Critical analysis of treatment options for proximal ureteral calculus
Análise crítica das opções de tratamento para câlculo ureteral proximal

Antonio Corrêa Lopes Neto¹, Eric Roger Wroclawski²

ABSTRACT
Ureteral lithiasis is a prevalent problem that may cause painful renal colic. When interventions are necessary, various techniques may be employed. Endourological techniques and minimally invasive procedures are the preferred options to treat lithiasis and they dramatically reduced indications for open conventional ureterolithotomy. The most recent guidelines for treating urinary stones, published in 1997 and based on a meta-analysis of literature data, recommends extracorporeal shock-wave lithotripsy as the first option to treat most ureteral calculi. After the publication of this guideline, some studies presented excellent results using narrower endourological instruments, laser energy source, and laparoscopic ureterolithotomy. These publications support the use of the techniques to treat ureteral stones, which will probably be included in the next updated guideline. Particularly for proximal ureteral calculi, the results of extracorporeal shock-wave lithotripsy and endourological techniques have been inferior when compared to other ureteral segments, mainly when stones are larger than 10 mm. The new approaches and studies demonstrated better results than those published in the 1997 guidelines, which may be altered in relation to treatment of proximal ureteral stones. This review assesses the results of current options to treat proximal calculi and suggests a treatment algorithm.

Keywords: Urinary calculus; Ureteral calculi/therapy; Ureteroscopy; Ureteroscopes; Lithotripsy

INTRODUCTION
Urinary lithiasis is a very common condition in Brazil. When obstructive lithiasis occurs, it causes painful renal colic that frequently forces patients to seek urgent medical care. After clinical improvement, diagnostic investigation aims to determine the calculus location, size and its effect on the urinary tract. With this information and awareness of the treatment options, the best strategy can be provided for a quick and efficient cure.

The endourological breakthroughs and the emergence of minimally invasive procedures have changed the therapeutics of urinary lithiasis, providing excellent results with low morbidity and rapid recovery. Open surgery has slowly become an exception to the rule and it is currently used in the absence of endourological material, failure of using minimally invasive techniques or the presence of anatomic irregularities and combined surgeries.

Due to the availability of several treatment options, it is necessary to establish consensus and guidelines in order to define the best approach for each condition.

¹ MD; Assistant physican of the Discipline of Urology, Responsible for the Urinary Lithiasis and Endourology group, Faculdade de Medicina do ABC – FMABC, Santo André (SP), Brazil.
² Adjunct and Regent Professor of the Discipline of Urology, Faculdade de Medicina do ABC – FMABC, Santo André (SP), Brazil.

Corresponding author: Antonio Corrêa Lopes Neto – R. Ramon Penharrubia, 130 – Sala 302 – Bela Vista – CEP 01340-140 – São Paulo (SP), Brazil – Tel.: 11 3288-1003 – e-mail: lopes.neto@superig.com.br

Received on May 21, 2006 – Accepted on Jul 18, 2006
based on a thorough literature review and the opinion of experts. As far as ureteral calculi are concerned, the last guideline published in 1997 recommends the use of extracorporeal lithotripsy (ESWL) as the 1st treatment option for most ureteral calculi.

Particularly concerning proximal ureteral lithiasis, the results of ESWL and endourological techniques are less successful compared to other segments of the ureter, especially if the calculi are larger than 10mm.

New approaches and publications after 1997 have demonstrated better results than those published in the guideline, which may change the procedures in future consensus.

**OBJECTIVE**
The goal of this review is to evaluate, through the literature, the results of each procedure and express our opinion about the therapeutic options for proximal ureteral lithiasis. Based on the results of this research, we will propose a guideline for the treatment of proximal ureteral calculi.

**METHODS**
A literature review was conducted and the results of several types of treatment for proximal ureteral calculi were evaluated. The bibliographic search was carried out using the medical literature (MEDLINE) and some non-indexed urology journals, from 1980 to 2006. Emphasis was given to articles published after 1997, when the last guideline on the topic was issued, which was based on a prior meta-analysis.

