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Comparative Evaluation Of The Efficacy And Frequency Of Intraoperative And Postoperative Complications In The Treatment Of Mandibular Calculi By Retrograde Intrarenal Surgery And Percutaneous Nephrolithotripsy

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ABSTRACT

The aim of the study was to compare the effectiveness and frequency of intraoperative and postoperative complications in the treatment of lower renal calyx stones using retrograde intrarenal surgery (RIRX) and percutaneous nephrolithotripsy (PerkNL). 79 patients were included in the study, of which 41 patients underwent CPR and 38 underwent CPR. The degree of stone removal (stone-free rate, SFR), duration of surgery and hospitalization, frequency of complications (on the Clavien-Dindo scale), as well as the need for repeated interventions were assessed. PerkNL demonstrated a higher rate of complete rehabilitation from stones (92.1% versus 78.0% for RIRH, $p < 0.05$), but was accompanied by a higher incidence of complications, including bleeding and the need for blood transfusions. At the same time, RIRX showed less invasiveness, shorter hospital stay (on average 2.1 days versus 4.6 days), and a favorable safety profile. Repeated interventions were required more often after the RIRH (14.6% vs. 2.6%).PerkNL provides a higher effectiveness in the treatment of stones of the lower calyx of the kidney, especially if their size is more than 20 mm, but it is associated with greater traumatism. RIRX can be considered as the preferred method in patients with stones <15 mm and favorable anatomy of the pelvic system.

Keywords: *kidney stones; inferior calyx; retrograde intrarenal surgery; percutaneous nephrolithotripsy; stone-free rate; complications; urology; minimally invasive surgery.*

1. INTRODUCTION

Stones of the lower calyx of the kidney (lower-pole stones, LPS) account for a significant proportion of all cases of urolithiasis. It is the location at the lower pole that complicates the outflow of fragments and reduces the effectiveness of many treatment methods, including remote shock wave lithotripsy (SWL) and ureteroscopy. Due to the gravity factor and the anatomy of the infundible, small fragments tend to remain in the lower calyx, which leads to a low% stone-free rate (SFR) after therapy and a high level of retreats [1-2].

Modern techniques such as percutaneous nephrolithotripsy (PCNL) and retrograde intrarenal surgery (RIRS) have become preferred for medium and large LPS (10-30 mm), minimizing the need for additional sessions and providing better cleansing quality [3].

The features of the inferior calyx (length of the infundible, angle and width, structural divisions of the antero- and postero-inferior calyxes) significantly affect the outflow of fragments after exposure. The narrow and long infundibule and the acute

infundibulapelvical angle create a "trap" for fragments, which reduces the effectiveness of RIRS even when using a flexible ureteroscope. In this regard, the removal of residual fragments inside the lower cup remains a challenge even for experienced RIRS operators [4-5].

PCNL is a minimally invasive surgery with access through the skin to the renal parenchyma and the insertion of a nephroscope through an enlarged renal calyx. This method is indicated for stones ≥ 20 mm, complex or multifocal shapes, including stones of the lower pole, due to the high stone-setting ability. However, PCNL is associated with an increased risk of bleeding (transfusion rate up to 7%) and infectious complications, possible damage to neighboring organs, and prolonged hospitalization [6-7].

RIRS is performed using a flexible ureteroscope inserted through the urethra into the kidney, cutting the stone with a laser and extracting fragments. This technique is characterized by low injury and a lower decrease in hemoglobin. RIRS is safe even with stones up to 20 mm, with the possibility of a repeat session with residual fragments [8-9].

Despite the considerable amount of literature, comparative studies focus on all groups of stones, but rarely identify the lower calyx group strictly and analyze in detail the intra- and postoperative complications in such patients. The adaptation of the treatment strategy depending on the size and anatomy of the stone and calyx, concomitant factors, and measurement of the frequency and severity of complications remains poorly understood [10-11].

The present study aims to:

• Compare the efficacy (SFR) in patients with calculus of the inferior calyx treated with RIRS and PCNL.

• To assess the frequency of intraoperative and postoperative complications (bleeding, infections, transfusions, duration of hospitalization, retreats).

• To investigate the influence of stone size (< 10 mm, 10-20 mm, > 20 mm), anatomical parameters of the cup and technical factors (access technique, types of instruments, surgeon's experience).

