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Original Research Article

Evaluation of efficacy and outcome of retroperitoneal laparoscopic pyelolithotomy and open pyelolithotomy in patients with renal stones

Vitrag*, Aakansha Saraf

[1]Department of Surgery, [2]Department of Physiotherapy, Maharishi Markandeshwar Institute of Medical Sciences and Research, Maharishi, Markandeshwar, Mullana, Haryana, India

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***Correspondence:**
Dr. Vitrag,
E-mail: sainivitrag@gmail.com

ABSTRACT

Background: Urolithiasis has affected humans since antiquity. The aim of the study was to evaluate the efficacy and outcome of retroperitoneal laproscopic pyelolithotomy and open pyelolithotomy in patients with renal stones.
Methods: The present prospective randomized clinical study was carried out in department of surgery from June 2017 to April 2021 in patients with renal stones. A total of 100 patients with solitary renal pelvic stone were properly assessed radiologically and clinically before planning the surgical intervention.
Results: The overall mean age of presentation among patients undergoing pyelolithotomy was 41.9±12.30 years (χ^2=5.14, p≤0.001). Minimum number of patients were 41-60 years age group i.e.; 58 patients. 70 patients were males while 30 patients were females with male to female ratio 2.33:1. The mean stone size among patients undergoing LP and OP was 1.9±0.5 cm. The mean operative time (min) among patients undergoing LP group (123.9±9.5 minutes) was more as compared to OP group was 80.1±17.5 min. The mean duration of return to work was 3.86±1.39 days. The mean duration of return to work in LP group was 3.87±1.37 days, while in OP group was 5.87±1.34 days (χ^2=18.56, p<0.02).
Conclusions: Retroperitoneal laproscopic pyelolithotomy proved to be safer in all the aspects than open pyelolithotomy.

Keywords: Urolithiasis, Renal pelvic stone, Open pyelolithotomy, Laproscopic pyelolithotomy

INTRODUCTION

Urolithiasis has affected humans since mankind. Stone disease is one of the most common afflictions of modern society, but it has been described since antiquity. The lifetime prevalence of kidney stone disease is estimated to be 1% to 15%, with the probability of stone characteristics variation, depending on age, gender, race and geographical location. Stone disease typically affects adult men, two to three times more common than women. Stone occurrence is relatively uncommon, before age 20, but peaks its incidence in the fourth to sixth decade of life.[1] The introduction of endourological procedures such as percutaneous nephrolithotomy and ureterorenoscopy have led to a revolution in the management of urinary stone disease. The development of endourological minimally invasive surgical techniques for treatment of patients suffering from urinary lithiasis has been greatly dependent on technological advances like fibreoptics, radiographic imaging and lithotripsy (shockwave, ultrasonic, electrohydraulic and laser). Today, the indications for open stone surgery have been narrowed significantly, making it a second or third-line treatment option.[2] The clearance rate of stones relies mainly on factors like stone bulk, location, composition and collecting system anatomy. The complexity of stone distribution within the kidney, can sometimes be hindrance for clearing stones in one session, with established endourological techniques like percutaneous nephrolithotomy (PCNL). Several sessions are required

in such cases and even a combination of different methods is required to completely clear the stones. Several sessions incur more expenditure and more complications. PCNL, considered the standard for stone size >2 cm in complex situations, is associated with greater risk of renal parenchymal injury or massive bleeding intraoperatively.Alternatives are retrograde intrarenal surgery (RIRS) or laparoscopic pyelolithotomy.

Laparoscopic pyelolithotomy, however, is associated comparatively with shorter duration of surgery, less intraoperative complications, less postoperative pain, better cosmesis, less hospital stay and more stone free rate in experienced hands.[3] Laparoscopic pyelolithotomy is the procedure of choice in certain conditions, like large stone, the need for concomitant other surgery and inaccessibility to ESWL or PCN. Other indications of laparoscopic pyelolithotomy are relative and include failure of stone clearance via PCN, ureteroscopy, or ESWL due to difficult extraction and hard stone composition (i.e., cystine stones). Laparoscopic pyelolithotomy is also indicated in combination with pyeloplasty without increasing morbidity or decreasing the success rate.[4] Laparoscopic surgery has an added advantage over endourological procedures, in congenital anatomical malformations like ectopic, pelvic or horse shoe kidney, where extracorporeal shock wave lithotripsy is only moderately successful and PCNL is difficult. Retroperitoneal laparoscopic pyelolithotomy has procedural similarity to open pyelolithotomy and is not only nephron sparing, but also nephron reviving.[5] Retroperitoneal laparoscopic surgery has an added advantage to transperitoneal access, in causing minimal peritoneal contamination, but needs more experience and training and is associated with longer operative time in earlier part of learning curve.[6] The risk of spillage depends upon the size of stone, surgical technique, surgeon's experience and the site from where specimen is extracted.[7]

