FLEXIBLE URETERORENOSCOPY (URS): TECHNIQUE AND RESULTS

Jose Ramon Cansino Alcaide, Javier Reinoso Elbers, David Lopez Perez, Sonia Sanchez Rodriguez, Alfredo Aguilera Bazan, Alberto Rando Tous, Luis Hidalgo Togores and Javier De La Peña Barthel.


Summary.- OBJECTIVES: This paper has two main objectives: First, to expose the URS technique used in our Department because there are important differences with respect to others centres published, explaining same aspect that can benefit to the better development of the technique. Second, we present the results of a series of 100 cases. Flexible ureterorenoscopy (Flex URS) has been little used to date, mainly because of the technical difficulties created by the deficient quality of the instruments used, such as ureteroscopes offering scant visibility, poor illumination, a small working channel, deficient quality of the forceps and baskets, etc.

METHODS: We present our recent series of flexible URS for the treatment of renal lithiasis. We performes a retrospective analysis of this treatment corresponding to the period between January 2007 and March 2010. In this period we have treated 100 patients. The medium size of the stone treated is 1.5cm (0.5-6cm) and we used ureteroscopic protector sheath in all cases. The lithotripter system used in all cases was Ho:YAG Laser with 200 and 365 micras fibers

RESULTS: The stone-free rate (SFR) in the immediate postoperative period was 77% (77/100 patients). Residual stones, defined as stone fragments visualized in the operating room via fluoroscopy and directly with the flexible ureteroscope. Three months after surgery, the SFR was 92.7% (89/96 patients) confirmed by intravenous urography. Regarding complications, we had 5 patients with ureteral lesions during protector sheath pass and 9 patients that presented at the emergency room with pain secondary to the double J catheter.

CONCLUSIONS: Flexible URS for of renal lithiasis can be defended in stones measuring up to 2 cm in diameter, based on our treatment algorithm.

Keywords: Flexible ureterorenoscopy. Lithiasis. Endourology.

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Resumen.- OBJETIVO: Los objetivos fundamentales de éste trabajo son dos. Por una parte exponer la técnica empleada en nuestro Servicio ya que difiere en algunos aspectos importantes de las publicadas en otros centros, explicando en algunos casos pequeños detalles que pueden ayudar al mejor desarrollo de la técnica. Por otra parte, exponemos los resultados de una serie de 100 casos.
MÉTODOS: Presentamos nuestra serie reciente de URS Flex para el tratamiento de la litiasis renal. Para ello hemos revisado de forma retrospectiva éste tratamiento desde Enero de 2007 hasta Marzo de 2010. El tamaño medio de la litiasis tratada es de 1.5 cm (0.5-6 cm) y en todos los casos utilizamos vainas protectoras del ureteroscopio. La litotricia empleada en todos los casos fue láser de holmio con fibras de 200 y 365 micras.

RESULTADOS: El porcentaje de pacientes que quedaron libres de litiasis (stone free rate-SFR) tras la cirugía en el postoperatorio inmediato fue de 77/100 pacientes (77%) contabilizando como resto litásico fragmentos visualizados mediante la fluoroscopia del quirófano y la visión directa del URS Flex. A los 3 meses de la cirugía 89/96 pacientes (92.7%) estaban libres de litiasis comprobado mediante urografía intravenosa.

Respecto a las complicaciones destacar 5 pacientes con lesión ureteral durante la colocación de la vaina protectora y 9 pacientes que acudieron a urgencias en el postoperatorio por molestias secundarias al catéter doble J.

CONCLUSIÓN: Como conclusión podemos defender el tratamiento de las litiasis renales mediante URS Flex hasta un tamaño máximo de 2 cm siguiendo nuestro algoritmo terapéutico.


INTRODUCTION

Flexible ureterorenoscopy (Flex URS) has been little used to date, mainly because of the technical difficulties created by the deficient quality of the instruments used, such as ureteroscopes offering scant visibility, poor illumination, a small working canal, deficient quality of the forceps and baskets, etc. and limited a lot the medium life of this instruments with the high cost to the Service, especially if were used by several urologists.

The beginning of Flex URS can be founded in 1964 with a Marshall publication where it is described by first time an endoscopic exploration of the upper urinary tract (1), but Takayasu (2) in 1971 did it with a flexible instrument and published it. Later, we had to wait almost 20 years to start to see more frequently publications about this technique, thanks to the development of the modern ureteroscopes, like Bagley publications (3,4) in 1987 who proposed the guidelines of this technique.

