ORIGINAL ARTICLE

Flexible ureteroscopy for renal stones

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KEYWORDS
Renal lithiasis; Flexible ureteroscopy; Retrograde intrarenal surgery

Abstract
Objectives: The objectives of this prospective study are to present our experience with retrograde intrarenal surgery (RIRS), and to analyze its results and complications.
Materials and methods: 150 patients with renal stones were treated with RIRS. 111 cases showed single stones whilst multiple stones were observed in 39 cases. The mean size was 19.12 mm (r: 5–74). Success rate was defined as the absence of residual stones or the presence of fragments <2 mm.
Results: In 21 (14%) patients RIRS could not be performed on first attempt because it was impossible to place the ureteral access sheath. The immediate success rate was 85.7% and 91.6% at three months later. The average operating time was 85 min (r: 25–220). Postoperative complications were observed in 22 cases (14.6%), although most of them were classified as Clavien 1 and 2 (19 cases), and only 2% (3 cases) showed Clavien 4 complications (sepsis requiring admission in the intensive care unit). 10 patients underwent a second procedure in order to complete the treatment. Thus, the number of procedures per patient was 1.06. There were nolte complications.
Conclusions: The treatment of renal stones with flexible ureteroscopy using the uretal access sheath shows a high successful rate with a low complication rate. In order to define its indication more precisely, randomized studies comparing RIRS with minimally invasive percutaneous nephrolithotomy procedures (miniperc and microperc) would be necessary.
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PALABRAS CLAVE
Litiasis renal; Ureteroscopia flexible; Cirugía retrógrada intrarrenal

Tratamiento de la litiasis renal mediante ureteroscopia flexible

Resumen
Objetivos: Presentamos en este trabajo prospectivo nuestra experiencia con la cirugía retrógrada intrarrenal (CRIR), analizando sus resultados y las complicaciones.
Material y métodos: Hemos tratado 150 pacientes afectados de litiasis renal mediante CRIR. Lalitiasis fue única en 111 casos y múltiple en 39, siendo el tamaño medio de 19.12 mm (r: 5-74).

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Definimos éxito en nuestra serie como la ausencia de litiasis o fragmentos residuales menores de 2 mm.

**Resultados:** En 21 pacientes (14%) no pudo realizarse la CRIR en un primer intento por imposibilidad de ascenso de la vaina ureteral. La tasa de éxito inmediata fue del 85,7% y a los 3 meses del 91,6%. El tiempo medio operatorio fue 85 min (r: 25-220). En el postoperatorio inmediato hubo complicaciones en 22 pacientes (14,6%), si bien la mayoría de ellas fueron Clavien 1 y 2 (19 casos) y solo un 2% sufrió complicaciones Clavien 4 (3 casos de sepsis que precisaron ingreso en la unidad de cuidados intensivos). En 10 pacientes se precisó una segunda intervención para completar el tratamiento, por lo que el número de procedimientos por paciente fue de 1,06. No hubo complicaciones tardías.

**Conclusión:** El tratamiento de la litiasis renal mediante ureteroscopia flexible obtiene una tasa alta de éxito con bajas complicaciones. Precisamos estudios aleatorizados que la comparen con la nefrolitotricia percutánea, en sus modalidades menos invasivas (miniper y microperc) para definir con exactitud sus indicaciones.

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**Introducción**

It has been over 2 decades since the first flexible ureteroscopies (FUR) were performed by Bagley.\(^1\) Subsequently, Fuchs\(^1\) systematized the technique and from then until now, technological advances have allowed for the treatment of renal lithiasis by FUR to be a reality.

Although in the endourological era extracorporeal lithotripsy (ESWL) and percutaneous nephrolithotomy (PNL) have been the gold standard in the treatment of renal lithiasis, FUR is now another option, as provided by the latest update of the European clinical guidelines in urolithiasis.\(^2\) This has been made possible thanks to the improvement of flexible ureteroscopes, not only in view with the advent of digital technology, but in deflection, mobility, ergonomics, and durability. These advances, coupled with the miniaturization of holmium laser fibers and the use of nitinol in the manufacture of baskets, have made it possible to report high success rates in recent series.\(^3\)\(^-\)\(^6\)

In this prospective study, we present our experience with retrograde intrarenal surgery (RIRS), analyzing its results and complications.

