Treatment of ureterolithiasis with the use of percutaneous antegrade ureterolithotripsy

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Study purpose – to assess the possibility of percutaneous antegrade ureterolithotripsy as an alternative treatment for patients with large calculi of the proximal part of ureter.

Patients and methods. Results of 75 mini percutaneous antegrade ureterolithotripsy with contact lithotripsy were studied. The mean size of the ureteral calculi was 1.8 ± 0.7 cm. The operations were performed with epidural anesthesia with intravenous sedation, in the patient’s position ‘on the abdomen’ in 62 (82.7 %) cases and in the patient’s position ‘on the back’ in 13 (17.3 %) cases. Puncture of the renal cavity system was performed with combined ultrasound and fluoroscopic guidance. Accesses were performed through the lower calices group in 14 (18.7 %) cases, through the middle calices group in 39 (52.0 %), and through the upper calices group in 22 (29.3 %) cases.

Results. The mean time of mini percutaneous antegrade ureterolithotripsy was 58.5 ± 14.5 min, while the stone free rate was achieved in all 100% of patients. The mean level of hemoglobin drop was not more than 15.5 ± 5.4 GM/DL. In the postoperative period, aggravation of pyelonephritis was noted in 8 (10.6 %) patients. Nephrostomy drainage followed percutaneous antegrade ureterolithotripsy in 24 (32.0 %) cases, nephrostomy drainage and internal ureteral JJ stent in 33 (44.0 %), and the operation was ended with a tubeless method with only ureteral JJ stent placement in 14 (18.7 %) cases. Nephrostomy drainage, as well as ureteral stants (with tubeless method), were removed in 1–2 days. The mean period of postoperative stay of patients in the hospital was 2.3 ± 0.8 days. It was noted that antegrade fiberureteropyeloscopy is an extremely time-consuming and cost-demanding method, as an alternative to which may be percutaneous antegrade ureterolithotripsy with use of mini-nephroscope tubes.

Conclusions. Analysis of urolithiasis treatment with the method of mini percutaneous antegrade ureterolithotripsy indicates that this method is an attractive direction in the treatment of patients with large calculi of the proximal part of ureter that allows achievement of the full stone free rate state, time of surgical treatment and hospital stay for patients with this pathology reduction.

Key words: ureterolithiasis, percutaneous lithotripsy, mini percutaneous nephrolithotripsy.
anestesie with intravenous sedation in the position of the patient on a bed in 62 (82.7 %) cases, in 13 (17.3 %) cases in the position of the patient on the table. Function of the complete system of the perineum was performed under combined ultrasonic and fluoroscopic examination. In the absence of a group of access that are performed in 14 (18.7 %) cases, through the median — in 39 (52.0 %), and through the suprapubic — in 22 (29.3 %) cases.

**Results.** In the period of 2014-2017, 75 mini-percutaneous nephroscopy and 65 antegrade percutaneous antegrade ureterolithotomy (PAULT) with contact lithotripsy. The average size of the ureteral calculi was 1.8 ± 0.7 cm. There was bilateral ureterolithiasis in 17 (22.0 %) cases, married women were aged from 23 to 69 years. The mean size of the ureteral calculi was 17 (22.0 %) women and 41 (54.7 %) men.

**Patients and methods**

During the period from 2014 to 2017, 75 mini percutaneous antegrade ureterolithotomy (PAULT) with contact lithotripsy were performed in P. L. Shupyk National Medical Academy of Postgraduate Education, on the basis of the Kyiv Regional Hospital and Kyiv City Hospital No 6. Among the patients, there were 34 (45.3 %) women and 41 (54.7 %) men aged from 23 to 69 years. The mean size of the ureteral calculi was 1.8 ± 0.7 cm. There was bilateral ureterolithiasis in 17 (22.0 %) women.

Thus, despite the availability of various methods of ureterolithiasis treatment, there is still no ideal, effective and absolutely safe method of calculus removal from the middle and upper third of the ureter. A number of other factors influencing the choice of methodologies should be noted, in particular, the method available in the clinic with its pros and cons is often offered to a patient. At the same time, priority is given to the method that is better mastered and for which technical support is provided. In turn, the technical level of hospital provision, availability of various endoscopes, fiberscopes, laser lithotriptors, X-ray and ultrasound devices, and most importantly — qualified and sufficiently experienced in the above method personnel, are crucial when applying a method or their combination in the treatment of proximal ureterolithiasis.

