ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 07 | July - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE ANALYSIS OF LAPAROSCOPIC PYELOLITHOTOMY AND PERCUTANEOUS NEPHROLITHOTOMY IN THE MANAGEMENT OF LARGE SOLITARY RENAL PELVIC STONE

Surgery

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KEYWORDS

INTRODUCTION

The management of large solitary renal pelvic stones poses a significant challenge in urological practice. With advancements in surgical techniques, minimally invasive procedures have become the gold standard for treating such conditions. Two prominent techniques in this regard are Laparoscopic Pyelolithotomy (LPL) and Percutaneous Nephrolithotomy (PCNL). Both methods aim to provide effective stone clearance with minimal patient morbidity, yet they differ in their approaches, indications, and outcomes.

Laparoscopic Pyelolithotomy involves the removal of stones through a laparoscopic approach, allowing direct visualization and precise stone extraction. This technique is often preferred for its ability to minimize tissue damage and offer faster recovery times compared to traditional open surgery. However, it requires a high level of surgical expertise and longer operative times, which can be a limiting factor in its widespread adoption.

Percutaneous Nephrolithotomy, on the other hand, involves creating a small tract through the skin into the kidney to directly access and remove the stone. PCNL is well-established for its high efficacy in managing large and complex renal stones. It offers a balance between invasiveness and effectiveness, making it a commonly chosen method for large renal pelvic stones. However, it carries risks such as bleeding, infection, and injury to surrounding tissues.

This comparative analysis aims to evaluate the efficacy, safety, and overall outcomes of Laparoscopic Pyelolithotomy and Percutaneous Nephrolithotomy in the management of large solitary renal pelvic stones. By examining parameters such as operative time, stone clearance rates, complication rates, hospital stay duration, and patient recovery, this study seeks to provide a comprehensive understanding of the advantages and limitations of each technique. This information will be crucial for urologists in making informed decisions and optimizing treatment strategies for patients with large renal pelvic stones.

Material And Methodology:

Source of data:
All eligible cases undergoing laparoscopic pyelolithotomy or percutaneous nephrolithotomy in the Department of surgery, S .N. Medical college Agra during the study period of two years i.e from June 2022 till June 2024.

Study design :
Non-randomised comparative study

Sample size :
All the patients with large (>=2cm) renal pelvic stone who will be admitted and operated in the department of General Surgery, S.N. Medical College, Agra during the period of thesis. These patients will be divided into 2 groups according to the type of technique used:

1. **Group A**
In these patients Percutaneous Nephrolithotomy will be done

2. **Group B**
In these patients Laparoscopic Nephrolithotomy will be done

Sample design:
Purposive sampling

Sample place:
Department of General Surgery, S.N Medical College Agra

Study period :
June 2022 - June 2024

Inclusion Criteria:
1. Patients with age more than or equal to 12 years,
2. size of calculus >2 cm,
3. Calculi within renal pelvis

Exclusion Criteria:
1. Patients with age >12 years,
2. Patients with uncorrected coagulopathy,
3. Pregnant female patients,
4. Extensive prior abdominal and retroperitoneal surgeries,
5. Pelvic Uretric Junction obstruction with secondary calculi and
6. Patients with ureteric stricture

Methodology:
Using purposive sampling 60 patients admitted to S N Medical College Hospital are included in the study if they meet subsequent inclusion and exclusion criteria. Patient is examined after receiving permission for any procedure, and once the patient is deemed fit, surgery is performed. Every patient has a potential record in our database. We counted the stone's size, location, and age. Preoperative testing for every patient comprised a urine analysis, serum creatinine, platelet count, bleeding and coagulation profile, and complete blood count. Ultrasonography (U/S) and intravenous urography (IVU) were radiological evaluation methods used; in cases of radiolucent stones, non-contrast computed tomography (CT) was also performed.

Usage of radiographic investigations was to measure the burden of calculi . The stone surface area (SA) was computed using the following formula: SA = L × W × × 0.25 (= 3.14159) after the stone was traced on KUB (kidney, ureter, bladder) film in the anteroposterior aspect. Patient is instantly encouraged to proceed with open hernial repair treatments, which can be carried out under regional anesthesia, in the event that they are deemed unfit for general anesthesia. Notable were the operational procedures and each operating complication. Post-operative care was provided in accordance with the accompanying protocol. Following surgery, there was the follow-up for six month, once a week after surgery, once a month for three months, and finally at six months post surgery.

