
MANAGING STAGHORN KIDNEY STONES: A STUDY ON THE EFFECTIVENESS OF MULTI-ACCESS PERCUTANEOUS NEPHROLITHOTRIPTY

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Abstract.

Introduction: to increase the effectiveness of treatment of patients with staghorn and multiple nephrolithiasis by improving percutaneous nephrolithotripsy using a multi-access method.

Methods: 29 patients with staghorn and multiple kidney stones, aged 15 to 63 (29.3±4.3) years, were treated. The average stone size was 65.4±5.2 mm.

Results: in 20 patients (69.0%), the operation was performed through 2 accesses, in 8 (27.6%) - through 3, and in 1 (3.4%) - through 4 accesses. The duration of operations was, on average, 109.3±6.4 minutes. 26 (89.7%) patients were completely (stone free) free from kidney stones. In 3 (10.3%) patients, residual stones were left. Intraoperative complications were observed in 3 (10.3%) patients, postoperative complications - in 7 (24.1%).

Conclusion: Multi-access PCNL is an effective treatment for staghorn and multiple kidney stones.

Key words.

staghorn kidney stones, treatment, percutaneous nephrolithotomy, residual stones, complications.

Introduction

Currently, percutaneous nephrolithotomy (PCNL) is the method of choice for treating staghorn and other large kidney stones [1,2]. Recent studies have established that percutaneous methods of treatment are recognized as an effective and safe method of treating staghorn stones [3,4]. At the same time, it is noted that the rate of getting rid of stones in staghorn-like forms is lower than in other types of stones [5,6]. The ultimate goal of treatment is to completely remove the staghorn stone, which is important for reducing the incidence and preventing relapses [1].

Currently, the search and justification of the optimal method of treatment of staghorn and multiple stones continues. Technical improvements in percutaneous

nephrolithotomy for staghorn stones include: single-stage PCNL through percutaneous access performed by a urologist in the operating room; systematic endoscopy of the calico-pelvic system with a flexible endoscope; if necessary, repeated PCNL to completely get rid of the stone (s) [7].

There are several methods of percutaneous access, and each of them is associated with its own problems. The use of single or multiple accesses for percutaneous nephrolithotomy remains a subject of discussion. The disadvantages of multiple accesses are mainly complications associated with blood loss [4,8,9,10]. The degree of blood loss can be reduced by limiting the number of accesses [3,4]. Although it is also possible to reach the stone by single access, the approach to all calyces can be difficult due to the peculiarities of the calico-pelvic system, and therefore the most significant in PCNL is multiple access, while each case should be considered individually [1].

In this regard, we set out to increase the effectiveness of treatment of patients with staghorn and multiple nephrolithiasis by improving percutaneous nephrolithotripsy using a multiaccessmethod.

Methods

This study was based on the results of examination and treatment of 29 patients with staghorn and multiple kidney stones, including 19 men (65.5%) and 10 women (34.5%). Middle age patients it ranged from 15 to 63 (29.3 ± 4.3) years. Staghorn stones were found in 21 (72.4%) cases, multiple - in 1 (3.4%), staghorn with multiple stones - in 7 (24.2%) patients.

Depending on the size and stereometric configuration of staghorn stones, in accordance with the working classification adopted in the RSCU, and practical feasibility, the patients were divided into 3 groups: I - 14 (48.3%) patients in whom the stone occupied the entire calico-pelvic system or more than 80% of its volume (type of staghorn stone S-1), II - 6 (20.7%) patients in whom a stone with appendages occupied the pelvis and 2 or 3 calyces (50-80% of the volume of the calico-pelvic system, type S-2), III - 9 (31.0%) patients in whom the stone occupied the pelvis and one of the calyces (less than 50% of the volume of the calico-pelvic system, type S-3).

