Comparison between retrograde intrarenal surgery and extracorporeal shock wave lithotripsy in the treatment of lower pole kidney stones up to 15 mm. Prospective, randomized study

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Abstract

Introduction: Extracorporeal Shock Wave Lithotripsy (ESWL) is currently the recommended treatment for intra-renal calculi smaller than 2 cm. However, the low Stone Free Rate (SFR) in lower pole calculi gives rise to new techniques, such as retrograde intrarenal surgery (RIRS), for improvement of the surgery outcomes.

Objective: To compare the efficacy of a treatment with ESWL with RIRS, in terms of SFR after surgery, in patients with kidney stones up to 15 mm in the lower pole.

Materials and methods: A prospective study was carried out in order to assess the results of ESWL and RIRS in patients with lower pole stones less than 15 mm. Among a total of 55 patients, 31 were undergone to ESWL (Group 1) and the remaining 24 to RIRS (Group 2). Clinical data recorded, including general characteristics of each patient, were: calculi size, side, operative time, complications according to Clavien scale, SFR and the presence of residual fragments at 2 months post-treatment assessed by a CT scan. STATA 11 was used to perform the statistical analysis.

Results: There were no differences for general descriptors among groups with the exception of a significantly longer operative time for RIRS. The rates of SFR and residual fragments lesser than 3 mm were lower in the RIRS group than in ESWL ones. RIRS also showed a lower rate of clinically significant fragments (0% versus 42.3%, p < 0.05). In the subgroup of patients with stones between 10 and 15 mm RIRS showed higher SFR (75% versus 41.2%) and a lower rate of stones > 3 mm (0% versus 58.8%), being statistically significant (p < 0.05). Clavien III or higher complications were not reported in any of the groups.


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Conclusions: In the treatment of lower pole stone RIRS has the same results than ESWL in terms of SFR. Regarding absence of a clinically significant residual fragment, RIRS was superior to ESWL. A bigger sample size is required in order to confirm this result.
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Introduction

Renal lithiasis is a common problem amongst the general population. It is associated with various complications, such as size progression, urinary tract infection, chronic low-back pain or renal colic, which make active treatment for this disease necessary. These complications occur in up to 50% of previously asymptomatic patients, which even makes active treatment feasible in these cases.1

There is a consensus that extracorporeal shock wave lithotripsy (ESWL) is the treatment of choice for renal stones smaller than 2 cm, achieving overall stone-free rates (SFR) of around 80%.1 However, the management of lower-pole renal stones represents a controversial area in endourology, given the low efficiency of ESWL when treating stones in such a location, with a SFR of 40–62%.2 On the contrary, percutaneous nephrolithotomy (PCNL) achieves a better SFR in the treatment of lower-pole stones, with a rate of 90–100% in this patient group. Unfortunately, the higher complication rate, perioperative morbidity, inpatient days, anesthetic requirements and the cost this technique entails limit its use in these cases.2,3 In this context, flexible ureteroscopy (URS), due to the technological advances which have resulted in better imaging tools (digital camera), wider distal deflection angles, the effective intracorporeal laser lithotripsy and various tools for the removal of calculi with a smaller diameter, has progressively gained ground over the last 15 years for the treatment of renal calculi. The comparative studies versus other techniques have shown that retrograde intrarenal surgery (RIRS) has a SFR equal to or better than ESWL, so it represents an alternative for the treatment of lower-pole renal stones, with prospective studies on stones smaller than 1 cm4,5 and retrospective studies on stones between 10 and 20 mm6 being available. A meta-analysis was even published in 2012, reviewing information about 445 patients, and described that for stones larger than

PALABRAS CLAVE
Cirugía intrarrenal retrógrada;
Litiásis polo inferior;
Litotricia extracorpórea

Comparación entre cirugía retrógrada intrarrenal y litotricia extracorpórea para el tratamiento de la litiásis de polo inferior renal de hasta 15 mm. Estudio prospectivo aleatorizado

Resumen

Introducción: La litotricia extracorpórea (LEC) es el tratamiento más recomendado para la litiásis renal menor de 2 cm. Sin embargo, las bajas tasas libre de cálculos (SFR) en litiásis de polo renal inferior hace plantear nuevas técnicas que ofrezcan mejores resultados, como la cirugía intrarrenal retrógrada (CRIR).

