International Surgery Journal
Rudramani et al. Int Surg J. 2018 Jul;5(7):2449-2454
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20182486

Original Research Article

Evaluation of laparoscopic retroperitoneal approach for management of various renal calculi

Rudramani, Vikas Singh*, Shesh Kumar, Anil Kumar, Shailendra Kumar, Manish Kr. Singh

Department of Surgery, Uttar Pradesh University of Medical Sciences, Saifai Etawah, Uttar Pradesh, India

Received: 28 May 2018
Accepted: 04 June 2018

***Correspondence:**
Dr. Vikas Singh,
E-mail: drvikas_singh @yahoo.com

ABSTRACT

Background: Despite the availability of Multimodality treatment for management of renal calculi as ESWL (Extra Corporeal Shock Wave Lithotripsy), PCNL (Percutaneous nephrolithotomy), URS (Ureterorenoscopy), RIRS (Retrograde intrarenal surgery) and open surgery and Percutaneous nephrolithotomy (PCNL), the gold standard, laparoscopic pyelolithotomy is an alternative treatment modality as long as the operator has adequate laparoscopic experience. Evaluation of Laparoscopic retroperitoneal approach for management of various renal calculi must be done to get the efficacy of the procedure according to the calculus and renal morphology.
Methods: Laparoscopic retroperitoneal pyelolithotomy/nephrolithotomy was performed on 58 patients with various renal calculi patterns viz. solitary pelvic calculus, staghorn calculus, staghorn calculus with calyceal and isolated calyceal calculi. Extended pyelolithotomy, Gilvernet's technique were used as per the need.
Results: Out of the 58 cases with renal calculi, solitary renal pelvic stones (n=23; 39.7%) were most common followed by staghorn (n=11; 19% Mean size 4.40±1.17 cm) and isolated caliceal stones (n=9; 15.5% with Mean size2.21±0.25 cm) respectively. There were 15 (25.9%) cases with mixed stones (11 cases solitary renal pelvic and isolated caliceal stones and 4 cases had staghorn and isolated caliceal stones). Stone clearance was 93.3 to 100%.
Conclusions: laparoscopic retroperitoneal approach is a useful modality for clearance of renal calculi of different types with minimum complications and a high success rate. However, the technique seems to have a limited role for isolated caliceal stones where direct or C-arm guided nephrolithotomy can be performed for better clearance of stones.

Keywords: Caliceal stones, Gilvernet's technique, Laparoscopic retroperitoneal pyelolithotomy

INTRODUCTION

Multimodality treatment options are available for management of renal calculi, including ESWL (Extra Corporeal Shock Wave Lithotripsy), PCNL (Percutaneous nephrolithotomy), URS (Ureterorenoscopy), RIRS (Retrograde intrarenal surgery) making the role of open surgery almost obsolete, though Open Pyelolithotomy is most common surgery being performed for renal calculi in our country. Extracorporeal shockwave lithotripsy (ESWL) uses high energy 'shockwaves' from a machine outside the body, to shatter the stones into small fragments that can be passed with the urine. Several sessions of ESWL may be needed for larger stones. Percutaneous nephrolithotomy (PCNL) is accepted as the gold standard surgery for most patients suffering from large renal calculi. Despite the progressive advances in percutaneous approach, some concerns still remain about its complications such as immediate or late hemorrhage (due to arteriovenous fistula or pseudo aneurism), parenchymal loss and injury to the adjacent organs.[1]

Gaur et al. first described the technique of laparoscopic pyelolithotomy (LP) as a nephron-sparing procedure more than two decades ago.[2] Retroperitoneal laparoscopy is a minimally invasive approach, compared to endourologic treatment for a variety of reconstructive indications for different pathologic conditions. After adequate training, surgeons should be able to use the approach proficiently. Despite the limited surgical space, direct posterior access to the kidney and renal hilum makes this attractive as, it allows early ligation of renal vessels. Emerging techniques such as single port or single incision could also be performed in a selected subset of patient. The general acceptance of this technique worldwide is confirmation of its potential value. The role of retroperitoneoscopic surgery has been established for the removal of nonfunctioning kidneys and renal tumors.[3] During fetal development, if the kidneys do not complete their normal anatomical rotation, pelvis is situated in front of the kidney, and ureter enters into pelvis at a higher level than its normal insertion site leading to the formation of a horseshoe kidney. This anatomical alteration constitutes a risk for formation of renal stones which are refractory to spontaneous passage. Even though extracorporeal shock wave lithotripsy has yielded successful outcomes, in cases with higher stone burden same success rates cannot be achieved. Inferiorly situated calyces, caudal, and medial location of the lower calyces, anterior position of kidneys relative to their normal anatomical location do not only adversely affect the response of the kidneys to ESWL, but also complicate percutaneous interventions.[4] Conventionally, stone in a horseshoe kidney together with anatomical obstruction carries an indication for an open surgery. Nowadays, in line with the development of laparoscopic surgery, this indication has been thought only for complex stones.[5,6]

Laparoscopic management of stone disease in a patient with a horseshoe kidney was firstly performed by Maheshwari et al in 2004.[7] Retroperitoneal laparoscopic pyelolithotomy was successful in most patients. This technique is minimally invasive and can surpass open surgery in merit, with no injury to the nephron, less bleeding, simple manipulation, short hospitalization, and quick postoperative recovery, without incision of the renal parenchyma.