At 90’s and 2000 is when really has become in an important approach with application in several centres like it can be see in many publications in those years almost to the treatment of staghorn stones (5).

However, in the last decade and particularly in the last 5 years, with the introduction of new and more resistant Flex URS offering improved imaging quality, the development of lasers and their fine-caliber fibers, and the design of a great variety of baskets allowing maximum URS flexion and deflection, the technique has increased greatly in popularity – with an expansion of its uses, indications and possibilities.

MATERIAL AND METHODS

We present our recent series of Flex URS for the treatment of renal lithiasis.

To this effect, a retrospective analysis has been made of this treatment corresponding to the period between January 2007 and March 2010.

All the surgeries were made by two Urologists of our Service (R.C and L.H) both with wide previous experience in endourology.

In this period we have treated 100 patients with a mean age of 51.7 years (range 24-84).

Intravenous urography was made to all patients prior to surgery in order to know the size and location of the stone, and choose the approach by Flex URS.

In all cases was made of Flex URS protective sheathes (Cook Urological Flexor® 12-14 Fr; Boston Scientific Microvasive Urology NavigatorTM 11-13 Fr; ACMI UroPass® 12-14 Fr).

For most of the procedures we used a Wolf Flex URS of external diameter 9 charrier, and occasionally (less than 10 surgeries) Gyrus ACMI’s digital ureterorenoscope DUR-D.

Fifty-seven percent of the patients were males and 43% females – lithiasis being located on the left side in 48 patients and on the right side in 52.

The size of the stones ranged from 0.5-6 cm, with a mean size of 1.5 cm.

128 stones were treated in 100 patients with the next anatomic distribution:

- 95 (74.21%) inferior calyx,
- 23 (17.96%) middle calyx,
- 8 (6.25%) superior calyx,
- 2 (1.56%) partial staghorn stones (Table I).
One of the treated patients had one stone of 4 cm from inferior calyx to renal pelvis and other stone of 2 cm on the superior calyx (complete stone mass treated of 6 cm) that was successfully treated in only one surgery.

The majority composition of the stones in each patient was:

- Calcium oxalate monohydrate 22
- Calcium oxalate dihydrate 29
- Magnesium ammonium phosphate 18
- Calcium phosphate 12
- Uric acid 18
- Cystine 1

**TECHNIQUE**

The patient lithotomy position should not be too forced, in order to facilitate easy passage of the protective sheath and Flex URS in as straight a manner as possible.

We usually begin by advancing a guidewire through the ureteral orifice to the renal pelvis or superior calyx, visualizing the stone under fluoroscopic control.

Posteriorly and through the guidewire, we pass a dilatation balloon catheter (we used Boston or Cook if depend of the disponibility in our Service) to dilate to 15 Fr from the ureteral orifice to the iliac ureter where necessary.

This is done because the protective sheath usually has an external diameter of 13-14 Fr, though the newer and finer Flex URS offer a smaller caliber. We insert a 10-12 Fr bladder catheter to ensure bladder voiding during surgery.

After dilating the ureter to the iliac crossing, we perform retrograde ureteropyelography to help control posterior passage of the protective sheath of the Flex URS, which is used in all cases.

The protective sheath is passed over the guidewire and is lodged in the renal pelvis. Posteriorly, we remove the protective sheath obturator with the guidewire, leaving only the protective sheath in the renal pelvis and the bladder catheter.

We agree with the team of Preminger in defending the use of the protective sheath of the Flex URS in all our procedures, since it not only helps during surgery to improve visibility, maintain low intrarenal pressures or facilitate the extraction of fragments, but moreover also considerably extends the service life of the Flex URS – thus ensuring considerable economical savings (5).

Although we never use a safety guidewire, the latter may be useful in some cases. Thus, if preferred by the surgeon, such a guidewire can be used without affecting performance of the technique.

Once the Flex URS is located in the renal pelvis, we attempt to locate the stone and guide it with the help of a basket towards a location allowing us to work in a straight line, such as in the superior calyx or renal pelvis.

Within the calyx, we have the added advantage of lesser stone mobility during laser fragmentation.

It is difficult to trap stones over 1.5 cm in diameter with the basket, since the maximum diameter of the latter is usually 1 cm. As a result, fragmentation must be started wherever the stone is located, and the resulting smaller fragments then can be moved to another location, or alternatively we can continue working in the same place if convenient.