Several types of studies were evaluated: comparative, retrospective and prospective studies, meta-analyses, isolated results taken from selected series and from the last guideline. After 1997, no other meta-analysis about the topic has been published. Thus, we have found interesting information in prospective or retrospective comparative studies.

**RESULTS**
To better display our findings, we chose to sort the results within each treatment option. Currently, all possible approaches to treat calculi in this site are listed in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Treatment options for proximal ureteral calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ Expectant clinical management</td>
</tr>
<tr>
<td>▶ Extracorporeal shock-wave lithotripsy (ESWL)</td>
</tr>
<tr>
<td>▶ Semi-rigid / flexible retrograde ureteroscopy with laser lithotripsy</td>
</tr>
<tr>
<td>▶ Percutaneous anterograde ureteroscopy</td>
</tr>
<tr>
<td>▶ Conventional ureterolithotomy</td>
</tr>
<tr>
<td>▶ Laparoscopic or retroperitoneoscopic</td>
</tr>
</tbody>
</table>

So far, we have followed the guidelines of the American Urology Association, based on a meta-analysis of the literature and on the opinion of experts in the matter.

For proximal ureteral calculi smaller than 10 mm, recommendations rate ESWL as the first option of treatment. If ESWL is not successful, ureteroscopy and percutaneous access are then attempted. The conventional open ureterolithotomy is an exception procedure due to its greater morbidity, despite providing excellent stone-free results.

When these calculi are larger than 10 mm, ESWL results are inferior; therefore the panel suggests that percutaneous access and ureteroscopy are acceptable procedures.

Another recommendation is to consider an expectant management, especially for calculi that are smaller than 5 mm.

This guideline was published in 1997 and some of the procedures listed in table 1 had no support and sufficient number of publications in the literature to be considered a treatment option. The development of flexible materials, laser energy sources and laparoscopy may change this scenario.

Probably, when an updated guideline becomes available, some of these procedures will appear in the recommendations to manage proximal ureteral calculi.

**Expectant clinical treatment**
The various minimally invasive alternatives for treatment of ureteral lithiasis should not encourage urologists to intervene in cases that can be solved spontaneously.

Some studies demonstrated that the probability of spontaneous elimination of the ureteral calculi, especially when smaller than 5 mm, vary from 56 to 98%. We know that, for proximal calculi, the success rate is greatly reduced (table 2), reaching values which are much lower, as reported by Morse et al., who found only 22% of spontaneous elimination for proximal calculi.

On the other hand, for medial and distal cases, the rate increased to 46% and 71%, respectively.

| Table 2. Spontaneous elimination rates based on size and site of calculus |
|----------------------------------------|-------------------|-------------------|
| Calculus < 5mm | 29 – 98 % | 10 – 53 % |
| Calculus 5 – 10mm | 71 – 98 % | 25 – 53 % |

Miller and Kane followed up 75 patients with ureteral calculus and 83% of them were monitored until spontaneous elimination. The results for proximal ureteral calculi are displayed in table 3.
One line of research showed an increase of 32 to 44% in elimination rate when patients were given corticosteroids, calcium channel blockers and antibiotics\(^1,5\). When the expectant management is chosen, the use of such medication may be encouraged, even before the fact that proximal calculi have a smaller chance of spontaneous elimination. Alpha-blockers are useful only for distal intramural ureteral lithiasis.

**ESWL**

Since the first studies published by Chaussy, in 1980\(^6\), the excellent results of this type of treatment have been reported by means of several studies, and today it is considered as the first treatment option for most renal and ureteral calculi.

As to proximal ureteral lithiasis, the results of the guideline show that when the size of the calculus is less than 10 mm, the average success rate may be as high as 87%. This rate is reduced to 76% when the size of the calculus is larger than 10 mm and, in this case, further treatment is often required\(^2\).

Lam et al. found 80% of success with ESWL for calculi smaller than 10 mm, and 50% when their size is larger than 10 mm\(^7\).

Unlike the results shown above, Parker et al. used ESWL to treat proximal ureteral calculi that were smaller than 10 mm and obtained a “stone-free” rate of only 55%\(^8\). Other ESWL results are expressed below in comparative studies with ureteroscopy.

