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Original Research Article

Laparoscopic pyelolithotomy: its current place in the management of renal pelvis stones

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ABSTRACT

Background: Laparoscopic pyelolithotomy is assumed to preserve functional renal parenchyma, and there is a limited risk for immediate or late renal hemorrhage. Therefore, it might be an alternative for the patients in whom maximal preservation of renal parenchyma is necessary. In the present study, we aimed to compare the success rate and perioperative complications of laparoscopic pyelolithotomy. In the present study, we aimed to document and compare the success rate and perioperative complications of laparoscopic pyelolithotomy with published literature about percutaneous nephrolithotomy (PCNL).
Methods: We retrospectively reviewed the clinical charts of all patients subjected to laparoscopic pyelolithotomy (18 cases) in the Department of General Surgery at SMIMER Hospital (tertiary care centre), Surat between the period of January 2014 to December 2018. Record of all patients were assessed for demographic profile, co morbidities, routine blood investigations, including RFT, urine cytology and culture sensitivity, specialized investigation as X-ray KUB, USG KUB, IVP/CT-Urography, DTPA scan, all patients were called for follow up evaluation with radiological, clinical and RFT studies at regular intervals upto 3 months.
Results: LP is considered a successful alternative therapy for PCNL in selected cases with large renal stones like those in the extra renal pelvis in patients without a history of previous surgery. In addition, laparoscopic pyelolithotomy (LP) can be considered as a reasonable therapeutic option for large staghorn calculus which cannot be removed with a reasonable number of access and sessions of PCNL.
Conclusions: Our results show that laparoscopic pyelolithotomy is equally good or better as compared to PCNL in selected cases.

Keywords: LP, PCNL, Uretero pelvic junction obstruction

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is accepted as the gold standard surgery for most patients suffering from large or complex renal calculi. Despite its advantage in percutaneous approach with high stone free rate (SFR), some concerns still remain about its complications such as immediate or late hemorrhage (due to arteriovenous fistula or pseudo aneurysm), parenchymal loss and injury to the adjacent organs.[1] The ideal procedure for large or complex renal stones would be the one that achieve complete stone free status with minimal morbidity and with the least number of procedures. The traditional standard procedure was open nephrolithotomy, which evolved into PCNL or retrograde intrarenal surgery.[2]

With the evolution of laparoscopy, a new era in the field of stone removal surgery is developing. Theoretically,

laparoscopic pyelolithotomy is assumed to preserve functional renal parenchyma, and there is a minimal risk for immediate or late complications. Therefore, it might be an alternative for the patients in whom maximal preservation of renal parenchyma is necessary.

Aims and objectives

In the present study, we aimed to document and compare the success rate and perioperative complications of laparoscopic pyelolithotomy with published literature about PCNL.

METHODS

We retrospectively reviewed the clinical charts of all patients subjected to laparoscopic pyelolithotomy (18 cases) in the Department of General Surgery at SMIMER Hospital (tertiary care centre), Surat between the period of January 2014 to December 2018. Record of all patients were assessed for demographic profile, co morbidities, routine blood investigations, including RFT, urine cytology and culture sensitivity, specialized investigation as X-ray KUB, USG KUB, IVP/CT-Urography, DTPA scan. No specific statistical software was used to analyze the data as the number of patients for each subgroup were manually categorized.

Inclusion criteria[3]

Stones in extra-renal pelvis; renal pelvic stones associated with congenital renal anomalies such as uretero pelvic junction obstruction (UPJO).

Exclusion criteria

Diabetes mellitus; extracorporeal shock wave lithotripsy (swl); patients with separate stone burden in different calyces or intra-renal pelvis; solitary kidney with UPJO; recurrent cases; non-functional kidney; bleeding and coagulation disorders; previous laparotomy; previous retroperitoneal surgery.