Objetivo: Comparar la eficacia del tratamiento con LEC vs la CRIR en términos de SFR pos-tratamiento en pacientes con litiásis renal de polo inferior de menos de 15 mm.

Material y métodos: Se realizó un estudio prospectivo aleatorizado para evaluar los resultados de LEC y CRIR en pacientes portadores de litiasis renal de polo inferior menor a 15 mm. De un total de 55 pacientes en 31 se realizaron LEC (grupo 1) y 24 CRIR (grupo 2). Se evaluó el tamaño de la litiásis, lateralidad, tiempo operatorio, complicaciones de las técnicas según escala de Clavien, SFR y litiasis residuales a los 2 meses evaluado por tomografía computarizada de abdomen y pelvis sin contraste. Se realizó análisis estadístico para comparar las variables utilizando el programa Stata 11.

Resultados: Los grupos no mostraron diferencias significativas en sus características generales, a excepción del tiempo operatorio (mayor para CRIR). CRIR mostró tener mayor proporción de SFR y de litiásis menor de 3 mm. Además CRIR mostró menor tasa de litiásis clínicamente significativa, siendo esta asociación estadísticamente significativa (0% vs 42,3%; p < 0,05). En el subgrupo de pacientes con litiásis entre 10 y 15 mm CRIR presento mayor SFR (75% vs 41,2%) y menor tasa de litiásis clínicamente significativa (0% vs 58,8%), alcanzando significación estadística (valor de p < 0,05). No se registraron complicaciones perioperatorias Clavien III o mayores para ambas técnicas.

Conclusiones: En el tratamiento de litiásis de polo inferior CRIR mostró globalmente resultados de SFR similares a LEC y una menor tasa de litiásis residual clínicamente significativa, más aún en el subgrupo de pacientes con litiásis entre 10 y 15 mm, que mostró mejor SFR y mejor tasa de litiásis residual clínicamente significativa. Se requiere un mayor tamaño muestral para confirmar este resultado.
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2 cm, where treatment with percutaneous nephrolithotomy was traditionally indicated, RIRS showed an average SFR of 93.7%, with an average of 1.6 procedures per patient and a mean complication rate of 10.1%, thus positioning RIRS as a safe and effective procedure for stones larger than 2 cm. Therefore, there has been a growing interest in defining the indications and the outcomes of RIRS in the management of the lithiasic disease.

In this context, a prospective, randomized study was designed, with the main aim of comparing the efficiency of RIRS versus ESWL in respect of SFR in a first procedure for the treatment of patients with lower-pole renal stones smaller than 15 mm. Besides, as a secondary aim, we assessed the proportion of cases with clinically significant residual lithiasis, residual stones larger than 3 mm, following both treatments.

Materials and methods

Between January 2009 and November 2010, a prospective, randomized study was conducted, which included patients with a diagnosis of a single lower-pole renal stone smaller than 15 mm in largest diameter, treated at the Urology Service in the Clinical Hospital University of Chile. Those patients with anatomical alterations in the kidney or the urinary tract were excluded. This study was approved by the Research Ethics Committee of the Clinical Hospital University of Chile, and all patients signed an informed consent document when entering the study.

Non-contrast computed tomography (CT) scan of the abdomen and the pelvis, complete blood count, biochemical profile, serum creatinine, complete urine test and urine culture were recorded. Patients with a positive urine culture were treated prior to the procedure. Each patient’s demographic variables, stone size, laterality, surgical time and complications associated with the procedure were also recorded.

