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RETROPERITONEAL LAPAROSCOPIC PYELOLITHOTOMY IN RENAL PELVIC STONE VERSUS OPEN SURGERY - A COMPARATIVE STUDY

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Abstract

Background. *The introduction of endourological procedures such as percutaneous nephrolithotomy and ureterorenoscopy have led to a revolution in the the management of urinary stone disease. The indications for open stone surgery have been narrowed significantly, making it a second- or third-line treatment option.*

Aims and Objectives. *To study the safety and efficacy of retroperitoneal laparoscopic pyelolithotomy in retroperitoneal renal stone. We compared the results of laparoscopic and open surgery in terms of easy accessibility, operative period, renal injuries, and early recovery.*

Methods. *This prospective study was conducted on renal pelvic stone cases from January 2009 to February 2016 in Suchkhand Hospital, Agra, India. The study included a total of 1700 cases with the diagnosis of solitary renal pelvic stones. In group A - 850 cases - retroperitoneal laparoscopic pyelolithotomy was performed, while group B - 850 cases – underwent open pyelolithotomy.*

Results. *The mean operative time was less in group B than group A (74.83 min vs. 94.43 min) which was significant ($p<0.001$).The blood loss was less in the laparoscopic group than in the open group (63 mL vs. 103mL). There were statistically significant differences in the post-operative pain scores, and postoperative complications compared to group B ($p<0.001$). The mean hospital stay was less in group A ($p<0.03$), which was significant.*

Conclusion. *Laparoscopic surgery reduces analgesic requirements, hospital stay, and blood loss. The disadvantages include the reduced working space, the cost of equipment and the availability of a trained surgeon.*

Keywords: kidney calculi, extrarenal pelvis, retroperitoneum, laparoscopy, non invasive surgery

Introduction

Retroperitoneal laparoscopy for renal surgery is a viable alternative to transperitoneal access. In spite of various significant advances in laparoscopy technologies, laparoscopic urologic surgery remains technically demanding regarding various surgical steps including the challenge of specimen retrieval and extraction [1]. The indications for open renal surgery to treat renal calculi are limited to special situations; it is needed in only 0.47% to 5.4% of the cases [2]. Laparoscopy is a preferable approach for large renal stones with an excellent stone-free rate, especially when it requires a single session [3]. The development of both approaches (transperitoneal/ retroperitoneum) paralleled during the last two decades however, retroperitoneal laparoscopy witnessed a steep learning curve because of the constraint of working space [4]. The risk of spillage depends upon the size of the cyst, surgical technique, experience and the site from where specimen extracted [5].

It is yet to be established the role of retroperitoneal

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pyelolithotomy (RPL) though each modality has its specific role in the management of large renal stones [6]. The studies evaluated that the chances of bleeding and hospital stay are less with the retroperitoneal laparoscopic method for the management of complex renal stones [7]. Retroperitoneoscopic nephrectomy should also be offered as a standard treatment modality to patients needing pre-transplant or post-transplant native kidney nephrectomy for different indications [8]. Even after the advent of balloon dissection techniques, retroperitoneoscopic pyelolithotomy has not gained much popularity [9]. Our study compared the RPL versus open procedure for solitary large pelvic stones and evaluated the advantages and disadvantages of both procedures.

Material and methods

The present prospective clinical study was carried out in Department of Surgery, at Suchkhand Hospital, Agra, India from January 2009 to February 2016. Written informed consent was obtained from each patient, and it was approved by the ethical committee of our institution. In the present study, a total number of 1700 patients of either gender and in the age group of 12 to 70 years admitted to surgery was included. We compared the results of laparoscopic retroperitoneal and open pyelolithotomy.

The study was divided into 2 groups. In Group A - 850 patients underwent Retroperitoneal Laparoscopic Pyelolithotomy (RLP) and in Group B - 850 patients underwent open pyelolithotomy. Patients' age ranged from 12 – 70 years, all unilateral and bilateral solitary pelvic stones (2-3 cm), intrarenal and extrarenal pelvis were included (Table I). Patients were excluded if age <12 and >70 years, pelvic stones less than 2 cm and more than 3 cm, multiple renal calculi and ureteric calculi either single or multiple. Patients with congenital or acquired anatomical abnormalities, previous history of renal surgery, bleeding disorders, pregnant cases, cardiac problem, disturbed renal function were excluded from the study. The pre-operative assessment of all the patients included the following investigations: plain X-ray and ultrasound of the KUB, renal function tests, urine routine and microscopy examination, intravenous urography. The patients with urinary infection received a course of antimicrobial therapy and they were taken up for the procedure after the urine culture was sterile. If required, plain CT scan (Computed Tomography), DTPA scan (Diaethylene Triamine Pentaetic Acid) were also performed.