When the research is finished
1. Procedure safety and effectiveness
2. Open method conversion rates
3. Intraoperative complications
4. Procedure duration

5. Pain following surgery
6. Complications following surgery
7. Duration of stay in hospital
8. Time required to get back to normal work
9. Recurrence percentages
10. Economic viability.
11. Patient's satisfaction

Technique Of Lpl

While patient was in lithotomy position and under general anesthesia, an open-ended ureteral catheter was initially inserted, and guide wire then advanced into renal pelvis through it. Table was flexed for retroperitoneal approach, and patient was placed in full-flank position. Applying usual retroperitoneoscopic technique as outlined by Rassweiler and associates is the method.[1]

Once the kidney was dissected , based upon the shape and size of stone , incision over renal pelvis was made longitudinally or curvedly. Using stone forceps, the stone inside the renal pelvis is extracted as a whole , then kept in bag for specimen retrieval following pyelotomy. Following the calculi's removal, D-J stent is positioned over the guide wire that was inserted under laparoscopic supervision into renal pelvis.

Pyelolithotomy is approximated in continuous fashion from superior to inferior margin of the incision using 4-0 polyglactin suture. Under endoscopic guidance, a vaccum drain is inserted into peripelvic tissues via lateral port with the trans peritoneal technique, with minimal bending ranging from 30-45 degrees , patient positioned in modified lateral decubitus posture and fastened to the surgical table using cushioned fixators. A standard procedure known as a Anderson Hynes dismembered laparoscopic pyeloplasty is carried out in patients who have renal pelvis stones and ureter pelvic junction (UPJ), as previously detailed.

Technique Of Pnl:

In every situation, the same standardized PNL process as previously mentioned is carried out.[2] In summary, patient was originally placed in lithotomy position with 5-French ureteral catheter while under general anesthesia. The surgeon uses C-armed fluoroscopy guidance to establish percutaneous access. A high-pressure NephroMax balloon dilator (Boston Scientific, Natick, MA) was used to dilate the tract. It was accompanied by LeVeen inflator (Boston Scientific, Natick, MA) and 30 French Amplatz sheath (Cook Medical, Bloomington, IN) placed over inflated NephroMax under fluoroscopic monitoring. A stiff 26 French nephroscope is used to perform nephroscopy. For breaking up stones, a pneumatic lithotripter is used . Grabbers used to remove the fragments. In the same session, more tracts were produced when necessary. Stone removal and the authenticity of the gathering system were verified during surgery using antegrade nephrostography and fluoroscopic screening. All patients receive 14 French nephrostomy tube at conclusion of surgery. In case of pelvi- uretric junction obstruction (UPJO) an incision is was made lateral to the UPJ using a hook knife. The surgery concludes with 6 French D-J stent placement . KUB radiography used to assess patients when they are discharged in order to determine the initial postoperative stone-free rates. Using a spiral CT scan, the postoperative stone-free rate is ascertained three months after surgery. If the patient has no stones after the operation, it is deemed successful.

RESULT AND ANALYSIS

Graph Pad Prism version 5 and SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) were utilized for statistical analysis after data were entered into a Microsoft Excel spreadsheet. In two-sample t-tests, unpaired samples were utilized to determine the mean difference. When it came to blocking, paired t-tests had more power in comparison to unpaired tests. One-way analysis of variance (one-way ANOVA) used the F distribution to compare the means of three or more numerical data samples. Chi-squares are defined as statistical hypothesis tests in which the sample distribution of the test statistic is chi-squared when the null hypothesis is true. The theory is correct. It is common to refer to the Pearson's chi-squared test as "chi-squared test" without providing any more context . Depending on the circumstance, unpaired proportions were compared using either the Chi-square test or Fischer's exact test.

Following list contains explicit expressions that can be used to perform different chi square and t- tests. Formula for test statistic under null hypothesis that either closely approximates or follows t-distribution is provided in each situation. Each situation, proper degrees of freedom are also provided. One-tailed or two-tailed tests can be performed using each of these statistics. . After determining p value, p-value can be found using table of values from Student's t-distribution. Computed p-value ($\chi 2$ test) should be less than the red test. Alternative hypothesis is accepted when null hypothesis is smaller than the chosen level of statistical significance, which is often 0.10, 0.05, or 0.01. Statistical significance was defined as P-values less than 0.05.

Table 1: Operating Time Distribution Of Two Groups (Lpl & Pcnl)

Group Statistics						
	group	N	Mean	Std. Deviation	t-value	P-value
OPERATIVE TIME (min)	LPL	30	129.30	8.887	23.349	P<0.001
	PCNL	30	81.77	6.735		

Table 2 : Haemorrhage Requiring Blood Transfusion Distribution Of Two Groups (Lpl & Pcnl)

HAEMORRHAGE REQUIRING BLOOD TRANSFUSION	Yes	No
LPL	0 (0%)	30 (100%)
PCNL	3 (10%)	27 (90%)

Table 3 : 100% Stone Clearance Distribution Of Two Groups (Lpl & Pcnl)

100% STONE CLEARANCE	Yes	No
LPL	30 (100%)	0 (0%)
PCNL	26 (86.7 %)	4 (13.3%)