Randomization of patients to either ESWL or RIRS was performed by using RANDI 0.9 randomization software, which is available on the Internet (available at: http://dschri.mpf.github.io/randi3/).

In the case of those patients who underwent ESWL, we used the lithotriptor Modulith Storz SLX (Karl Storz GmbH & Co., Tuttingen, Germany). Stone location was determined using fluoroscopy. All the procedures were conducted by the same urologist, under sedoanalgesia with midazolam 5 mg and intravenous fentanyl 50 gamma. Routine antibiotic prophylaxis was not used. A maximum intensity of 20 kW was applied, depending on the patient’s tolerance, at a shock wave frequency of 1 Hz. The procedure stopped after 3000 shockwaves or until the visualization of stone fragmentation. Oral analgesia was subsequently administered to every patient, depending on their needs with non-steroidal anti-inflammatory drugs for a week and tamsulosin 0.4 mg/day for a month. Only one ESWL session was conducted.

RIRS was performed with the patient placed in the lithotomy position under general anesthesia and using intra-operative fluoroscopic guidance in all cases. Cystoscopy was performed (Storz 21 F cystoscope, 30° visual field) and 0.035” ureteral hydrophilic guide wire placement (Cook Medical, Bloomington, Indiana, USA) into the renal pelvis of the affected side. A 12-14 F Flexor® ureteral access sheath (Cook Medical, Bloomington, Indiana, USA) was placed in all cases. We used an Olympus URF P3 flexible ureteroscope (Olympus, Hamburg, Germany) and intracorporeal lithotripsy was done with the Holmium-YAG Sphinx 30 Minimally Invasive Holmium Laser (LISA Laser USA, Pleasanton, CA, USA). The laser was calibrated at 1.9 J, 4 Hz and 11 W for a 200 µ fiber. Fragments were removed using a N-Gage® basket (Cook Medical, Bloomington, Indiana, USA) and the ureteral access sheath was subsequently removed under fluoroscopic guidance. A double-J stent was left in place in all patients for 7 days, along with tamsulosin 0.4 mg/day for 7 days until the removal of the double-J stent. The stent was removed on an outpatient basis using cystoscopy under local anesthesia.

In order to determine treatment effectiveness, patients underwent a non-contrast CT scan of the abdomen and pelvis 2 months prior to surgery. Residual stone-free cases (SFR) were defined as the absence of stones in the control CT scan; clinically non-significant residual stones were defined as those fragments smaller than or equal to 3 mm in largest diameter. Perioperative complications were recorded and classified according to Clavien’s scoring system.

Variables were analyzed using the statistical software STATA 11. We used general statistical descriptors, such as the average number or standard deviation for continuous variables, since all of them showed a parametric distribution according to Shapiro–Wilk’s test. To compare differences between continuous variables, Student’s t-test was used. To assess the association between categorical variables, we used Fisher’s exact test, and the Z-test for proportions. A p value equal to or less than 0.05 was considered significant for all analyses.

Results

Over the studied period, 63 patients with a single lower-pole stone were recruited. Randomization established that 32 patients were included in group 1 (ESWL) and 31 patients in group 2 (RIRS). One patient from group 1 could not be treated due to an imbalance of type 2 diabetes mellitus and was excluded from the study. Likewise, 7 patients from group 2 were excluded, 6 patients rejected RIRS as an alternative treatment and one patient had uncompensated arterial hypertension. Finally, the study included 55 patients lower-pole stones who underwent treatment. Group 1 (ESWL) included 31 patients and group 2 (RIRS) 24. Male patients accounted for 60% of the total and women for 40%. The patients’ mean age was 44 years. Demographic variables and stone characteristics according to the groups are described in Table 1, both groups being comparable for the variables of age, gender, BMI and laterality. All patients who underwent ESWL were discharged the same day and those in the RIRS group the following day. Surgical time was significantly higher in group 2 (42.7 min versus 59.6 min) ($p < 0.05$) (Table 1).