Operative details

All the patients received routine pre-operative and post-operative antibiotics (Ceftriaxone 1gm, Amikacin 500mg, and Metrogyl 100ml). The patient was later moved into a right or left lateral position, depending on the side of the patient on which the operation was performed. Three ports were made; the 1st port of 1.5 cm size was at the lateral border of the erecta spinae in the line of the umblicus. A long hemostatic artery was inserted into the retroperitoneal space to create the space followed by index finger to make sure correct plane by feeling the kidney. Then a working space was created retroperitoneally by a balloon (glove finger) filled with 150 ml of water and kept in place for a minimum of 3 minutes to achieve bloodless space. Two other working ports 5 mm in size, one in the renal angle just below the 12th rib at the lateral border of the sacrospinalis muscle, and the 3rd was anterior and 1 cm above the anterior superior iliac spine (Figure 1). The 5 mm one was converted into 8 mm port if required to insert the cold knife to give pelvic incision or directly pelvis can be opened with the scissor. Finally, a Hasson trocar was inserted in the middle of the port of 10 mm size and fixed to the musculature with a silk no 1 suture in order to avoid air leakage and subcutaneous emphysema.

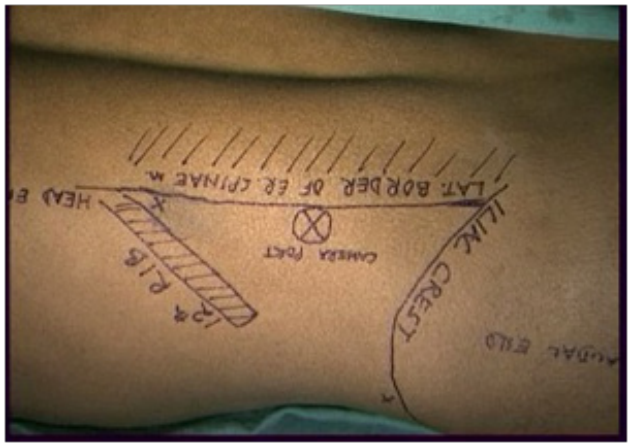

Figure 1. Pre-operative picture showing the landmark for insertion of the trocars at three ports.

CO_2 insufflation was performed until reaching 12-mm Hg tension. The ureter recognized and the renal pelvis identified, the incision was made with endoknife/cold knife or directly with scissor (Figure 2). The incision in the renal pelvis will be made as high as possible and will be linear or curvilinear depending upon the configuration of the stone and the exposure of the renal pelvis. If it was large in size, the 10 mm Mixter forceps was used (Figure 3). The stone was kept at retroperitoneal space. DJ stent was inserted through the 5 mm port with the help of the suction tip through the 5 mm port (Figure 4). We did not insert the DJ before proceeding for surgery. The pelvis closed with intracorporeal knot by absorbable 4.0 - Vicryl sutures. The cystoscope was inserted through the lower 5 mm port and under the guidance of the cystoscope the pelvic stone was removed by the 10 mm port incision site. Ureteric stent was kept for 4-6 weeks and confirmed on X- ray KUB on next day of Surgery.

