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Standard Pressure Vs Low Pressure Laparoscopic Cholecystectomy: Comparative Insights into a Tertiary Healthcare Setting in Lahore

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) had been taken as the standard of care in the treatment of the gallbladder disease. Another alternative that could be put in place of countering the undesirable side effects associated with the LC was the low-pressure laparoscopic cholecystectomy (LPLC). This study was done to compare the performance of SPLC and LPLC based on the postoperative pain, operating time and occurrence of shoulder tip pain.

Methods: A total of one hundred and eighty patients undergoing elective LC were randomised into SPLC group (n=90) or the LPLC group (n=90). Sampling was done using the Open Epi 3.0.0 with CI of 95 and power of 80. The postoperative pain was measured using visual analogue scale (VAS) at 6, 12, 18 and 24 hours of operation. The pain at the tip of the shoulder and length of surgery were recorded as well. All statistical procedures have been performed in SPSS 25.0.

Results: The mean operative time was similar in both the SPLC and LPLC groups (35.40 ± 8.94 minutes vs. 37.40 ± 7.89 minutes, p=0.1125). Postoperative pain scores were lower in the LPLC group at all measured time points (p=0.0001). The frequency of shoulder tip pain was notably reduced in the LPLC group 6 (6.67%) compared to the SPLC group 23 (25.56%). SPSS version 26.0 was used with p-value<0.05.

Conclusion: LPLC offered significant advantages over SPLC by reducing the postoperative pain as well as the incidence of shoulder tip pain without altering the operative time.

Keywords: Cholecystectomy, Laparoscopic, Laparoscopy, Intra-Abdominal Hypertension.

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INTRODUCTION

Introduction of laparoscopic cholecystectomy in the late 1980s made it the gold standard in the management of cholelithiasis and cholecystitis among the numerous other illnesses of the gallbladder 1. The operation, which was a poorly invasive process, had numerous advantages to the open cholecystectomy that was always practiced in the past 2. Among the benefits, there was reduced hospitalization, postoperative pain, less recovery time, and complications 3. However, the standard pressure used in laparoscopic cholecystectomy, which is usually between 12 and 15 mmHg, did not entirely have no adverse effects, such as the pain experienced post-surgical operations, shoulder tip pains, and other cardiovascular and respiratory issues [4].

In order to minimize such adverse effects, LPLC emerged as an alternative solution that was used to delay such adverse effects [5]. This technique employs low intra-abdominal pressure which reduces the degree of diaphragmatic irritation and nerve stretching thereby reducing pain and discomfort during surgery processes [6]. A number of studies had already proposed comparable results of LPLC to SPLC and an increased post-operative comfort among patients [7].

This research had its value in refining surgical procedures by having evidence on the comparative advantage of LPLC in relation to SPLC [8]. Although the results reported in the previous research were promising, there was still a necessity to conduct even more powerful and large-scale comparative research, which would help to prove the unquestioned advantages and possible limitations of LPLC [9]. To address this gap, this study would offer an elaborated comparison of SPLC with LPLC, with significant considerations, especially the postoperative pain, the duration of operation, and the shoulder tip pain.

The objective of this research was to analyze whether LPLC would lead to less postoperative pain and fewer complications than SPLC or not.

METHODS

The comparative prospective study was carried out at SIMS, Lahore, from January to June 2021 (Ref: 236-DME/SIMS/SHL). All participants provided written informed consent before enrolment. A total of 180 patients undergoing laparoscopic cholecystectomy were recruited. The participants were allocated randomly to either the SPLC group (n=90) or LPLC group (n=90). OpenEpi software version 3.0.0 (released 2013, Atlanta, GA, USA) was used to determine the sample size and to perform the calculations with a 95% confidence level and 80% power to identify a clinically significant difference between the LPLC and SPLC groups [10].

