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COMPARISON BETWEEN ROBOTIC ASSISTED LAPAROSCOPIC PYELOPLASTY AND LAPAROSCOPIC PYELOPLASTY AS STANDARD OF CARE FOR PELVI-URETERIC JUNCTION OBSTRUCTION: HOSPITAL-BASED COHORT STUDY.

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ABSTRACT

Introduction
Pelvi-Ureteric Junction Obstruction (PUJO) is a significant clinical difficulty that frequently necessitates surgical treatment. This study examines and contrasts the efficacy of Robotic-Assisted Laparoscopic Pyeloplasty (RALP) and Laparoscopic Pyeloplasty (LP) in treating this problem. The objective is to assess perioperative parameters and patient outcomes to identify the most effective technique for controlling PUJO.

Methods
The study comprised individuals diagnosed with PUJO who were scheduled to undergo surgical intervention. The study included a total of 48 patients, with 32 of them undergoing LP and the remaining 16 getting RALP.

Results
48 patients (32 LP, 16 RALP) aged 10-70 years were studied, with mean ages of 34.28 (LP) and 39.38 (RALP), a male-to-female ratio of 2.2:1, and success rates of 90.63% (LP) and 93.75% (RALP) in transitioning from an obstructed (TYPE 2) to a normal (TYPE 1) O' The RALP group had a longer mean operative time (226.87 ± 32.39 minutes) than the LP group (186.53 ± 33.58 minutes). The RALP group had better patient outcomes, including faster drain removal time (1.69 ± 1.40 days vs. 3.75 ± 1.50 days), shorter hospital stay (2.88 ± 0.88 days vs. 4.06 ± 1.39 days), and somewhat higher success rate (93.75% vs. 90.63%). The success criteria were an obstructed (TYPE 2) to normal (TYPE 1) O'Reilly Curve within 3 months of surgery.

Conclusion
Although RALP has a longer operational time, it has been shown to achieve better results than LP in terms of success rate, duration of drain usage, and total length of hospital stay.

Recommendations
It is recommended that future studies include larger sample sizes and longer follow-up periods to further evaluate the long-term effectiveness of RALP and LP in the management of PUJO.

Keywords: *Pyeloplasty, Laparoscopic pyeloplasty, Robotic-assisted pyeloplasty, Pelvi-Ureteric Junction Obstruction*
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INTRODUCTION

Pelvi-Ureteric Junction Obstruction (PUJO) refers to a blockage that occurs in the passage of urine from the renal pelvis to the proximal ureter, causing increased pressure in the renal pelvis. If not addressed, this illness can result in gradual harm to the kidneys and a decline in their functioning.1 PUJO can manifest as either congenital or acquired, and it may occur bilaterally in around 10-20% of instances.2Histopathological examinations demonstrate that in pelvic ureteric junction obstruction (PUJO), the typical spiral muscle fibers of the renal pelvis are substituted with anomalous fibrous tissue, leading to the disruption of normal renal function.

Traditionally, open dismembered pyeloplasty has been regarded as the "gold standard" treatment for PUJO, with the Anderson-Hynes technique being the most commonly employed method.3 In recent years, surgical techniques have made significant progress by introducing minimally invasive options such as Laparoscopic Pyeloplasty (LP) and Robotic-Assisted Laparoscopic Pyeloplasty (RALP), along with Endo-urological treatments.4-9Laparoscopic Pyeloplasty, initially documented in 1993, provides numerous advantages compared to traditional surgery, such as reduced hospitalization duration, enhanced aesthetic outcomes, and developments in laparoscopic technology.10,11 Nevertheless, the utilization of LP is constrained by the need for comprehensive training and proficiency in intra-corporeal suturing, thereby restricting its potential applications.12

Introduced in 1999, Robotic-Assisted Laparoscopic Pyeloplasty (RALP) has effectively overcome some constraints commonly associated with conventional laparoscopic procedures.13 The benefits of RALP stem from the utilization of cutting-edge robotic technology, which includes improved three-dimensional visualization, filtering of tremors, and a wider range of motion in comparison to conventional laparoscopic devices.14Although RALP offers certain benefits, it is also linked to elevated expenses, more utilization of operating room facilities, and a requirement for specialized personnel. In addition, robotic technology restricts the sense of touch, which is a notable disadvantage when compared to traditional laparoscopy.