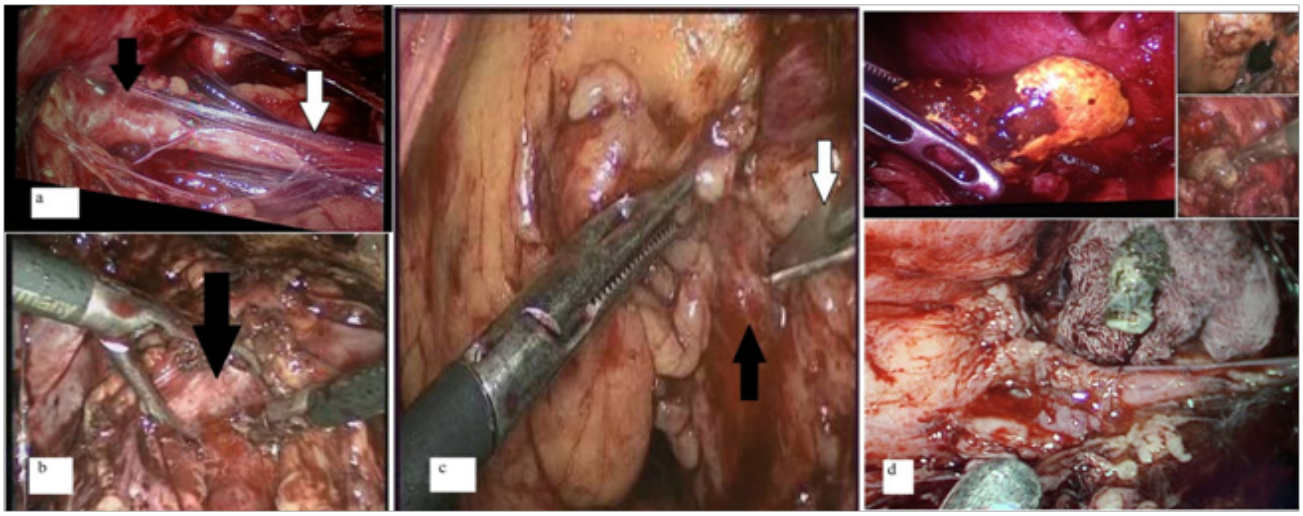

Figure 2. a) operative picture revealed renal pelvis and ureter; b) pelvis area separated by grasper; c) incision made over the renal pelvis; d) section showed stone removed from the renal pelvis.

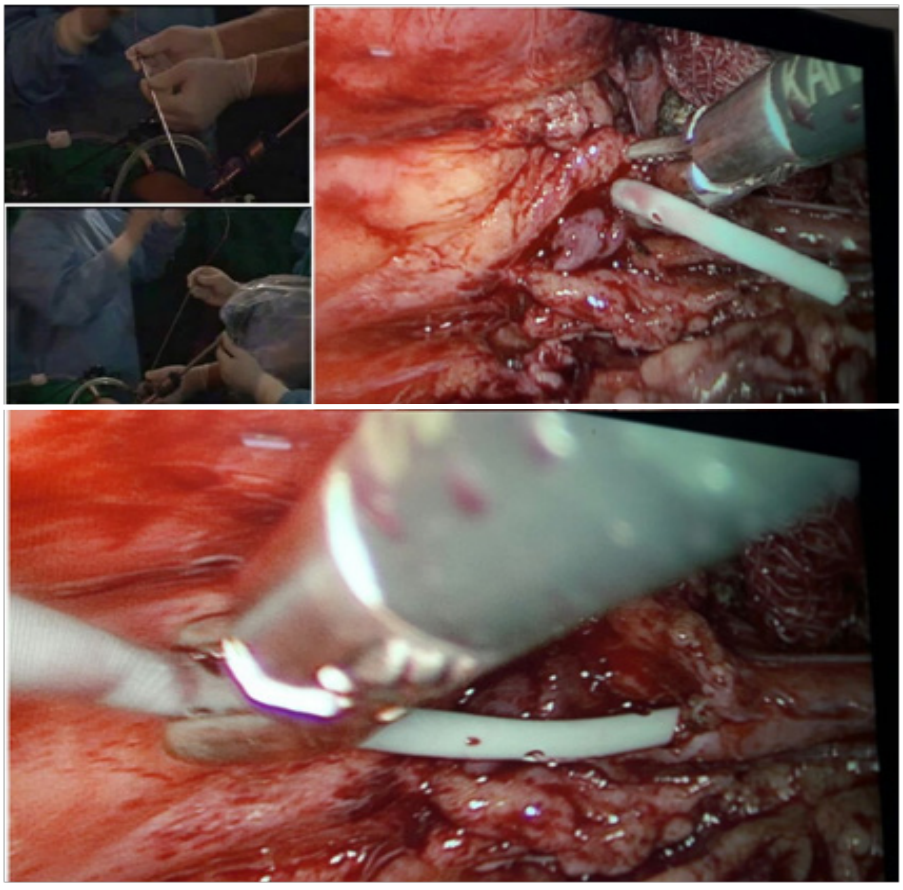

Figure 3. insertion of the stent from the 5 mm port with the help of the suction cannula and one end inserted into the ureter and other end into the pelvis.