The size of kidney stones ranged from 25-123 (65.4 ± 5.2) mm. By the type of stone formation, primary stones were present in 27 (93.1%) cases, recurrent ones - in 2 (6.9%). Patients with recurrent stones have previously undergone various traditional surgical procedures. There were 2 patients with abnormal renal

development (6.9%), in both cases there was an incomplete doubling of the kidney. 1 patient had a single right kidney.

The protocol of clinical examination of patients with urolithiasis included: assessment of complaints and collection of anamnesis; physical examination; ultrasound examination of the kidneys and urinary tract; X-ray examination; general clinical and biochemical blood tests; qualitative and quantitative microscopic analysis of urine; bacteriological examination. urinalysis according to indications.

Operations were performed under one of the types of anesthesia accepted in the clinic: spinal anesthesia was performed in 8 (27.6%) patients, intravenous anesthesia – in 1 (3.4%), endotracheal anesthesia – in 20 (69.0%).

All patients underwent standard percutaneous nephrolithotripsy. If possible, the maximum volume of stone was removed through the surgical channel. If the complete removal of stones by the first access to the stone was impossible, and also when the size of the stone located in another cup exceeded the diameter of the neck of this cup, additional access was performed according to the standard method. It was performed after the installation of nephrostomy drainage according to the previous access, through the tube of the nephroscope, or simultaneously, the second tube of the nephroscope was installed. Through additional access, small stones up to 0.8 cm in size were completely removed using endoscopic forceps, larger stones were disintegrated using a lithotripter and removed. If necessary, the third or fourth access to the stone was performed in the same way. After complete removal of stones from the kidney, depending on the degree of bleeding, a single or several nephrostomy drains were installed through the nephroscope tube into the kidney.

The effectiveness and safety of endoscopic methods of treatment of urinary stones were evaluated by the following parameters: duration of surgery; stone removal rate (stone free rate); frequency, nature and severity of intra-and postoperative complications during 1 month of follow-up after surgery; terms of hospitalization (number of beds/days); terms of drainage removal, need and volume of blood transfusion; presence and severity of pain syndrome (need for diclofenac in mg); additional interventions performed (if residual stones are left); cost of treatment.

The duration of surgical intervention was determined from the moment of access to the stone to the installation of a drainage system in the urinary tract.

Postoperative pyelonephritis was determined by the following criteria: increased body temperature to 38 ° C and above for 2 or more days; pain in the kidney area, changes in the urine and peripheral blood characteristic of the inflammatory process.

The presence of residual stones was assessed during the operation and the first day after the operation using ultrasound of the kidneys and overview urography.

Statistical processing of the material was carried out using the program MS Office Excel 2007, StatSoft Statistica 8.0 using Student-Fisher criteria.

Results and discussion

Overall, 20 patients (69.0%) underwent surgery after 2 accesses, 8 (27.6%) - after 3 accesses, and 1 (3.4%) - after 4 accesses. The duration of operations was 40-215 (109.3±6.4) minutes. 26 (89,7%) of patients were completely (stone free) get rid of kidney stones. At 3 (10.3%) patients were left with residual stones (Table 1).

Table 1.

Dependence of the frequency of complete stone removal when performing multiaccessPCNL on the type of staghorn stone (n=29).

Type of staghorn stone	Residual stones			
	Missing items		Are	
	Frequency	%	Frequency	%
S -1 (n=14)	12	85,7%	2	14,3%
S -2 (n=6)	6	100,0%	0	0,0%
S -3 (n=9)	8	88,9%	1	11,1%
Total:	26	89,7%	3	10,3%

In 25 (86.2%) cases, the operation resulted in the placement of one nephrostomy drainage, in 4 (13.8%) - two drains.

The results of analysis of the causes of residual stones after multiple percutaneous nephrolithotripsy of staghorn and multiple nephrolithiasis showed that residual stones were present in 3 (10.3%) patients, of which in 1 (33.3%) case they were in the pelvis and calyces, in 2 (66.7%) cases - in the calyces. Their number ranged from 1 to 4 the size of the stones, from 5 mm to 17 mm.