Recently, there has been a concentration of research on evaluating various minimally invasive procedures to ascertain their comparative efficacy and patient outcomes. Research indicates that whereas RALP provides better clarity and accuracy, LP remains a cost-efficient alternative with similar rates of success.10-12 The continued examination of both laparoscopic pyeloplasty (LP) and robot-assisted laparoscopic pyeloplasty (RALP) is necessary to determine the most effective strategy for diverse patient demographics, as the progress of surgical techniques continues to influence treatment decisions for PUJO.15-19 It is essential to continuously assess both techniques as there is a limited number of studies that examine the experience of individual surgeons with both LAP and RAP and compare their effectiveness in performing both operations within a single institution. In light of this, the present study was carried out to evaluate the effectiveness of Laparoscopic Pyeloplasty (LP) and Robotic-Assisted Laparoscopic Pyeloplasty (RALP) in treating Pelvi-Ureteric Junction Obstruction and determine the optimal standard of care.

Aim of the study

The present study aims to assess and compare Robotic Assisted Laparoscopic Pyeloplasty (RALP) and Laparoscopic Pyeloplasty (LP) as the standard of care concerning perioperative parameters and compare the outcome of the two different treatment modalities of PUJO. The study seeks to assess the effectiveness of surgery by analyzing kidney scans conducted before and after the operation. In addition, the study will examine intra-operative and post-operative factors, such as the duration of the operation, the presence of ongoing pain, the length of time a drain is needed, and the duration of the hospital stay. A detailed study of both methods, Laparoscopic Pyeloplasty (LP) and Robotic-Assisted Laparoscopic Pyeloplasty (RALP) will be done to examine their merits and disadvantages.

MATERIALS AND METHOD

Study Design

Hospital-based Cohort Study.

Study site

The study was conducted at the Department of Urology of Swami Rama Himalayan University, Dehradun, India. Data were collected retrospectively from January 2019 to August 2019 as well as prospectively from September 2019 to June 2021.

Study Population

Patients suffering from PUJO and who visited the Department of Urology outpatient unit.

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Sample size

The total sample size was 48, with 32 being in the LP group and 16 being in the RALP group.

Inclusion Criteria

The study included all individuals who have recently been diagnosed with pelvic uterine Junction Obstruction (PUJO). It primarily targets cases where PUJO is found in the functioning part of the kidney.

Exclusion Criteria

This study excluded children who are 5 years old or less, as well as patients who are above 70 years old. Additionally, it does not include instances where the surgical method was changed to open surgery, patients who were not able to be tracked for further observation, and individuals who underwent a repeat pyeloplasty.

Parameters studied

During this investigation, intra-operative data, such as operating time, were measured from the moment the initial skin incision was made to the ultimate closure of the incision. Additionally, post-operative parameters were evaluated. This encompassed enduring discomfort, as characterized by the necessity of taking paracetamol pills four times a day, at a dose suitable for the individual's age, for more than 48 hours after the surgical procedure, or the need for further opioid medicine to manage the pain. Additional post-operative factors encompass the length of time the drain is in place, the duration of the hospital stay, and the measure of success, which is defined as the enhancement of the O'Reilly Curve from blocked (TYPE 2) to normal (TYPE 1) three months following the surgical procedure.

Follow-up

Subsequent evaluations or follow-ups were performed at three specific time points: one week after the operation to inspect the wound and handle any patient grievances; six weeks after the surgery to remove the stent; and twelve weeks after the surgery to conduct a postoperative diuretic renal scan.

Statistical analysis

The study utilized statistical analysis methods to compare the outcomes between the two groups, LP and RALP. Specifically, the data were analyzed using mean ± standard deviation (SD) for continuous variables like age, operative time, and duration of hospital stay. Chi-square tests were likely used to compare categorical variables such as the success rate, and p-values were reported to determine statistical significance.