Compared to PCNL, as a standard technique, for patients with a solitary renal pelvis stone larger than 3 cm, laparoscopic pyelolithotomy can be considered as an alternative treatment modality as long as the operator has adequate laparoscopic experience. A lesser need for ancillary procedures may make LP a cost-effective procedure. However, the potential benefits need to be weighed against the greater invasiveness of LP compared to PCNL. With the evolution of era of laparoscopy has given better access to various renal pathology including in the management of renal calculi. In the centres with adequate experience in minimally invasive surgery the need for open stone surgery has been reduced. Concomitant with this breakthrough the acceptance of Laparoscopic surgery as an alternate to open surgery has been grown in recent years as a result of the increasing use of laparoscopy in urology together with inherent limitations of PCNL. Laparoscopic pyelolithotomy is nephron sparing technique. The European Association of Urology considered laparoscopic pyelolithotomy preferred method over open surgeries.

The aim of present study was to evaluate laparoscopic retroperitoneal approach for management of various renal calculi.

METHODS

The study was conducted at the Department of Surgery, UP University of Medical Sciences, Saifai, Etawah (UP) from Jan 2016 to June 2017.

Inclusion criteria

- Stone > 2 cm Renal
- Failed ESWL in stone < 2 cm
- Solitary renal pelvic calculi
- Staghorn calculi
- Isolated Calyceal calculi >1cm, symptomatic
- Only radiopaque stone.

Exclusion criteria

- Patient with recurrent / residual stones
- <15 years of age
- Bleeding diathesis
- Pregnancy
- Congenital anomalies that precluded retroperitoneoscopy
- Severe co-morbid conditions leading to unfit PAC.

Technique

All the patients were subjected to the standard technique of laparoscopic retroperitoneal approach under general anesthesia (GA) using conventional laparoscopic instruments. Patients were positioned in standard kidney position. 1st port was placed through 10 mm incision at the tip of 12th rib by dividing the muscles under vision, opening thoracolumbar fascia to gain access into retroperitoneum. Inserting double gloved finger of 8 no. latex surgical gloves indigenous balloon on 5 mm port. Balloon dissection of retroperitoneum using 200 to 250 ml saline for 3 to 5 min for better hemostasis. Later 10 mm port for camera was inserted through the same. Rest two ports were introduced under vision and guidance of camera maintaining the triangulation. Psoas muscle as the standard landmark, either renal pelvis directly or ureter was followed upwards to reach the renal pelvis. Pyelotomy with monopolar hook and extension with micro scissors. If required Gilvernet's plane was dissected and extended Pyelotomy in case of Staghorn calculi or in cases of intra renal pelvis. In Calyceal

calculi, direct nephrolithotomy was performed after localization with C-Arm. Proper use of C-Arm to ensure clearance of calculi intraoperatively.

All the included patients were divided into three groups:

1. GROUP A- Solitary renal pelvic calculi
2. GROUP B- Staghorn calculi
3. GROUP C- Isolated Calyceal calculi.

Intraoperatively DJ Stent was placed in all the cases of group A and B only. Pyelotomy incision was closed in A and B with Vicryl 3-0 suture. In all the cases, there was a drain placement in the retroperitoneum.

RESULTS

During the study period a total of 58 patients were enrolled in the study, which were further classified according to the morphology of the calculi viz. Solitary renal pelvic calculus (Group A n=23), Staghorn calculus (Group B n=11), Isolated calyceal (Group C n=9) and Mixed (Group D n=15) (Table 1).

Table 1: Distribution of cases according to type of stone (n=58).

Type of Stone	No. of cases	Percentage
Group A – Solitary renal pelvic	23	39.7
Group B – Staghorn	11	19.0
Group C – Isolated caliceal	9	15.5
Group D – Mixed	15	25.9

Being an important determinant of calculus retrieval, the stone size and the type of pelvis were taken into account on the basis of IVP. Mean calculus size was 3.3±1.01 cm, with 2.91±0.47cms, 4.4±1.17 cm, 1.17±2.21 cm and 3.93±0.66 cm respectively in Group A, B, C and D. 25 patients (43.1%) had an extrarenal pelvis and 33 patients (56.9%) had intrarenal pelvis (Table 2).