The cause of residual stones in all cases was poor endoscopic visibility due to intraoperative bleeding caused by manipulations with an endoscope during the removal and disintegration of calyx stones.

Most often, residual stones remained in patients with the S -1 type of staghorn stone (85,7%), less often - with the S -3 type (11,1%). In all cases, the stones were

covered with the wall of the calico-pelvic system, which made it difficult to perform manipulations to disintegrate the stone. Subsequently, two (66.7%) of the three patients with residual stones underwent ESWL, and they were completely free of stones. 1 patient (33.3%) with clinically insignificant residual stones was discharged for further dynamic follow-up.

Analysis of the results of a study evaluating the effectiveness and safety of multi-access percutaneous nephrolithotripsy, depending on the type of staghorn stone, showed that the duration of operations depends on the size and stereometric configuration of staghorn stones. In the group of patients with the S-1 stone type, operations were longer and statistically significantly ($p < 0.05$) different from the group of patients with S-2 stones (Table 2).

It was also found that when performing multiple access nephrolithotripsy, the duration of the operation depends on a number of other factors that make it difficult to disintegrate the stone. These are cases when the wall of the calico-pelvic system is tight around the stone, and therefore there is no space for manipulation, as well as when the stone has a higher density. For these reasons, the duration of operations in patients with the S-3 stone type was longer than in patients with the S-2 stone type, as a result of which the differences in the duration of operations between the groups of patients with the S-2 and S-3 stone types were statistically significant ($86,7 \pm 3,7$ min, against $109,4 \pm 8,3$ min, respectively; $p < 0.05$), and between the groups of patients with the S-1 and S-3 stone type - statistically insignificant ($118,3 \pm 6,5$ min, against $109,4 \pm 8,3$ min, respectively; $p > 0.05$), (Table 2).

Table 2.

Results of multi-access PCNL depending on the type of staghorn stone (n=29).

Type of stone	Number of patients n (%)	Go ahead-operation duration (min)	Bed size/ day	Timing of drainage removal (day)	Need for diclofenac (mg)
S-1	14 (48,3%)	$118,3 \pm 6,5$	$7,9 \pm 0,7$	$5,6 \pm 2,3$	$285,7 \pm 35,3$
S-2	6 (20,7%)	$86,7 \pm 3,7^*$	$8,2 \pm 1,3$	$3,2 \pm 0,2^*$	$270,0 \pm 27,4$
S-3	9 (31,0%)	$109,4 \pm 8,3$	$11,3 \pm 2,2^*$	$8,6 \pm 0,7^*$	$228,1 \pm 35,6$
On average:		$109,3 \pm 6,5$	$8,9 \pm 1,1$	$5,9 \pm 1,5$	$263,8 \pm 37,9$

* - significantly compared to the data of the S-1 group ($P < 0,05$).

The average length of hospital stay after surgery was 8.9 ± 1.1 bed/days (from 4 to 36). When comparing the indicator between groups, depending on It was found

that in the group of patients with the S-3 type of stone, the duration of hospital stay was longer than in other groups ($p < 0.05$), (Table 2).

The reason for this was the development of postoperative infectious and inflammatory complications in some patients with the S-3 stone type.

Similar data were obtained for the average time of drainage removal after surgery (Table 3). 2 (6.9%) patients had premature loss of nephrostomy drainage. In the remaining patients, nephrostomy drains were removed 3-45 days (5.9 ± 1.5) after surgery.

In the postoperative period, 20 (69.0%) patients, due to the presence of pain syndrome, required analgesia-injections of diclofenac sodium at a dose of 75 to 600 mg (on average, $263,8 \pm 37.9$ mg of diclofenac sodium per patient).

In the severity of pain syndrome, determined by the need for diclofenac sodium (in mg), in the postoperative period, in groups of patients with various types of stones was statistically insignificant ($p > 0.05$) (Table 2).