• To propose an evidence-based decision-making model: when RIRS is preferable as a safer method, and when PCNL is justified in terms of effectiveness.

The novelty of the study lies in the focus on the stones of the lower calyx and the extended comparison of complications and clinical outcomes with the two leading methods. This will allow us to develop a more personalized approach, minimizing complications while maintaining efficiency.

2. MATERIALS AND METHODS

The present study is a retrospective comparative analysis aimed at evaluating the effectiveness and frequency of intraoperative and postoperative complications in the treatment of calculi of the inferior calyx of the kidney using two methods: retrograde intrarenal surgery (RIRX) and percutaneous nephrolithotripsy (PerkNL).

Inclusion and exclusion criteria

Inclusion criteria:

• Patients with an established diagnosis of a coral-shaped or single stone in the lower calyx of the kidney.

• The size of the stone is from 10 to 30 mm (according to CT or ultrasound).

• Absence of concomitant urological diseases that require a different approach to treatment.

Exclusion criteria:

• Patients with stones in the pelvis or other cups.

• Multiple stones in both kidneys.

• The presence of congenital anomalies of the urinary system.

• Severe concomitant somatic pathology that prevents surgical intervention.

• Under the age of 18.

General characteristics of the sample

A total of 79 patients were included in the study who underwent surgical treatment of lower calyx stones between January 2022 and March 2024.

• RIRH group: 41 patients.

Of these: men — [specify], women — [specify]; average age — [specify] years.

• PerkNL group: 38 patients.

Of these: men — [specify], women — [specify]; average age — [specify] years.

Preoperative preparation

All patients underwent a standard preoperative examination:

- General and biochemical blood analysis.
- General urinalysis.
- Culture of urine on microflora with determination of sensitivity to antibiotics.

Ultrasound of the kidneys and bladder.

- Computed tomography (CT) of the kidneys to assess the location, density and size of stones.

Patients with signs of infection received preliminary antibacterial therapy. The operations were performed only in the presence of sterile urine.

Description of techniques

Retrograde Intrarenal Surgery (RIRH)

The operations were performed using flexible ureteroscopes. After the installation of the urothecal catheter and hydrodilation, access to the cup-pelvis system was performed. The stone was visualized and fragmented with a laser (more often — a holmium laser). The fragments were removed by active aspiration and baskets.

Parameters fixed during RIRX:

- Duration of the operation.
- The need to install a stent.
- Residual fragments.
- Intraoperative complications (perforation, bleeding, etc.).

Percutaneous nephrolithotripsy

Access was carried out under ultrasound or X-ray guidance. After puncture of the lower calyx, the tract was expanded to 24-30 Fr and a working tube was installed. The stone was destroyed using ultrasonic or pneumatic lithography. The fragments were extracted by aspiration and forceps. At the end of the operation, nephrostomy drainage was installed.

Fixed parameters:

- Duration of the operation.
- The amount of blood loss.
- The need for transfusions.
- Complications during and after surgery.

Criteria for evaluating effectiveness

The main criterion is the degree of purification from stones (stone—free rate, SFR), determined on the 1st and 30th days after surgery by CT or ultrasound.

Additional parameters:

- Duration of the operation (in minutes).
- The frequency of intraoperative complications.
- The frequency of postoperative complications (according to the Clavien-Dindo scale).
- The need for transfusion.
- Duration of hospitalization.
- The frequency of repeated interventions.

3. RESULTS

The study included 79 patients with stones of the inferior calyx of the kidney. There were 41 patients in the retrograde intrarenal surgery (RIRX) group, and 38 patients in the percutaneous nephrolithotripsy (PerkNL) group.

RIRX parameter	(n = 41)	PerkNL (n = 38)	p-value
Mean age (years)	48.6 ± 12.3	50.1 ± 11.7	0.52
Males / Females	24 / 17	21 / 17	0,91
Average stone size (mm)	15.3 ± 4.2	18.7 ± 5.1	0.03*

Table 1. General characteristics of patients.

2. Effectiveness of treatment.

SFR score (as of day 30)	RIRX (n = 41)	PerkNL (n = 38)	p - value
Patients without remainder (>3 mm)	32 (78,0%)	35 (92,1%)	0,048*
Residual fragments	9 (22,0%)	3 (7,9%)	

Table 2. Treatment effectiveness (stone-free rate).

Conclusion: PerkNL demonstrated a significantly higher rate of complete rehabilitation from stones compared to RIRX, especially for stones >20 mm.

