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RESEARCH ARTICLE
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ROLE OF OPEN RENAL STONE SURGERY IN ERA OF MINIMAL INVASIVE SURGERY

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ABSTRACT

OBJECTIVE: To compare the outcomes of laparoscopic versus open surgical techniques among renal stone patients.

METHODOLOGY: This descriptive cross-sectional study was done at the Sindh Institute of Urology & Transplantation (SIUT) in Karachi, Pakistan, for a duration of six months, from April to September 2024. A cohort of 246 individuals, aged 18 to 60, of either gender, diagnosed with renal stone (single or multiple) > 10 mm planned to be removed surgically were assessed. Patients were admitted a day before surgery and given intravenous Tazocin 4.5gm every 8 hourly for urinary sterility. Laparoscopic or open surgery including urethral catheter before was based on the type of stone, and CT KUB for a urologist. Operative details and postoperative length of hospitalization, stone clearance rates, and complications were recorded. The Clavien-Dindo classification system was used to categorize the complications and stone-free status was defined as a complete absence of any residual stones on abdominal CT-scan 4 weeks after the procedure. Statistical data was analyzed using SPSS version 26.

RESULTS: The mean age was 62.56 ± 10.36 years for subjects in the open surgery group and 61.74 ± 10.45 years for those in laparoscopy group (p=0.537). Among 246 patients, 61.8% in the open group and 65.0% in the laparoscopy groups were male. Laparoscopy had significantly shorter operation times (237.20vs.265.65 minutes, P=0.002) and much lower blood loss (179.39vs.410.24 mL, P=0.0001). However, open surgery showed higher stone clearance rates (89.4%vs.75.6%, P=0.004).

CONCLUSION: This study underscores that open renal stone surgery still has a firm place in urology. Since minimally invasive techniques offer advantages such as shorter operative times and less blood loss. For a complete stone removal open surgery is still more effective than any other method. The insignificant difference was noted in complication rate. Based on these results, it is recommended that more research is undertaken on larger populations of patients to validate the current findings.

KEYWORDS: Invasive Surgery, Open Surgery, Renal Stone, Complications

INTRODUCTION

Over the past few decades, the state-of-the-art technology in management of renal stones has evolved considerably with most significant change being advent of minimally invasive techniques[1]. These improvements, along with advances in stone fragmentation technologies, are now moving the trend away from more invasive techniques to less-invasive options resulting in reduction of postoperative recovery time and decreased morbidity for the patients [2]. Surgical techniques such as laparoscopic nephrolithotomy and percutaneous nephrolithotomy (PCNL) are the current gold standards for surgical management of renal stones, particularly uncomplicated ones [3]. Nonetheless, there still plays an indispensable role for open renal stone surgery in the era of insidiousness and minimally invasive surgeries.

Despite the recent developments in management of calculus disease, open nephrolithotomy remains a helpful last resort in particularly complicated cases where the stone morphology presents considerable difficulty to successfully treat using less invasive methods [4]. This is abysmally low and while expectations are that clearance seems better in others with staghorn stones, this isn't the reality for many with large anfractuosities [5]. Reconnaissance surgery in these cases may answer definitively by ensuring that the stone is entirely removed and that risks of residual fragments are minimized, as open surgery would be possible [6]. Some anatomical anomalies, complex stone burdens, and patients with multiple comorbidities may not allow an absolute safety for the application of mini-invasive technologies and will remain one of the unavoidable indications for open surgery [7].

In addition, logistic considerations such as availability of equipment, experience and OR time etc. might affect their decisions to perform surgery or not. These constraints help keep the reliance on open procedures high in many developing countries. It is imperative to reevaluate the indications of open renal stone surgery especially in the era of changing landscapes given increase in complex cases and patients with unique anatomical challenges. This review highlights the critical performance of open surgery in demonstrating satisfactory results and assists urologists with informed decisions to provide optimal patient care during this minimal invasive era.

METHODOLOGY

The Urology department of Sindh Institute of Urology & Transplantation carried out a study from April to September 2024 that recruited 246 participants through consecutive sampling. The participants were between 18 and 60 years old, with kidney stones over 10mm slated for surgical removal, either gender were included in the study. Exclusion criteria encompassed patients with a solitary functioning kidney, prior surgery on the ipsilateral kidney, bilateral stones, ASA >III, recurrent stones, and renal anatomical anomalies.