Table 2: IVP Findings.

Parameter	Total (n=58)		Group A (n=23)		Group B (n=11)		Group C (n=9)		Group D (n=15)		Statistical significance	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**p**
Size of stone (cm)	3.35	1.01	2.91	0.47	4.40	1.17	2.21	0.25	3.93	0.66	23.924	<0.001
Type of renal pelvis	No.	%	No.	%	No.	%	No.	%	No.	%	χ^2	'p'
Extra renal	25	43.1	13	56.5	5	45.5	2	22.2	5	33.3	3.897	0.273
Intra renal	33	56.9	10	43.5	6	54.5	7	77.8	10	66.7		

Table 3: Surgical approach.

Parameter	Total (n=58)	Group A (n=23)	Group B (n=11)	Group C (n=9)	Group D (n=15)	Statistical significance	
	No.	**No.**	**No.**	**No.**	**No.**	**χ^2**	**p**
Gilvernet's dissection	21(36.2%)	3 (13.0%)	7 (63.6%)	2 (22.2%)	9 (60%)	13.364	0.004
Extended pyelotomy	12 (20.7%)	2 (8.7%)	6 (54.5%)	0	4 (26.7%)	12.375	0.006
Mode of stone retrieval							
Direct pyelotomy	35 (60.3%)	23 (100%)	11(100%)	0	1 (6.7%)	110.59	<0.001
Direct+ Flexible uretero-scope+ C-arm	1 (1.7%)	0	0	0	1(6.7%)		
Direct + C-arm	8 (13.8%)	0	0	0	8 (53.3%)		
Direct + C-arm + Nephrolith.	2 (3.4%)	0	0	0	2 (13.3)		
C-arm + Nephrolith	9 (15.5%)	0	0	9 (100%)	0		
Direct + Nephrolith	3 (5.2%)	0	0	0	3 (20.0%)		
DJ Stent placement	47 (81%)	21 (91.3%)	11(100%)	0	15(100%)	46.118	<0.001
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	'p'
Time taken for surgery (min)	76.40±24.24	67.65±20.16	79.91±18.71	84.67±35.90	82.27±23.46	1.789	0.160
Blood loss (ml)	42.76±29.33	34.87±16.39	59.82±47.76	49.67±±38.06	38.20±15.49	2.215	0.097

Various surgical approaches were used for stone retrieval and to define the best possible approach. A total number of 21 cases needed Gilvernet's dissection technique, which predominated in the Group B and Group D groups because of their large size and irregular shape, 63.6% and 60 % respectively within the group.

Extended pyelotomy was needed in total 12 cases, which again was highest in the Staghorn group i.e. 54.4%. Different modalities, as flexible ureteroscope with C-arm were used for stone retrieval. DJ stent was placed in 47 patients successfully (95.91%), as 9 were isolated calyceal calculi with no need of stenting. Mean time of surgery was 76.40±24.24 minutes with no statistical significance between the groups. The mean blood loss is 42.76±29.33 ml (Table 3).

3 cases were converted to open surgery, 2 because of dense adhesions and loss of planes due to long standing pyelonephritis and 1 because of C-arm failure and non-localization of calyceal stone. Stone clearance achieved was 96.5 % with 100 % clearance in Group A and B. Concomitant Anderson Hyne's pyeloplasty was done in 1 case (Table 4).

Table 4: Distribution of cases according to Conversion, Stone clearance and intraoperative difficulty.

Finding	Total (n=58)	Group A (n=23)	Group B (n=11)	Group C (n=9)	Group D (n=15)	Statistical significance	
	N (%)	N (%)	N (%)	N (%)	N (%)	χ^2	p
Conversion to open	3 (5.2%)	1 (4.3%)	1 (9.1%)	1 (11.1%)	0	1.842	0.606
Stone clearance	56 (96.5%)	23 (100%)	11 (100%)	8 (88.9%)	14 (93.3%)	15.701	.269
Intra op Bleeding	3 (5.2%)	1 (4.3%)	1 (9.1%)	1 (11.1%)	0	1.842	0.606
Concomitant procedure due to PUJ obstruction	1 (1.7%)	0	1 (9.1%)	0	0	4.348	0.226

Table 5: Post-operative assessment.

Parameter	Total (n=58)	Group A (n=23)	Group B (n=11)	Group C (n=9)	Group D (n=15)	Statistical significance	
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	p
Time taken for drain removal (days)	3.78±1.43	3.61±1.20	3.18±0.87	4.44±2.19	4.07±1.44	1.67	0.185
Drain output (ml) in first 48 hours	116.7±89.0	103.9±80.1	83.9±40.1	146.1±106.4	142.7±110.2	1.443	0.241
Duration of hospital stay (days)	7.36±3.98	6.39±3.41	6.09±1.22	10.11±7.75	8.13±1.60	2.662	0.057

Average drain output was 116.7±89.0 ml with mean drain removal duration of 3.78±1.43 days. Mean duration of hospital stay is 7.36±3.93 days with no statistical significance in between the groups (Table 5).