Patients who underwent RIRS (group 2) showed higher SFR 2 months after treatment: 70% of the patients were stone-free (Table 2). Similarly, patients who underwent RIRS also showed a higher proportion of clinically non-significant residual stones ($\leq$3 mm); however, for both outcomes, the
Comparison between with ESWL and RIRS

Table 1  General characteristics of patients according to the treatment group.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (ESWL)</th>
<th>Group 2 (RIRS)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>18 (57.7%) men</td>
<td>15 (63.2%) men</td>
<td>0.76a</td>
</tr>
<tr>
<td></td>
<td>13 (42.3%) women</td>
<td>9 (36.8%) women</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>45.6 (13.7 SD)</td>
<td>43.7 (9.2 DS)</td>
<td>0.60b</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.7 (3.1 SD)</td>
<td>26.6 (1.5 DS)</td>
<td>0.17b</td>
</tr>
<tr>
<td>Laterality</td>
<td>19 (61%) Left</td>
<td>10 (42%) Left</td>
<td>0.23b</td>
</tr>
<tr>
<td></td>
<td>12 (39%) Right</td>
<td>14 (58%) Right</td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>42.7 min (12.2 SD)</td>
<td>59.6 min (16.5 SD)</td>
<td>0.0006b</td>
</tr>
<tr>
<td>Stone size</td>
<td>9.6 mm (0.6 SD)</td>
<td>9.7 mm (0.5 SD)</td>
<td>0.93b</td>
</tr>
</tbody>
</table>

a  Fisher’s exact test.
b  Student’s t-test.

Table 2  Stone free rate and residual stones by type of treatment.

<table>
<thead>
<tr>
<th>Results</th>
<th>Group 1 ESWL (n = 31)</th>
<th>Group 2 RIRS (n = 24)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone free</td>
<td>48.3% (15/31)</td>
<td>70.8% (17/24)</td>
<td>0.109a</td>
</tr>
<tr>
<td>No significant residual lithiasis</td>
<td>9.7% (3/31)</td>
<td>29.2% (7/24)</td>
<td>0.08a</td>
</tr>
<tr>
<td>Lithiasis &gt; 3 mm</td>
<td>42% (13/31)</td>
<td>0% (0/24)</td>
<td>0.001a</td>
</tr>
</tbody>
</table>

a  Fisher’s exact test.
b  Z test.

superiority shown by RIRS versus ESWL did not reach statistical significance; when assessing the presence of clinically significant stones instead, RIRS was clearly superior to ESWL with 0% of patients with clinically significant stones versus 42% of patients with clinically significant stones in the ESWL group (p < 0.05) (Table 2).

Out of the total of patients included, 29 of them (52.8%) had stones with a size of between 10 and 15 mm. Out of these, 17 underwent ESWL (58.6%) and 12 RIRS (41.4%). In this patient group with stones larger than 10 mm, it was noted that RIRS showed higher SFR (75% versus 41.2% for ESWL) and a lower rate of stones > 3 mm (0% versus 58.8%); both results were statistically significant (p < 0.05) (Table 3).

With regard to post-operative complications, group 1 showed a 16.1% complication rate: 3 patients with Clavien I complications (renal colic requiring higher doses of analgesics) and 2 with a Clavien II complication (asymptomatic bacteriuria requiring antibiotic treatment). Group 2 showed a 37.5% complication rate: 7 patients with Clavien I complications (poor tolerance to the double-J stent requiring an increased dose of analgesics) and 2 with Clavien II ones (asymptomatic bacteriuria requiring antibiotic treatment prior to double-J stent removal. No Clavien III or major complications were recorded, and differences between both groups were not statistically significant (Table 4).