In group B - a standard transverse incision was given retroperitoneally and opened in layers. First ureter was identified and then pelvis recognized. Incision was made over the pelvis and stone removed. DJ stent placed inside and pelvis closed with the vicryl 3-0. An abdominal drain was placed in the retroperitoneum and exteriorized through one of the port incisions, and was subsequently removed when the drainage was lower than 30 mL/24 hours in both the groups. The ureteral catheter was removed on average the 2nd day after surgery. The patient will be discharged on the 7th day of surgery or according to his/her condition . The drain will be removed as soon as the drainage becomes minimal (<20 ml). All the patients will be followed up to six months, initially at 15 days and thereafter 1 month and then at 3 & 6 months. Criteria- X- Ray KUB and USG KUB can be done to rule out retained stone.

Statistical Analysis – At the end of the study, the data will be collected and analyzed by using appropriate statistical methods. P value of less than or equal to .05 will be taken as the cut off point for statistical significance.

Results

The results were compared in both the groups in term of stone clearance, hospital stay, blood loss, analgesic requirement, and intra and post-operative complications. In the laparoscopic and open groups, the main complaint was flank pain; few cases presented with hematuria, and some presented recurrent urinary tract infections (UTI). The mean age and gender ratio was comparable in both groups. Also there was no significant difference observed in stone size in both groups. The mean stone size in group I was 1.9±0.9 and in group II 2.0±1.3 (Table I). The stone size less than of 2 cm, 2-2.5 cm, 2.5-3 cm in cases 340, 290, 220 in group A and in group B, in cases 355, 294, and 201 respectively.

The operative time was substantially less in the group B (64.8±22.4) than in the group A (84.2±41.7) and the mean time was 74.83 min vs. 94.43 min respectively, and this difference was statistically significant ($p<0.001$). The time required for pelvis closure was lower in the group B (3.4±1.4) than group A (10.2±4.3). The time taken for the stent insertion again was less in group B (4.1±1.9) than group A (9.8±3.7). But our technique was different from other studies for insertion of the stent. We inserted the stent through the suction cannula by the 5 mm port without increasing the port or the size. The mean blood loss was less in the laparoscopic group A than in the open group B (63 mL vs. 103 mL), although this difference was not statistically significant. It was observed that the blood loss, post operative analgesia required and post operative hospital stay was significantly lower in the laparoscopic pyelolithotomy group except for the operative time. Also no blood transfusion was required in laparoscopic group and it was required in 12 cases in group B. The mean time for drain removal was 24.7±8.9 hours in laparoscopic pyelolithotomy as compared to 96.5±16.2 hours in open pyelolithotomy. The mean operative time was significantly higher in the laparoscopic pyelolithotomy group as compared to open pyelolithotomy group. The time required for wound closure was lower in the laparoscopic group (Table II).

Table I. Pre-operative Patients Characteristics.

	Laparoscopic Pyelolithotomy (n=850)	Open Pyelolithotomy (n=850)	P- value
Age in yrs (Mean ± SD)	34.3±9.92	35.2±10.67	0.072
Sex (M:F)	600:250	535:315	0.080
Stone Size in cm (Mean ± SD)	1.9±0.9	2.0±1.3	0.065

Table II. Comparison of peri and post operative data in patients treated by laparoscopic and open procedure, or comparison of parameters between the open and laparoscopic groups.

Procedure	LPL(group-A)	Open(group – B)	P value
Mean Operative Time (min)	84.2±41.7	64.8±22.4	< 0.001
Pyelolithotomy pelvis Closure (min)	10.2±4.3	3.4±1.4	<0.001
Stent Insertion (min)	9.8±3.7	4.1±1.9	<0.001
Post- operative Hospital stay (days)	2.5±0.8	9.7±1.3	<0.001
Post- operative Analgesia (days)	1.2±0.4 days	3.3±0.9	<0.001
Blood Transfusion (%)	0	12	<0.001
Drain removal (hrs)	24.7±8.9	96.5±16.2	<0.001

