EXTRACORPOREAL SHOCKWAVE LITHOTRIPSY VERSUS LASER LITHOTRIPSY BY SEMIRIGID URETEROSCOPE IN TREATMENT OF UPPER URETERAL STONES

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Abstract

Background and aim: Aim of this study was to compare the efficacy and complications of transurethral lithotripsy (TUL) by semirigid ureteroscope and Holmium laser versus extracorporeal shockwave lithotripsy (ESWL) in treatment of radiopaque upper ureteral stones.

Materials and methods: In this randomized clinical trial, 59 patients with upper ureteral stones with size of 5-15 mm candidate for lithotripsy, after taking informed consent form and approval of ethics committee, randomly assigned in two groups. In the first group, ESWL was done in supine position using Dornier Delta 2 machine with ultrasound Shockwaves via standard methods. In second group, after Anesthesia by standard methods, patients were placed in lithotomy position and lithotripsy was done by semirigid ureteroscope (Wolf 6-8 F) and Holmium laser (Auriga) by standard methods. In both groups, two weeks post-operation, the patients visited again and a KUB with ultrasonography was done for efficacy of the operation and complications and results were checked and analyzed by SPSS software version 15 and statistical tests.

Results: The mean age of patients in ESWL and Ureteroscopic groups were 43.7 ± 15.5 and 45.25 ± 14.5 years respectively (p>0.05). The mean size of stones in two groups was 11.85 ± 3.7 and 10.44 ± 2.8 mm respectively (p>0.05). Complete efficacy (clearance of stones or residual stones less than 4 mm) in ESWL and semirigid ureteroscope were 87.5% and 85% respectively (p>0.05). Regarding complications, there was no significant difference between two groups.

Conclusion: transurethral lithotripsy by semirigidureteroscopy with Holmium laser has similar efficacy with ESWL in treatment of upper ureteral stones and this modality can be used as an alternative and efficient option in treatment of upper ureteral stones.

Keywords: ureteral stone, treatment, ESWL, ureteroscope, laser.

Introduction

Urinary stones are common in all societies\(^{(1)}\). Moreover, after urinary tract infection and prostatic disease, the urinary tract stone is the third common disease of the urinary system\(^{(2)}\). The prevalence of urinary stones is about 5-10% and its prevalence in men is more than women. Its recurrence is about 40-50% in a 5 year period. Prevalence of urinary stone in the last decade has increased\(^{(3-4)}\). Different reasons are known for stone formation such as inheritance, nutrition, metabolic disorders, geographic area and different infectious diseases\(^{(5)}\).

Treatment of urinary stones is highly dependent on their size and locations. The stones smaller than 5-6 mm which are seen in 50-60% of cases usually pass spontaneously, but stones larger than 6 mm often require Lithotripsy procedures such as ESWL, PCNL (percutaneous nephrolithotomy) and TUL\(^{(1,5-7)}\). The success rate of ESWL in one study for clearance of stones has been 95% in stones less than 1 cm and 88% in 1-2 cm stones of lower pole\(^{(5,7)}\).

Although the treatment of choice for proximal ureteral stones under 15 mm is ESWL, but nonopaque stones and hard stones such as calcium oxalate monohydrate and Cystinestones, and also in
fatty patients, its success rate is low\textsuperscript{(8-10)}. On the other hand, according to recent studies, transurethral lithotripsy with Holmium laser has high success rates in treatment of different stones, and has low complications\textsuperscript{(6,9)}. The semirigid and rigid ureteroscope have ability of tracing stone and crushing it in all part of ureter with high efficacy and low complication and wide working field without need to fluoroscopy in comparison to flexible ureteroscope\textsuperscript{(11-14)}. The aim of present study was to compare the efficacy and complication of this technique versus ESWL in treatment of upper ureteral stones.