**Study purpose**

To assess the possibility of percutaneous antegrade ureterolithotomy as an alternative treatment for patients with large calculi of the proximal part of the ureter.
When performing endourological operations, the following endoscopic equipment, manufactured by Karl Storz (Germany), was used: a rigid ureteroscope 6.8–8.0 Ch, a FLEX X fiberureteropyeloscope (7.5 Ch) and a rigid mini-nephroscope with a set of tubes (14, 16, 21 Ch) for mini-percutaneous nephrolithotripsy performing (m-PNL).

All operations were performed with epidural anesthesia with intravenous sedation, in the patient’s position “on the abdomen” (prone position) in 62 (82.7 %) cases and in the patient’s position “on the back” (supine position – Valdivia position) in 13 (17.3 %) cases. Puncture of the renal cavity system was performed with combined ultrasound and fluoroscopic guidance. Access to the kidney was performed through the lower, middle and upper calices groups. The choice of an access point was based on geometric anatomy between the caliceal neck and the proximal ureter part. We tried to access to pyelocaliceal system through that calix, which axis of the neck had an obtuse angle with the axis of the upper third ureter. Thus, accesses were performed between the caliceal neck and the proximal ureter part. We tried to access to pyelocaliceal system through that calix, which axis of the neck had an obtuse angle with the axis of the upper third ureter. Thus, accesses were performed through the lower calices group in 14 (18.7 %) cases, through the middle calices group in 39 (52.0 %), and through the upper calices group in 22 (29.3 %) cases.

In a number of cases with multiple kidney calculi additional access to the kidney cavity system was used that occurred in 11 (14.7 %) patients.

Direct contact lithotripsy was performed using a holmium laser of the Domier H-20 and a pneumatic lithotriptor of Karl Storz.

It should be noted that all endoscopic interventions were performed only in the absence of an acute phase of inflammatory process in the upper urinary tract (UUT). One of the predisposing factors contributing to the percutaneous antegrade ureterolithotripsy performance was the presence of detected earlier functioning percutaneous nephrostomy for obstructive calculi of the proximal parts of ureter in 23 (30.7 %) cases.

The statistical processing of the data was carried out using the Statistica software package (version 6.0, StatSoft Inc., USA). Reliability of the difference in a number of parameters between groups of patients was determined on the basis of Student’s t-test. The results of the analysis were considered statistically significant at the level of P < 0.05.

Results and discussion

When choosing the tactics for calculus of the proximal part of ureter treatment, we took into account the following criteria: the size of the calculus and the duration of its “standing” in the ureter, state of urodynamics (degree of pyelocecal system dilatation), functional state of the kidney and anatomical state of the ureter below calculus standing (its luminal diameter, tortuosity, presence of strictures below the calculus standing).

We determined the following indications for percutaneous nephrolithotripsy (or m-PNL) with calculus of the proximal part of ureter: calculus with a total mass of more than 1.0–1.5 cm; technical difficulties in performing the retrograde ureteroscopy; technical contraindications to remote lithotripsy or lack of remote crushing efficacy.

Acute purulent obstructive pyelonephritis (or pyonephrosis) against the background of upper or middle third of the ureter calculus; the presence of extensive ureter stricture, its high shift, an additional vessel of the kidney should be considered as contraindications to the PAULT application. In such cases surgical correction of these states is indicated above all.

The percutaneous antegrade ureteroscopy was performed directly after the percutaneous access to the kidney using mini-nephroscope tubes and doing the nephroscopy, followed by entering the nephroscope optics in the proximal part of ureter and performing the ureteroscopy.

It was noted that the performance of both m-PNL and percutaneous antegrade ureterolithotripsy allowed only lithoxtraction of whole calculi 0.5–0.7 cm from the proximal parts of ureter or from the kidney cavity moved to the pelvis during ureter catheterization before the main stage of m-PNL performance. In particular, this variant of litholapaxy was successfully performed in 21 (28.0 %) cases, while the time of the operative intervention main stage (access to the kidney, dilatation of the nephrostomy channel, nephroureteroscopy, litholapaxy, nephrostomy drainage procedures) was 17.3 ± 5.2 minutes in average.

