

FLEXIBLE NEPHROSCOPY: A STEP TOWARDS COMPLETE STONE CLEARANCE IN PCNL

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ABSTRACT

Objectives

To determine the usefulness of flexible nephroscopy after per-cutaneous nephrolithotomy (PCNL) in detecting residual fragments.

Materials and Methods

A prospective study was conducted between January 2018 and December 2019 on patients undergoing standard PCNL using a flexible nephroscope to inspect all the calyces for residual stones. When residual stones were noted, either they were removed by basketing or by performing additional puncture to ensure complete clearance. Patients were followed up for 6 months and at the end of 1 month a plain CT KUB was done to look for residual fragments.

Results

The study cohort included 212 patients. Significant RFs were found in 28 patients during flexible nephroscopy and in two patients at 1 month follow up CT scan. All patients were stone free during 6 months follow up.

Conclusion

Flexible nephroscopy during PCNL decreases the chance of residual fragments and thereby reducing the chance of re-procedure rates.

Keywords: *flexible nephroscope; PCNL; residual fragments*

INTRODUCTION

The management of kidney stones has evolved over the years from the era of cutting open for stones to the minimally invasive techniques available today thereby reducing the hospital stay and faster recovery. In present day situation, most of the stones in kidney are managed endourologically.

The current guidelines recommend per-cutaneous nephrolithotomy (PCNL) for the management of renal stones larger than 2 cms and lower pole stones larger than 15 mm.¹

PCNL is time tested and offers stone free rates (SFR) in the range between 70 and 85% in various studies.² The central dogma of treatment for renal

stones is complete clearance without any residual fragments. If any residual fragments remain after surgery, they may cause symptoms and there will be a need for additional ancillary procedures which burden the patient. So it is best in the interest of the patient to do away with as minimal procedure as deemed possible.

The term SFR is a guarded statement as the meaning varies according to different studies because of the phrase “clinically insignificant residual fragments” (CIRF). The definition of CIRF is any fragment less than or equal to 4 mm which means the patient in reality is not stone free.^{3,4} Because of this CIRF, many studies have credited themselves for rendering patients stone free.⁵

Moreover, it is found that fragments larger than 2 mm left behind after surgery can lead to symptoms propelling them for second procedure.⁶ So the definition of “insignificant fragments” needs a revisit as there is no proper consensus statement currently available.

Conventionally, plain X-ray KUB and ultrasound are used to look for residual fragments because of their lower cost and availability. Even today, most centres rely on these methods as they are readily available and patients’ exposure to radiation is less when compared to CT.^{7,8,9}

In one of the studies conducted by Pires et al.,¹⁰ they have found that plain CT has 100% sensitivity in ruling out residual fragments when compared with traditional X-ray which has only 87% sensitivity in detecting stone fragments less than 5 mm. So, when it comes to a trade-off between radiation and residual fragments, even though radiation is a problem with CT, it is wise to choose this modality to detect stone fragments.¹⁰

Whatsoever, residual fragments are both physically and mentally problematic to the patient as these can re-grow and form a nidus for recurrent urinary tract infection (UTI).¹¹

With this preamble, what needs to be seen is how to minimise the chance of leaving behind stone fragments. There are various factors which need to be attended in order to achieve stone-free status. The first factor is proper choice of lithotripter. It is shown that the use of ultrasonic lithotripter with suction can minimise the chance of stone fragment migration. The second one is the use of laser energy for fragmentation. The

third is the use of intra-operative ultrasound and C-arm combination to look for residual fragments. With these entire manoeuvres, one can reduce the chance of residual fragments but not completely eliminate the probability of leaving them behind. As the old saying goes, “When you can see with your eyes, it exists” holds good for looking for residual fragments under direct vision using a flexible nephroscope. There are only few published studies on flexible nephroscopy after PCNL.¹²

In this study, we did flexible nephroscopy after PCNL in each case in an effort to look for residual fragments.

MATERIALS AND METHODS

A prospective observational study was conducted between Dec 2018 and Dec 2019 in patients undergoing PCNL for renal stones larger than 2 cms. An informed and written consent was taken from all the patients explaining that flexible nephroscopy will be done at the end of surgery to look for residual fragments of stone. A total of 256 patients underwent PCNL for renal stones. After exclusion, 212 patients were included in the study. Standard prone PCNL was performed in all patients under fluoroscopy guidance. Amplatz sheath size varied from 18 Fr to 24 Fr. After completion of procedure, C-arm imaging was performed to look for any radio-opaque fragments. Once it was ensured that no visible fragments were noted, using 15.5 Fr Karl Storz Flexible nephroscope with c-arm guidance, an endoscopy was done through the amplatz sheath inspecting all the reachable calyces for any residual fragments. If residual fragments were identified, they were either basketted or flushed out with saline. In some cases, an additional puncture was made to clear the stone fragments. Once all fragments were cleared to surgeon’s satisfaction, DJ stent was placed and a nephrostomy tube was placed. On the first post-operative day, a digital X-ray and a USG was done. Nephrostomy tube was removed if there was no fever, bleeding or residual fragments in X-ray. After 15 days, a plain CT KUB was taken. Once stone clearance was ensured, stent was removed. If any residual fragments were noted, depending upon the location of the fragments they were observed for spontaneous expulsion, extracorporeal shock wave