**Semi-rigid / flexible retrograde ureteroscopy**

After release of the 1997 guideline, several studies were performed, especially comparative ones, to evaluate the efficiency of ureteroscopy (URS) for treating proximal ureteral calculi. Considering that the results of ESWL in calculi larger than 10 mm yields less than ideal results, these studies indicate URS as the best option for these cases.

The results of URS also underwent an evolutionary aspect regarding device caliber and the energy source used for lithotripsy. In 1989, Liong et al. used devices with a caliber of 9.5 to 12 Fr and they managed to reach a 74% stone-free rate, and if insignificant fragments were also taken into account, the rate was 79%\(^9\). Likewise, using a ballistic lithotriptor and an 8.5-10 Fr ureteroscope, Ather treated calculi measuring 12 to 14 mm and reached a 75% stone-free rate\(^10\). In 1999, despite using thin ureteroscopes and a pneumatic energy source, Hamano reached a 72.8% stone-free rate for calculi larger than 9 mm\(^11\). With the same equipment, Lopes Neto obtained only 50% of success for calculi in proximal ureter. Push-up was the main cause of failure\(^12\).

With technology evolution, the use of thin caliber or flexible ureteroscopes, associated to laser lithotriptor allowed higher stone-free rates. Such equipment helps to access the higher ureter and this type of energy source reduces impulsion of the calculus and the incidence of push-up to the renal pelvis.

Wu et al. compared the ESWL and URS techniques for 80 proximal calculi larger than 10 mm and the rate of success was 61% and 92%\(^13\), respectively. The same authors extended their clinical studies and in the following year they presented 220 cases: the use of semi-rigid ureteroscopy with a lithotriptor laser resulted in 98% of accessibility to calculus and an 83% stone-free rate; on the other hand, ESWL led to only 63.9% of calculi disintegration\(^14\).

In a similar study, Lam et al. have obtained 93% of success against 50% for ESWL\(^7\).

**Anterograde ureteroscopy**

The renal percutaneous access to proximal ureter is an excellent option for impacted and large ureteral calculi. In order to be reached with a rigid nephroscope, a calculus should be near the ureteropelvic junction (UPJ) and the puncture must usually be in the medial or upper calix. The use of flexible material allows access to calculi that are located farther down the JUP.

A study performed by Maheshwari et al. showed 100% of success with anterograde access, whereas only 55% of retrograde access was capable of solving the problem and in 45% of cases, the calculus moved to the kidney\(^15\).

Goel et al. also reported excellent results (98.5% of success) with the anterograde access and they suggested this option for extremely impacted calculi, which are larger than 15 mm and located up to the height of the fourth lumbar vertebrae\(^16\).

**Laparoscopic or retroperitoneoscopic ureterolithotomy**

This type of treatment is described in the literature as an option for calculi that have not been eliminated through ESWL and URS, or for large, dense and impacted calculi.

---

**Table 3. Spontaneous elimination time of proximal ureteral calculi**

<table>
<thead>
<tr>
<th>Size</th>
<th>Number of cases</th>
<th>Mean elimination time</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 2 mm</td>
<td>03</td>
<td>5.7 days (1-14)</td>
</tr>
<tr>
<td>2 – 4 mm</td>
<td>04</td>
<td>7 days (2-11)</td>
</tr>
<tr>
<td>&gt; 4 mm</td>
<td>06</td>
<td>53 days (15 – 105)</td>
</tr>
</tbody>
</table>
A few series published showed success rates of 90–100% for proximal ureteral calculi\(^{17-18}\).

Perhaps the largest series of studies was conducted by Gaur et al., who performed 101 procedures in calculi measuring 10-47 mm (mean of 16 mm), in which 75 of them were located in the proximal ureter. The calculus was completely removed in 92% of cases\(^\text{(19)}\).

**Conventional open ureterolithotomy**

The benefits of minimally invasive procedures restricted the role of this procedure for treating ureteral lithiasis. Open ureterolithotomy require longer hospitalization and recovery time, and give poorer aesthetic results.