Table 4: Post-operative Pain Distribution Of Two Groups (Lpl & Pcnl)

		POST OPERATIVE PAIN(PCNL)		Total
		N	Y	
POST OPERATIVE PAIN (LPL)	N	21(70%)	7(23.3%)	28
	Y	2(6.7%)	0(0%)	2
Total		23	7	30

Chi Square Value = 0.652
P-value = 0.419
No Statistical Association

Table 5 : Urinary Leak Distribution Of Two Groups (Lpl & Pcnl)

URINARY LEAK	Yes	No
LPL	6 (20%)	24 (80%)
PCNL	0 (0%)	30 (100%)

Table 6: Parenchymal Trauma Distribution Of Two Groups (Lpl & Pcnl)

PARENCHYMAL TRAUMA	Yes	No
LPL	0 (0%)	30 (100%)
PCNL	3 (10%)	27 (90%)

Table 7 : Conversion To Open Distribution Of Two Groups (Lpl & Pcnl)

CONVERSION TO OPEN	Yes	No
LPL	6 (20%)	24 (80%)
PCNL	0(0%)	30 (100%)

Table 8: Mean Hospital Stay (days) Distribution Of Two Groups (Lpl & Pcnl)

Group Statistics						
	group	N	Mean	Std. Deviation	t-. value	p-value
MEAN HOSPITAL Stay (Days)	LPL	30	3.20	1.095	3.80	P<0.
	PCNL	30	2.37	.490	3	001

p-value < 0.05--- significant

DISCUSSION:

According to a research by Micali S. et al. (1997), PNL is the recommended course of action for treating renal stones of two centimeters or larger.[3] Despite being first documented in the early 1990s, LPL's lengthy learning curve and the well-established PNL procedure prevented it from becoming widely used among urologists.50 Renal stone treatment using laparoscopy has been reported to be successful recently; however, the indications and results

have not yet been compared with known methods like PNL.[4][5]

The present investigation evaluated PNL and LPL as monotherapy for management of renal pelvic stones. Preoperative data of both groups in our analysis, had statistically no significant difference in respect of age, sex, and stone size.

Regarding conversion rate, blood transfusion, and delayed urine leakage, seven studies comprising 176 patients undergoing laparoscopic pyelolithotomy and 187 per cutaneous nephroliyhotomy were shown to be equal in an earlier meta-analysis [6]. Furthermore, individuals who undergone LPL had a higher SFR, a decreased incidence of hemorrhage, and a lower postoperative fever. Yunjin Bai et al. reported these findings in a study conducted in 2017.Furthermore, earlier study's findings demonstrated a decrease in hemoglobin levels, less time in surgery and small duration in hospital in percutaneous nephrolithotomy group. In the laparoscopic pyelolithotomy group levels were much lower . Current research, which comprised 14 papers with four hundred and thirty two individuals undergoing LPL and four hundred and sixty nine PCNL, found comparable outcomes to earlier meta-analysis concerning hemoglobin decline, surgical fever, hospital duration, SFR, and conversion rate. On the other hand, contrary to the prior meta-analysis finding, it was discovered , blood transfusion rate in individuals undergoing LPL was less .Additionally, we discovered that LPL offered a noticeably reduced rate of re-treatment and auxiliary operations. The primary cause of this discrepancy may be attributed to the varying sample sizes used in the current and prior research, which is also why the current study was conducted.

Distribution of Ages:
In the current investigation, the average age with standard deviation in the LPL group was 32.43 ± 4.86, while in the PCNL group, it was 33.33 ± 5.05. Between them, statistically no significant differences were present . Study by Yunjin Bai et. conducted in 2017 had similar results.

Distribution of sexes :
roughly equal sex ratios in both groups

Stone Size:
Large size stones were discovered in LPL in 36.67% of cases (3.7–4.2 cm) and 3.33% of cases (4.3–4.6 cm). In PCNL, 30% of the stones were big (3.7–4.2 cm), whereas 10% of the stones were little (4.3–4.6 cm). similar outcome as reported by multiple studies.

Operating Time:
As the the p-value was less than 0.001, there were statistically significant variations in average operating time between LPL and PCNL. Comparing LPL and PCNL, mean operating time was 129.30 min and 8.887 sd, respectively, and 81.77 min and 6.735 sd, respectively. PCNL was a better surgical procedure than LPL in terms of operating time. In a 1997 study, Micali S. et al., similar outcomes were noted. Study by Gandhi et al. included 49 patients with larger than 3-5 cm staghorn stones who underwent LPL. [7]. Two patients merely had urine leakage, the mean SFR was 90% in one session with less issues, and no blood transfusion was needed (Clavien-Dindo grade IIIa). But in both patients, the leak halted after ten days.