Objectives

The objective of the study were (a) to study the clinical, biochemical and radiological spectrum of renal stone disease with regards to size, characteristics and location of stone; (b) to study the efficacy, safety and outcome of retroperitoneal laparoscopic pyelolithotomy; and (c) to evaluate retroperitoneal laparoscopic pyelolithotomy and open pyelolithotomy in terms of ease of accessibility, operative time, complications (intraoperative and post-operative- immediate and delayed), post-operative pain, hospital stay and return to routine work.

METHODS

Study settings

The present prospective randomized clinical study was carried out in Maharishi Markandeshwar superspeciality hospital, department of surgery, Maharishi Markandeshwar institute of medical sciences and research, Mullana, Ambala, Haryana from October 2018 to July 2020.

Sample size

A total of 100 patients with solitary renal pelvic stone were carefully selected by applying specific inclusion and exclusion criteria. The patients were divided into two groups by random selection (using computer generated tables of random numbers), group I undergoing laparoscopic retroperitoneal pyelolithotomy and group II undergoing open pyelolithotomy. Each selected patient was then evaluated clinically, radiologically and biochemically to confirm the diagnosis and rule out complications and were then subjected to allotted treatment option. All selected patients were subjected to radiological assessment with chest X-ray, X-ray kidney ureter bladder (KUB) and ultrasonography KUB, abdomen and pelvis.

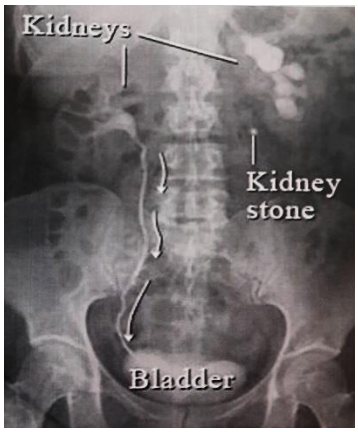

Figure 1: The IVP showing renal stones.

Inclusion and exclusion criteria

Inclusion criteria for current study were; all patients, in age group 18-70 years, either sex with unilateral or bilateral solitary renal pelvic calculus, of stone size ≥9 mm. Exclusion criteria for current study were; patients with recurrent or residual stones after pyelolithotomy, patients with multiple renal calculi, patients with intractable urinary tract infection, patients with renal stone disease with perinephric abscess, patients with renal stone disease with pelvi-ureteric obstruction, or congenital or acquired anatomical renal abnormalities, patients with percutaneous nephrostomy, patient with concomitant stone disease and malignancy, patients with bleeding disorders and patients with pregnancy.

Pre-operative evaluation and anaesthesia

All selected patients were then explained regarding the need for surgery and a fully explained well informed consent was taken from them, regarding the procedure and type of procedure performed. The patients were then

subjected to detailed pre-anaesthetic check-up. All patients received preoperative antimicrobial prophylaxis before surgery.

Intra-operative assessment

The Karl Storz laparoscopic unit was used consisting of television monitor, a high flow insufflator, a video camera unit, camera head, high intensity light source, light cable, 30-degree telescope and CO_2 cylinder. The patient was kept in pyelolithotomy (lumbar) position with bridge raised, table break, head end elevation and cleaned and draped. In cases of retroperitoneal laparoscopic pyelolithotomy, CO_2 was used as insufflation gas in all cases. The retroperitoneal pressure was maintained at 14 mm Hg CO_2 pressure. The CO_2 insufflation rate was kept at 6 l/min.

