Mini-PCNL vs RIRS – A Single Centre Retrospective Comparison Experience of 5 Years

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ABSTRACT

Introduction: Recent technological advances have led to the implementation of mini– and micro–percutaneous nephrolithotomy (PCNL) and retrograde intrarenal surgery (RIRS) in managing kidney stones. This study aims to offer a retrospective comparison over a period of 5 years between mini-PCNL and RIRS (Retrograde intrarenal surgery).

Materials and method: We retrospectively analysed a total of 341 patients who underwent either mini-PCNL (237) or RIRS (104) between 2018 and 2023. The hospitalization length, history of previous renal interventions (open/percutaneous), presence of double J catheter pre-op, number of access tracts, stone dimensions, stone-free rate (as documented by ultrasonography), rate of intraoperative and postoperative complications, haemoglobin variation (pre and postoperatively), the visual analogic scale of pain scores and the use of analgesics and the use of postoperative catheters were studied.

Results: Our analysis revealed a shorter hospitalization period in patients who underwent RIRS with a average of 2.9 days over 4.1 days in patients who underwent mini-PCNL. The stone free rate was similar with no statistically significant differences. On visual analogic scale for pain score, the patients which underwent mini perc had an average score of 7.1 vs. 5.4 in the RIRS group and the need for postoperative analgesic administration was 37.6% higher.

Conclusion. Mini-PCNL is a safe and reliable procedure, with a very high level of cost-effectiveness, which can be used to treat complex renal stones, with quite large volumes at the expense of higher complication rates, blood loss, and admission times, whereas RIRS has a shorter hospitalization period, offers greater comfort to the patient and lowers the quantity of analgesic medication needed but also comes with a higher rate of urosepsis occurrence and urinary tract infection recurrence at 1 month.

Keywords: less pain, mini-PCNL, RIRS, urolithiasis.

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Introduction

The prevalence and incidence of urinary stones in Romania are increasing. In the Banat region, urolithiasis is a pandemic disease, with an incidence of more than 240 new cases per 100 000 individuals.
Mini-PCNL is one of the most important minimally invasive treatment methods for renal stones and, concomitantly, the procedure with the highest stone-free rates reported after standard PCNL [1]. In time, this technique has evolved, reducing the calibre of dilatation from 30 Fr to 15 Fr. This miniaturization of both equipment and renal access tracts, offered significant clinical benefits, reflected by the shorter hospitalization periods and the reduced perioperative haemoglobin loss, with blood transfusions becoming unnecessary and rarely utilized [2].

An alternative to the percutaneous approaches is provided by flexible ureteroscopy, also called retrograde intrarenal surgery (RIRS). Originally proposed in treating a lower pole stone not amenable to shockwave lithotripsy (SWL), this procedure has shown its utility in managing larger renal stones throughout the entire pelvicalyceal system [3].
The main drawbacks of retrograde access include the requirement of flexible (expensive) scopes, limited visualisation and the small size of the removed fragments [4]. Cost is a major drawback to RIRS, particularly in developing countries [5]. On the other hand, the "traditional" percutaneous approaches offer an enhanced capacity for stone removal, given the use of larger-sheath diameters. This paradigm has recently changed with the progressive miniaturization of devices for percutaneous access. The mini-PCNL technique offer significant financial advantages due to the decreased reliance on disposable instrumentation [6].
Mini-PCNL was first implemented in Timişoara 7 years ago, and within the last 5 years (including the 2020-2021 Covid period), we performed a total of 237 interventions.
The aim of the current study is to assess the clinical role of the mini-PCNL technique compared with the newer RIRS approach, within a period of five years in a urology centre with a rich tradition of standard PCNL and mini-PCNL.