With calculus of the proximal part of ureter more than 0.8–1.0 cm and especially long standing (impacted), their movement into the renal cavity system was not always successful. In these cases, the retrograde ureteral catheter was placed distal to the calculus and the irrigation fluid, flowing through it, prevented calculus fragments distal migration when percutaneous antegrade ureterolithotripsy performing.

The mean time of percutaneous antegrade ureterolithotripsy (the main stage of the operation with the lithotripsy) was 58.5 ± 15.4 min, while the stone free rate was achieved in all 100 % of patients. Such complications as bleeding were not noted, the mean level of hemoglobin drop was 15.5 ± 5.4 GM/DL. In the postoperative period there was a slight aggravation of pyelonephritis (subfebrility to 37.5) in 8 (10.6 %) patients, which was stopped by the antibacterial therapy intensification.

With long standing calculi in the ureter an internal ureteral JJ stent was placed by the antegrade method after the lithotripsy and litholapaxy. Thus, the nephrostomy drainage was placed in 24 (32.0 %) cases, nephrostomy drainage and internal ureteral JJ stent was placed in 33 (44.0 %), and the operation was ended with tubeless method and ureteral stent placement according to the Shpall method in 14 (18.7 %) cases. Nephrostomy drainage, as well as ureteral stents (with tubeless method), were removed in 1–2 days. The mean period of postoperative stay of patients in the hospital was 2.3 ± 0.8 days. The duration of the ureteral stent application was determined individually and it was 2.1 ± 0.8 weeks in average.

In the course of the work, we were faced with very important moments, both tactical and technical. Thus, access to the renal cavity system was performed as standard with the use of the mini-nephroscope tubes and we proceeded directly to contact lithotripsy of the calculus in the kidney or ureter after renal system examination. However, in cases where it was impossible to reach the calculus in the upper or middle third of the ureter by a nephroscope or as a result of calculus fragments distal migration along the ureter, the nephroscope was removed and a ureteroscope (flexible or rigid) was entered through a tube to a point, where the calculus stands in the ureter, and the lithotripsy was performed there. The fragments were extracted with forceps.
or washed through the tube of the nephroscope (together with the ureteroscope) by intensive fluid flow through a pre-placed ureteral catheter.

Analyzing the procedure of percutaneous antegrade ureterolitholapaxy and its results of treatment, it has been noted that the antegrade approach is a safe and effective option for ureteral calculi treatment in individual patients. And the use of the nephroscope tube allows for large fragments of calculus evacuation that significantly reduces the time of operation. These conclusions have been noted by previous researchers [7–10]. However, a number of authors believe that with large ureteral calculi the frequency of urethral injury and the percentage of ureteric stricture development in the antegrade approach are higher than in retrograde ureteroscopy [9, 10]. To prevent these complications they recommend using a smaller caliber ureteroscope and avoiding the ureteral mucosal damage during lithotripsy, which is achieved using a flexible ureteroscope that usually has a smaller caliber than a rigid or semi-rigid ureteroscope, and using an ureteroscope with a casing can reduce friction between the mucosa ureter and ureteroscope. Also, the use of a laser lithotripter avoids direct thermal damage and reduces the risk of mechanical mucosa damage by calculus fragments compared to other lithotripters.

However, in our opinion, the method of the antegrade flexible ureteroscopy has two peculiarities, on the one hand, it is of less traumatic treatment and allows the successful passage of “complex” ureteral areas, as well as a highly efficient for calculus lithotripsy, but on the other hand, it is extremely time-consuming and long-lasting at stages of lithotripsy and litholapaxy, especially with large calculi of the ureter (more than 1.0 cm) and, importantly, cost demanding. Therefore, its use is necessary in complex cases of antegrade ureteroscopy.

Conclusions

Analysis of experience gained in urolithiasis with application of antegrade mini percutaneous ureterolitholapaxy treatment indicates that this method is an attractive direction in the treatment of patients with large calculi of the proximal parts of ureter which are not suitable for retrograde ureteroscopy options, that allows achievement of the full state of stone free rate, reduction of not only the time of surgical treatment and the length of stay in the hospital, but also the number of repeated operations for residual calculi in patients with this pathology.

However, for this technique more active application more extensive and in-depth studies are needed.

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