Procedure

Open pyelolithotomy: the patient was placed in lateral decubitus position, and the kidney bridge is elevated to flatten out the lumbar region. The subcoastal incision was given, beginning from renal angle, just below 12th rib and extending forward along the direction of umbilicus. The incision was deepened to cut subcutaneous tissue and anteriorly external oblique, internal oblique and transverse abdominis muscle and posteriorly latissmus dorsi, quadratus lumborum and serratus posterior inferior. The gerota's fascia was opened and perirenal fat was dissected to visualize the kidney. The ureter was identified and hooked over infant feeding tube. The ureter was followed to reach pelvis, which was dissected free of perirenal fat. An incision was given over the pelvis and stone extracted from pelvis using Randell's pyelolithotomy forceps. The pelvis is closed with vicryl 3-0, adequate hemostasis achieved and number 28 ADK drain was placed in perinephric space. The abdomen was closed in layers with vicryl no 1, subcutaneous tissue with vicryl 2-0 and skin with ethilon 3-0.

Retroperitoneal laparoscopic pyelolithotomy

The patient was placed in lateral decubitus position, and the kidney bridge was elevated to flatten out the lumbar region. The retroperitoneal laparoscopic pyelolithotomy was performed using the same technique as standard laparoscopic renal procedures. In general, three to four port placements were used. The 1st port of size 1.1 cm was in the renal fossa, at the upper border of the erector spinae muscle (in the middle of the lower coastal rib and the coccyx). The balloon was inserted, inflated with 150 ml saline and kept inflated for 3 min to create adequate retroperitoneal dissection space and hemostasis. The second 5 mm port was inserted in the renal angle. The third 5 mm port was made above the iliac crest. After identification of the ureter and dissection of the renal pelvis, the renal pelvis was incised with endoscissor/cold knife. The stone was delivered with an endograsper or maryl and forcep, out of renal pelvis and kept near to the ureter. The double J ureteric stent was placed, taking help of the suction tip and the pelvis was closed with absorbable 4-0 vicryl suture. 30° 5 mm telescope was inserted through the lower 5 mm port and under vision of 5 mm telescope, the pelvic stone was removed through the 10 mm port. Adequate hemostasis was achieved. A nelcath no 20 was inserted as drain through 5 mm port and skin closed with ethilon 3-0.

Figure 2: Stone removal with pyelolithotomy forcep.

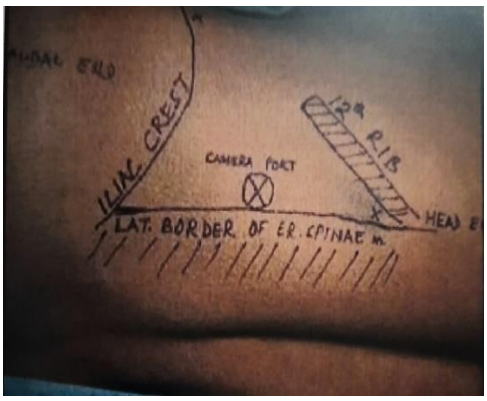

Figure 3: The pre-operative landmarks for insertion of the trocars at three ports.

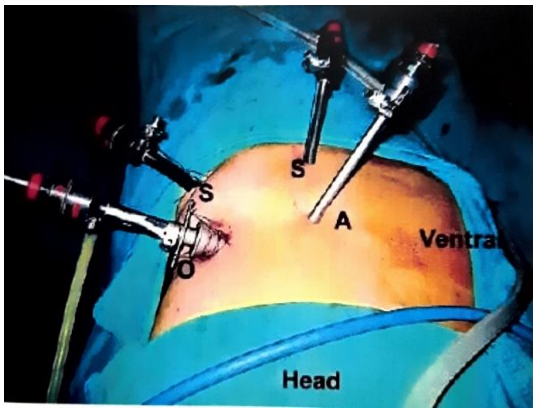

Figure 4: The landmarks for the insertion of ports.

Figure 5: Removal of stones.

Post-operative assessment

All patients were given postoperative antibiotic prophylaxis (injection ceftriaxone 1 g BD on day 1). Antibiotic doses were continued in cases of complications. The mean pain grade was calculated for both the groups.

Statistical analysis

The data was entered into a spreadsheet (Excel, Microsoft corp.) and then transferred to statistical software, SPSS version 21 for data analysis. Chi square test was used to compare continuous variables and Mann Whitney test was used to compare medians, $p<0.05$ was considered statistically significant and $p<0.01$ was considered highly significant.