Ethical consideration

The study was conducted after obtaining approval from the ethical committee of Swami Rama Himalayan University Hospital (Approval number: NHH/AEC-CL-2020-538) and having obtained written informed consent from all patients. Informed consent was also obtained from the patients for retrospective data collection.

RESULTS

Socio-demographic parameters

Age

This study involved the evaluation of 48 individuals, whose ages ranged from 10 to 70 years. The age distribution was as stated: Out of the total number of patients, 4 (8.33%) were between the ages of 10 and 20, 17 (35.41%) were between the ages of 21 and 30, 11 (22.91%) were between the ages of 31 and 40, 8 (16.67%) were between the ages of 41 and 50, 4 (8.34%) were between the ages of 51 and 60, and 4 (8.34%) were between the ages of 61 and 70. The average age was 34.28 ± 12.53 years for the LP group and 39.38 ± 16.41 years for the RALP group. The age distributions are significant as they offer a valuable understanding of the demographics that are most impacted by PUJO and aid in identifying any age-related patterns or disparities in treatment results.

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Table 1: Socio-demographic parameters

Demographic Variables	LP Group (N= 32)	RALP Group (N= 16)
Age (years)	34.28 ± 12.53	39.38 ± 16.41
Gender		
Male	22 (68.75%)	11 (68.75%)
Female	10 (31.25%)	5 (31.25%)
Side of PUJO		
Right	16 (50%)	6 (37.5%)
Left	16 (50%)	10 (62.5%)
Comorbidities		
Hypertension	3 (9.38%)	1 (6.25%)
Diabetes mellitus	1 (3.13%)	1 (6.25%)
Coronary artery disease	1 (3.13%)	0 (0%)

Sex

Concerning the distribution of sex, out of the total of 48 patients, 33 (68.75%) were male and 15 (31.25%) were female. The LP group comprised 22 male patients, accounting for 68.75% of the total, and 10 female patients, representing 31.25%. Similarly, the RALP group included 11 male patients, making up 68.75%, and 5 female patients, constituting 31.25%. The comparable sex ratio in both groups indicates that gender does not have a substantial influence on the selection of the surgical strategy for PUJO.

Side

The incidence of PUJO was observed on both sides, with 26 patients (54.16%) presenting with left-sided PUJO and 22 patients (45.84%) presenting with right-sided PUJO. Within the LP group, 16 patients (50%) exhibited right-sided PUJO, while another 16 patients (50%) had left-sided PUJO. In the RALP group, 6 patients (37.5%) had right-sided PUJO, and 10 patients (62.5%) had left-sided PUJO. This distribution offers an equitable perspective on the lateralization of the condition, which is essential for comprehending any side-specific consequences or variances in surgical success.

Comorbidities

Out of the total of 48 patients, 3 (6.25%) had hypertension (HTN), 1 (2.08%) had diabetes mellitus (DM), and 1 (2.08%) had coronary artery disease (CAD). In addition, one patient (2.08%) presented with both hypertension (HTN) and coronary artery disease (CAD), three patients (6.25%) had diabetes mellitus (DM) and hypertension, and two patients (4.16%) had diabetes mellitus and coronary artery disease. The existence of these comorbidities is crucial as it aids in evaluating how underlying health issues may impact surgical outcomes and recuperation.

Preoperative creatinine

The average preoperative creatinine level was 0.84 ± 0.15 mg/dl in the laparoscopic pyeloplasty (LP) group and 0.91 ± 0.16 mg/dl in the robot-assisted laparoscopic pyeloplasty (RALP) group. The mean creatinine level was slightly elevated in the RALP group but not statistically significant.

Intraoperative parameters

Crossing vessels

Out of the 32 patients who underwent LP, 7 (21.87%) had crossing vessels, while 25 (78.13%) did not. Among the patients in the RALP group, 4 individuals (25%) had crossing vessels, while the remaining 12 patients (75%) did not have crossing vessels. Having crossing vessels might make the surgical procedure more complicated, and knowing their distribution assists in evaluating any extra difficulties or variations between the two surgical techniques.