**Materiales y métodos**

From June 2009 to March 2013 we treated 150 patients (83 men, 67 women) suffering from renal lithiasis by means of RIRS. The mean age was 52.3 years (r: 19–81). The lithiasis was single in 111 cases and multiple in 39, the average size being 19.12 mm (r: 5–74). The inclusion criteria for this treatment included the previous failure of other endourological techniques, malformation of the urinary tract, obesity, and preference of the patient (Table 1). The demographic variables of the lithiases are presented in Table 2.

The image diagnosis was performed by means of intravenous urography (IVU) and ultrasound. A total of 39 patients (26%) were carriers of double-J at the time of surgery.

**Evaluación del éxito**

We define success in our series as the absence of lithiasis or residual fragments smaller than 2 mm. Its immediate assessment was made by means of the endoscopic examination of the renal cavities at the end of the procedure and with plain abdominal ultrasound the day after the surgery. The final success rate was evaluated by intravenous urography and ultrasound at 3 months postoperatively.

**Técnica**

The patient was placed in lithotomy position under general anesthesia. We systematically used, as antibiotic prophylaxis, 2 g iv amoxicillin-clavulanic. In case of allergy to beta-lactams, we switched to 400 mg iv ciprofloxacin. We started the process with rigid ureteroscopy to place a guide wire to the renal cavities and perform ureteroscopy of the distal section of the ureter, making dilation under the view of this segment. Then, we collected urine from the renal cavities that we sent for bacteriological study, very useful in postsurgical infections and vital in cases of sepsis. The

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Demographic variables of the lithiases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean size</td>
<td>19.12 mm (r: 5–74)</td>
</tr>
<tr>
<td>Single lithiasis</td>
<td>111</td>
</tr>
<tr>
<td>Lower calyx</td>
<td>37</td>
</tr>
<tr>
<td>Middle calyx</td>
<td>19</td>
</tr>
<tr>
<td>Upper calyx</td>
<td>27</td>
</tr>
<tr>
<td>Upper calyx diverticulum</td>
<td>1</td>
</tr>
<tr>
<td>Middle cáiz diverticulum</td>
<td>2</td>
</tr>
<tr>
<td>Pyelic</td>
<td>15</td>
</tr>
<tr>
<td>Pyelic associated to UPJ</td>
<td>8</td>
</tr>
<tr>
<td>Horseshoe kidney</td>
<td>2</td>
</tr>
<tr>
<td>Multiple lithiasis</td>
<td>39</td>
</tr>
</tbody>
</table>

**Table 1 | Inclusion criteria.**

<table>
<thead>
<tr>
<th>Indications</th>
<th>N: 150</th>
</tr>
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<tbody>
<tr>
<td>Failure ESWL</td>
<td>57 (38%)</td>
</tr>
<tr>
<td>Residual post-PNL</td>
<td>29 (19.3%)</td>
</tr>
<tr>
<td>Malformation of the excretory pathway</td>
<td>13 (8.6%)</td>
</tr>
<tr>
<td>Obesity</td>
<td>37 (24.6%)</td>
</tr>
<tr>
<td>Patient preference</td>
<td>14 (9.3%)</td>
</tr>
</tbody>
</table>
next step is the placement under radiological control of the ureteral access sheath. We used a 11–13 (Navigator-Boston Scientific) or 12–14 (Flexor-Cook) Fr sheath. It is important to leave the sheath placed in the proximal ureter at a point that allows for the deflection of the endoscope, and that at the same time makes a good washing of cavities, that is, we should not leave it in the renal pelvis or far from the ureteropelvic junction. Later, we placed a 10Fr urinary catheter to have the bladder drained during the procedure.