RESULTS

Retroperitoneal laparoscopic pyelolithotomy proved to be safer, in terms of decreased intraoperative complications, than open pyelolithotomy and had less bleeding, less stone migration, less difficulty assessing renal pelvis, less renal parenchymal injury and less opening of peritoneum. Laparoscopic pyelolithotomy patients experienced significantly lesser pain, required lesser analgesia, had early removal of drain and returned to normal routine activity earlier, than their open counterpart. Thus, retroperitoneal laparoscopic pyelolithotomy is safe, minimally invasive, cost effective and cosmetically superior procedure as compared to open pyelolithotomy with advantages of less pain, reduced complications, early discharge and early return to routine work.

The patients undergoing open pyelolithotomy, 35% were in age group of 41-60 years while 9% and 6% were in age group of 31-40 years and 21-30 years respectively (χ^2=29.76, p=0.0002). The overall mean age of presentation, among patients undergoing pyelolithotomy was 41.9±12.3 years.

The mean age of presentation in laparoscopic pyelolithotomy group was 36.2±11.9 years, while mean age of presentation in open pyelolithotomy group was 47.5±10.0 years (χ^2=5.14, p≤0.001). In the study population, 70% were males while 30% were females. The male to female ratio was 2.33:1. Among laparoscopic pyelolithotomy group, 34% were males, while 16% were females. The male to female ratio was 2.13:1. Among open pyelolithotomy group, 36% were males, while 14% were females. The male to female ratio was 2.57:1 (χ^2=0.048, p=0.022). In laparoscopic pyelolithotomy group, maximum number of patients (10%) had diabetes mellitus, followed by 5% patients and 4% patients, who had hypertension and previous history of tuberculosis respectively. 3% patients had coronary artery disease while 2% patients were suffering from COPD. 1% patients were affected by thyroid disorder. In open pyelolithotomy group, 7% patients each were suffering from hypertension and diabetes mellitus, while 4% patients had COPD. 2% patients each undergoing open pyelolithotomy were suffering from coronary artery disease, past history of tuberculosis and thyroid disorder (χ^2=2.71, p=0.148).

Pain was most common symptom seen in all patients (100%). In laparoscopic pyelolithotomy, all patients (100%) had pain in lumbar region followed by 23% patients, who had nausea during episodes of pain. In open pyelolithotomy group, most common symptom was pain in lumbar region (100%) followed by nausea seen in 21% patients. 16% patients had vomiting while 11% patients had dysuria. 7% patients presented with hematuria while 2% patients presented with fever (χ^2=3.79, p=0.048).

In the present study, 57% patients presented with right sided stone while 43% patients presented with left sided stone. In laparoscopic pyelolithotomy group, 30% patients had right-sided stone, while 20% patients had left sided stones. In open pyelolithotomy group, 27% patients had right-sided stones while 23% patients had left sided stones (χ^2=0.163, p=0.0404). In the present study, 51% patients presented with stone size between 1-2 cm while 48% patients presented with stone size greater than 2 cm. The mean stone size among patients undergoing laparoscopic and open pyelolithotomy, in the study population, was 1.9±0.5 cm. The mean stone size in laparoscopic pyelolithotomy group was 1.8±0.5 cm while mean stone size in open pyelolithotomy group was 2.0±0.5 cm (χ^2=2.0, p=0.048).

Maximum number of patients (52%) were operated in time range of 60-80 min, while 18% patients were operated in time range of 80-100 min. The mean operative time (minutes) among patients undergoing pyelolithotomy was 149.16±17.79 minutes. The mean operative time in laparoscopic pyelolithotomy group was 123.9±9.5 min, while mean operative time in open pyelolithotomy group was 80.1±17.5 minutes (χ^2=15.55, p≤0.001).

In the present study, difficulty in assessing renal pelvis was the most common complication seen in 34% patients. In laparoscopic pyelolithotomy group 13% patients had difficulty assessing renal pelvis as intraoperative

complications. 9% patients had intraoperative bleeding. 8% patients had renal parenchymal injury, in form of capsule tear or cautery burn, while peritoneum was opened in 7% patients. In open pyelolithotomy group, difficulty in assessing renal pelvis was main intraoperative complication in 21% patients followed by bleeding, which was observed in 18% patients. 17% patients had renal parenchymal injury while mobilizing kidney, while peritoneum was accidentally opened in 15% patients. 8% patients had stone migration from renal pelvis to one of dilated calyx (χ^2=0.462, p=0.555). In the present study, a total of 9% patients had post-operative fever, which was managed by antipyretics and urine culture specific antibiotics.