Working in locations other than the inferior calyx is not only important for increased convenience during stone fragmentation operating in a straight line, but moreover also for facilitating spontaneous and easier expulsion of any residual stone fragments.

The laser fiber caliber may be 150-220-360 μm, though in very selected cases a 550 μm fiber

<table>
<thead>
<tr>
<th>TABLE 1.</th>
<th>Nº stones</th>
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<tr>
<td>Inferior calix</td>
<td>95 (74,21%)</td>
</tr>
<tr>
<td>Mid calix</td>
<td>23 (17,96%)</td>
</tr>
<tr>
<td>Superior calix</td>
<td>8 (6,25%)</td>
</tr>
<tr>
<td>Staghorn</td>
<td>2 (1,56%)</td>
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can be used working in a straight line. This latter fiber does not allow flexion, and forcing it may cause Flex URS rupture.

In contrast, the 150-220 μm fiber allows all degrees of flexion of the Flex URS, with improved visibility, since flushing is less limited as a result. In contrast, less laser power can be used, and the fibers are more fragile and vulnerable to rupture - with the consequent added costs.

In turn, the 365 μm fiber is the most used fiber in our experience and causes very little limitation in flexion, and since its diameter is greater, increased contact surface with the stone is achieved. As a result, fragmentation takes less time and a higher lithotripsy power rating can be used, with increased handling resistance of the fiber.

Blood in the working environment should be avoided as far as possible, since the Flex URS flushing canal would not afford good visibility.

In the presence of blood, the input flow pressure should be increased without worrying about intrarenal pressure increments, since we always use the protective sheath of the Flex URS and keep intrarenal pressure constant.

While we usually use a gravidity irrigation system, some times, we help us with a manual increasing presion using a 60 ml syringe connected to the Flex URS by saline system.

Once lithotripsy has been completed, that we start with 0.5 J and 5 Hz and growing depending of the stone hard, we use tipless nitinol baskets to extract the larger fragments through the protective sheath, avoiding the use of forceps through the Flex URS, since they may damage the instrument.

We try to leave as few fragments as possible, though the philosophy of this treatment is different from that of percutaneous nephrolithotomy (PNL).

In the case of Flex URS we perform in situ lithotripsy. As a result, residual lithiasic granules with or without residual fragments always remain, particularly in the case of larger stones. These small residual lithiasic granules or fragments are expelled spontaneously with the help of the doubleJ catheter left in place in most patients, and adopting postural measures with correct hydration, in a way similar to the protocol applied after extracorporeal lithotripsy.

In the case of particularly hard stones, we prefer to perform fragmentation only as far as needed, in order to extract as many fragments as possible and leave few residual particles for spontaneous expulsion or clearance. However, in the case of soft stones, fragments can be left behind after in situ lithotripsy which will be eliminated spontaneously during the postoperative period – thereby shortening the operating time.

FIGURE 1. View of lithiasis after lasertripsy.

FIGURE 2. Trapping lithiasis with dormia.
In certain cases the use of alpha-blockers can favor such elimination and improve catheter tolerance.

Patient evaluation is required 1-3 weeks after surgery to remove the double-J catheter, or after 6 weeks if there was ureteral damage. Posteriorly, after three months, urographic or URO-CT imaging control is indicated.

It is at this point where we can evaluate the presence of possible residual lithiasis and the need or not for some kind of treatment, depending on the clinical manifestations observed.

RESULTS

Of all the patients, we have only been able to report lithiasis-free rates corresponding to 96 subjects, since the remaining four are pending evaluation.

The mean surgical time was 72.3 minutes (range 30-120), and bleeding proved negligible in all cases, with no need for transfusions.

In 7 of the 100 patients the procedure was carried out without suspending antiplatelet medication, due to anesthetic recommendation.

In all patients lithotripsy was performed with the holmium laser, and the ureteroscope protective sheath was used in all cases.

After surgery most of the patients carried a pigtail catheter for three weeks, with the exception of 5 subjects in which the catheter was left in place for 6 weeks due to ureteral damage during placement of the protective sheath. In turn, two patients were discharged without a catheter, since the ureteral caliber in these cases was large.

None of the patients developed ureteral stricture in this period of time, though 9% (9 subjects) reported to the emergency room in the postoperative period due to discomfort associated with the double-J catheter, requiring oral anticholinergic or alpha-blocker medication and conventional analgesia. In no case did hospital admission prove necessary.