Materials and methods

In the present study, from March 2013 to 2015 fifty nine (59) patients with radiopaque upper ureteral stones that confirmed by KUB and ultrasonography with size of 5-15 mm referred to Shahid Beheshti Hospital of Yasuj, Iran, that were candidate for Lithotripsy. First, after taking informed consent form and obtaining the approval of the ethics committee, the participants were randomly assigned into two groups. Patients with uncontrolled coagulopathy and hypertension, urosepsis, azotemia, pregnancy and ASA class 3 or more excluded from study. In the first group, lithotripsy was done in supine position using Dornier delta 2 machine with Shock Waves by standard methods. Lithotripsy started with 12 KW voltages and in 10 minutes increased to 18 KW and in maximum it continued to 3500 shockwave. After the intervention, patients were observed for two hours, then in the absence of any side effects or complications patients were discharged with medication. The patients visited two weeks later and KUB and ultrasonography were done and the success of lithotripsy according to the change of stone size was measured and recorded.

In failure of ESWL patients were treated by semirigid ureteroscope and holmium laser again. In the second group, after anesthesia of the patient by applying standard methods, they were placed in lithotomy position and TUL was conducted with semirigid ureteroscope (Wolf 6-8 F) and Holmium laser (Auria- 600 µ fiber) by standard methods. If the stone migrates to the kidney a JJ stent was inserted and after retreatment by ESWL JJ stent removed during one month later. After operation, patients were admitted in the hospital. In the absence of any complications, the patients were discharged with medication and out patient follow up. In both groups, two weeks post-operative patients visited again and a KUB with ultrasonography was done for efficacy of operation and complications and results again checked and data were recorded and analyzed by SPSS version 15 and statistical tests such as chi-square and t-test.

Results

In the present study, the mean age of patients in two groups were 43.7 ± 15.5 and 45.25 ± 14.5 years respectively, no significant difference was observed ($p>$0.05). The mean size of stones in ESWL group was 11.85 ± 3.7 and in group 2 (ureteroscopy) it was 10.44 ± 2.8 mm, which no meaningful difference was also observed between them (Table 1).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Variables</th>
<th>Group 1 (ESWL)</th>
<th>Group 2 (Ureteroscope and laser)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td></td>
<td>32</td>
<td>27</td>
<td>NS</td>
</tr>
<tr>
<td>Mean age (year)</td>
<td></td>
<td>43.7 ± 15.5</td>
<td>45.25 ± 14.5</td>
<td>NS</td>
</tr>
<tr>
<td>Mean stone size (mm)</td>
<td></td>
<td>11.85 ± 3.7</td>
<td>10.44 ± 2.8</td>
<td>NS</td>
</tr>
<tr>
<td>Male gender N (%)</td>
<td></td>
<td>15 (58.3%)</td>
<td>15 (41.7%)</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td></td>
<td>21.27 ± 3.4</td>
<td>23.14 ± 2.3</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 1: Demographic and preoperative characteristics of patients in two groups.

Sex distribution of patients undergoing ESWL were 15 women and 17 men overall. The number of patients who performed semirigid ureteroscopy and laser lithotripsy were 12 women and 15 men, meaning that there was no significant difference between gender and type of treatment ($p=0.06$).

Regarding efficacy of treatment in two groups, complete efficacy (clearance of stones or residual stones less than 4 mm) in ESWL and semirigid ureteroscopy groups were 87.5% and 85% respectively (Table 2).

In both groups, there were four cases of treatment failures ($p>0.05$). In semirigid ureteroscopy 3 cases were due to stone migration and one case was due to stricture and difficult access to stones that JJ stent was hold for them and then they treat by ESWL. There was no difference between size of stone and methods of treatment. Moreover, there was no relationship between the size of the stone and complication and efficacy in two groups.

Regarding complications, there was only two cases of postoperative fever which were seen in the ESWL group, but in ureteroscopy group three cases
(11.5) developed complications which in two cases-their hemoglobin level decreased and in the other case, urinary tract infection was developed that improved by antibiotic and JJ insertion. There was no significant difference in complications between ESWL and rigidureteroscopy with Holmium laser lithotripsy.