Table 1: Mean age among patients undergoing laparoscopic and open pyelolithotomy.

Age (years)	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	Total (N=100)	χ^2	P value
Mean±SD	36.2±11.9	47.5±10.0	41.9±12.3	5.14	<0.001

Table 2: Age and gender wise distribution among patients undergoing laparoscopic and open pyelolithotomy.

Age (years)	Laparoscopic pyelolithotomy (N=50)		Open pyelolithotomy (N=50)		χ^2	P value
	Male	**Female**	**Male**	**Female**		
21-30	13 (13)	4 (4)	4 (4)	2 (2)	40.35	0.030
31-40	9 (9)	0	7 (7)	2 (2)		
41-50	11 (11)	10 (10)	8 (8)	2 (2)		
51-60	0	2 (2)	17 (17)	8 (8)		
>60	1 (1)	0	0	0		
Total (n=100)	34 (34)	16 (16)	36 (36)	14 (14)		

Table 3: Comorbidities among patients undergoing laparoscopic and open pyelolithotomy.

Comorbidities	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	Total (N=100)	χ^2	P value
HTN	5 (5)	7 (7)	12 (12)	2.71	0.148
DM	10 (10)	7 (7)	17 (17)		
CAD	3 (3)	2 (2)	5 (5)		
COPD	2 (2)	4 (4)	6 (6)		
Post TB	4 (4)	2 (2)	6 (6)		
THYROID	1 (1)	2 (2)	3 (3)		

Table 4: Symptomatology among patients undergoing laparoscopic and open pyelolithotomy.

Symptoms	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	Total (N=100)	χ^2	P value
Pain	50 (100)	50 (100)	100 (100)	3.79	0.048
Nausea	23 (23)	21 (21)	44 (44)		
Vomiting	12 (12)	16 (16)	28 (28)		
Fever	0	2 (2)	2 (2)		
Burning micturition	10 (10)	11 (11)	21 (21)		
Hematuria	5 (5)	7 (7)	12 (12)		
Lump	0	0	0		

Table 5: Mean stone size (mm) among patients undergoing laparoscopic and open pyelolithotomy.

Stone size (mm)	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	Total (N=100)	χ^2	P value
Mean±SD	1.8±0.5	2.0±0.5	1.9±0.5	2.0	0.048

Table 6: Visual analogue scale (VAS) scores among patients undergoing laparoscopic and open pyelolithotomy.

Days	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	χ^2	P value
VAS score day 1	3.94±0.65	7.56±1.45	98	0.014
VAS score day 2	2.42±0.88	6.2±1.81	98	<0.001
VAS score day 3	1.78±0.72	4.00±1.51	98	0.009
VAS score day 4	1.49±0.63	3.04±1.01	98	0.004
VAS score day 5	1.14±0.83	2.70±1.39	98	0.002
VAS score day 6	0.88±0.81	2.64±1.10	98	0.021
VAS score day 7	0.83±0.82	1.84±0.79	98	0.007

Table 7: Mean return to work among patients undergoing laparoscopic and open pyelolithotomy.

Return to work	Laparoscopic pyelolithotomy (N=50)	Open pyelolithotomy (N=50)	Total (N=100)	χ^2	P value
Mean±SD	3.87±1.37	5.87±1.34	3.86±1.39	18.56	<0.02

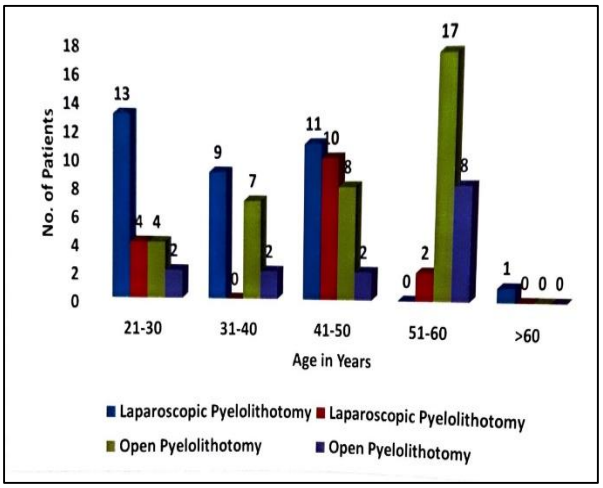

Figure 6: Mean age among patients undergoing laparoscopic and open pyelolithotomy.