Patients were included if they were between 18 to 70 years and were about to undergo elective laparoscopic cholecystectomy and had an ASA physical status I or II. The patients with a history of emergency cholecystectomy, prior upper abdominal surgery, or having severe cardiopulmonary diseases were excluded. Demographic information, such as age, gender, and body mass index, was taken at the baseline. The operative time from incision to skin closure was recorded. All the readings were taken at 6, 12, 18, and 24 hours after surgery on a visual analogue scale (VAS, a scale of 10 points) based on the experience of pain. Moreover, the frequency of postoperative shoulder tip pain, which was a frequent complication of laparoscopic procedures, was specifically noted. Both groups received standardized postoperative analgesia, and pain was measured by trained staff members who were blinded to the methods used during surgery.

SPSS version 26.0 was used to analyse the data. Continuous variables, such as age, BMI, operative time, and VAS scores, were expressed as mean ± standard deviation, and comparison between the groups was made using the independent sample t-test. The Chi-square test was used to compare categorical variables, including gender type and shoulder tip pain prevalence. Any p-value lower than 0.05 was taken to be statistically significant.

RESULTS

The study enrolled 180 patients following the inclusion criteria. 90 patients were taken in the SPLC group, and 90 patients were taken in the LPLC group. The two groups were similar with regard to baseline characteristics. **Figure 1** depicts the distribution of patients with respect to age.

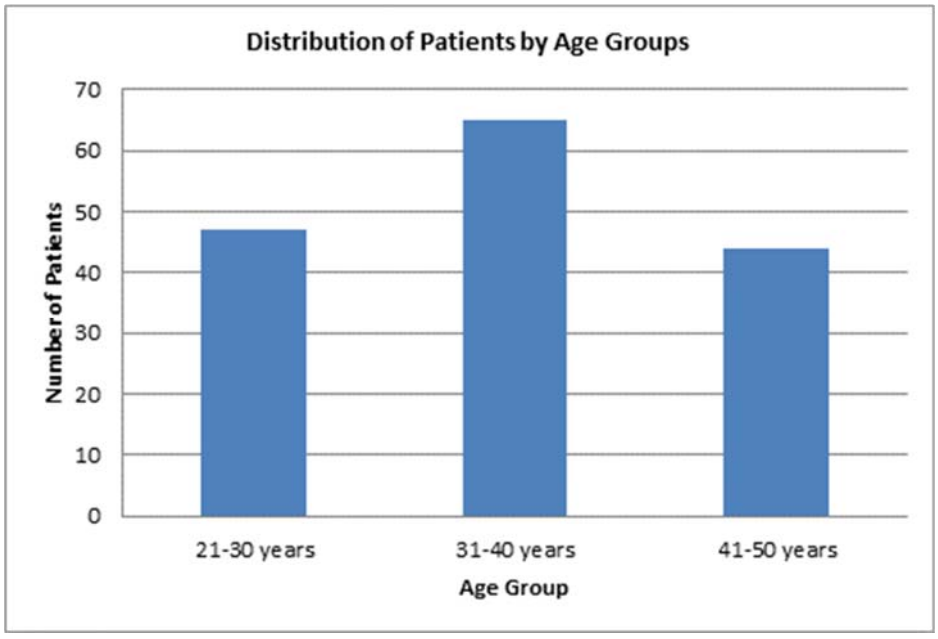

Figure 1: Distribution of patients by age groups

Most of the patients were aged between 31-40 years, constituting 36.11% (n=65) of the entire sample size. A considerable proportion of patients were seen to be in the 21-30 years and 41-50 years groups as well (26.12% (n= 47) and 24.43% (n= 44), respectively). The mean age ± standard deviation for the LPLC group was 38.71 ± 8.84 years, and 40.41 ± 12.50 years for the SPLC group. Although a slight difference in mean age between groups was noticed, it was not statistically significant ($p>0.05$), indicating that the age distribution was balanced between the two groups. **Figure 2** demonstrates the gender distribution by group among patients.