<table>
<thead>
<tr>
<th>Method of treatment</th>
<th>Complete response</th>
<th>Incomplete response or failure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESWL (N)</td>
<td>28(87.5%)</td>
<td>4(12.5%)</td>
<td>32(100%)</td>
</tr>
<tr>
<td>semirigidureteroscopy with laser lithotripsy</td>
<td>23(85%)</td>
<td>4(15%)</td>
<td>27(100%)</td>
</tr>
<tr>
<td>total</td>
<td>51(86.4%)</td>
<td>8(13.6%)</td>
<td>59(100%)</td>
</tr>
</tbody>
</table>

Table 2: Frequency distribution of patients according to efficacy of treatment modality in two groups.

**Discussion**

The preferred treatment of the upper ureteral stones smaller than 15 mm is ESWL, but in nonopaque and hard stones, such as calcium oxalate monohydrate and Cystine stones and also in obese patients, the success rate of this modality is low\(^{(14)}\). On the other hand, according to recent studies, ureteroscopy with use of Holmium laser lithotripsy in addition to high success rate in treatment of different types of stones has a low complication rate. Its success rate in one study for the clearance of stones was 95% in stones smaller than one cm, and it was 88 percent in stones of 1-2 cm of lower renal pole\(^{(15,16)}\). Treatment of upper ureteral stones with a semirigidureteroscope is a well-known and commonly used technique in adults and children. However, the use of semirigidureteroscopes for upper ureteral stones has become controversial. In the presence of flexible ureteroscopy and small-caliber ureteroscope some authors preferred the use of semirigidureteroscope in the absence of flexible instruments\(^{(19)}\). Ureteroscopic treatment of upper ureteral calculi has similar or higher efficacy in comparison to ESWL, with faster cleaning of the stone and immediate resolution of obstruction\(^{(20)}\).

This study was conducted to compare the efficacy and complications of transurethral lithotripsy (TUL) with Holmium laser versus extracorporeal shockwave lithotripsy (ESWL) in the treatment of upper ureteral stones. Results of this study showed that there was no meaningful difference between the two types of treatment regarding efficacy and complication in stones between 5-15 mm of size.

The majority of complications and unsuccessfulness were observed in stones larger than 10 mm. In the study done by Shigemura K and colleagues in 2010, the efficacy of one time operation was 83.3%\(^{(13)}\).

Also Dretler et al. reported the role of laser lithotripsy in the treatment of non-impacted ureteral calculi and stones that were resistant to ESWL. The success rate of endoscopic treatment in this study was 92.5 percent and it was reported that the stone-free rate associated with holmium laser lithotripsy was related to the degree of impaction and the location of the stone, but it was not related to stone size, or stone composition\(^{(21)}\). Also Khaled Mursi and his colleagues reported that the overall success rate with semirigidureteroscopy was 86.6% and the stones migrated in 7%\(^{(22)}\). Rabani and his coworker reported similar efficacy in Management of Large Proximal Ureteral Stones with faster stone free in TUL\(^{(23)}\).

In present study, the efficacy of the Ureteroscopic treatment was 85% and the majority of cases with unsuccessfulness were in stones larger than 10 mm which was similar to the previous studies, although its efficacy was similar to extracorporeal shockwave lithotripsy (ESWL). In a study by Best SL and colleagues in 2007 three of patients (7%) developed urinary tract infection\(^{(19)}\), and in study done by Wu CF and his colleagues in 2004, the general complication rate was 7.4%\(^{(24)}\). Takazawa R and his colleagues reported that efficacy of rigid and flexible ureteroscopy in treatment of ureteral stones were 99% and 5 patient developed pyelonephritis that managed with conservative treatment\(^{(25)}\).

In the present study, the complication rate was 11.1% which all of them was minor complication and was similar to other studies and managed by conservative treatment and JJ insertion. One of the limitations of this study is that cost of laser fiber and therefore Ureteroscopic treatment is more than ESWL but we don’t compare them.

**Conclusion**

In this study the efficacy and complication of the semirigid ureteroscope with laser lithotripsy was similar to ESWL in treatment of upper radiopaque ureteral stones. Moreover, this modality can be used as a safe and efficient treatment for upper ureteral stones; although for better decision making further studies with larger sample size is needed.
References

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