All patients underwent routine laboratory tests including complete blood count, blood chemistry and urine analysis and urine culture preoperatively. To evaluate the impact of surgery on renal function, glomerular filtration rate (GFR) was measured preoperatively, at day 3 and three months after surgery. Estimated GFR was calculated using Cockcroft-Gault formula. To assess selective renal function, kidney scintigraphy with single-shot diethylene-triaminepentaacetic acid (DTPA) was done before operation and at three months postoperatively in selected cases. Drainage was classified as good if T1/2 was <20 minutes; fair if T1/2 was >20 minutes and the drainage curve was descending, or poor if T1/2 could not be counted and there was an increasing drainage curve.[4] The patients were followed up clinically and radiologically at regular intervals.

All perioperative and post-operative complications up to 3 months were recorded and classified according to the Clavien grading system.[5] Stone-free result (as the primary end point of the study) was defined as no residual fragments or a residual fragment smaller than 4 mm on the postoperative imaging profiles (ultrasonography and kidney-ureter-bladder X-ray).

Preoperative radiological assessment included renal USG, CT-urography for all patients, and DTPA scan for patients with poor renal function on CT-urography.

We have followed standard technique of laparoscopic trans peritoneal pyelolithotomy. Retroperitoneal approach was not followed due to ergonomic problem and anatomical delinent issues.

Technical details

Anesthesia: General anesthesia

Patient position: 45-60 degree lateral

Pneumoperitoneum created with veress needle followed by insertion of first 11 mm trocar at umbilicus, used as camera port. Then three trocar; 5 mm (sub xiphoid), 10 mm (para rectal region at the level of umbilicus) and 5 mm (subcostal anterior axillary line) were inserted under direct vision.

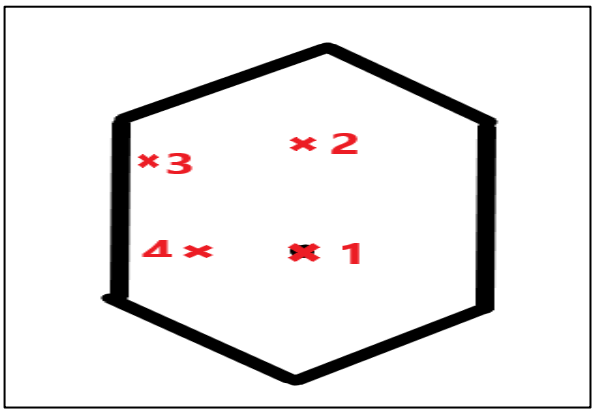

Figure 1: 1) 11 mm trocar at umbilicus, used as camera port; 2) 5 mm (sub xiphoid); 3) 5 mm (subcostal anterior axillary line) were inserted under direct vision; 4) 11 mm (para rectal region at the level of umbilicus).

After medial mobilization of colon and once renal pelvis and ureteropelvic junction were exposed, a longitudinal incision was made on the renal pelvis, depending on the location and shape of the stone. Stones were removed from renal pelvis using grasper forceps and delivered via an Endobag. After suction- irrigation of renal pelvis (to wash out further tiny stone particles), a double J ureter-al stent was passed through renal pelvis to the bladder through the anterior axillary port. Finally, pelvis was

closed using vicryl 3-0 round body (absorbable polyglactin) suture in an interrupted fashion. Drain insertion was done through anterior axillary port followed by placement of mobilized colon and reverting the patient to supine position Foley catheter was removed 48 hours after operation. Drain was removed when its daily output reached lower than 25 ml. Double J ureteral stent was removed under local anesthesia 4 weeks later.

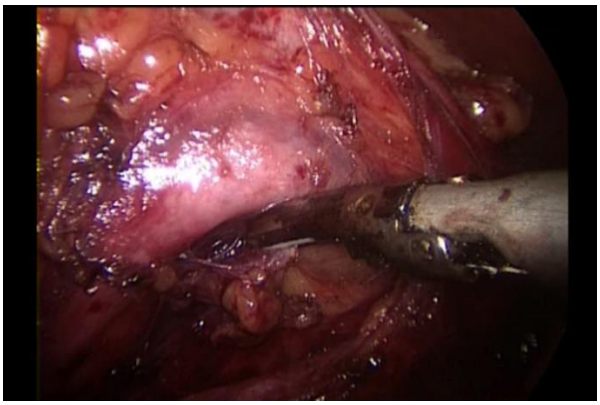

Figure 2: Renal pelvis and ureteropelvic junction were exposed.