Discussion

The ideal management of lower-pole renal stones smaller than 2 cm is a controversial issue. In the present study, we aimed at comparing the effectiveness of RIRS versus ESWL in terms of SFR following a single surgical procedure for this type of calculi. Our results show that RIRS had higher SFR (70.8% versus 48.3%) and a higher rate of clinically non-significant stones (29.2% versus 9.7%) than ESWL, although both results were not statistically significant, so in our overall series RIRS was at least as effective as ESWL for the treatment of lower-pole stones, which was the same result as that shown in a meta-analysis conducted by Cochrane, where only percutaneous nephrolithotomy was superior to ESWL and RIRS. However, when assessing the presence of clinically significant stones, as defined by Osman et al., RIRS proved to be superior to ESWL (0% versus 42% [p < 0.05]). Besides, when assessing the patient group with stones between 10 and 15 mm exclusively, RIRS was superior to ESWL, showing higher SFR (75% versus 41.2%, p < 0.05) and a lower rate of clinically significant stones, since 52.8% of the patients treated with ESWL showed residual stones larger than 3 mm, whereas no patient treated with RIRS showed clinically significant residual stones (p < 0.05). These results guide us on the fact that

Table 3  Stone-free rate and residual stones by type of treatment in subgroup of patients with stones between 10 and 15 mm.

<table>
<thead>
<tr>
<th>Results</th>
<th>Group 1 ESWL (n = 17)</th>
<th>Group 2 RIRS (n = 12)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone free</td>
<td>41.2% (7/17)</td>
<td>75% (9/12)</td>
<td>0.006a</td>
</tr>
<tr>
<td>No significant residual lithiasis</td>
<td>0% (0/17)</td>
<td>25% (3/12)</td>
<td></td>
</tr>
<tr>
<td>Lithiasis &gt; 3 mm</td>
<td>58.8% (10/17)</td>
<td>0% (0/12)</td>
<td></td>
</tr>
</tbody>
</table>

a  Fisher’s exact test.
RIRS is the treatment with the best results for lower-pole stones.

It is documented in the literature that stone volume is an independent predictor of SFR in RIRS, it being inversely correlated with the efficiency of the procedure, that is to say, the greater the volume the lower SFR. However, the success rate of RIRS in a single session has been described as higher than 90% in stones up to 15 mm, and it decreases only in the case of larger stones, although we do not have a clear explanation as to why RIRS had better results only in stones larger than 1 cm in terms of SFR. The literature confirms an effectiveness rate comparable to that described by us; one possible explanation is that given the sample size, because of the small size of the series, we did not achieve enough statistical power to prove our trend. However, one should also consider that there might be factors which were not assessed in our study but which could explain these results. These include the variability in the anatomy of calyces and infundibuli among patients, which could determine better drainage of residual fragments, since in previous studies the decrease in the effectiveness of ESWL in lower-pole stones has been associated with the low clearance of stones within this area due to anatomical factors, such as the infundibulo-pelvic angle, the infundibular width and length and the infundibulo-pelvic height index. Unfortunately, no CT scan at a phase of delayed removal prior to surgery was available in this study to assess lower-pole anatomy. As mentioned before, this could certainly have an influence on the results in favor or in detriment to RIRS. In any case, we believe that this does not invalidate the results obtained, since in clinical practice a significant number of these procedures are performed with no CT scan at a phase of delayed removal prior to surgery.

Although ESWL is the standard treatment for stones smaller than 2 cm, several authors have pointed out its limitations in the management of lower-pole stones. McDougall et al., in 1989, retrospectively compared ESWL and PCNL, obtaining significantly lower SFR for ESWL (56% versus 85%). Subsequently, several papers showed similar results, obtaining efficiency percentage for upper- and middle-pole stones of around 80%, which fell to 40–60% in the case of the lower pole. The Lower Pole Study Group determined that the effectiveness of ESWL decreased as stone size increased, from 63% for stones smaller than 1 cm, 21% for those between 1 and 2 cm and 14% for stones larger than 2 cm. Anatomical factors might explain the differences found in the effectiveness rates of ESWL. Another important aspect to be taken into consideration is that in our series we only evaluated outcomes following one single ESWL session; however, the literature describes the need to conduct multiple ESWL sessions; furthermore, it has been described that the larger the stone size, the more ESWL sessions are required on average, so the rates we obtained might underestimate ESWL effectiveness when considered as multi-session therapy.