Material and method

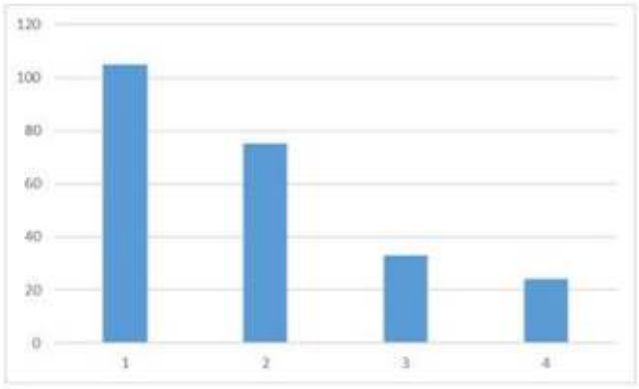
This is a single-centre, retrospective study. We analysed 341 patients, who underwent either mini-PCNL (237) or RIRS (104) between 2018-2023. For each case, we documented the intervention time, history of previous renal interventions (open/percutaneous); the number of access tracts, stone-free rate, as quantified by ultrasonography, hospitalization period; haemoglobin variation (pre and postoperatively); the visual analogic scale of pain scores and the use of a postoperative tube (JJ/nephrostomy tube or tubeless) and the rate of postoperative haematuria occurrence and persistence.
Preoperatively, a sterile urine culture was mandatory for all patients and had to be obtained. For prophylaxis, we administered only two doses of 3rd generation Cephalosporin (one intraoperative dose and another 12 hours postoperatively). The evaluation of the stone (size and position) was assessed by unenhanced computed tomography and by ultrasound.
The mini-PCNL procedure is quite standardized. Using a rigid cystoscope, a 6 Fr ureteral catheter is advanced towards the renal pelvis under fluoroscopic control. A Foley catheter is inserted and used to secure the ureteral catheter. Afterwards, the patient is repositioned, in either prone or supine position - depending on patient particularities and/or surgeon preference [7].
In most of the cases, the renal puncture was performed in an ultrasound-guided manner. After placing a Lunderquist guidewire in the renal pelvis, a fluoroscopy-guided, three-step dilatation of the access tract is performed.
In our centre, for most cases, we usually perform this access tract dilatation to 16 Fr, yet, in a few particular situations, we prefer to achieve a greater access tract diameter. In most cases, the stone fragments were retrieved through direct exteriorization, based on the Bernouli effect, or by using a grasper and/or different types of Dormia baskets [8, 9].
Commonly, in most cases, after the lithotripsy procedure was finalized, we placed a small nephrostomy tube(12CH) for 12 hours, and, in some specific situations, an additional JJ stent.
The RIRS procedure is done in the dorsal lithotomy position. The cystoscope is introduced in bladder

and a guidewire is placed in the ureter till pelvicalyceal system under fluoroscopic guidance. A ureteric dilator can be passed over a guidewire to dilate the ureter for easy passage of flexible ureteroscopes. The flexible ureteroscope is advanced either over a guidewire directly or via a ureteral access sheath (UAS) under fluoroscopic control. The UAS in placed beneath the uretero-pelvic junction and only in selected cases we pass the ureteropelvic junction. If the UAS passage on the ureter is not very easily performed, we let it just above the iliac vessels. Entire pelvicalyceal system is .

visualized and the stone is identified. After the stone is visualized, it is fragmented using laser (dusting/fragmentation). Double J stent can be placed, if needed after the completion of procedure [10,11].

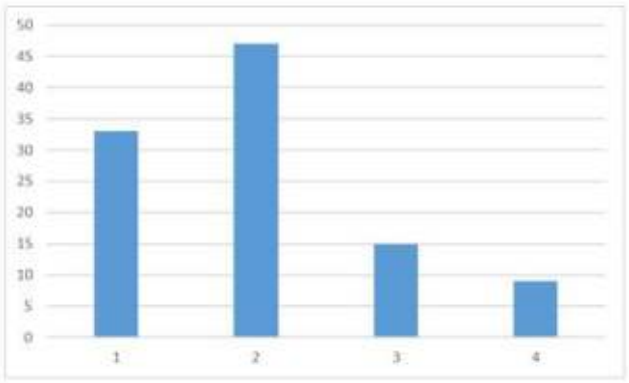
Results

Our study groups consisted in a cohort of 341 patients, which underwent mini-PCNL or RIRS. Out of them, 181 were male and 160 were female patients. The localization of the stones in most cases differed by the type of intervention (Figures 1-2)