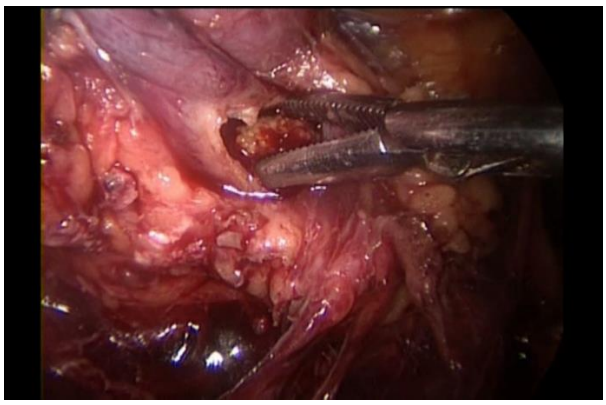

Figure 3: Longitudinal incision was made on the renal pelvis, depending on the location and shape of the stone, with stone extraction done with graspers.

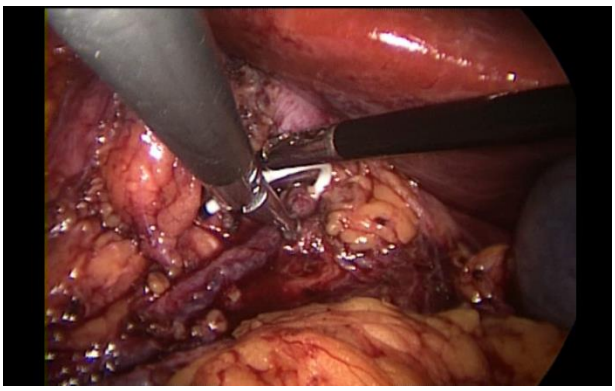

Figure 4: Double J ureteral stent was passed through renal pelvis to the bladder through the anterior axillary port.

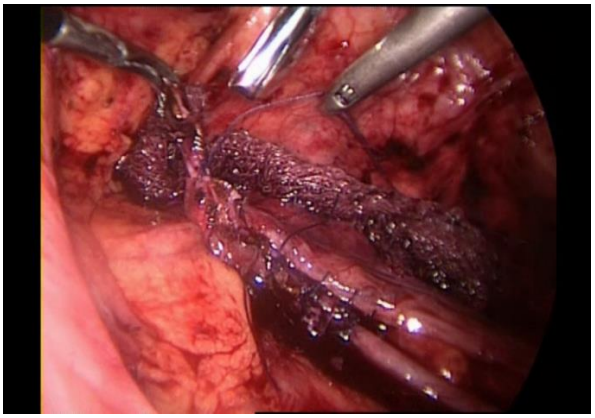

Figure 5: Pelvis was closed using vicryl 3-0 round body (absorbable polyglactin) suture in an interrupted fashion.

RESULTS

As per categorization of patients based on the gender and subdivided into different pre-operative, operative and post-operative categories, it is noted that incidence is higher in females, preponderance to right kidney, solitary staghorn stone is common, while the operative time and post-operative phenomena are common to both the genders.

Table 1: Profile of patients with laproscopic pyelolithotomy.