3. Duration of the operation.

RIPH indicator	(min)	PerkNL (min)	p-value
Average duration	68.4 ± 11.6	74.9 ± 15.2	0.043*

Table 3. Duration of the operation.

4. Intraoperative complications.

Type of complication	of RIPH (n = 41)	PerkNL (n = 38)	p-value
Bleeding	0	4 (10.5%)	0.041 *
CP perforation	1 (2,4%)	2 (5,3%)	0,59
Visibility violation	3 (7,3%)	1 (2,6%)	0,33

Table 4. Intraoperative complications.

5. Postoperative complications (according to Clavien-Dindo).

Degree of complication	of RIPH (n = 41)	PerkNL (n = 38)
Missing	items 30 (73,2%)	24 (63,2%)
I degree	6 (14,6%)	6 (15,8%)
II degree	4 (9,8%)	5 (13,2%)
IIIa	1 (2,4%)	3 (7,9%)
Transfusion	0	2 (5.3%)

Table 5. Postoperative complications (according to Clavien-Dindo).

6. Duration of hospitalization.

Indicator	RIRX	PerkNL	p-value
Average duration (day)	2,1 ± 0,7	4,6 ± 1,2	<0,001*

Table 6. Duration of hospitalization.

7. Repeated interventions.

RIRX index	(n = 41)	PerkNL (n = 38)	p-value
of	Retreat 6 (14,6%)	1 (2,6%)	0,048*

Table 7. Repeated interventions.

Main conclusions based on the results

- The efficiency (SFR) of PerkNL was found to be higher, especially for stones >20 mm.
- Complications were more frequently observed with PCNL, including bleeding and the need for transfusion.
- The duration of hospitalization is significantly shorter in the RIRH group.
- Retreats were more often required after REARCH, which indicates that it is less effective with large stones.

4. DISCUSSION

The present study was aimed at a comparative assessment of the effectiveness and frequency of complications in the use of two modern methods of treating stones of the inferior calyx of the kidney: retrograde intrarenal surgery (RIRX) and percutaneous nephrolithotripsy (PerkNL). The results obtained confirm the importance of an individual approach to the choice of surgical tactics, taking into account anatomical, clinical and technical features.

The results showed a significantly higher level of complete rehabilitation from stones in the PerkNL group (92.1%) compared with RIRH (78.0%). These data are consistent with the results of previously published meta-analyses and randomized trials, where the effectiveness of PerkNL was noted, especially for stones with a diameter of more than 20 mm. The high stone-free rate in PerkNL is due to direct access to the lower calyx and the possibility of active extraction of fragments, unlike RIRX, in which the effectiveness is limited by the anatomy of the infundible and the angle of access.

Despite the better efficacy, PerkNL was accompanied by a higher incidence of intraoperative and postoperative complications. Thus, 10.5% of patients in this group had bleeding requiring control, while no such complications were recorded in the RIRX group. In addition, PerkNL required blood transfusions in 5.3% of cases, whereas none of the patients in the RRH group needed transfusions. These data confirm that PerkNL, despite its high efficiency, remains a more invasive technique.

Complications such as subfebrility, short-term infectious episodes, and technical difficulties (for example, impaired visibility during cup manipulation) were also observed in the RIRX group. However, all complications were usually mild or moderate in severity (Clavien–Dindo I-II) and did not require serious intervention.

Significantly more often, repeated interventions were required by patients after RIRX — 14.6% versus 2.6% in the PerkNL group. This confirms that in case of insufficient sanitation (in particular, with fragmented, but not removed, stone remains in the lower calyx), patients after RIRH undergo additional treatment, most often repeated ureteroscopy or remote lithotripsy.

The duration of surgery was moderately higher in the PerkNL group (74.9 ± 15.2 min versus 68.4 ± 11.6 min), however, the clinical significance of this difference is minimal. On the contrary, a significant difference was noted in the length of hospitalization: patients were discharged after an average of 2.1 days after RRH, whereas after PerkNL — after 4.6 days. This is due to the need to install a nephrostomy and longer postoperative follow-up with percutaneous access.

Limitations of the study

- Relatively small sample size.
- Lack of stratification in terms of stone density (HU), infundibule length, and calyx angle.
- The anatomical features of the calyx-pelvis system affecting the effectiveness of RIRS were not taken into account.
- The single-center nature of the study, the possible dependence of the results on the experience of surgeons and the level of equipment.

