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Original Research Article

Extracorporeal Shockwave Lithotripsy Vs Urerteroscopy in The Treatment of Upper Ureteric Stones

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Abstract

There are two main options for the intervention which are usually used for the treatment of calculi in the upper ureters and these are: extra corporeal shock wave lithotripsy (ESWL) and the lithotripsy by ureteroscope.
Till now,there is controversy regarding which method is the most optimum in the treatment of calculi in the upper ureters.
In this study we try to compare both modalities of treatment and which option consider the first-line treatment for upper ureteric calculi.From Jan. 2013 to Jan. 2014,one handered patients (54 males and 46 females) with single, unilateral upper ureteric stone size from (6-18 mm) treated in Al hilla teaching hospital are included in this randomized prospective study.
The choice certain method for treatment was based on the clinical state of the patients and patients' choice.
Fifty (31 males and 19 females) patients are treated by ESWL, while the other fifty (23 males and 27 females) patients treated by ureteroscopy.
Patients treated with ESWL achieved a 80% overall SFR with a 30 % auxiliary procedure rate. While Complications occur in 8% of cases who are treated by ESWL.
Regarding group of patients treated with URS had a 92% SFR with an additional procedure rate of 28% While Complications occur in 18% of patients treated with ureteroscopy. (For ESWL group, the need of auxiliary procedures and complication rate are more common where stone size >1cm.
Where as in ureteroscope group, the need of auxiliary procedures are higher for those with stone size<1cm. but the complication rate is still higher in patients with stone size >1cm.
So in the urological centers in which both modalities of treatment are present, ESWL is the preferable option for treatment of patients with single upper stone in the upper ureterof ≤1 cm while ureteroscopy used for patients had stones of >1 cm.

Key Words: ESWL: Extracorporial Shock Waves Lithotripsy, Ureteroscopy.

الخلاصة

هنالك خياران رئيسيان للتداخل الجراحي في علاج حصى أعلى الحالب وهما: تفتيت الحصى بموجات الصدمةالخارجيةوالمتولدة من جهاز تفتيت الحصى والخيار الثاني هو استعمال ناظور الحالب وتفتيت الحصى بأجهزة تفتيت داخليه.لايوجد أتفاق حول أي الطريقتين هي الأفضل والأكثر مثالية في علاج حصى أعلى الحالب.

في الدراسة الحاليةأجريت مقارنة بين كلتا الطريقتين اعتمادا على نسب النجاح لكل طريقة ونسب استخدام طرق وتقنيات أضافيه في العلاج بالنسبة لكل طريقة والتعقيدات الناجمة عن كل طريقة.مئة مريض(54 ذكر و 46 انثى) تمت معالجتهم في مستشفى الحلة التعليمي للفترة من كانون الثاني 2013م الى كانون الثاني 2014م لوجود حصى في أحد الحالبين حجمها يتراوح بين(6–18) ملم.

اختيار اي طريقه للعلاج يعتمد على الحالةالصحية للمريض وعلى رغبة المريض.50 مريض تم علاجهم بجهاز تفتيت الحصى بموجات الصدمةالخارجية بينما 50 مريض اخرين تم علاجهم بواسطة ناظور الحالب والتفتيت الداخلي وتم مقارنة نتائج المجموعتين اعتمادا على نسب النجاح ونسب الاحتياج الى طرق اضافيه لاكمال العلاج وعلى التعقيدات الحاصلة مع كل طريقة علاج.

بالنسبة الى مجموعة المرضى المعالجين بجهاز تفتيت الحصى من خارج الجسم فان نسبة النجاح كانت (80%) والحاجة الى طرق اضافيه لاكمال التفتيت والعلاج في (30%) من الحالات أما نسبة التعقيدات كانت (8%) وتشمل ألم او تبول دموي غير مستجيب للعلاج أو التهاب حوض الكلية.

بينما مجموعة المرضى المعالجين بناظور الحالب والتفتيت الداخلي فكانت نسبة النجاح (92%) ونسبة الحاجه الى طرق اضافيه هي (28%) أما التعقيدات الحاصلة مع ناظور الحالب فكانت نسبتها (18%) وتزداد التعقيدات والحاجه الى طرق اضافيه للعلا ج عندما يكون حجم الحصاة أقل من 10 ملم. وبصورة عامة فانه في مراكز الجراحة البولية تتوافر طريقتين من العلاج، وعادة يفضل استخدام جهاز التفتيت الخارجي لحصى الحالب ذات حجم أقل من 10 ملم بينما يفضل استخدام ناظور الحالب والتفتيت الداخلي لحصى الحالب ذات حجم اكبر من 10ملم.