1.pelvic stones 2.inferior calix stone 3.middle calix stones 4.ramified stones

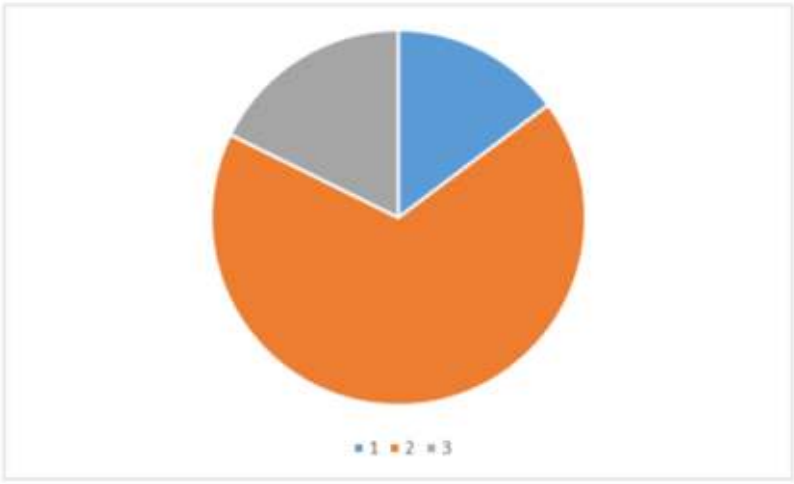
Fig 1. Stone location in mini PCNL group



1.pelvic stones 2.inferior calix stone 3.middle calix stones 4.ramified stones

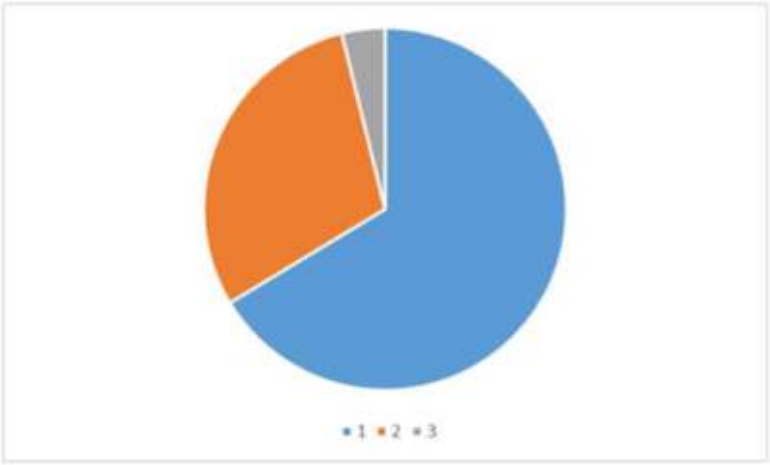
Fig2. Stone location in RIRS group

The stone dimensions were bigger in the mini-PCNL group (Figure 3-4).



1.≤1cm ;2.1-2cm; 3.>2cm

Fig3.Stone size distribution in the miniPCNL group



1.≤1cm ;2.1-2cm; 3.>2cm

Fig 4. Stone size distribution in the RIRS group

The stone size and the localization of the stone were assessed by unenhanced computed tomography and ultrasonography.

The mean duration time of mini-PCNL procedure was 70 minutes and 80 minutes in RIRS group. This time include also the repositioning time and the time for accessing the kidney, and in the RIRS group the time needed to place the UAS.

Double J stents were placed before the intervention only in 34 cases in mini-PCNL group (intermittent pelvic obstructive stone or pyuria at the first attempt) and in 97 cases in RIRS group.

The fluoroscopy time in mini-PCNL was 53 seconds (median time) compared to 25 seconds (median time) in the RIRS group.

The main intraoperative complications with the

mini-PCNL procedure were the following: loss of the dilatation tract (one case); small perforation during lithotripsy (16 cases); and perforation of the renal pelvis during the dilatation procedure (3 in the subgroup), yet without important contrast extravasation (the procedure was continued and finalized for all those cases). We had 2 cases of pleural injury without important breathing alterations and without hydrothorax.

In the RIRS group, we experienced 5 cases of hypotension at the end of the procedure and 2 cases of haematuria that forced us to end the procedure.

Most frequent postoperative complications were haematuria, fever, urinary fistula in mini-PCNL group and urinary sepsis (Table 1).

	miniPCNL	RIRS
Fever	21	15
Sepsis	6	8
Hematuria>24 hours	25	11
Urinary fistula	19	0

Table 1. Complications in the two groups

In the mini-PCNL group, using the visual analogic scale for pain score, we found an average score of 7.1 vs 5.4 in the RIRS group. The need for postoperative analgesic administration was 37.6 % higher in the mini PCNL group vs the RIRS group.