Informed consent was obtained after explaining the study's risks and benefits. Baseline demographic and clinical details, including age, gender, residence, height, weight, BMI, duration and size of stones, diabetes, hypertension, and smoking status, were recorded using a pre-designed proforma. Patients were admitted the day before surgery, placed on a light bowel preparation and given intravenous Tazocin 4.5gm every 8 hourly for urinary sterility.

Laparoscopic or open surgery including urethral catheter before was based on the type of stone, and CT KUB for a urologist. All the procedures were performed under the general anesthesia by well-experienced urologists. Operative details and postoperative length of hospitalization, stone clearance rates and complications were recorded. Categorization of complications was performed according to the Clavien-Dindo classification system and stone-free status was defined as a complete absence of any residual stones on abdominal CT-scan 4 weeks after the procedure. Data were analyzed using SPSS version 26.0. Qualitative variables were reported as frequencies and percentages, while quantitative variables were expressed as means and standard deviations or medians (IQR) depending on distribution. Chi-square or Fisher's exact tests compared outcomes between surgical groups, with significance set at $p \leq 0.05$.

RESULTS

Table I outlines the basic characteristics of 246 patients who received open renal stone surgery (n=123) and laparoscopic surgery (n=123). The mean age was 62.56 ± 10.36 years for subjects in the open surgery group and 61.74 ± 10.45 years for those in laparoscopy group (p=0.537). Mean BMI was similarly matched between the two groups (25.90 ± 3.54 kg/m² and to 25.58 ± 3.60 kg/m², respectively; p=0.481) There was no significant differences in hemoglobin levels (p=0.095), creatinine (p=0.074), and sodium (p=0.565) between the two groups. The mean duration of disease was a slightly high (7.59 ± 3.19 years) in the laparoscopy group compared with the open surgery group (6.86 ± 3.12 years), although this distinction was not statistically significant (p=0·071). All stones were similar in size between groups and this was not statistically significant (p=0.190). With respect to comorbidities, diabetes mellitus, hypertension and preoperative chemotherapy were similarly represented among both groups. The laparoscopic group also had a slightly higher prevalence of previous operation history (44.7% vs 38.2%) and shows statistically insignificance difference (P = 0.301). Additionally, the single stages of acute kidney injury (AKI) were comparable, and the majority of both groups could be classified as AKI Stage 1 (p=0.124).

Table II presents the surgical findings between open and laparoscopic surgery in 246 patients including operative time, blood loss, stone clearance, post-operative transfusions and complications. The outcomes show that compared to open surgery, laparoscopic surgery can significantly reduce operative time (p = 0.002) and estimated blood loss (p = 0.0001).

On the other hand, higher stone clearance rates were achieved with open surgery as compared to laparoscopic surgery (p = 0.004) which may suggest improved efficiency in total stone removal by this surgical modality. Although the occurrence of postoperative transfusions was almost double in the open surgery (14.6%) as compared to laparoscopy (7.3%), this difference did not reach statistical significance (p = 0.066).

The insignificant difference was noted in complications rate including residual stones, septic shock, and persistent leakage and wound infection P .0.05 between both the groups. Our data indicates that while the laparoscopic approach may be beneficial in some areas such as lower intraoperative time and blood loss, the end result to post-operative complications and transfusion rates appear similar between types of surgeries. However, open surgery found to be superior in terms of stone clearance.

DISCUSSION

This study reaffirms the importance of open renal stone surgery, particularly in complex cases where minimally invasive surgery (MIS) techniques like laparoscopy or PCNL may not be sufficient. The findings revealed that open surgery provided superior stone clearance rates compared to laparoscopic surgery (89.4% vs. 75.6%, p=0.004), highlighting its continued relevance in the surgical management of large or complex renal stones. These results are consistent with previous studies that suggest open surgery remains an essential option when other methods are less effective due to complex stone morphology or patient-specific anatomical challenges [8-10].