lithotripsy (ESWL) or retrograde intrarenal surgery (RIRS) to achieve complete stone clearance.

RESULTS

The patient demographics are given in Table 1. All PCNL procedures were done in prone position. Out of the 212 patients, 152 patients underwent lower calyceal puncture, 44 had middle calyceal puncture and the rest 16 needed superior calyceal puncture. The tract size varied from 18 Fr to 24 Fr size (Table 2). Flexible nephroscopy was done in all cases. Out of the 212 patients, at the end of the procedure when residual fragments were not visualised by C-arm imaging, 28 patients had residual fragments detectable by direct vision by flexible nephroscope. Most common location of the fragments were in lower calyx (16) followed by upper calyx (7) and middle calyx (5). All the lower pole residual fragments were either basketted out (10), laser dusted (4) or flushed out with saline (2) achieving complete clearance. Of the seven upper calyceal fragments, three cases were basketted out, two cases were laser dusted and remaining two cases required another puncture. Out of the five cases in middle calyx, two cases were basketted out, one case was laser dusted and remaining two cases were planned for ESWL at a later date (Table 3).

On the first post-operative day, two patients had residual fragments noted in x-ray and ultrasound. Most probably, these fragments were missed during nephroscopy; either one of the calyx was not accessible because of acute angle or may have been camouflaged by blood clots. Both the patients were counselled to follow up for 1 month and to wait for probability of spontaneous expulsion. During the 1-month follow

TABLE 1 Patient Demography.

Age (yrs)		21–65
Sex	Male	128
	Female	84
Side	Right	104
	Left	108
Stone burden	Pelvis	98
	Calyceal	24
	Staghorn	30

TABLE 2 Approach to the Stone and Calyx Chosen for Puncture.

Approach	Sub-costal	162
	Supra-costal	32
	Combined	18
Site of entry	Lower calyx	152
	Mid calyx	44
	Upper calyx	16

up, both the patients were advised plain CT KUB and both the patients had residual fragments of size more than 5 mm and they were advised ESWL. All patients were stone free during 6 months follow up proven by plain CT scan (Table 4).

DISCUSSION

The steps and approaches to renal stones are standardised and time tested. It is not uncommon to find residual fragments left behind after PCNL which burdens the patient as well as the operating surgeon, physically and mentally. Moreover, it adds to the cost of the patient for the additional procedure to achieve stone clearance. There is a lot of many evidence in the literature that certain steps during the PCNL can decrease the chance of leaving behind residual stones but none of them are fool proof.

Of all the techniques—like C-arm imaging, ultrasound imaging and flexible nephroscopy available to ensure stone clearance—none is superior to the other in ruling out residual stones because each technique has its own disadvantage. Like in C-arm

TABLE 3 Location and Modes of Treatment for Residual Fragments.

Total number of residual fragments		28
Location of fragments	Lower calyx	16
	Middle calyx	5
	Upper calyx	7
Treatment method	Basketting	15
	Laser	7
	Flushed out	2
	ESWL	2
	Additional puncture	2

TABLE 4 Stone Clearance (out of 212 patients).

Intra-operative	Before nephroscopy	184
	After nephroscopy	210
Post-operative period	15 days	210
	30 days	210
	180 days	212

imaging, fragments may be radiolucent; ultrasound in operated patients can be false positive or negative because of blood clots; air interference and flexible nephroscopy may not reach all calyces. Having said that, of the three techniques, direct visualisation of accessible calyces gives us an opportunity to detect as well as treat the residual fragments. Hence, it scores over the other two techniques.

We have used flexible nephroscopy in all cases and found it useful in most if not all cases in reducing the chance of leaving behind stone fragments. Limitation of our study is that it is an observational type and did not provide comparison with standard PCNL as this was our pilot study. In future, conducting a randomised control study will throw more light towards success in eliminating residual fragments during PCNL.

CONCLUSIONS

Flexible nephroscopy offers a unique advantage of directly visualising the individual calyces after PCNL and there by offering a chance to minimise the chance of leaving behind residual fragments. More randomised studies are required to justify the claim. But this single, small step during PCNL may become a norm in future.

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