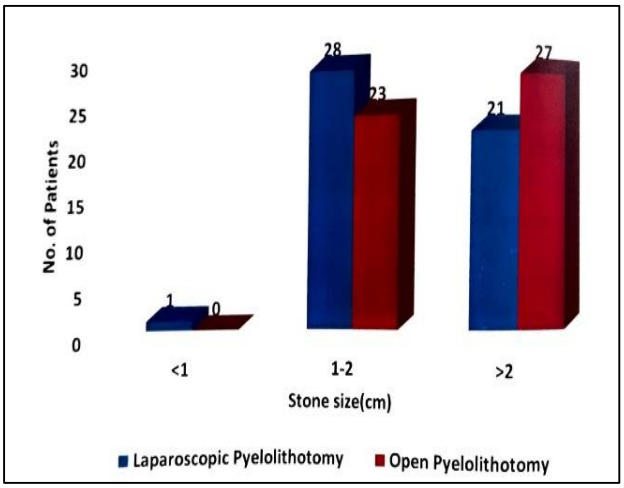

Figure 8: Mean stone size (mm) among patients undergoing laparoscopic and open pyelolithotomy.

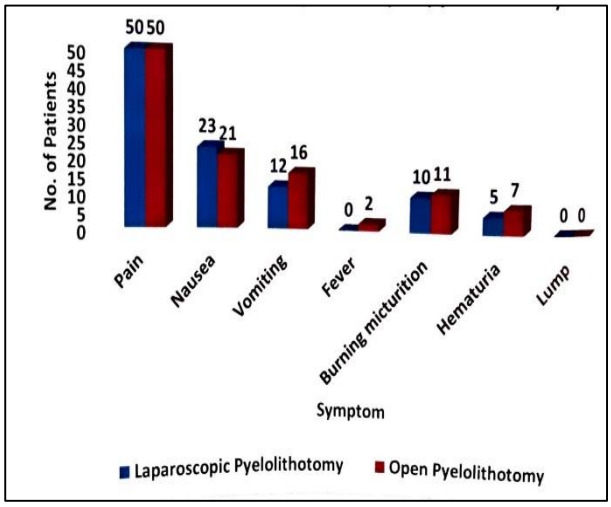

Figure 7: Symptomatology among patients undergoing laparoscopic and open pyelolithotomy.

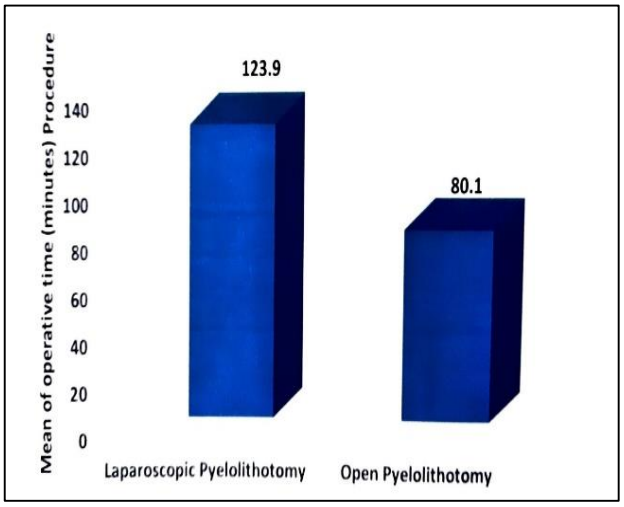

Figure 9: Mean of operative time (minutes) among patients undergoing laparoscopic and open pyelolithotomy.