Ather conducted a study and concluded that the indications for this approach dropped from 26% (between 1987 and 1995) to 8% (between 1996 and 1998)\(^\text{(20)}\).

Currently, this option should be considered for endourological techniques, anatomical abnormalities, concomitant surgeries, in locations with no access to technology and in large proximal ureteral impacted calculi, although laparoscopic procedures have been gradually being used instead\(^\text{(20)}\).

**DISCUSSION**

This literature review allowed us to observe that technological evolution and the emergence of new treatments for proximal ureteral calculi forces us to keep updated and to analyze results, in order to check if we are providing patients with the best therapeutic approach.

It is verified that expectant management for proximal ureteral calculi should be considered, especially for calculi smaller than 5 mm\(^\text{(3-4)}\), except in the cases in which there is an associated infection, impaired renal function or excruciating pain, which demand prompt action for treatment. It should be noted that the rate of spontaneous elimination is smaller in the proximal ureter, but this should not rule out this option, which should be offered to the patient.

For calculi that are up to 10 mm wide, there is evidence in the medical literature, based on the 1997 meta-analysis and other articles\(^\text{(2,7,8,21)}\), that ESWL should be the first treatment option. Currently two ESWL attempts should be tried prior to considering other minimally invasive procedures.

When the calculi are larger than 10 mm, due to the poorer results obtained with ESWL, various comparative studies demonstrated the advantage of rigid ureteroscopy compared to ESWL. And this advantage was even greater when flexible material was used in conjunction with a laser energy source\(^\text{(7,9,11-14)}\).

The cases in which rigid ureteroscopy is not successful are usually due to the inability of accessing the calculus or due to push-up to the kidney. The use of a stone cone placed above the calculus serves as a barrier against its migration to the kidney. Maislos et al. reported 19 cases treated using this type of catheter and there was no migration of fragments, resulting in 100% of success\(^\text{(22)}\).

Other than the push-up, another cause for the failure of semi-rigid ureteroscopy is a difficult access to the calculus. An interesting study published in the Journal of Endourology demonstrated that the access to proximal ureter was easier by exerting pressure on the lower abdomen during a URS with a semi-rigid device 7.5 Fr in 50% of cases, and it was effective in 56% of them\(^\text{(23)}\).

The drawbacks are high cost and low durability of flexible devices and high cost of a laser lithotripter and its fibers. Therefore, most urological centers in Brazil are unable to acquire such equipment.

When endourological treatment is not successful for very large and impacted calculi located in the proximal ureter, the retroperitoneoscopy is a favorable option. The excellent results obtained with this technique make it a treatment option for proximal ureteral calculi\(^\text{(16-18)}\). It may be used especially for larger calculi that present poorer results with endourological techniques and those that may require further treatment.

In spite of the excellent results yielded by laparoscopy and fewer chances of further treatment, its morbidity seems to be greater than that of ESWL and/or ureteroscopy, both from the anesthetic and surgical viewpoints, although we have not found any comparative studies to confirm this hypothesis. Therefore, we should not consider it as a first line treatment for proximal ureteral calculi.

Following this rationale, the anesthetic/surgical injury inflicted in the retrograde percutaneous approach seems more similar to the laparoscopic ureterolithotomy, which can really be the technique of choice whenever the retrograde percutaneous access is the selected option. Regarding open ureterolithotomy, this procedure is described practically in the recent literature, except in exceptional cases, such as giant ureteral calculi\(^\text{(20)}\).

**CONCLUSION**

The ideal treatment for urinary lithiasis aims at the disintegration of the calcareous mass in the least invasive manner and using the smaller number of procedures. To reach this goal, there are several therapeutic options available, and their selection should be based on the size, location of the calculus and the results described in the literature.
After analyzing the studies about the theme, one can say that the new guideline for treatment of proximal ureteral calculi will probably bring many changes as compared to the one published in 1997. With this publication in mind, below we include a suggestion for a treatment algorithm for proximal ureteral calculi that have not been eliminated spontaneously.

![Algorithm to treat proximal ureteral calculi](image)

**REFERENCES**