Minor intra-operative complications were seen in the laparoscopic group, including an inadvertent opening of the peritoneum in 9 patients, stone migration in 35 patients, and the inability to negotiate the DJ stent in three patients which were managed successfully. All of these procedures were completed laparoscopically and without much difficulty. In those cases where we were not able to place a stent the DJ stenting was done through the cystoscopy per urethra. The patient who experienced stone migration into the calyx was managed by localizing the stone using the cystoscope, and the procedure was completed laparoscopically. The patient whose stone could not be located despite an adequate dissection was switched to the open surgery group and was finally managed by open pyelolithotomy with double-J stenting. The patient for whom it was not possible to negotiate the stent from above was managed by stenting the ureter retrogradely using a cystoscope. In the open group, stone fragmentation and stone migration occurred in 40 cases. These cases were managed by thorough normal wash and using a rigid nephroscope for stone localization, respectively.

There was no significant difference in the timing of the return of bowel function, the resumption of oral intake or drain removal between the open and the laparoscopic groups. There were a total of 141 post-operative complications, out of which 24 were in the laparoscopic group (A) and 117 in the open group (B). Three patients in the open group developed superficial wound infections, which were managed by a short course of empirical antibiotics against Staphylococcus aureus. One patient experienced a severe wound infection which necessitated skin-stitch removal, twice daily dressing and a broad spectrum antibiotic. The patient was subsequently scheduled for secondary suturing after discharge. Another patient who developed a wound infection experienced a prolonged urinary leak, which was managed by keeping both the drain and the indwelling catheter in place until the leak ceased. In the laparoscopic cohort, 7 complications occurred. One patient developed surgical emphysema, which was managed conservatively; 3 patients developed port site infections, which required daily dressings, and the remaining 2 experienced prolonged urinary leaks with port site infections, which were managed in the same way as in the open group. A patient who had a prolonged ileus was managed by Ryle's tube suction, and oral intake was started on the 4th post-operative day (Table III). *Hospital stays and postoperative analgesia requirements*: the length of the hospital stay was shorter in the laparoscopic group than in the open group (3.8 vs. 5.13 days; $p<0.03$). Post-operative pain was quantified using a visual analogue scale (VAS score) and the total quantities of analgesic and diclofenac sodium (intramuscular) used in the postoperative period. The post operative pain as observed by VAS score was significantly lower in the laparoscopic group A as analyzed till the third postoperative day as compared to group B (Table IV).

Table III. Complications assessed in both the groups.

Complications	Laparoscopic Pyelolithotomy	Open Pyelolithotomy	P value
Superficial Wound infection	5	46	<0.001
Prolonged Leak	6	27	<0.001
Fever	5	28	0.005
Prolonged Ileus	2	5	0.452
Parenchymal trauma	2	5	0.579
S/C Emphysema	4	0	<0.001
Lumbar Hernia	0	6	0.031
Total	24	117	<0.001

Table IV. Post-Operative Pain and VAS score.

Days	Lap Pyelolithotomy	Open Pyelolithotomy	P value
	Mean±SD	Mean±SD	
Day 1	4.2±1.6	6.8±1.9	<0.001
Day 2	2.6±0.8	5.3±1.4	<0.001
Day 3	1.4±0.7	3.2±0.9	<0.001

Follow up, patient satisfaction and convalescence (the average period required to return to normal activity in weeks. Patients undergoing laparoscopic surgery rated their overall satisfaction higher. The mean period of convalescence in the open and the laparoscopic groups was 4.75 weeks and 2.64 weeks, respectively; this difference was statistically significant ($p<0.001$). The laparoscopic surgery was significantly more costly than the open procedure. However, considering the relatively short hospital stays, lower morbidity rates and shorter convalescences, the overall costs associated with the laparoscopic surgery are expected to be less than those associated with the open surgery. Laparoscopic pyelolithotomy is cosmetically superior to open pyelolithotomy. In laparoscopic pyelolithotomy, the average scar size was 3.5 cm (range 3-3.5 cm), while in open pyelolithotomy, the average scar size was 15 cm (range 9-17 cm). This difference was statistically significant ($p<0.001$).