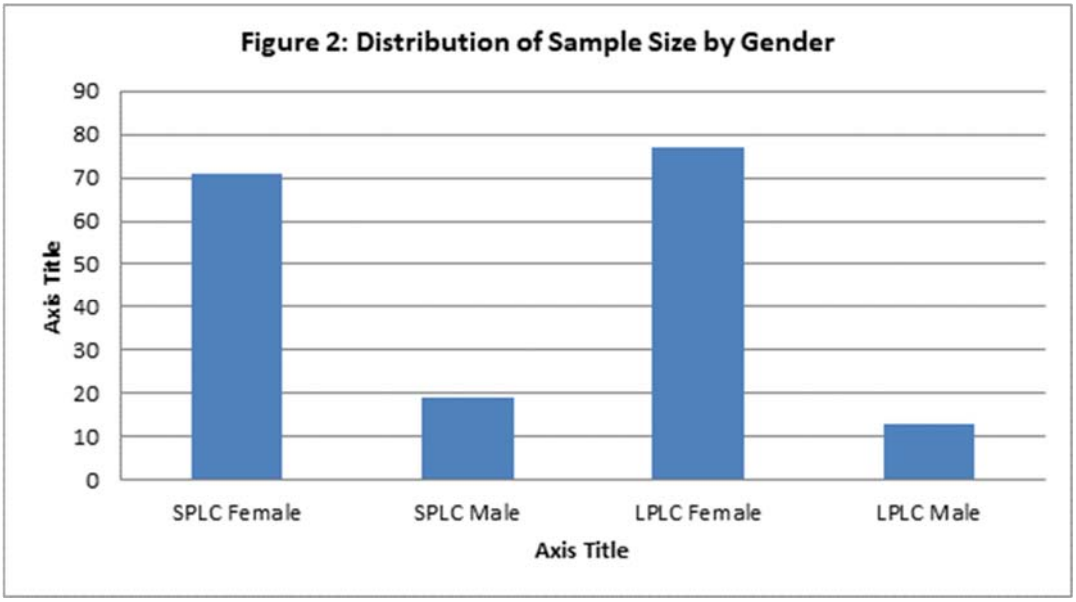

Figure 2: Distribution of sample size by gender

Of the overall 180 patients, 148 (82.22%) were women and 32 (17.78%) were men, which provided a female-to-male ratio of about 4.6:1. In SPLC group, 71 female participants (79%) and 19 male participants (21%) were seen, respectively, whereas in LPLC group 77 female participants (86%), and 13 male participants (14%) were seen. No significant differences were found between the groups in the gender distribution ($p>0.05$). **Figure 3** highlights the VAS scores in terms of postoperative pain over time.