Dismembered/non-dismembered pyeloplasty

Among the 32 LP cases, 13 (40.63%) had dismembered pyeloplasty, while 19 (59.37%) underwent non-dismembered pyeloplasty. Within the RALP group, 31.25% of patients underwent dismembered pyeloplasty, whereas 68.75% underwent non-dismembered pyeloplasty. The choice of pyeloplasty procedure can have an impact on surgical results and the speed of recovery. Analyzing this data can provide insights into the effects of different approaches on success rates and patient recovery.

Operative time

The operative time, which is the time from making the skin incision to closing it, had an average duration of 186.53 ± 33.58 minutes in the LP group and 226.87 ± 32.39 minutes

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in the RALP group. The considerably extended duration of RALP (p= 0.001) suggests heightened intricacy or supplementary stages in robot-assisted surgeries. This holds significance for surgical planning and allocation of resources (Figure 1).

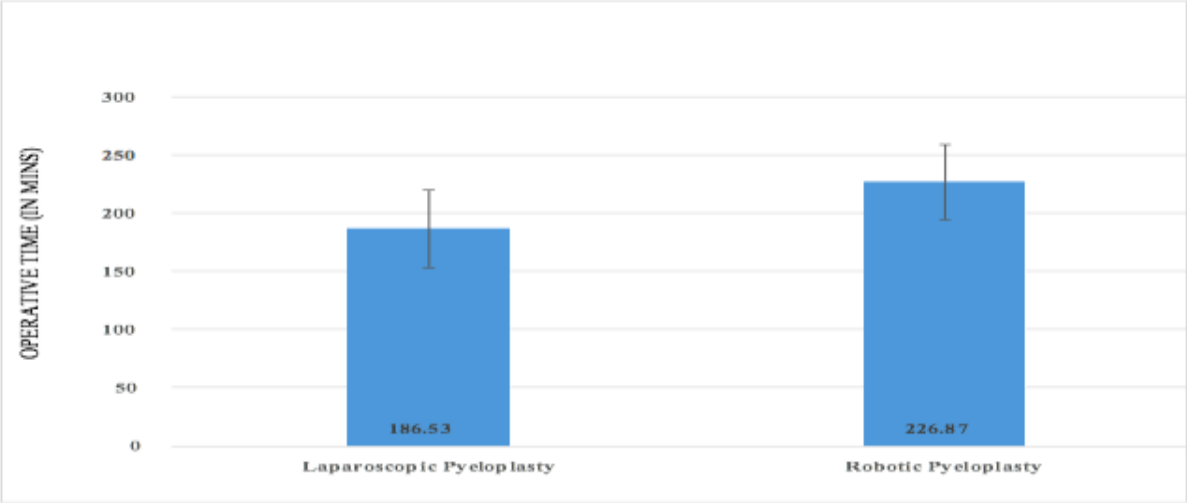

Figure 1: Operative time in both groups

Post-operative parameters

Persistent pain

Persistent pain was characterized as the requirement for paracetamol four times daily for a duration exceeding 48 hours after surgery, or the necessity for supplementary opioid medicine. Within the LP group, 10 patients (31.25%) reported enduring pain, whereas 22 patients (68.75%) did not. Within the RALP group, a total of 3 patients (18.75%) encountered enduring pain, while 13 patients (81.25%) indicated the absence of pain. The non-significant difference (p = 0.358) indicates that both methods yield comparable pain management outcomes, however individual patient experiences may differ (Figure 2).