Discussion

The most common entity worldwide is kidney calculi, a condition whose treatment is widely discussed by urologists. Laparoscopic Pyelolithotomy (LP) may be done where SWL and PCNL are not possible, and also feasible in cases that have renal abnormalities, or have a solitary large stone in renal-pelvic calculus [10]. The retroperitoneoscopic approach is spread widely in which space was created with the help of the balloon. It gives full vision to the urinary tract, easy to mange and prevents the leakage of urine into the peritoneum. The main problem in retroperitoneoscopic approach is lesser working area, due to which it is difficult to do the suturing for the urinary tract [11]. In our experience, to create the retroperitoneal space with help of the balloon is useful, bloodless. We didn't encounter any problem for suturing the pelvis but it is was difficult in intrarenal pelvis cases. Some studies observed that in retroperitoneoscopic surgery alongwith RP, it is sometime difficult to create the pneumoretroperitoneum by the needle and is slow as compared to the transperitoneal approach [12]. In our study, with the help of the curved long artery sheath was pierced to enter the retroperitoneum space and with the help of glove finger, (ballooning) the fat was got separated without any peritoneum breach. They stated that in laparoscopic retroperitoneal pyelolithotomy hospital stays is shorter with better cosmetic results. Even the chances of conversion from retroperitoneum laparoscopy into open surgery are less and few complications. Our results have also showed that LRP is a better option than open surgery. We observed that bleeding was less and one can even identify the ureteric stent if it gets misplaced from the ureter, while inserting it in the ureter.

Other authors have reported that the LPL is harmless to the parenchyma so bleeding is higher in PNL which is a frequent complication. They stated that laparoscopic surgery should be considered over open surgery only when expertise is available (Table V) [13]. Our study also declared stone free rate and without any parenchymal or blood loss or major complications and quick recovery. Although in retroperitoneal approach the renal pelvis can be accessed directly which prevents extensive dissection, without any urine and blood leakage into the peritoneal space alongwith early recovery, they preferred the transperitoneal route to access the renal pelvis [14]. So to avoid peritoneal injuries or contamination, we preferred retroperitoneum approach for the renal stones. Though in RPL, space is less for surgery or approaching pelvis closure, these disadvantages may be overcome by the surgeon's experience.

Another study stated that despite of absence of landmarks and paucity of space, no significant complications occurred in their study except peritoneal rent prolonged urinary leakage, subcutaneous emphysema and superficial port site infections [15], but in our study we did not encounter any difficulty with the port site position and neither any surgical emphysema or peritoneal tear. To avoid the surgical emphysema, we used the Hasson cannula which prevents gas leakage. Another study has reported that mean surgical time and hospital stay is longer in transperitoneal LP, hemoglobin loss and requirement of blood transfusion is significantly less than PCNL [16]. We fully agreed with this study and our results are comparable. Another study also preferred the retroperitoneal approach to achieve the renal pelvis as it allows direct access to the posterior aspect of the renal pelvis [17]. We agreed with another point that RPL is difficult in cases of past history of surgery. We observed that RPL allows direct access to the renal pelvis, avoids extensive dissection, postoperative recovery is faster and our results were also same as of above study. In our group A, the analgesic requirement was less as compared to group B. there were no radiation exposure in either group. The cosmetic result was again much better than the group B.

Table V. Comparison between the various studies.

Study	Age (yrs)			Operative time (min)		Blood loss (ml)		Intra Op complication		Conversion rate		Post Op complication		Removal of drain (days)		Hospital stay (days)	
	Lap		Open	Lap	Open	Lap	Open	Lap	Open	Lap	Open	Lap	Open	Lap	Open	Lap	Open
Chander J [12], 2005	33	74		81		27		5/56		2/56		5/56				4.3	
Patloo AM [10], 2012	38.53		38.42	94.43	74.83	73	103	5/30	2/30	1/30	-	7/30	5/30	3.6	3.3	3.8	5.13
Tefekli A [13], 2012	36	54		138.4		1±.6 hb drop		-		1/26		1/26				3.9	
Present Study	34.3		35.2	98.6	60.8	51.7	113.4			-	-	77/850	204/850	24.7hrs	96.5 hrs	2.5	9.7

Conclusion

Laparoscopic pyelolithotomy is a promising alternative for patients who are candidates for open surgery, with an acceptable stone-free rate. RPL is a non invasive procedure as we never used the C arm and is a feasible option that can be recommended for management of renal calculi.

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