The stone-free rate (SFR) in the immediate postoperative period was 77% (77/100 patients). Li-
thiastic remains, defined as stone fragments visualized in the operating room via fluoroscopy and directly with the Flex URS.

Three months after surgery, the SFR was 92.7% (89/96 patients) confirmed by intravenous urography.

The remaining 7 patients with residual lithiasis are asymptomatic (residual fragments less than 5 mm in all cases) and to date no subject has required repeat treatment.

**DISCUSSION**

Flex URS has gained popularity in recent years thanks to development of the new generation ureteroscopes, increased surgeon experience and the efficacy and safety of the treatment.

Other advance is the systematic use of the protector sheath.

We share the opinion of Preminger (6) in order to defend his use that we do in all cases, and we think that it is an important point because one of the hardest critic to the Flex URS is the short life and his elevated cost in reparations, that it can be minimize with the systematic use of the protector sheath.

In those cases that we need dilatation, we prefer to use catheter balloon because despite a mayor cost, it give us more safety and minimize the risk of ureteral damage comparing with dilatation made by the protector sheath directly.

With the catheter balloon we made a wide expansion of de diameter of the ureter and when it is dilated, we can pass the sheath without any difficult.

With the directly dilatation made by the sheath, we are making a double aggression to the ureter like is the dilatation and the traction to ascend the sheath, so we think that it is a worse aggression and that you are not going to be always allow to pass correctly the sheath without any ureteral lesion.

We have to remember that the more frequent protector sheath gauges used are 12-14 Fr (internal-external) that is the most used in our Service, or 13-15 Fr.

Thus, in 2005, Pearle, Lingeman et al. (7) published their comparative series versus extracorporeal shock wave lithotripsy (ESWL) in 67 patients with stones 1 cm in size, reporting a stone-free rate (SFR) of 50%.

Respect to the stone size to treat, the limit has been growing with the experience of the Urologists, but also the stone free rate is worst with the mayor size of the stone treated.

So we can see that Wong (8) established a limiting size of 1.5 cm in the lower pole for treatment with Flex URS, while Grasso and Ficazzola, with 90 treated lower pole stones, reported a SFR of 95% three months after surgery for stones under 2 cm in size, versus 82% for stones over 2 cm in size (9).

In 2008, Chung et al. compared percutaneous nephrolithotomy (PNL) and Flex URS in application to stones measuring 1-2 cm in size. Both the SFR and the number of complications were greater with PNL, though the differences were not statistically significant (10).

That same year, Breda offered new data on the use of Flex URS in his series of 21 treatments of stones measuring up to 4 cm in size (11).

The SFR in this case was 93.3% despite the need for several treatments (up to 3). Although other authors have also reported good results (SFR 75-95%) with large stones, such as the series published by El-Anay et al. (12), other investigators such as Miller and Lingeman, and Mc Dougall, have reported a SFR of 95% with PNL in a single procedure in application to stones measuring over 2 cm in size (13,14).

In 2009, Breda published another series involving 51 patients with multiple kidney stones (3.1 per patient on average, with a mean size of 6.6 mm).

The mean surgical time was 65 minutes, and the SFR for stones under 2 cm in size was 100%, versus 85.1% for larger stones (with even 2 procedures per patient) (15).

In turn, Mariani published his series of Flex URS applied to stones over 4 cm in size in patients with numerous comorbidities. In certain cases several Flex URS sessions were found to be better than PNL or open surgery (16).

In the case of large stones, the “popcorn effect” technique may be of use, since it shortens the operating time and is truly effective.

This technique involves application of the laser without the need for direct contact with the surface of any concrete stone. Rather, the laser is continuously pulsed at high frequency, generating a centripetal...
circuit over the stones, which are fragmented without having to move the fiber (17).

This technique works best with moderate to low hardness stones, and the authors recommend the combination 1 J and 20 Hz, though we usually use the combination 1-1.4 J and 10 Hz. to reach this effect.

Consideration is required of the principle demonstrated by Sampaio and Aragao in relation to lithiasic clearance (18).

Obviously, the larger the size of the stone, the greater the percentage residual lithiasis. However, we consider it a mistake to evaluate the results in the immediate postoperative period, unlike in the case of PNL.