According to our findings, PCNL required a considerably shorter operating time than LPL.It is common knowledge that various factors, including the style of intervention, surgeon's experience , individual variances of patients, and the various pieces of instrument utilized, directly affect how long an operation takes. Closing the pyelotomy incision in an LPL surgery calls very sophisticated laparoscopic abilities. Delicate renal pelvic tissues can occasionally present numerous closure complications for the pyelotomy incision [8] and increase the length of the surgical procedure. These tissues are always the result of chronic, long-term inflammation. Long learning curves and duration of taking intracorporeal sutures as well as endobag retrieval of stone were typically linked to prolonged LPL times [8].

Bleeding That Needs a Blood Transfusion:
Blood transfusion was not necessary for hemorrhage in LPL surgery, however it was in PCNL, when a 10% blood transfusion was needed. Lee et al. found same results in their research [9].

Complete stone removal :
While there was 86.7 percent stone clearance in PCNL, there was 100% stone clearance in LPL surgery. A study named "The comparison of laparoscopic pyelolithotomy and percutaneous nephrolithotomy in the treatment of solitary large renal pelvic stones" was carried out in 2012 by Ahmet Tefekli et al. sought to determine if laparoscopic pyelolithotomy (LPL), which is typically regarded as an excellent rationale for percutaneous nephrolithotomy (PNL), may be useful to treat big kidney calculi . Found that pyelolithotomy performed under laparoscopy is related Compared to PNL, this procedure is more intrusive, takes longer to complete, and calls for greater skill. LPL is linked to decreased blood loss, though. When a patient has congenitally abnormal kidneys, laparoscopic pyelolithotomy is recommended, particularly if they also have concurrent UPJ.[10]

Pain following surgery:
No statistically significant relationship between post-operative pain and both LPL and PCNL surgical procedures was identified in our study. 2017 research by Yunjin Bai et al. had equivalent results.

Urinary Leak :
According to the current study, 20% of urine leaks after LPL surgery occurred, but none after PCNL.Numerous research studies corroborated this information. According to a research by Lee et al. [9], the LPL group had higher rates of persistent urine leakage and longer hospital stays. A longer hospital stay may result from urine leakage, which is caused by inadequate closure of the pyelotomy incision during LPL [11]. Pyelotomy incision closure during laparoscopic surgery is technically challenging, requiring significant experience and high proficiency or surgery assisted by a robot is required. However, improvements in intracorporeal suturing methods, including barbed suture, have reduced urine leakage [12]. Additionally, using barbed sutures during laparoscopic pyeloplasty was shown to drastically reduce suture time [13], which will save operating time.

Parenthymal Trauma:
In the current study, 10% of PCNL surgeries had parenchymal trauma, whereas there was none in LPL surgeries. This conclusion was supported by other investigations.

Average Hospital Stay(days) :
Given that the p-value in this study been < 0.001, significant statistical variation in the mean hospital stay (in days) between LPL & PCNL was seen. Compared to PCNL, where the mean hospital stay was 2.37 minutes with standard deviation being 0.490, LPL had average stay in hospital for 3.20 days. having SD of 1.095. PCNL was a better surgical procedure than LPL in terms of hospital stay. According to a research by Lee et al. [9], the LPL group had higher rates of persistent urine leakage and longer hospital stays. Incomplete closure of the pyelotomy incision following LPL may be the cause of urine leakage, which may lengthen the patient's stay in the hospital [11].

CONCLUSION:
In treatment of large-size renal pelvic stones, LPL is less appropriate than PCNL in terms of duration of hospital stay, analgesic requirement, and operating time. PCNL has a respectable rate of stone clearance, a low conversion to open surgery rate, a brief stay at hospital with a reasonable overall problems rate.

Retrospective laparoscopic intrasinusal pyelolithotomy is less invasive, also an effective treatment option for intra-renal pelvic stones, although not being appropriate for large staghorn stones, based on our experience. By using the laparoscope and ureteroscope in tandem, we were able to treat several pelvic calyceal stones with a significantly lower percentage of residual stones by grasping the stones through the pelvic incision. Treatment for infected kidney and ureteral stones can be achieved with single operation. Benefit of this method include minimal bleeding, minimal nephron damage, easy manipulation, brief hospital stay, and speedy recovery after surgery.

Among various minimally invasive techniques, laparoscopic therapy has clear advantages for individuals with UPJO, retrocaval ureter, and nephroptosis. By removing urinary tract obstructions using pyeloplasty, nephropexy, ureter pelvic anastomosis, and crossing vessel amputation, we were able to significantly lower the incidence of stone recurrence.

Consequently, the decision between these two methods ought to be made in light of the unique needs of each patient, the qualities 0f calculi

as well as experience of surgeon. To evaluate long term viability of stone clearance and overall patient outcomes, more extensive follow-up research is necessary.

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