	Males	Females
Number of patients	7	11
BMI	24.23	23.22
Abdominal operative history	None	None
Affected kidney side	Right-4 Left-3	Right-8 Left-3
Mean stone size	2.1cm	2.3cm
Stone feature (with number)	Single-6 Multiple- 1	Single-10 Multiple- 1
Staghorn	5 cases	8 cases
Non staghorn	2 cases	3 cases
Cases with UPJO developing renal pelvis stones	none	2 cases
Operative time (min.)(±30 minutes)	147	154
Calculated blood loss (ml)	50 ml	50 ml
Total drained amount	50 ml	50 ml
Hospital stay	3 days	4 days
Drain removal	3 days	3 days
Split function in DTPA scan in %	1 case	3 cases
Preoperative split function	33.2	33.2
Postoperative split function	42.4	42.4

Demographic profile of all patients is mentioned and concomitant pathology if present is mentioned in Table 1.

Table 2: Follow up table.

	1st Post operative day	2nd Post operative day	2 weeks	4 weeks	8 weeks	3 months
X-ray KUB	No calculi visualised,DJ stent in situ					No calculi visualised
USG KUB		No calculi visualised and DJ stent in situ				No calculi visualised
DJ stent removal				Stent removed in 16 cases	2 cases	
Clinical			Asymptomatic with normal physical examination	2/18 cases symptomatic and rest asymptomatic with normal physical examination	Asymptomatic with Normal physical examination	Asymptomatic with Normal physical examination
RFT	WNL	WNL	WNL	WNL	WNL	WNL
DTPA SCAN						Done in 4 cases with split renal function pre op 33.2% to post op 42.4% was evaluated

Table 3: Post operative complications.

Complications	Laproscopic pyelolithotomy (our study)	PCNL[1]
Bleeding	No. of cases	4-20% cases due to injury to renal parenchyma
Blood transfusion rate	Not required w.r.t estimated blood loss intraoperatively	Required in 1.1% cases
Conversion rate to open procedure	None	Few cases
Visceral injury	None	<1% cases
Prolonged urine leakage	None	None
Stone free rate	100 %	90%
Postoperative fever	None	13.5% cases
Neurological complications[9]	None	2 cases
Hospital stay	4-5 days	5-6 days

Data had been collected by retrospective evaluation of postoperative patients by follow up on post-operative day 1st, 2nd, 2nd week, 4 weeks, 8 weeks, and 3 months; for which the patients are evaluated radiologically (X-ray KUB, USG KUB, DTPA scan), clinically and on blood investigations (RFT).

Also, stent removal was planned and respective data has been mentioned in Table 2.

Post-operative complications have been compared with PCNL with more percentage of stone free rate in LP in Table 3.

DISCUSSION

Although PCNL is considered as the gold standard treatment modality for most of large renal stones, with global increase in experience of laparoscopic surgery, there is an upward trend toward the usage of laparoscopy in stone removal surgery. Nowadays, LP can be recommended for confined pelvic stones without extension to several renal calyces as an alternative to PCNL.

It is a fact that introduction of PCNL has led to a revolution in the field of urolithiasis surgery, but some concern still remains regarding its side effects. Colon injury and damage to the large blood vessels are some of the rare (less than 1%), but important PCNL complications. Immediate or late hemorrhage (4-20% and 1%, respectively) may also happen. Blood transfusion and prolonged hospital stay, or rehospitalization may occur due to the hemorrhage, which impose extra cost on the patient and the health care system.[1] Radiation exposure during PCNL is another hazard for both the patient and physician.[7,8]

Our study found that LP provided a significantly lower blood transfusion rate, lower bleeding rate, and fewer

hemoglobin decrease. The reason was probably due to the fact that LP is harmlessness for renal parenchyma.

For conversion rate and prolonged urine leakage, incidence of prolonged urine leakage and longer hospital stay were found in the LP group. Urine leakage can be attributed to incomplete closure of the pyelotomy incision after LP, which can prolong hospital stay.[9] Closure of pyelotomy incision is technically difficult during laparoscopic surgery, advanced experience and high skills or robot-assisted surgery are needed. But urinary leakage has been minimized with advances in intracorporeal suturing techniques, such as barbed suture.[10] In our study, no conversion to open pyelolithotomy and no incidence of urinary leakage were reported in any case.