Double J stenting at the end of procedure in mini PCNL group was needed in 25 cases. In the RIRS group, we inserted JJ stents in all patients at the end of the procedure. The stent was removed in 7 to 14 days after the procedure

Our analysis revealed a shorter hospitalization period in patients who underwent RIRS, with an average of 2.9 days vs 4.1 days in patients who underwent mini-PCNL. The nephrostomy tube was removed on the first day after surgery.

The stone-free rate was evaluated by ultrasonography on the patient's discharge. In the miniPCNL group, 92% of the cases had no residual fragments (larger than 4 mm). In the RIRS group, only 87% of the cases were stone-free (stones larger than 4 mm)

In the mini-PCNL group, we had only 5 cases of recurrent UTI with fever after discharge. Still, in the RIRS group we had 11 cases, 3 of them being admitted in the hospital with sepsis within 7 days after discharge.

Discussions

Since the first PCNL was performed in 1976, and with the development of the mini-PCNL technique, this lithotripsy technique has been greatly and continuously improved. Mini-PCNL is constantly evolving, mainly through the development of superior technical instruments reflected in the steadily increasing stone free rates, further nuanced therapeutic indications and significant gains in patient outcomes [12]. Mini-PCNL has proven to be a viable option, which can be safely used for calyceal stones, in obese patients, in centres which cannot afford flexible ureteroscopy and/or when previous SWL attempts have failed [13].

A preoperative computer tomography (CT) scan is generally regarded as mandatory before mini-PCNL and RIRS to explore further the relationship between the kidney and its surrounding organs and the complexity of the intrinsic pyelocaliceal system [14].

In our study we treated larger stones by miniPCNL. We aimed to treat more pelvic stones with mini PCNL than by RIRS, keeping the "flexible approach" for lower pole stones that are difficult cu treat percutaneously.

Usually, we don't exceed the 90 minutes limit for intrarenal surgery, to avoid the risks associated to

longer procedures [15,16].
The duration of both procedures can be increased by using UAS with suction, which also lowers the intrarenal pressure, and with this device, we could treat larger stones [17,18].
The development of the lasers can also improve the outcomes of both procedures. The Thulium lasers can increase the speed and decrease the stone fragments' size during lithotripsy, lowering the risks of complications related to the migration of larger stone fragments [19]. Unfortunately, with the exception of the 2-week period when we had a Thulium laser for a demo, we did not have the opportunity to lease the stones with Thulium.
The stone culture could be an important factor in lowering the risk of sepsis despite the preoperative sterile urine culture [20,21]. Unstented RIRS could also lower the burden on the admission capacity because we won't have to insert the JJ stent before the procedure but, this comes with the higher risk of ureteral injuries by the UAS as long as the 12/14 Ch UAS are routinely use [22,23]. Noteworthy, there were no PULSE 2 or larger ureteral lesions in our RIRS group as JJ stenting 1 week before the procedure was routinely performed.
The time of fluoroscopy was longer in the miniPCNL group because we had to access the kidney percutaneous, but studies show that miniPCNL can be guided by ultrasonography only [24].
Therefore, mini PCNL and RIRS compete for the same mid-sized stones [25]. The group of miniPCNL was larger because the lack of flexible scope for almost 2 years so we were aimed to treat stones suitable for RIRS by mini PCNL.
Consequently, when choosing an option, it comes down to other factors such as availability of infrastructure, of surgical competence, the surgeon's preference and the patient's preference [26,27].

Conclusions

In the current study, we report our experience and emerging therapeutic results regarding using mini-PCNL and RIRS methods in clinical practice. After a period of time necessary for completing the learning curve, mini-PCNL is a safe and reliable procedure with a very high level of cost-effectiveness, which can be used to treat complex renal stones with quite large volumes at the expense of higher complication rates, blood loss, and hospitalization whereas RIRS has a shorter hospitalization period, offers greater comfort to the patient and lowers the quantity of analgesic medication needed, higher rates of urosepsis and urinary tract infection recurrences at 1 month. The stone free rate was similar with no statistically significant differences between the two groups.

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