الكلمات المفتاحية: جهاز تفتيت الحصى بموجات الصدمة من خارج الجسم, ناظور الحالب , علاج حصى الحالب.

Introduction

Urinary stones are the third most common pathology of the urinary tract, preceded by urinary tract infections and diseases of the prostate [1].

The majority of ureteral stones pass spontaneously and do not require intervention (expectant treatment)[1].

The passage of ureteric stones by expectant treatment depends on the site of the stone in the ureter, its size ,shape and associated edema of the ureteric wall (which is mostly related to the time length that a stone has been impacted in that site) [1].

Studies show that ureteral stones of 4–5 mm in size have a 40–50%chance of spontaneous passage whereas stones>6 mmhave a <5% chance of passage with expectant treatment[1].

This not a role and not mean that any stone of 1 cm. will never passed or astone of 1-2 mm. will always pass uneventfully [1].

Most of stones that pass spontaneously do so within a period of 6 weeks after the onset of symptoms [1].

Stones that remain in the same site of the ureter for more than 2 months is called impacted stone which not pass spontaneously and need intervention [1].

There is controversy regarding which option is consider the optimal treatment for stones in the upper ureters[1-3].

The available options are expectant treatment withfollow-up therapy, treatment with extracorporeal shock wave lithotripsy (ESWL), lithotripsy with ureteroscope (URS) or open surgery (ureterolithotomy) [1].

At time being, treatment with ESWL and lithotripsy by ureteroscope are the most common treatment methods used for the cases where stones cannot pass spontaneously and for cases where intervention is indicated rapidly [2,3].

Most of the urologist are familiar with both ureteroscope and ESWL in addition they have minimal adverse effects[2,3,4].

In general, both ESWL and URS have advantages anddisadvantages.

However, many researchers studied lower ureteral stones[2, 3,4-13] and only few studies dealt with stones in the upper ureters[5,14,15].

In this research, we try to compare the results of treatment with URS and ESWL for upper ureteral calculi.

Extracorporeal shock wave lithotripsy made a revolution in the strategy of treatment of urinary calculi[1].

Usingshock waves for fragmenting stones started as a concept firstly in the 1950sin Russia [1].

This concept remain dormant until a German aircraft corporation (Dornier) who rediscovered that these shock waves which can be generated by passing debris in the atmosphere capable for cracking and brokensomething that is hardduring the investigation ofpitting on supersonic aircraft [1].

In general, there are 2 basic types of shock wave sources: the supersonic and the finite amplitude emitters.

Supersonic emitters act y delivering energy in a limited space, and thereby causing expanding plasma lead to acoustic shock wave.

While Finite amplitude emitters, generate pulsatile acoustic shock waves by electrical discharge which displaced a surface creating shock waves.

The piezoceramic and electromagnetic are the two major types of finite amplitude emitters. The piezoceramic type used electrical discharge to activate and elongate the ceramic component of the device like that of displaced surface causing shock waves.While the concept of Electromagnetic systems likes that ofstereo speaker system.

An electrical discharge to a slab, adjacent to an insulating foil, creates an electric current that repulses a metal membrane,displacing it and there by generating an acoustic pulse intoan adjacent medium.

The waves which are generated by any of the previous methods must be focused and directed toward the stone to be cracked and broken [1].

Ureteroscope is highly effective for treatment of stones in the lower ureter [1].

With developing of urological instruments make the urologist use small-caliber ureteroscopes and balloon dilation and ureteral access sheaths to increase the success rate of ureteroscopic lithotripsy and decrease complications.

Studies show that the stone-free rates for ureteroscopic stone extraction ranging from 66% to 100% which dependent on the stone size, site, length of impaction time, any history of retroperitoneal surgery, and the experience of the urosurgeon [1].

While the complication rates is (5% - 30%) and the higher rate when ureteroscope introduce into the proximal part of the ureter.

Ureteral stricture occur in less than 5%.

While vesicoureteral reflux is extremely rare postoperatively in the majority of studies.

By ureteroscope with the aid of round wire stone basket, the urosurgeon can remove ureteral stones that measure <8mm. intact[1].

These instruments if used with forcein the ureter may result in injury of the ureter.

A different types of lithotrities can be used through the ureteroscope, including electrohydraulic, solid and hollow-core ultrasonic probes, a variety of laser systems, and pneumatic systems such as the Swiss litho last [1].

The electrohydraulic lithotrities act through the formation of cavitation bubble (from the high power setting about 120 V) which then collapsed resulting in cracking and subsequent destruction of the stones.