Basiri and colleagues have reported few cases of neurologic complications including paraplegia and hemiplegia following PCNL. Despite the fact that some of this hazards may happen during laparoscopy too (like visceral and great vessels injury), some urologists have proposed it as an appropriate alternative to PCNL in selected cases.[11] Earlier studies suggested LP for limited conditions such as solitary stone in extra renal pelvis and coexistence of congenital anomalies such as UPJO and pelvic kidney.[10,11]

In our study, no neurological complications were reported post operatively in any cases, nor any visceral injury was reported.

Nambirajan et al, reported 18 patients with kidney stones who underwent LP, several patients had coexisting anomalies such as UPJO, calyceal diverticulum and horse shoe kidney. Despite the relatively prolonged mean hospital stay in this case series (10.5 days) and small to moderate stone size (mean 1.3 cm length), Nambirajan and colleagues concluded that laparoscopic surgery would be effective for complex kidney stones and it could be an alternative to PCNL.[12] Several studies have reported a higher success rate for LP in extraction of more complex and staghorn stones.[13] In our study, 2 cases with renal pelvis stones in UPJO were taken, which had successfully undergone LP without any post-operative urine leakage at pelvis site with preserved split renal function in DTPA studies postoperatively after 3 months.

Nouralizadeh et al have reported 13 patients with large stones in extra renal pelvis who had underwent LP. Mean stone size and mean hospital stay were 5.1 cm and 4 days, respectively. Overall success rate was 84.6% and there was no major complication.[14] Another advantage of LP is that often stone is extracted in whole form, in contrast to PCNL, in which tiny stone particles can become a nidus for future stone formation.

Li et al randomized 178 patients with large renal pelvis stones into two groups; found the mean operative time was significantly longer in the LP than PCNL.[15] In LP procedure, closure of the pyelotomy incision requires advanced laparoscopic skills. Sometimes, delicate renal pelvis tissues, always caused by long-term chronic inflammation, brings many challenges for the closure of the pyelotomy incision and prolongs the operative time.[16] The longer time of LP was usually related to the long learning curve as well as the time needed for intracorporeal suturing and delivery of the stone into the endobag. Although LP have a longer operation time, this may be compensated by the lower complication and higher SFR.[16]

Ramakumar et al described a study of 16 patients who had undergone LP; showed that operation time was longer in LP, but success rate and mean hospital stay were not significantly different between two groups.[17]

In a cohort study by Tefekli et al on two groups (LP and PCNL) including 26 patients in each side, operation time and hospital stay were significantly higher in LP group, but mean hemoglobin drop was less (p=0.024). Stone free rate was similar between two groups.[18]

Aminsharifi et al have carried out another cohort study on 60 patients to compare LP and PCNL for solitary pelvic stones larger than 3 cm. According to their results, mean operation time was significantly higher in LP group (p=0.01); but stone free rate and average treatment cost were significantly lower in LP group. In this study, no significant difference in mean hemoglobin drop was noted be-tween LP and PCNL groups.[19]

Wang et al have reviewed 7 trials and a total of 176 and 187 patients who had undergone LP and PCNL for single pelvic stones.[20] They concluded that operation time and hospital stay were shorter in PCNL group; but decrease in hemoglobin level and rate of fever were lower in patients treated with LP. Also, they showed equivalency for conversion rate, blood transfusion, prolonged urine leakage, and found higher SFR and lower incidence of bleeding and postoperative fever in the LP group than PCNL group. In addition, the results of the previous study showed that operative time and length of hospital stay were shorter in the PCNL group, drop in hemoglobin level was fewer in the PL group.