All cases of superficial wound infection belonged to open pyelolithotomy group. Surgical emphysema, due to entry of carbon dioxide into subcutaneous plane, was observed in 3% patients of laparoscopic pyelolithotomy group. Fever was observed in 2% patients of laparoscopic pyelolithotomy group and 7% patients of open pyelolithotomy group (χ^2=9.51, p=0.310). In the present study, prolonged urinary leak from drain was seen in 4% patients and was due to infected renal pelvis with give-away of sutures. Prolonged leak was seen in 2% patients of laparoscopic pyelolithotomy group and 2% patients of open pyelolithotomy group. The mean VAS score on day 1, in laparoscopic pyelolithotomy group was 3.94±0.65, while in open pyelolithotomy group was 7.56±1.45. The mean VAS score, 48 hours after surgery, in laparoscopic pyelolithotomy group (2.42±0.88) was significantly less (χ^2=98, p<0.001) than mean VAS score, at 48 hours, in open pyelolithotomy group (6.20±1.8). At day 7, laparoscopic pyelolithotomy patients significantly experienced less pain, as documented by low VAS Score (0.83±0.82) in comparison to open pyelolithotomy group (1.84±0.79) (χ^2=98, p=0.007). The mean duration of drain in the present study was 2.97±1.05 days. The mean duration of drain in the laparoscopic pyelolithotomy group was 2.60±0.67 days, while mean duration of drain in open pyelolithotomy group was 3.30±1.22 days (χ^2=7.34, p<0.04). In open pyelolithotomy group, maximum number of patients (19%) had calcium oxalate stones, while 15% patients had triple phosphate (struvite), stones detected on stone analysis. 12% patients had calcium phosphate stones detected on stone analysis. 2% patients each had uric acid and cysteine stone, detected on stone analysis, respectively (χ^2=5.12, p=0.020). In the present study, maximum number of patients (74%) was discharged within 4 days of surgery, while 18% patients were discharged 5 to 6 days after surgery. The mean hospital stay, of the study population, was 4.45±1.30 days. In laparoscopic pyelolithotomy group, the mean hospital stay was 3.56±1.35 days, while in open pyelolithotomy group, the mean hospital stay was 5.34±1.34 days (χ^2=20.56, p≤0.001). In the present study, maximum number of patients (62%) significantly (χ^2=11.79, p=0.011) enjoyed early return to work in 3-4 days, followed by 18% patients, who returned to work, 5-6 days after discharge. The mean duration of return to work in the present study was 3.86±1.39 days. The mean duration of return to work in laparoscopic pyelolithotomy group was3.87±1.37 days, while in open pyelolithotomy group was 5.87±1.34 days (χ^2=18.56, p<0.02).

DISCUSSION

Urolithiasis from the antiquity has been a topic of discussion for the urologists in the entire globe. Although it's surgical treatment options are wide but the most-safest and minimally invasive of all is retroperitoneal laparoscopic pyelolithotomy. The present study applied aimed at analyzing the efficacy of open pyelolithotomy and RLP. RLP proved to be safer, in terms of decreased intraoperative complications, than open pyelolithotomy and had less bleeding, less stone migration, less difficulty assessing renal pelvis, less renal parenchymal injury and less opening of peritoneum.[8] Laparoscopic pyelolithotomy patients experienced significantly lesser pain, required lesser analgesia, had early removal of drain and returned to normal routine activity earlier, than their open counterpart.

Thus, retroperitoneal laparoscopic pyelolithotomy is safe, minimally invasive, cost effective and cosmetically superior procedure as compared to open pyelolithotomy with advantages of less pain, reduced complications, early discharge and early return to routine work.[9] In the present study, maximum number of patients (58%) were seen in age group of 41-60 years followed by 41% patients in 21-40 years age group. In laparoscopic pyelolithotomy group, 23% patients were in age group of 41-60 years, while 53% patients were in age group of 21-40 years. In open pyelolithotomy group, 35% patients were in age group of 41-60 years while 30% patients were in age group of 21-40 years (χ^2=29.76 , p=0.0002). Among 57% presented with right sided stone while 43% presented with left sided stone.

In laparoscopic pyelolithotomy group, 30% had right-sided stone, while 20% had left sided stones. In open pyelolithotomy group, 27% had right-sided stones while 23% had left sided stones (χ^2=0.163, p=0.0404). The ratio of right to left sided stones was 1.3:1. A total of 9% patients had postoperative fever, which was managed by antipyretics and urine culture specific antibiotics. 2% cases in the laparoscopic group and 7% cases in the open group had fever (p>0.05). Literature also supports that RLP is a better and safer surgical intervention for removal of renal stones.[10]

Limitations

The limitation of the study is that the results found solely depends on the experience of the surgeon. If the surgeon is inexperienced the results may differ.

CONCLUSION

The present study concludes that retroperitoneal laparoscopic pyelolithotomy is safe, minimally invasive, cost effective and cosmetically superior procedure as compared to open pyelolithotomy with advantages of less pain, reduced complications, early discharge and early return to routine work.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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