After Flex URS treatment, we must wait a few months, in the same way as in evaluating some cases of extracorporeal lithotripsy (ESWL). The fragmented stone need not be eliminated immediately, since much of it may be pulverized or leave small fragments that can be identified by imaging techniques. We must wait at least 1-2 months to determine the true success of treatment after spontaneous lithiasic clearance.

This explains the improvement in SFR in our series over time (77% immediately after the procedure versus 92.7% after 3 months).

The double-J catheter may be of help in facilitating expulsion of the residual stone fragments.

With respect to those patients with residual fragments after surgery, we use to do what recommends the Guidelines on Urolithiasis 2010 (14. Residual Fragments, table 25) of the European Association of Urology. They recommend us to follow up residual fragments less than 5 mm in asymptomatic patients.

Like we have mentioned previously, our patients have the double J catheter during 3 weeks postoperatively.

Although admittedly three weeks with the double-J catheter may be excessive (perhaps one week being enough), the planning of follow-up in our Service makes it difficult to control the patients sooner and thus remove the catheter earlier.

One of the main limitations of Flex URS is an unfavorable anatomy, as commented by Geavlete in his article on the influence of the pyelocaliceal anatomical features upon the success of Flex URS (19).

In our case, and thanks to the experience gained in our Service with PNL since 1986, we consider that an important limitation would be represented by patients previously subjected to open renal surgery (open pyelonephrolitotomy), with a certain degree of residual pyelic retraction and fibrosis that would not allow correct distension of the upper via with the irrigation fluid and thus difficult the creation of sufficient space to work comfortably. This is what we have observed in patients with such surgical antecedents in which PNL was posteriorly carried out – though we do not have experience with Flex URS in these cases.

Smith and Patel evaluated the impact of Flex URS in the management of nephrolithiasis and confirmed its benefits in obese patients or subjects with bleeding alterations, as an alternative to ESWL or PNL.

The authors underscore that in certain cases where treatment is limited to vaporization of the stone, the existence of anatomical difficulties can lead to treatment failure in the same way as in ESWL, since the stone fragments cannot be eliminated and thus become consolidated again – in coincidence with the observations of Holland et al. (20,21).

It must be pointed out that although the SFR is more limited than in PNL, considerations such as cost, invasiveness and the number and clinical importance of the complications define Flex URS as a better option when the stones measure about 2 cm in size.

At present, we consider that if the stone can be effectively treated in a single operation, patient acceptance and satisfaction may be superior even if the surgical aggression involved is greater.

Therefore, we use PNL for stones over 2 cm in size, and only perform Flex URS if the stone shows low radiological density (allowing easy and rapid fragmentation) and the patient anatomy is favorable for correct spontaneous elimination of the residual fragments (Table II).

In the case of stones measuring 1-2 cm in diameter, we consider Flex URS to be the treatment of choice.

Although we feel this to be a good treatment algorithm, we are aware that it must be adjusted to the particular conditions of each center, such as the availability of ESWL or stone fragmentation performance, which may influence the best indication in each case.
Another interesting field is represented by pediatric patients. Flex URS has been shown to be an alternative to ESWL or at least a valid treatment option, offering high efficacy and low morbidity – as demonstrated by the 88% SFR reported by Corcoran in 2007 in a series of 47 patients with a mean age of 9.4 years, or by Kims et al. in 170 patients aged 62.4 months on average, with a 100% SFR in application to stones measuring under 1 cm in size, versus 97% in those measuring over 1 cm in diameter (this figure increasing to 100% after a second session) (22,23).

The technique has been shown to be safe not only in pediatric patients but also in pregnant women (24) and in subjects receiving anticoagulation or antiplatelet treatment – as demonstrated by the series published by Turna, involving 37 patients, of which only three presented postoperative hematuria that did not require transfusion (25).

In certain cases the presence of a preoperative catheter may facilitate surgery, passage of the protective sheath, and extraction of the fragments – though this does not justify the prior catheterization of all patients, as commented by Shields et al. (26).

Hyams and Shah compared the costs and results of PNL versus Flex URS in application to stones measuring 2-3 cm in size. The latter technique was found to be less expensive than PNL, and equally valid in terms of the results obtained (27).
CONCLUSION

Flex URS treatment of renal lithiasis can be defended in application to stones measuring up to 2 cm in diameter, based on our treatment algorithm.

We consider that in expert hands, Flex URS moreover can be a safe alternative to PNL in certain cases involving larger stones.

REFERENCES AND RECOMMENDED READINGS (*of special interest, **of outstanding interest)