Postoperative fever secondary to a urinary tract infection (UTI) in patients with PCNL ranges between 2.8 and 32.1%.[21] Kidney stones are foreign bodies of the urinary tract and can allow bacteria to grow onto them and then become a reservoir for bacteria. They are disintegrated, bacteria are released from the stone into the collecting system, which tends to result in bacteriuria, bacteremia, and clinical UTI. Recently study demonstrated residual stone is a major contributing factor for the development of fever after tubeless PCNL.[22] This finding may translate into a clinical benefit for the patients in that stones removed integrally or the higher SFR of the LP was associated to lower incidence of postoperative fever. Septic shock, the incidence after PCNL was 2.4%, is one

of the most dangerous complications after lithotomy due to it can lead to significant mortality.[23,24] The risk factors for septic shock includes positive urine culture, female gender, renal insufficiency, diabetes mellitus, high pressure of irrigation fluid during PCNL, staghorn calculus, infected stones, indwelling catheters, obstruction, and duration of the operation (>90 minutes).[25,26] In addition, infective or septic complications may be associated with laparoscopic approach.

In our study, we included 18 patients who underwent LP, and found similar results from the previous meta-analysis regarding SFR, conversion rate, operative time, length of hospital stay, Estimated blood loss, and postoperative fever. We also found that LP required a significantly lower auxiliary procedures and re-treatment rate. Although the SFR was assessed for all cases in our study (exclusive LP) and compared to PCNL group in other studies, the result revealed LP provided a statistically higher SFR at 3 months after treatment than PCNL, regardless of the definition. The reason may be that most of the stones can be removed intact in LP. In the PCNL group, disintegration of the stone may have left some residual stones which can form nuclei for stone recurrence, and the scattering of stone fragments may reduce success rates.

Currently, PCNL is the recommended treatment option for patients with staghorn calculi. However, SFR after PCNL for staghorn calculi only ranges between 49 and 78%.[22] It is noteworthy that LP can be considered an alternative and feasible technique to PCNL for patients with complex and large renal stones.

Our study showed a better improvement in renal function following LP at 3 months after surgery. Stone extraction may lead to the improvement of postoperative renal function by relieving of urinary tract obstruction, possible infection and inflammation. Also, several studies have reported significant increase in GFR after PCNL, but it can be assumed that this improvement is due to the resolution of stone burden rather than PCNL itself.[2,4,6] Theoretically, PCNL may cause harm to the kidney parenchyma. This can happen by either direct injury to the renal tissue during tract dilation and lithotripsy, or indirect mechanisms like massive hemorrhage and vasoconstriction of kidney vessels.

Giving the fact that total GFR is resultant of function of both kidneys and does not specifically show the impact of surgery on the affected kidney, we performed a DTPA scan before and after surgery in 4 cases (including two cases of UPJO obstruction with renal pelvis calculi) in order to compare changes in split renal function. Three months after surgery, while the burden of stone is removed and the effect of surgery and medications are nearly resolved; GFR increased and renal split function showed improvement. Nevertheless, our study shows that mean changes in total GFR and split function of the operated site were significantly higher in LP group at three months after surgery. Hence, LP can be assumed as a reasonable alternative for PCNL in the patients for whom preservations of renal performance is a matter of utmost importance. Larger and staghorn stones were independent risk factors for perioperative hemorrhage in all cases.

LP is certainly safe and feasible in experienced hands, but should not replace PCNL, which remains the gold standard for kidney stones greater than 2 cm. According to previous studies, LP is more suitable for patients with urinary deformity require concomitant pyeloplasty. Patients with previous history of open renal surgery always have significant perinephric adhesion which may affect the success or complication rate in LP, does not in PCNL.[26] Therefore, PCNL is the first-selected treatment in such situation. All in all, LP is considered a successful alternative therapy for PCNL in selected cases with large renal stones like those in the extra renal pelvis in patients without a history of previous surgery. In addition, LP can be considered as a reasonable therapeutic option for large staghorn calculus which cannot be removed with a reasonable number of access and sessions of PCNL.

CONCLUSION

From our study, we conclude that LP can be considered as a safer and better therapeutic option to PCNL for selected patients with renal pelvis stones and with extra renal pelvis stones and with UPJO or other congenital anomalies in competent hands in current practice. LP is not associated with radiation exposure and its success rate is comparable to PCNL.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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