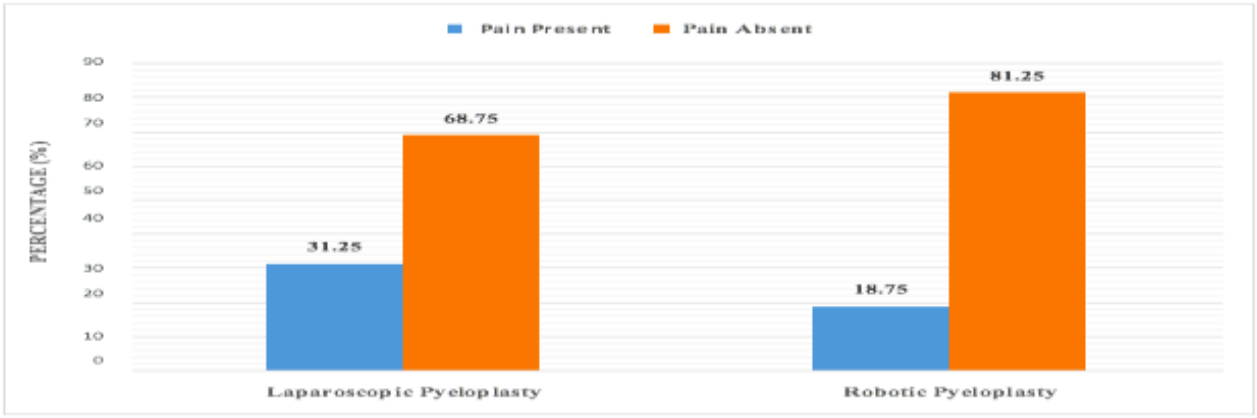

Figure 2: Pain distribution

Duration of drain

In the LP group, the average length of time for the postoperative drain was 3.75 ± 1.50 days, while in the RALP group, it was 1.69 ± 1.40 days (Figure 3). The observed statistical significance (p = 0.001) emphasizes the benefit of RALP in terms of decreased length of drainage, which can result in a more comfortable recuperation and potentially shorter hospitalization.

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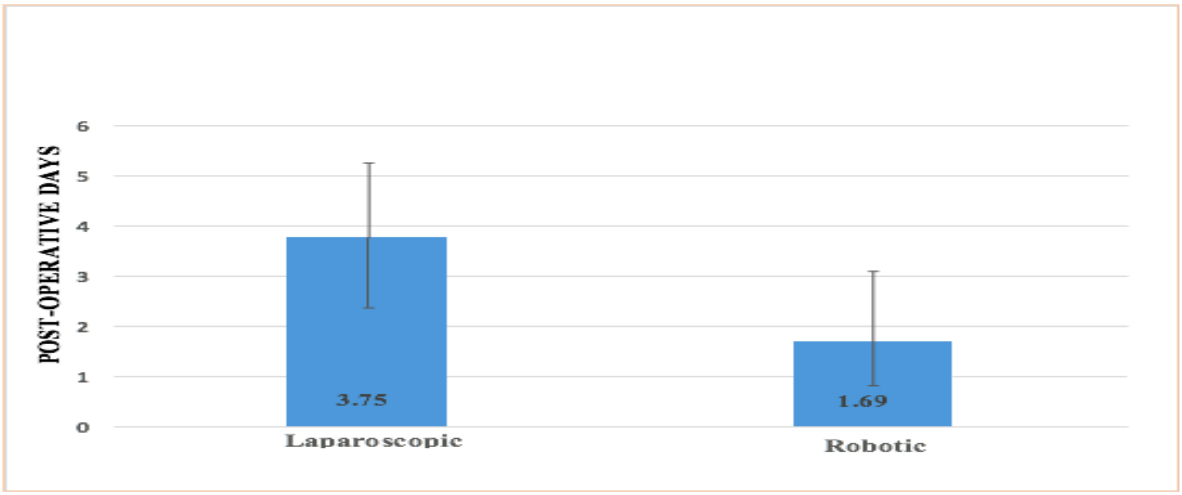

Figure 3: Duration of post-operative drain

Hospital stay

The average duration of hospitalization for the LP group was 4.06 ± 1.39 days, which was substantially longer compared to the RALP group with an average of 2.88 ± 0.88 days (p = 0.003) (Figure 4). The notable disparity highlights the advantage of RALP in diminishing the duration of hospitalization, hence improving patient contentment and decreasing healthcare expenses.