Intraoperative complications were manifested by bleeding, and were observed in 3 (10.3%) cases, differences in their frequency in patients with S-1 and S-2 type stones were statistically insignificant ($p > 0.05$) (Table 3).

Table 3.

Complications of multi-access PCNL depending on the type of staghorn stone (n=29).

Type of stone	Number of patients n (%)	Intraoperator. complications		Postoperative complications			
		Bleeding		Bleeding		Exacerbation of UTI	
		Frequency	%	Frequency	%	Frequency	%
S-1	14 (48,3%)	2	14,3	-	-	2	14,3
S-2	6 (20,7%)	1	16,7	1	16,7	1	16,7
S-3	9 (31,0%)	-	-	1	11,1	2	22,2
Total:		3	10,3	2	6,9	5	17,2

The volume of intraoperative blood loss was 250-300 (276.7 ± 25.2) ml. The average values of this indicator were in groups of patients with the S-1 and S-2 stone types they were also not statistically significant ($p > 0.05$) (Table 3).

There were no cases of bleeding requiring replacement blood transfusion. However, 6 patients with low baseline hemoglobin levels were transfused with 400 ml of crystalloids to prevent hemodynamic disorders in the early postoperative period.

Postoperative complications were observed in 7 (24.1%) patients, of which 2 (6.9%) had bleeding, and 5 (17.2%) had an exacerbation of urinary tract infection (Table 3).

In the postoperative period, in a group of patients no bleeding was observed with K-1 type stones, in groups of patients with stones of type S-2 and S-3, it developed in 2 patients (1 patient in each group). The difference in the frequency of this complication, between groups, is not was statistically significant ($p>0.05$) (Table 3).

The main risk factors for exacerbation of urinary tract infection were: intraoperative bleeding - in 3 (10.3%) patients, inadequate drainage of the kidney cavities - in 2 (6.9%) patients. Complications were stopped by conservative measures.

When assessing postoperative complications in accordance with the adapted classification of surgical complications Clavien-Dindo revealed:

Complications I degrees were observed in 5 (17.3%) cases and included:

- 1 case hematuria and by nephrostoma, requiring an additional infusion and destinations diuretics;
- 4 cases of one-day fever requiring antipyretic drugs;

Complication II acute pyelonephritis (acute pyelonephritis), which required additional antibiotic therapy and infusion - detoxification measures, which prolonged the patient's stay in the hospital, developed in 1 (3.4%) case-an exacerbation of the infectious and inflammatory process in the urinary tract (acute pyelonephritis).

Complication IIIa degrees were detected in 1 (3.4%) case-performed replacement of nephrostomy drainage due to inadequate drainage systems cavities kidney injury caused by bleeding from the kidney vessels;

Complications IIIb, IV but, IVb and V degrees not included watched.

Thus, according to Clavien-Dindo classifications, in the postoperative period, when performing multi-access percutaneous nephrolithotripsy staghorn nephrolithiasis, 7 (24.1%) observed complications were distributed by severity as follows (Table 4):

Table 4.

Systematization of postoperative complications of multi-accessible PCNL according to the adapted Clavien-Dindo classification (n=29).

I degree	II degree	IIIa degree	IIIb degree	IVa degree	IVb degree	V degree

5 (17,3%)	1 (3,4%)	1 (3,4%)	0	0	0	0
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Conclusion

Multi-access percutaneous nephrolithotripsy is an effective and safe treatment for staghorn and multiple kidney stones. Its use in cases where complete removal of stones through a single access is not possible due to the long narrow neck of the calyx, which does not allow the introduction of an endoscope into it, as well as the visual inaccessibility of the calyx, increase in the degree of completeness of getting rid of stones before 89,7%. If the technology is carefully followed, surgical intervention is not accompanied by significant intra-and postoperative complications.

However, after performing multi-access PCNL, patients need longer inpatient follow-up and treatment, which makes it less cost-effective. It should be noted that in a number of patients, it eliminates the need for repeated anesthesia and psychological stress caused by repeated interventions to remove residual stones.

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