It is important to note that previous studies are consistent with our results that RIRS is a better treatment in terms of SFR for lower-pole stones. Less contemporary retrospective series reported SFR rates between 60% and 80% in lower-pole stones treated with RIRS.

To the best of our knowledge to date, there are 3 prospective, randomized, controlled studies comparing ESWL and RIRS in the lower pole. The first one by Pearle et al., published in 2005, compared ESWL with RIRS in 67 patients with lower-pole stones smaller than 1 cm, observing higher SFR for RIRS (50% versus 35% for ESWL), although this difference was not statistically significant. The second one, by Singh et al., and which is a more contemporary series, compared patients who had undergone ESWL (n = 35) or RIRS (n = 35) between 2011 and 2013, showing a higher success rate (SFR plus stones smaller than 3 mm) for RIRS (85% versus 54.28% for ESWL, p = 0.005). Besides, RIRS showed a lower retreatment rate and better satisfaction. A limitation of this study is that patients were included in the study and followed up after treatment with X-ray and ultrasound scanning rather than with CT. The last study was conducted by Sener et al. and represents the largest series comparing patients who had undergone ESWL (n = 70) or RIRS (n = 70) with lower-pole stones smaller than 10 mm, reporting a success rate of 100% for RIRS versus 91.5% for ESWL (p < 0.05), and performing 2.7 ESWL sessions on average versus one single RIRS session, reporting similar complications, SFR for both procedures and highlighting the emerging role of RIRS as the first line of treatment for lower-pole stones. However, in this study, stone status was verified with X-ray plus ultrasonography, which may have influenced outcomes.

Furthermore, some retrospective studies stand out within this field. El-Nahas et al. published a retrospective series comparing ESWL with RIRS for lower-pole stones of between 10 and 20 mm between the years 2007 and 2011. A paired analysis was performed according to the clinical variables (stone size and location and gender) of 62 patients who had undergone ESWL and 37 to RIRS and their stone status was verified after 3 months with CT, finding significant differences in favor of RIRS: SFR for RIRS: 86.5% versus ESWL: 67.7%, p = 0.038 and a significantly lower retreatment rate in favor of RIRS. Ozturk et al. carried out a retrospective, descriptive study of patients who had undergone ESWL (n = 221), PCNL (n = 144) or RIRS (n = 38) for stones of 10–20 mm between 2007 and 2012. They found SFR (correlated with X-ray plus ultrasonography after a month) of 76%, 94% and 73%. However, the retrospective nature of this study, with its possible selection biases, stone status control with no CT scan and the lack of statistical comparison

<table>
<thead>
<tr>
<th>Grade</th>
<th>Group 1 ESWL (n = 31)</th>
<th>Group 2 RIRS (n = 24)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>9.6% (3)</td>
<td>29.2% (7)</td>
<td>NS</td>
</tr>
<tr>
<td>II</td>
<td>6.5% (2)</td>
<td>8.3% (2)</td>
<td>NS</td>
</tr>
<tr>
<td>III</td>
<td>0%</td>
<td>0%</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS, no significant p value between groups.
among groups, hampers the achievement of more definitive conclusions.

No contrast study of the urinary tract was conducted prior to the procedure in any of the previous comparative studies. In this scenario, the limitation of RIRS lies in the possible inaccessibility of the lower pole, which can reach up to 7% according to some studies, given the necessary deflection of the ureteroscope. However, technology has progressively helped to increase the deflection capacity of these tools, highly effective laser fibers, increasingly smaller dumortier baskets in terms of diameter and peripheral optics with a greater capacity for image processing, which explains the growing interest and the improved results of this technique. This technological development might explain the better SFR observed in more contemporary series and in ours.