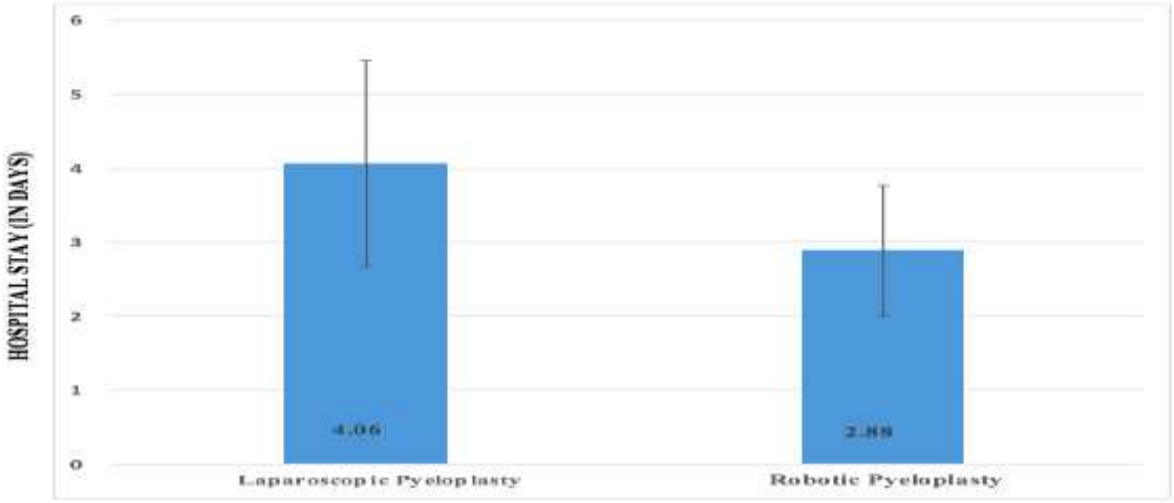

Figure 4: Total hospital stay in both groups

Success

Success, as measured by the transition of the O'Reilly Curve from obstructed (TYPE 2) to normal (TYPE 1) during three months, was attained in 90.63% of LP patients and 93.75% of RALP cases. The increased success rate observed in the RALP group indicates its potential benefits in generating positive results, while the disparity may not be significant enough to fundamentally change clinical practice (Figure 5).

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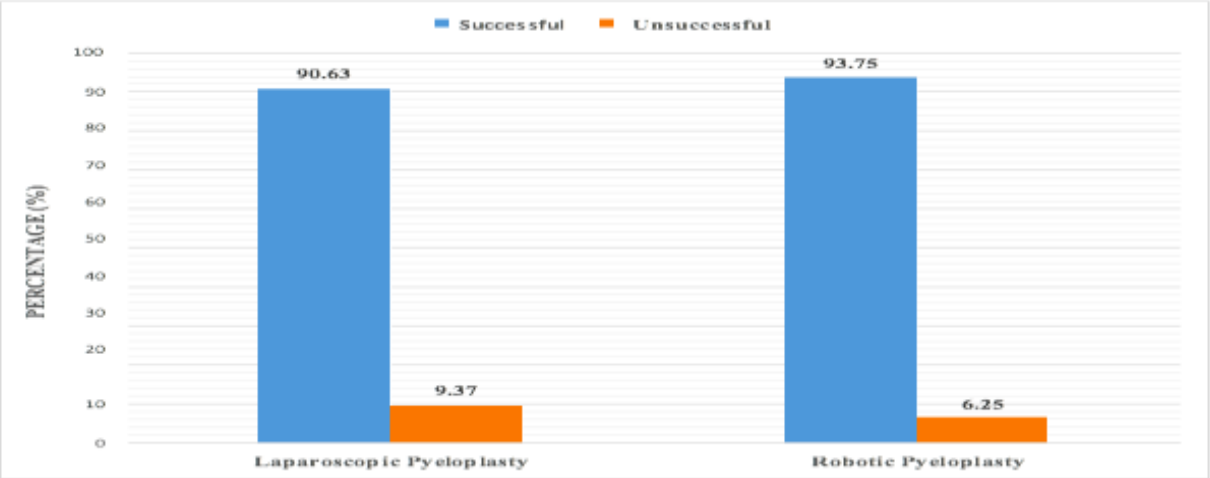

Figure 5: Bar chart of success in both groups

DISCUSSIONS

The study analyzed a cohort of 48 individuals with PUJO, ranging in age from 10 to 70 years. The age distribution highlights that the majority of patients were in their 20s and 30s, with the average age being slightly higher in the RALP group (39.38 ± 16.41 years) compared to the LP group (34.28 ± 12.53 years). This age variation is important as it suggests that older patients may be more likely to undergo RALP, potentially due to its less invasive nature and quicker recovery time. The gender distribution was consistent across both groups, with a male predominance (68.75% male, 31.25% female), indicating no significant gender-based selection for the surgical technique. The side of PUJO was also fairly distributed, with a slight predilection for left-sided obstruction in the RALP group (62.5%) compared to the LP group, where it was evenly split (50%).