DISCUSSION

With the advancement in the techniques to manage renal calculi by Laparoscopic retroperitoneal approach, various studies have been published. Gaur et al considered size of the stone, which was between 5 to 48 mm and managed successfully with mean operative time of 116.26 minutes.[8] Goel and Hemal reported 16 cases with a higher surgical time and blood loss in 2003, but in 2005 Chander et al presented their study with mean operative time of 81 minutes, with 27 ml blood loss and 3.6% conversion rates only and 96.4 % stone clearance10 very close to our results.[9] Al Hunayan et al reported mean operative time of 112.1 with 57.2 ml blood loss with 88.6% clearance.[11] Patloo et al, Haggag et al, and Singh et al presented their results with large calculi ranging from 1.5 cm to > 3 cm with 51.19 to 91.82 minutes of operative time and up to 95.5% clearance by Singh et al.[12-14] In the management of complex calculi, Qin et al reported 75 patients with 96 minutes of operative time with 2.7 % conversion rates.[15] Fawzi et al. also reported 100% clearance with 85.4 minutes operative time and > 2.5 cm of stones.[16] Our previous research evaluated 25 subjects with solitary and Staghorn calculi with 92% clearance and 8% conversion rates.17 Sharma et al. reported 160 cases with 1-3 cm stones with 75.33 minutes operative time, 40.7 ml blood loss and 8.86% conversion rates. The present study has comparable results to previously published data.[18]

Renal pelvis anatomy, stone size, alignment of the calculus, hydronephrosis, PUJ obstruction, anomalous anatomy, calyceal position and peri-renal adhesions have

been the major factors affecting the time duration, bleeding and successful outcome. Being a minimally invasive approach with close, accurate and wider vision the Laparoscopic retroperitoneal approach is very much feasible, with adequate experience.

CONCLUSION

Out of the 58 cases with renal calculi, solitary renal pelvic stones (n=23; 39.7%) were most common followed by staghorn (n=11; 19%) and isolated caliceal stones (n=9; 15.5%) respectively. There were 15 (25.9%) cases with mixed stones (11 cases solitary renal pelvic and isolated caliceal stones and 4 cases had staghorn and isolated caliceal stones).

Mean size of stone was 3.35±1.01 cm. Mean stone size was minimum for isolated caliceal stones (2.21±0.25 cm) and maximum for staghorn type (4.40±1.17 cm). Statistically, there was a significant difference in size of stone of different types.

Majority of stones were intra-renal type (56.9%). Though proportion of intrarenal stones was higher in solitary caliceal and mixed groups (77.8% and 66.7%) as compared to solitary renal pelvic and staghorn types (43.5% and 54.5%) yet this difference was not significant statistically.

Gilvernet's dissection was needed in 36.2% cases. Its need was more pronounced in staghorn and mixed types.

Conversion to open procedure was required in 3 (5.2%) cases. Stone clearance was achieved in 56 (96.5%) cases. Intraoperative difficulties occurred in 9 (15.5%) cases (4-post-placement clash, 3 peritoneal breech and 2 significant emphysema). Intraoperative bleeding was observed in 3 (6.2%) cases. Concomitant procedure due to PUJ obstruction was done in one case. There was one patient who required blood transfusion. Statistically, there was no significant difference among different stone types for any of these parameters.

Mean time taken for removal of drain was 3.78±1.43 days. Mean duration of hospital stay was 7.37±3.98 days and mean time taken to start oral intake was 2.16±0.91 days. Statistically, there was no significant difference among different stone types for any of these parameters.

Mean pain score at 6 hour and 24-hour post-operative intervals was 3.17±1.48 and 0.83±0.96 respectively. Mean drain output was 116.7±89.0 ml. Abdominal distension, fever was noticed in 7 (12.1%) and 8 (13.8%) cases respectively. None of the cases reported of vomiting. Statistically, there was no significant difference among different stone types for any of these parameters.

The findings of the present study showed that laparoscopic retroperitoneal approach is a useful modality for clearance of renal calculi of different types with minimum complications and a high success rate. However, the technique seems to have a limited role for isolated caliceal stones where direct or C-arm guided nephrolithotomy can be performed for better clearance of stones.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rudramani, Singh V, Kumar S, Kumar A, Kumar S, Singh MK. Evaluation of laparoscopic retroperitoneal approach for management of various renal calculi. Int Surg J 2018;5:2449-54.