During the use of electrohydraulic lithotrities, we must keep the tip of the electrode away from nearby tissues to prevent their injuries.

While the ultrasonic lithotrities use a piezoceramic energy source which converts the electrical energy into ultrasonic waves in the range of 25,000 Hz.

This ultrasonic waves cause vibratory action which used effectively to crack and broke calculi.

The hollow probes with the ultrasonic lithotrities can use for suction stone fragments and debris simultaneously.

Lasers lithotrities can be used through flexible and rigid endoscopes.

The holmium:YAG system is used with excellent results in fragmentation of calculi.

The electromechanical (pneumatic) lithotrities act similar to jackhammers with a movable piston-like tip that crake calculi lead to their destruction.[1].

Materials and Methods

From Jan. 2013 to Jan. 2015,one hundred patients(54 males and 46 females) with single,unilateral upper ureteric stone size from (8-16 mm) are included in this randomized prospective study.

Patients with lower and midureteric stone, those with bilateral ureteric stones and those with compromise renal function (uremic or azotemic patients) are excluded from the study to decrease biases.

All patients are evaluated pre-operatively by ultrasonography and K.U.B. radiography and sometimes native helical CT-scan to ensure the diagnosis and to localize the stones.

Also pre-operative urinalysis and renal function tests were done for all patients and patients with symptomatic urinary tract infection were treated pre operatively.
Fifty patient (31 males and 19 females) had been treated with ESWL while other fifty patient (27 males and 23 females) had been treated with ureteroscopy.
Patients who are treated with ESWL using Modulith SLX lithotripter, without need for any type of anesthesia , and in the secession we gave 3000-4000 shock waves , with duration of treatment secession from 25-35 minutes and discharge few hours later.
Patients who are treated with ureteroscopy using rigid type, under general anesthesia with the use of pneumatic lithotrite and the duration of operations lasts from 40-90 minutes, the stay in the hospital from 2-4 days.
Patients were fallowed for period ranging from 14-30 days and fallow up included urinalysis, imaging studies (ultrasonography and in some cases native abdominal CT–scan) and other investigations according to the patient clinical condition.
The two groups of patients were compared regarding success rate (stone free rate), need of auxiliary procedures, and complications rate.
Data analysis by meta-analysis and p-value<0.05 consider significant and p-value<0.001 consider highly significant.

Results and Discussion

1- Success rate (stone free):
In our study, we use ESWL as treatment method for 50 Patients (31 male and 19 females) and success occur in 40 patients (29 male and 11 females) withsuccess rate (rate of stone free) 80%. As shown in table (1)
Those 10 patients (2 males and 8 females) in whom ESWL failed to achieve stone free are as fallow: (as shown in diagram 1)
Six of those patients (1 male and 5 females) are very obese .
Two patients (2 females) stop the secession before complete 3000 shock waves because of pain while the other 2 patients may be due to the type of stone or other causes.
While the group of patients who are treated with uretroscopy were 50 patients also (27 males and 23 females) and success occur in 46 patients (24 male and 22 females) with percentage of 92%.
Tow of patients whom ureteroscopy failed to achieve stone free are because the site of the stone cannot be reached by the rigid ureteroscope either because the ureteric orifice not identified (1 patients) or injury to the ureter make ureterscopy cannot be completed (1 patients) while the other 2 patients stone migration occur as shown in diagram (2).
Although these results show higher success rate for group of patients treated with ureteroscopy 92% than those who are treated with ESWL 80% but these percentage are lower than those in references which appear that the success rate for ESWL is 85-90% and for ureteroscopy 98-99% and these may be due to:
1. The type and version of the ESWL device used in our hospital.
2. the selection of patients for ESWL since very obese patients with high BMI (body mass index) should treated with ureteroscopy rather than ESWL.
3. The type of intra corporeal stone destruction in ureteroscopy is electro hydrolic while laser or ultrasonic probe are not available.
Also the P-value for the difference in the success rate between both modalities of treatment is (0.084) which is not significant.