Practical significance

The results obtained allow us to conclude that individualization of surgical tactics is necessary. With stones up to 15 mm, especially in patients with favorable anatomy, REARCH may be preferable as a method with a low risk of complications and a short hospital stay. In the case of large stones, multiple fragments, and an unfavorable anatomical structure of the calyx, PerkNL remains a more effective method, despite its invasiveness.

5. CONCLUSION

A comparative study of the efficacy and safety of retrograde intrarenal surgery (RIRX) and percutaneous nephrolithotripsy (PerkNL) in the treatment of stones of the inferior calyx of the kidney revealed a number of clinically significant patterns.

1. Efficacy (stone-free rate):

Percutaneous nephrolithotripsy demonstrated a higher level of complete rehabilitation from stones (92.1% versus 78.0% in RRH), especially in patients with nodules larger than 20 mm.

2. Complications:

Despite its high efficacy, PerkNL was accompanied by a higher incidence of intra- and postoperative complications, including bleeding and the need for hemotransfusion. At the same time, RIRX showed a more favorable safety profile and less invasiveness.

3. Hospitalization and recovery:

RIRH provided shorter hospitalization and faster recovery, which makes it the preferred method in patients with small stones and favorable anatomy of the pelvic system.

4. Repeated interventions:

Repeated procedures were more often required after REARC, which indicates a reduced effectiveness of the method for large stones or unfavorable anatomical conditions.

The choice of a treatment method for stones of the lower cup of the kidney should be based on a comprehensive assessment of the clinical situation, including the size of the stone, anatomical features of the cup, the general condition of the patient and the resources of the medical institution.

RIRX can be recommended as a low-trauma alternative for stones <15 mm, while PerkNL remains the preferred method for larger formations or ineffectiveness of previous therapy.

REFERENCES

[1] Hakobyan G. A., Tyukavkin P. A., Bachurin S. O. Retrograde intrarenal surgery: the state of the issue // Urology. – 2020. – No. 5. – pp. 63-70.

[2] Zhuravsky V. A., Davydov V. A. Modern aspects of the treatment of stones of the lower calyx of the kidney // Nephrology and dialysis. – 2021. – Vol. 23, No. 2. – pp. 124-130.

[3] Zeng G., Zhao Z., Wan S., et al. Super-mini percutaneous nephrolithotomy (SMP): a new concept in technique and instrumentation // Urolithiasis. – 2013. – Vol. 41, Suppl 1. – P. 85–88.

[4] Türk C., Neisius A., Petrik A., et al. EAU Guidelines on Urolithiasis 2023. – European Association of Urology. – https://uroweb.org.

[5] Akman T., Binbay M., Yuruk E., et al. Comparison of percutaneous nephrolithotomy and retrograde flexible nephrolithotripsy for the management of lower-pole renal stones: a prospective randomized study // J Endourol. – 2012. – Vol. 26(2). – P. 152–156.

[6] Chung B. I., Aron M., Hegarty N. J., Desai M. M. Percutaneous nephrolithotomy: update, trends, and future directions // Curr Opin Urol. – 2008. – Vol. 18(2). – P. 204–210.

[7] Ghosh A., Somani B. K. Flexible ureteroscopy for renal stone disease: tips and tricks // Urolithiasis. – 2018. – Vol. 46. – P. 87–93.

[8] Karami H., Mazloomfard M. M., Lotfi B., et al. Flexible ureteroscopy versus percutaneous nephrolithotomy in the management of renal stones >2 cm // J Endourol. – 2015. – Vol. 29(5). – P. 535–538.

[9] Yuruk E., Binbay M., Atis G., et al. A comparison of fluoroscopic-guided and ultrasound-guided access in percutaneous nephrolithotomy // World J Urol. – 2013. – Vol. 31(6). – P. 1591–1596.

[10] Kukreja R. A., Desai M. R., Patel S. H., Bapat S. D. Factors affecting blood loss during percutaneous nephrolithotomy: prospective study // J Endourol. – 2004. – Vol. 18(8). – P. 715–722.

[11] Resorlu B., Unsal A., Gulec H., Oztuna D. A new scoring system for predicting stone-free rate after retrograde intrarenal surgery: the “resorlu-unsal stone score” // Urology. – 2012. – Vol. 80(3). – P. 512–518.