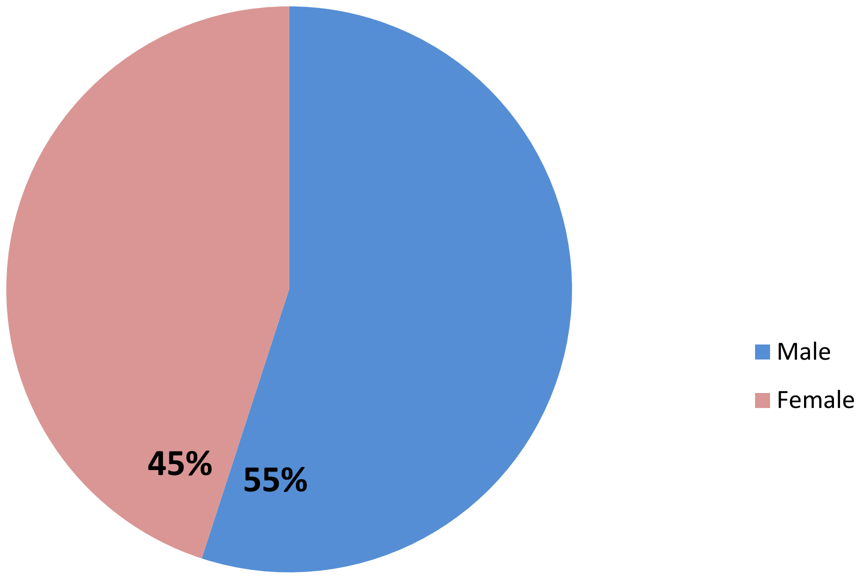

figure 1: Distribution of patients according to gender

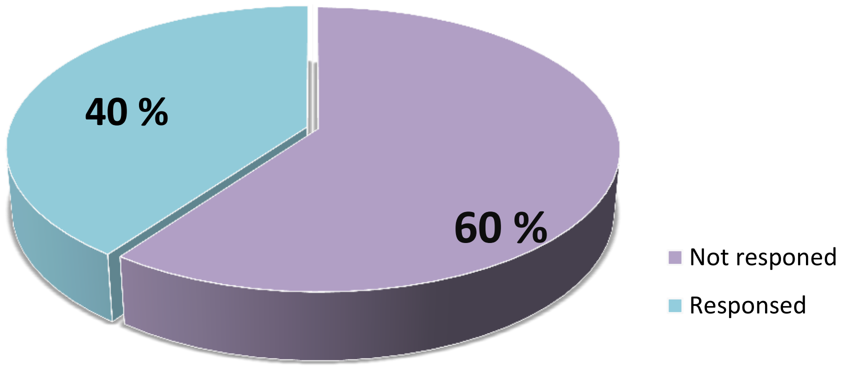

figure 2: total response and non-rspones percentage

Table 1:Results of the statistical analysis according to the agebetween Successful and Unsuccessful ESWL groups

age Response	Age > 30 years old	Age ≤ 30	Total	Level of significance at p value (0.05)
Response, n (%)	7 (35%)	1 (5%)	8 (40%)	
Non response, n (%)	7 (35%)	5 (25%)	12 (60%)	
Total	14	6	20	1.94

Table 2:Results of the statistical analysis according to the stonesize between Successful and Unsuccessful ESWL groups.

Stone size (ss) Response	SS ≤ 10mm	SS>10mm	Total	Level of significance at p value (0.05)
Response, n (%)	6 (30%)	2 (10%)	8 (40%)	
Non response,n (%)	11 (55%)	1 (5%)	12 (60%)	
Total	17	3	20	1.03

DISCUSSION :

Different success rates are being stated in the ESWL treatments of lower pole kidney stones. The success rates ranging from 30% to 70% were reports in various studies.

In our study, success rate of ESWL therapy in lower pole stones was determined as 40% which is similar to Pearle et al. [33], Deem et al. [34] , Süelözgen et al. [35] in which the results were 35 %, 33% , 46% respectively. while the results ofDavarcı et al. [36], Turna et al. [37], Danuser et al.[38]; were 52.4% , 67.5% , 68% respectively, which is higer rates than our results .

In general, besides the stone size, density and stone-skin distance affecting the success of ESWL, the parameters such as the straight infundibulum-pelvic angle, long calyx (above 10 mm), narrow infundibulum (below 5 mm) for the lower pole stones were reported as effective [39,40] .

We think that making the final control made after ESWL with the direct graphy or ultrasound might affect the success rates. In the literature, the final controls were revealed with only the direct graphies for the stone free rates [37, 38].

the residual stones smaller than 5 mm were only determined by ultrasonography . No significant opacity was demonstrated when the direct graphies of those patients were analyzed retrospectively after the sessions.

In the literature, the studies in which the controls after ESWL is being done with the non-contrast abdominal CT have similar rates (Deem 33%, Pearle 35%) and they have similar rates with our studies [33,34]. We think that another issue to be discussed should be which imaging technique will be used as the final control at the end of the ESWL sessions.

The success of ESWL treatment in lower pole stone is limited. Demand for a greater success and the rapid developments in urology made the comparison of minimal invasive surgeries (Retrograde intrarenal surgery (RIRS) percutaneous nephrolithotomy (PNL)) with the ESWL a current issue [39].Although there are no studies conducted with a large patients group, RIRS success is approximately two times higher as compared to ESWL [33,41,42]. Tepeler et al. reported the micro pnl as an alternative method in the treatment of the lower pole stones in their studies [43].the discussions for the ideal treatment method for the lower pole stones are still continuing. The disadvantages of the newly defined minimal invasive surgical methods are the anesthesia requirement and surgical complications [33]. ESWL might still be preferred as the first treatment since it is especially noninvasive, it does not require anesthesia and it has low complication rates. As a result, the follow up in the treatment of isolated lower pole stone should be evaluated with the ESWL and minimal invasive surgery options.

Although there is no exact opinion about the quantity of the total shock wave number, there are studies indicating that the less shock waves, espe¬cially per session, decrease the renal damage and also that the ESWL treatment applied slowly both decreases the renal damage and increase the stone breaking success [44,45]. However, in the studies conducted on ESWL success in lower pole stones how many stone breaking sessions were applied, the total shock waves per sessions, the power and the frequency were not indicated. Thus, while ex¬amining the different success rates for the similar sized stones, a healthier comment might be made by knowing the ESWL application details better.

Conclusion :

The responsiveness rate of multiple sessions of ESWL as minimally invasive therapy in the treatment of patients with lower pole kidney stone is slightly low , so we cannot depend on ESWL as definitive therapy for lower pole kidney stone,although,nowadays, ESWL treatment is still being preferred as a noninvasive and successful method in the treatment of lower pole stones. While the ESWL success is being determined, the imaging method chosen is important, the use of abdominal CT provides accurate evaluation. The higher success rates of minimal invasive surgery methods is promising and might change the treatment methods in the future

Recommendations :

Larger sample size and multi-centric approach ,over longer period are recommended to future confirmation of the result with prospective design .

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