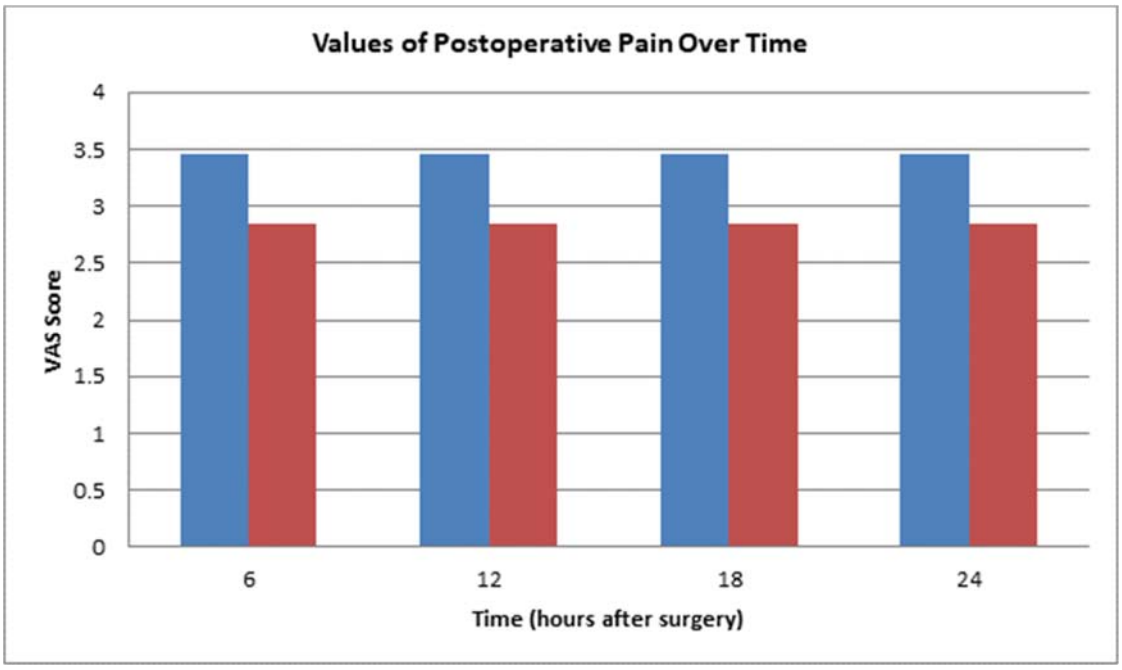

Figure 3: Values of postoperative pain over time

Table 1: Laparoscopic Cholecystectomy Results

Group	Mean Age	SD Age	Male (%)	Female (%)	Operative Time (min)	SD Operative Time	Postoperative Pain (VAS)	SD Postoperative Pain	Shoulder Tip Pain (%)
SPLC	38.71	8.84	21	79	35.40	8.94	3.46	0.74	25.56
LPLC	40.41	12.50	14	86	37.40	7.89	2.84	0.75	6.67

SD: Standard Deviation, VAS: Visual Analog Scale, LPLC: Low-pressure laparoscopic cholecystectomy, SPLC: Standard pressure laparoscopic cholecystectomy

The mean operative time was slightly less in the SPLC group (35.40 ± 8.94 minutes) than in the LPLC group (37.40 ± 7.89 minutes). However, the difference was statistically insignificant (p=0.1125), implying that both procedures took the same amount of time to be performed by trained surgeons. This evidence pointed out that SPLC did not require a certain extension in operating time, even when fewer incisions were involved. Intensity of pain was measured on a visual analogue scale (VAS) at 6, 12, 18, and 24 hours after surgery. The patients in the LPLC population frequently reported lower pain scores than those in the SPLC population at all intervals. The average general pain score was 2.84 ± 0.75 in the LPLC group as compared to 3.46 ± 0.74 in the SPLC group, and these scores were highly significant (p=0.0001). The findings indicated that LPLC was more beneficial when it came to postoperative relief as compared to SPLC. Table 1 demonstrates the summarized results of laparoscopic cholecystectomy.

A common postoperative complication observed in laparoscopic surgery was shoulder tip pain caused by the diaphragmatic irritation from residual pneumoperitoneum. This was found in 23

patients (25.56%) in the SPLC group as compared to only 6 patients (6.67%) in the LPLC group. The difference was statistically significant ($p<0.05$), indicating the lower incidence of shoulder tip pain in the LPLC group. The findings indicated that both groups had similar operative times, but LPLC showed advantages in the postoperative pain control and reduced frequency of shoulder tip pain.

DISCUSSION

Comprehensive research revealed that RA and SLE had the same pathogenic molecular basis, which guided their development. Across multiple evaluation systems, analysis of immune-related biomarkers showed a strong and statistically significant correlation with an increased risk of autoimmune disease. By offering mechanisms that clarify the molecular relationships between various autoimmune diseases, the study's findings supported previous findings regarding polyautoimmunity [20].

The molecular pattern of autoimmune diseases showed aberrant signaling events between the PI3K and MAPK pathways, which were crucial for the development of immune cells, the production of cytokines, and the maintenance of survival [21]. Their dysfunctional activations had been shown to maintain inflammation associated with autoimmune diseases while causing a breakdown in immune tolerance. Research on the transcriptional regulators GATA1 and PBX1 demonstrated that immune response patterns in RA and SLE patients were driven by developmental and lineage-specific gene regulators [22].

Current research shows that autoimmunity has become closely linked with markers from both megakaryocyte and platelet lineages [23]. Disease analysis showed that both RA and SLE caused the development and growth of cells that express GFI1B and TAL1, indicating that these disorders impacted more aspects of hematopoiesis compared to what normally occurred in lymphocyte-driven models [24].