Comorbidities were present in a minority of patients, with hypertension being the most common (6.25% in the RALP group, and 9.38% in the LP group). The presence of comorbid conditions, though limited, is critical in assessing surgical outcomes and recovery. Patients with additional health concerns may face increased risks during surgery and longer recovery periods, making it essential to tailor the surgical approach to individual health profiles.
The study revealed that a significant portion of patients undergoing pyeloplasty had crossing vessels (21.87% in LP, 25% in RALP), a factor that can complicate the surgical procedure. The higher prevalence of non-dismembered pyeloplasty in both groups suggests a preference for this technique, which may be associated with faster recovery and fewer complications. The operative time was notably longer in the RALP group, averaging 226.87 ± 32.39 minutes compared to 186.53 ± 33.58 minutes in the LP group. This difference is statistically significant and reflects the additional complexity and setup time associated with robotic surgery.

Postoperative outcomes highlighted the benefits of RALP, particularly in terms of reduced persistent pain and shorter duration of postoperative drainage. Only 18.75% of RALP patients experienced persistent pain, compared to 31.25% in the LP group, although this difference was not statistically significant. The significant reduction in drain duration in the RALP group (1.69 ± 1.40 days vs. 3.75 ± 1.50 days in LP) underscores the potential for quicker patient recovery and reduced discomfort. Similarly, the RALP group benefited from a shorter hospital stay (2.88 ± 0.88 days) compared to the LP group (4.06 ± 1.39 days), reflecting the advantages of robotic-assisted surgery in terms of recovery time and overall patient satisfaction.

The success rate, as defined by the transition from an obstructed (TYPE 2) to a normal (TYPE 1) O'Reilly Curve within three months post-surgery, was slightly higher in the RALP group (93.75%) compared to the LP group (90.63%). While this difference was not statistically significant, it indicates a trend towards better outcomes with RALP, suggesting its potential superiority in achieving positive surgical results. However, the small sample size may limit the generalizability of these findings, and further research with larger cohorts is necessary to confirm these observations.

Overall, the study results suggest that while RALP requires a longer operative time, it offers significant benefits in terms of recovery, pain management, and success rates, making it a potentially preferable option for managing PUJO, particularly in patients who can benefit from a less invasive approach.

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The RALP group had a significantly longer operative time compared to the LP group, with a statistically significant difference (p = 0.001). This outcome is consistent with several studies that have compared RALP with LP, revealing inconclusive results regarding operative duration.

A study found that the average duration for the LP procedure was 187.76 ± 22.1 minutes, while the average time for the RALP procedure was 136.76 ± 25.1 minutes.20 Similarly, another study reported that the average duration of the surgical procedure was 130 ± 45 minutes for LP and 114 ± 26 minutes with RALP.21 A meta-analysis revealed that RALP (robot-assisted laparoscopic pyeloplasty) has reduced operation times, while other similar studies didn't show any meaningful difference.22 The prolonged duration of the surgical procedure in RALP reported in the study is a result of the intricate nature of the procedure and the need for additional preparation for robotic surgeries.