With regard to the safety of both techniques, RIRS showed a higher incidence of complications, which reflects the more invasive nature of this procedure in comparison with ESWL; however, this difference was not statistically significant and the severity of complications was comparable among both groups with no grade III or greater complications according to Clavien’s scoring system.

An aspect which is becoming increasingly relevant, apart from the clinical outcomes themselves, are the costs associated with healthcare. It is known that the costs associated with the management of stones vary greatly from one country to another; Koo et al. analyzed in Northern Ireland the cost-effectiveness and the efficiency in the management of lower-pole stones between ESWL and RIRS. In their series, both techniques showed comparable SFR rates (65% for RIRS and 58.8% for ESWL), with a retreatment rate of 16.2% for RIRS and 21.6% for ESWL. When considering the cost per session of RIRS or ESWL, no significant differences were observed (£249 versus £292, respectively). However, when considering the costs of additional procedures, hospitalization, medication administration, anesthesia, among others, RIRS was significantly more expensive than ESWL (£2602 versus £426, p = 0.000). In our field, no cost-effectiveness studies have been conducted assessing ESWL versus RIRS; however, a study was carried out evaluating the costs of ESWL and endoscopic ureterolithotomy in distal ureteral stones. This study determines that, when assessing the value of each procedure, ESWL proved to be on average 132% more expensive than ureterolithotomy (£1753 versus £755, respectively; p < 0.001), a difference which remains the same when considering total costs, including reinterventions (£2130 versus £8942; p < 0.001). In our group’s opinion, the costs of ureterolithotomy in our field are similar to those of RIRS, so this should be a factor to be taken into consideration when offering our patients this treatment option. However, studies assessing specifically the costs of RIRS in comparison with ESWL for lower-pole stones are required in our field.

In summary, we underline that we have conducted a comparative, randomized study with well-defined inclusion and exclusion criteria and with procedures conducted by a single urologist at a university center of international reference. Patients belonged to a representative sample of our center, with no differences in the general descriptors, with the exception of surgical time, which was significantly lower for ESWL. Besides all patients were controlled with CT, which is the gold standard procedure for this disease.

As limitations of this study, it should be mentioned that it is a small study group, which might explain the lack of statistical significance in the differences found in our primary goal (absence of lithiasis). On the other hand, in our series we used the Olympus P3 flexible ureteroscope, which is not of the latest generation and has a maximum deflection capacity of 180°; this is considered a weakness, since more modern ureteroscopes have deflection capacities of up to 275°, which enables a better examination of all cavities in different anatomical situations. These developments associated with the surgeon’s experience are responsible for better results over time and for the lower outcomes obtained in Pearle’s study, which was published in 2005 and conducted on patients who had undergone surgery between 2000 and 2003. Although in our study there were no cases in which the inferior calyx was inaccessible, this situation might influence the results obtained. In any case, the results of this study support the previously published evidence on the good results of RIRS for the treatment of lower-pole renal stones.

Conclusion

The treatment of lower-pole renal stones smaller than 2 cm is a controversial issue in urology. The higher rate of residual lithiasis and the need for more than one procedure in patients treated with ESWL have enabled RIRS to position itself as a safe and effective alternative. In our study, RIRS showed overall SFR results similar to those of ESWL and a lower rate of clinically significant residual stones. Moreover, in the subgroup of patients with stones between 10 and 15 mm, it showed better SFR and a better rate of clinically significant residual stones. These results lead us to think that RIRS can position itself as an effective first line treatment in the management of lower-pole stones. However, further studies with a larger number of cases are required to confirm the differences obtained in this study.

Conflict of interest

The authors declare that they have no conflict of interest.

References