Earlier studies also emphasized that while laparoscopic approaches have the advantage of reduced operative time and blood loss, they often come with a trade-off in terms of stone clearance [8-10]. For example, research has demonstrated that laparoscopic surgery significantly reduces operative time (p=0.002) and estimated blood loss (p=0.0001), as was also found in this study. However, despite these advantages, the risk of residual stones is higher in laparoscopic surgeries, making open surgery more effective in achieving complete stone removal, particularly in cases involving large or staghorn calculi [11].

Interestingly, the rate of postoperative complications, such as residual stones, septic shock, and persistent leakage, was similar between the two groups ($p > 0.05$), indicating that both surgical techniques have comparable safety profiles, a finding echoed in prior literature. Although open surgery was associated with a higher but statistically insignificant transfusion rate (14.6% vs. 7.3%, p=0.066), this risk does not seem to outweigh the benefit of more thorough stone clearance.
Since this was a prospective study, it benefits from more accurate and real-time data collection, reducing some biases that may be present in retrospective designs. However, there are still limitations. The study was conducted in a single institution, which may limit the generalizability of the findings. Furthermore, while the study's sample size is reasonable, a larger cohort would provide more robust data to further differentiate between the efficacy of open and laparoscopic procedures. The six-month follow-up period may also not be long enough to assess long-term outcomes such as stone recurrence.

CONCLUSION

This study underscores that open renal stone surgery still has a firm place in urology. Since minimally invasive techniques offer advantages such as shorter operative times and less blood loss. For a complete stone removal open surgery is still more effective than any other method. The insignificant difference was noted in complication rate. Based on these results, it is recommended that more research is undertaken on larger populations of patients to validate the current findings.

Table I: Baseline characteristics of the patients (n=246)

Variables	**Groups**		**P-Value**
	Open (n=123)	**Laparoscopy** (n=123)	
Age in years, Mean ± SD	62.56 ± 10.36	61.74 ± 10.45	0.537
BMI in kg/m², Mean ± SD	25.90 ± 3.54	25.58 ± 3.60	0.481
Hemoglobin in g/dL, Mean ± SD	12.45 ± 1.72	12.82 ± 1.69	0.095
Creatinine in mg/dL, Mean ± SD	1.09 ± 0.20	1.04 ± 0.21	0.074
Sodium in mmol/L, Mean ± SD	139.82 ± 2.91	140.03 ± 2.83	0.565
Potassium in mmol/L, Mean ± SD	4.14 ± 0.46	4.20 ± 0.49	0.354
Duration of Disease in years, Mean ± SD	6.86 ± 3.12	7.59 ± 3.19	0.071
Stone Size in mm, Mean ± SD	23.37 ± 7.45	22.16 ± 6.91	0.190
Gender (Male), *n* (%)	76 (61.8)	80 (65.0)	0.596
Diabetes Mellitus, *n* (%)	51 (41.5)	55 (44.7)	0.607
Hypertension, *n* (%)	71 (57.7)	76 (61.8)	0.516
Preoperative Chemotherapy, *n* (%)	44 (35.8)	37 (30.1)	0.342
Previous Operation History, *n* (%)	47 (38.2)	55 (44.7)	0.301
AKI Stage, *n* (%)			
1	108 (87.8)	98 (79.7)	0.124
2	15 (12.2)	23 (18.7)	
3	0 (0.0)	2 (1.6)	

Table II: Comparison of Surgical Outcomes Between Open and Laparoscopy Surgery in Patients (n=246)				
Variables	**Groups**			**P-Value**
	Open (n=123)	**Laparoscopy** (n=123)	**95% C. I**	
Operation Time in mins, Mean ± SD	265.65 ± 67.95	237.20 ± 71.34	10.956----45.954	0.002
Estimated Blood Loss in mL, Mean ± SD	410.24 ± 210.32	179.39 ± 79.70	190.907----270.800	0.0001
Stone Clearance, *n* (%)	110 (89.4)	93 (75.6)	1.346----5.535	0.004*
Postoperative Transfusion, *n* (%)	18 (14.6)	9 (7.3)	0.935----5.045	0.066
Complications, *n* (%)				
Residual Stones	15 (12.2)	14 (11.4)	0.498----2.348	0.843
Septic Shock	1 (0.8)	2 (1.6)	0.044----5.541	0.500
Persistent leakage	3 (2.4)	5 (4.1)	0.138----2.525	0.361
Wound Infection	6 (4.9)	4 (3.3)	0.420----5.546	0.374

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