About surgical outcomes, chronic pain was defined as the need for paracetamol four times a day or extra opioids. The results of the study indicate that there was no notable disparity in persistent pain between the LP and RALP groups (p = 0.385). This conclusion is consistent with the research which also found no statistically significant difference in pain levels between the two procedures.21The average duration of postoperative drainage was substantially greater in the LP group (3.75 ± 1.50 days) compared to the RALP group (1.69 ± 1.40 days), indicating that RALP has a clear advantage in lowering the length of time surgical drains need to be in place. This outcome corroborates the discoveries made by a study and others who similarly noted a reduced duration of surgical drains in the RALP group. 21

The duration of hospitalization was considerably greater for the LP group (4.06 ± 1.39 days) in comparison to the RALP group (2.88 ± 0.88 days) (p = 0.003). This outcome implies that RALP may provide benefits in terms of expedited recuperation and early release from medical care. However, other studies found no statistically significant distinction in the duration of hospital stays between the two groups. 20,23 The divergence in results can be ascribed to differences in research methodologies and approaches to patient care. The decreased duration of hospitalization for patients undergoing RALP can be partially attributed to the reduced duration of post-operative surgical drains.

The success rate, which is defined as the percentage of cases where there was an improvement from an obstructed (TYPE 2) to a normal (TYPE 1) O'Reilly Curve after three months, was 90.63% for LP and 93.75% for RALP. This observation aligns with a meta-analysis that demonstrated similar rates of effectiveness between RALP and LP. 22,24 The relatively greater success rate observed in the RALP group, while not reaching statistical significance, indicates the possibility of better outcomes.

In the study, complications were limited, with just two patients in the LP group encountering postoperative problems. One patient had a urine leak, which was successfully controlled by prolonged per-urethral catheterization. The other patient had an infection, which was effectively treated without the need for invasive measures. The RALP group did not report any post-operative complications. The low number of complications seen indicates that both procedures are safe, although RALP seems to be more effective in reducing postoperative morbidities.

Although RALP is associated with increased duration of surgery, it outperforms LP in terms of success rate, decreased duration of the surgical drain, and shorter hospitalization. These benefits indicate that RALP may be a more favorable standard of treatment for PUJO management, however, both procedures are feasible depending on patient-specific characteristics and surgical expertise.

GENERALIZABILITY

The generalizability of this study may be limited due to the relatively small sample size and the specific demographic characteristics of the patient population, which was confined to a single institution. While the findings suggest that RALP may offer superior outcomes compared to LP, these results may not be fully applicable to broader, more diverse populations or different healthcare settings. Additionally, the study's focus on patients treated within a specific timeframe may not capture long-term outcomes. Future studies with larger, more diverse cohorts and extended follow-up periods are needed to validate these findings and enhance their applicability to a wider range of clinical practices.

CONCLUSION AND FUTURE SCOPES

This study demonstrates various strengths, such as the participation of surgeons who possess proficiency in both laparoscopic and robotic surgeries, which effectively reduced the possibility of surgeon-related biases. In addition, meticulous preoperative and postoperative evaluations, which included radiological assessments, were performed to provide comprehensive patient care. The absence of follow-up renal scans is a hindrance in evaluating the long-term success of the surgical procedures. In addition, the limited sample size could impact the generalizability of the findings. As per the results of this study, Robotic-Assisted Laparoscopic Pyeloplasty (RALP) is identified to be a more effective surgical treatment and might be regarded as the recommended approach for treating Pelvi-Ureteric Junction Obstruction (PUJO). The selection between Robotic-Assisted Laparoscopic Pyeloplasty (RALP) and Laparoscopic Pyeloplasty (LP) should be determined by the

patient's personal preferences, the surgeon's expertise, and the accessibility of institutional resources. Subsequent investigations should prioritize greater sample sizes and longer follow-up periods to better comprehend the effectiveness and results of RALP and LP. These investigations will improve surgical techniques and improve patient care for PUJO.

LIMITATIONS

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

RECOMMENDATION

It is recommended that future studies include larger sample sizes and longer follow-up periods to further evaluate the long-term effectiveness of RALP and LP in the management of PUJO.

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LIST OF ABBREVIATIONS

PUJO - Pelvi-Ureteric Junction Obstruction
RALP - Robotic-Assisted Laparoscopic Pyeloplasty
LP - Laparoscopic Pyeloplasty
HTN – Hypertension
DM - Diabetes Mellitus
CAD - Coronary Artery Disease
SD - Standard Deviation

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No funding was received.

CONFLICT OF INTEREST

The authors have no conflicting interests to declare.

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