Table 1: success rate of ESWL versus ureteroscopy in treatment of upper ureteric calculi

Method of treatment	No. of patients	Success	Failed	%
ESWL	50	40	10	80%
Ureteroscopy	50	46	4	92%

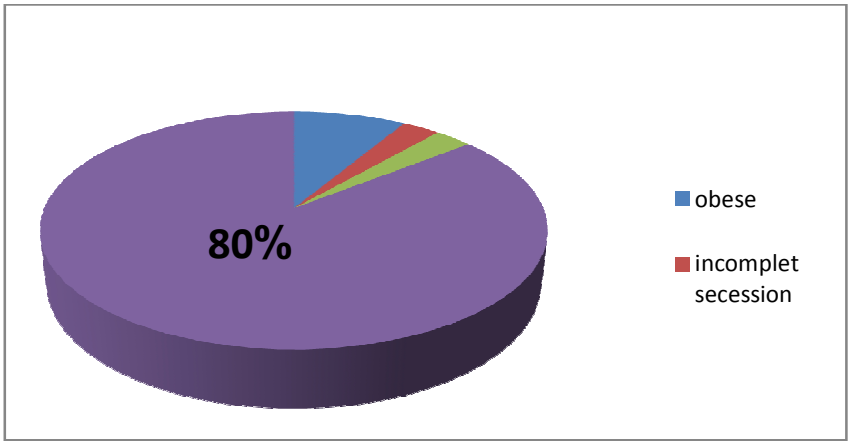

Figure 1: success and failure causes percentage for patients treated with ESWL.

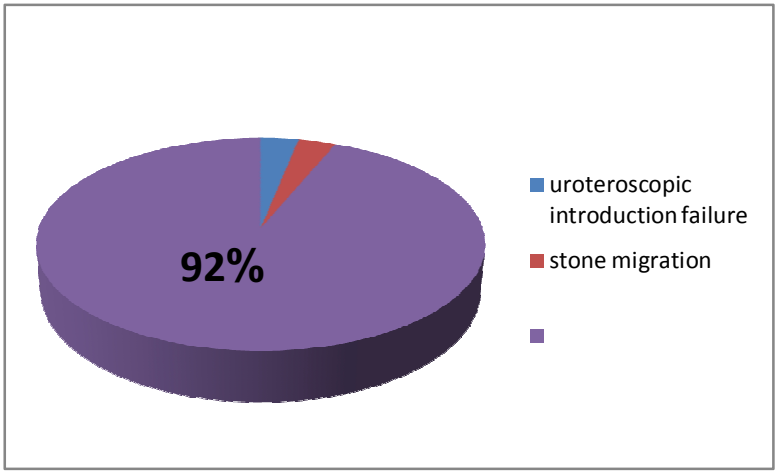

Figure 2: Success and failure causes for patients treated with ureteroscopy.

also 8/10 of the failed ESWL treatment have large sizes stones (> 1cm) while those with failed ureteroscopic treatment due to migration of stones have small sizes stones (< 1cm).

2- The need of auxiliary procedures:

For group of patients treated with ESWL , auxiliary procedures done for 15 patients (30%) this include retreatment with ESWL in 4 patients (8%) and double–J placement in 1 patients (2%) while re-treatment with ureteroscope in 10 patients (20%).

While for patients treated with ureteroscopy, auxiliary procedures need for 14 patients (28%) which include double-J placement in 10 patients (20%) and re-treatment with either ESWL or open surgery in 4 patients (8%).

This is shown in table (3) also in figures (3) and (4).

Table 3: Need of auxiliary procedures in ESWL and ureteroscope groups

Method of treatment	No. of patient	Need auxiliary procedures	%
ESWL	50	15	30%
Ureteroscope	50	14	28%

As clear, there is no significant difference between the need of auxiliary procedures for both modalities of treatment with P-value of (0.137).

Most of the auxiliary procedures for patients treated with ESWL are re treatment with ESWL (2^{nd} secession) while most of the auxiliary procedures for the group who treated with ureteroscopic lithotripsy are double J stent placement.

This means thatmore invasive auxiliary procedures may be needed in the patients who are treated with ureterscopy.

3- Complications:

For the group of patients who are treated with ESWL, complications occur in 4 patients (8%) these complications include (2 patients with refractory pain, 1 patient with refractory hemorrhage and 1 patient with acute pyelonephritis).

While for those who are treated with ureteroscopic lithotripsy,complication occur in 9 patients (18 %) which include (ascending UTI in 6 patients , while 2 patients present with complications related to anesthesia as pneumonia and 1 patient develop refractory hematuria).

The complications of both modalities showed in table (4):

Table 4: the complication rate for ESWL and ureteroscopiclithotripsy

Method of treatment	No. of patients	Complications	%
ESWL	50	4	8%
Ureteroscopic lithotripsy	50	9	18%

There is insignificant difference between complication rates for both modalities with P-value of (0.826).

This higher complication rate in the group of patients who are treated with ureteroscopic lithotripsy may due to the more invasiveness of the procedure and the effectiveness of the sterilization of the ureteroscope and the complications of general anesthesia which is not required for ESWL.

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