After placing the sheath, we introduced the flexible ureteroscope and explored the renal cavities until locating the lithiasis. In approximately 95% of the procedures we used a 7.5 Fr flexible fiber-optic ureteroscope (Flex Z, Storz). In the rest of the procedures we used a 9.9 Fr digital ureteroscope (URF-V, Olympus). As irrigation system, we used a pressure pump (Olympus) that allows us to have an adequate view at all times, by maintaining a constant flow. Working with ureteral access sheath decreases the pressure in the cavities and allows for a high flow, without increasing the pressure in excess. We tried to fragment the lithiasis without working in deflection, in order to extend the life of the endoscope, so if this is located in an unfavorable location, we mobilize it with a small basket into the pelvis or upper calyx. Lithotripsy was performed with 12 W holmium laser (Calculase, Storz) and 365 and 200 μ fibers. We use the lowest caliber fiber when we are forced to work in deflection because the lithiasis cannot be moved due to its excessive size or because we are in a narrow infundibulum. In these cases, we perform in situ lithotripsy, until we achieve mobilizable fragments. To mobilize or extract fragments we used a small nitinol 1.7 Fr basket. (N-Gage, Cook); this little basket, given its small size, barely diminishes deflection to the ureteroscope and it does not decrease the irrigation during its use, so it allows us to access complex chalices with proper vision for lithiasic manipulation. We performed lithotripsy until we achieved insignificant or removable remains through the ureteral access sheath; for this, we used the tip of the laser fiber as a benchmark. Once the lithotripsy was completed, we extracted the significant remains. To finish the procedure, we placed a double J stent that we will keep for about a week. In cases of rapid procedures, with no remains and with easy sheath passage, we left a ureteral catheter for 24 h.

**Results**

The average patient follow-up was 15 months (r: 4–20). In 21 patients (14%) the RIRS could not be performed in a first attempt due to the impossibility of ureteral sheath uptake, so a double-J catheter was left and the intervention was deferred one week, being performed later without difficulty.

The immediate success rate, evaluated endoscopically after the intervention and plain abdominal X-ray, was 85.7%. The success rate at 3 months assessed by intravenous urography and ultrasound was 91.6%.

The mean operative time was 85 ± 30.4 min (r: 25–220). There were no noteworthy intraoperative complications. We found no significant change in creatinine or hemoglobin levels postoperatively. The mean postoperative hospital stay was 2.1 ± 1.3 days (r: 1–7).

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Results.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surgical time (min)</strong></td>
<td>85 ± 30.4</td>
</tr>
<tr>
<td><strong>Immediate success rate</strong></td>
<td>85.7%</td>
</tr>
<tr>
<td><strong>Succes rate at 3 months</strong></td>
<td>91.6%</td>
</tr>
<tr>
<td><strong>Retreatment</strong></td>
<td>10 (6.6%)</td>
</tr>
<tr>
<td><strong>Procedures/patient</strong></td>
<td>1.06</td>
</tr>
<tr>
<td><strong>Postoperative stay (days)</strong></td>
<td>2.1 ± 1.3</td>
</tr>
<tr>
<td><strong>Complications (rate)</strong></td>
<td>14.6%</td>
</tr>
<tr>
<td>Clavien 1</td>
<td>10 (6.6%)</td>
</tr>
<tr>
<td>Clavien 2</td>
<td>9 (6%)</td>
</tr>
<tr>
<td>Clavien 4</td>
<td>3 (2%)</td>
</tr>
</tbody>
</table>

In the immediate postoperative period, complications occurred in 22 patients (14.6%), although most of them were Clavien 1 and 2 (19 cases) and only 2% had Clavien 4 complications (3 cases of sepsis requiring hospitalization in the intensive care unit).

In 10 patients a second operation was required to complete the treatment, so the number of procedures per patient was 1.06.

There were no late complications. We observed no ureteral stenosis in any patient following the use of the ureteral access sheath.

The data of results are expressed in Table 3.