The historical significance of type I IFN signalling in SLE is supported by the shared interferon gene signature between RA and SLE, which also provides evidence for the development of interferon-targeted therapies for autoimmune diseases in general [25,26].

New data underline the molecular heterogeneity of autoimmune diseases, where distinct subtypes are characterized by specific transcriptomic, proteomic, and signaling profiles. These subtypes of molecules are significant factors in the severity of the disease, responsiveness of the disease, and patterns of progression in RA and SLE, respectively, which explains why it is necessary to turn to precision-based diagnosis and treatment [27]. Furthermore, the role of immune tolerance failures,

inherited predispositions, and cytokine dysregulations, notably in IL-6, TNF-alpha, and type I interferons, has contributed to the elucidation of a common pathogenesis underlying autoimmune diseases [28].

Significant new understanding of the common molecular terrain between autoimmune diseases like RA and SLE, owing to breakthroughs in genetic mapping and system biology. Genome-wide studies have identified convergent genetic loci and pleiotropic variants linked with susceptibility to several autoimmune diseases, pointing to shared mechanisms [29]. Longitudinal birth cohort studies and genomic studies in those of similar age have found similar mechanisms of disease at work, both in terms of convergent genes [30].

Based on these, new research has found greater molecular overlap in autoimmune diseases and especially in RA and SLE [31]. The transcriptomic report has led to CD-A shared pathophysiology in terms of immune signaling dysregulation, particularly in T cell receptor pathways, JAK-STAT signaling, and cytokine-mediated reactions [32].

The role of miRNAs and epigenetic changes adds to the concept that common transcriptional plasticity is likely to contribute to the pathology of diseases [33]. Crosstalk between immune cells, especially Tregs, dendritic cells, and B cells, has also been suggested to perpetuate chronic inflammation in different types of diseases [34,35].

The mapping of converging molecular networks using Systems biology methods that combine multi-omics data has revealed co-expression of inflammatory mediators and a disease-associated cluster of genes [36]. These understandings justify cross-clinical-feature resemblances and cross-disease biomarkers and shared therapeutic objectives.

Immune-pathogenesis pathway concordance can also be found in tissue-specific gene expression profiles, including the synovium and kidney, which provides further support that unified pathogenic pathways exist [37].

Additionally, the disease progression in both conditions could be affected by the variation of autoantibody profiles and post-translational modifications of self-antigens [38]. Collectively, these results point to the necessity of establishing common driving forces of autoimmunity and support a paradigm shift in precision medicine to treat commonality across autoimmune processes rather than distinct clinical manifestations [39,40].

Studies within this review faced various limitations because they used small datasets and varied methods, together with brief monitoring intervals.

Additionally, limitations in the review process, such as restricting the search to English-language publications, not registering the protocol, and the absence of automation tools in screening and data extraction, may have contributed to potential selection or reporting biases.

Future studies should focus on immune profiling, as it would make it feasible to identify patients' vague autoimmune symptoms early on and make better treatment decisions in clinical settings. The evidence gathered suggested that mechanism-based taxonomy, which incorporates systems biology, should be used in future autoimmune disease classifications.

CONCLUSION

In conclusion, this study demonstrated that low-pressure laparoscopic cholecystectomy (LPLC) offered a significant advantage over standard pressure laparoscopic cholecystectomy (SPLC) by effectively reducing postoperative pain and the incidence of shoulder tip pain without compromising the operative time.

These findings suggested that LPLC should be considered as a viable alternative to SPLC, with the potential to improve patient outcomes and satisfaction in laparoscopic cholecystectomy procedures. Further research needs to confirm these results and should explore the additional benefits of low-pressure techniques in laparoscopic surgery.

LIST OF ABBREVIATIONS

LC Laparoscopic Cholecystectomy

SPLC Standard Pressure Laparoscopic Cholecystectomy

LPLC Low-Pressure Laparoscopic Cholecystectomy

ASA American Society of Anesthesiologists

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CONFLICT OF INTEREST

None

ETHICAL APPROVAL

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