**Discussion**

Technological advances have made it possible for the RIRS to currently reach satisfactory success rates. Although European guidelines on lithiasis establish PNl as a first-line treatment for stones over 2 cm, more and more groups deal with stones over 2 cm with RIRS, obtaining good results in a single time. This barrier, which seemed insurmountable years ago, today is a reality. Several factors influence the increased rate of success. The improvement in vision of digital ureteroscopes makes the process easier and faster, which clearly influences the rate of success. A digital vision, combined with the systematic use of ureteral access sheath and adequate irrigation, enables us to perform lithotripsy virtually without stopping fragmentation due to vision deficit. Another important factor is the emergence of more powerful holmium lasers that make it possible to modify the parameters of frequency and energy. This allows us to adapt the lithotripsy to the lithiasic composition. Thus, we can treat sizable stones completely vaporizing them, without the need to remove fragments, reducing the surgical time. The success rate at 3 months in our series is 91.6%, slightly lower than the 93.1% reported initially, but objectively better if we compare the average size of the lithiasis treated at the start of the series with the current cases. Furthermore, if we compare our results with those published by other authors that have expanded the indications for RIRS to lithiasises over 2 cm, we can conclude that we have achieved similar success rates with lower rates of retreatment. We performed a second procedure in those patients with significant or clinically relevant remains, and in 90% of the cases they corresponded to lithiasises over 2 cm. To explain our results, the success rate and low morbidity, we must consider some technical aspects. All cases were performed...
by 2 surgeons that, working together, have jointly overcome the learning curve, which accelerates the operative time. The systematic use of the ureteral access sheath, which although in the beginning had some detractors for fear of ureteral stenosis due to ischemic damage, is currently considered essential to perform the surgery.13–16 In our series, in 21 patients (14%), we did not manage to uptake the sheath in a first attempt. In these cases, a double J catheter was placed and surgery was postponed a week.

The choice of the sheath depends primarily on the flexible ureteroscope that we use, since we need to adapt it to the size of the endoscope. The sheath must have sufficient internal caliber for the endoscope to slide freely since the friction not only hinders the process but it also reduces the life of the ureteroscope. In turn, the external size greatly influences the success of the placement of the sheath. In general, the greater the sheath, the better drainage of cavities we will get and the larger lithiasic remains, but we also found more difficulty passing through the ureter. Therefore, we used an intermediate size, around 11–13 and 12–14Fr, which we consider sufficient to obtain good mobility and adequate drainage, minimizing as much as possible the ureteral invasion and the possibility of failure in the placement of the sheath. We have not detected in late controls any ureteral stenosis due to the use of sheath.

Would this small initial failure rate justify the use of the previous catheterization? This issue has already been discussed and we think, in line with other authors, that prior surgical catheterization adds another surgical gesture, and also that the waiting time for surgery is not always free from the inherent morbidity to the catheter.17,18

Most of the series keep a double J approximately 2 weeks after the procedure.5,6 In our series, we reduced the time of catheterization to a week, aware of the morbidity produced by the double J stent, although, obviously, in the cases in which it was required to perform ureteral dilatation for the uptake of the sheath, when we observed damage to the ureteral mucosa or lithiasic remains sufficient to form a lithiasic street, we were keen to keep the catheter for 4 weeks. And conversely, in short interventions, if we observed no lithiasic remains, we left an external ureteral catheter only 24 h.

We had no intraoperative complications and the hemoglobin and creatinine figures did not change in the immediate postoperative period. This is consistent with what is published in the literature.19,20 In the postoperative period, the complication rate was 14.6% (22 patients), higher than what was published in other series,14–24 but in our defense, we must say that the majority (86.3%) were Clavien 1 and 2 (febrile syndrome and hematoma) and that they occurred in the first 50 cases. We have had 3 cases of sepsis (2%) with ICU admission, resolved satisfactorily. Most complications are cases with long operating time (longer than 2 h) in order to achieve an adequate resolution rate with a single procedure. We firmly believe that the complication rate decreases when using the ureteral access sheath, maintaining good vision, working at low pressure, not damaging the mucosa, and not prolonging the operating time in excess. Currently, we do not lengthen the procedure above 2 h, as clearly complications increase.

Conclusion

The treatment of renal lithiasis with flexible ureteroscopy obtains a high success rate with low complications. Therefore, we think that, currently, it is an effective treatment option for renal lithiasis. We need randomized studies comparing it to the PNL, in its less invasive modalities (miniperc and microperc) to accurately define its indications.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Flexible ureteroscopy for renal stones


