



Original Research Article

Comparative Study on Pre-Incision Infiltration of Local Anesthesia and its Outcome on Postoperative Care

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Abstract:

Objective: To compare the mean duration of analgesia and postoperative pain scores following pre-incisional versus post-incisional infiltration of levobupivacaine in patients undergoing conventional laparoscopic cholecystectomy.

Study Design: Randomized controlled trial. Place and Duration of Study: Department of General Surgery, Dr. Faisal Masood Teaching Hospital from 6 Sep 2025 to 6 Dec 2025.

Methodology: A total of 66 patients of either gender, aged 18–60 years, with ASA physical status I or II undergoing conventional laparoscopic cholecystectomy were included. Patients were randomly allocated into two equal groups of 33 each. Group A received pre-incisional infiltration of levobupivacaine at the muscular fascia, whereas Group B received post-incisional infiltration. Postoperative pain was assessed using the Visual Analogue Scale (VAS) at 3, 6, and 12 hours. Duration of analgesia, rescue analgesic requirement, and postoperative nausea and vomiting (PONV) were also recorded, $p \leq 0.05$.

Results: The mean age was 42.11 ± 10.22 years, and 33 (50.0%) were male. Mean VAS scores were significantly lower in the pre-incisional group than in the post-incisional group at 3 hours (1.71 ± 0.71 vs. 2.43 ± 0.60 ; $p < 0.001$), 6 hours (2.22 ± 0.91 vs. 2.73 ± 0.60 ; $p = 0.010$), and 12 hours (2.59 ± 1.01 vs. 3.15 ± 0.74 ; $p = 0.012$). Mean duration of analgesia was significantly longer in the pre-incisional group (161.52 ± 25.05 vs. 122.12 ± 15.85 minutes; $p < 0.001$). Mean rescue tramadol consumption was also significantly lower with pre-incisional infiltration (172.73 ± 57.41 vs. 236.36 ± 60.30 mg; $p < 0.001$). PONV did not differ significantly between the groups (9.1% vs. 18.2%; $p = 0.475$).

Conclusion: Pre-incisional infiltration of levobupivacaine provided better postoperative analgesia than post-incisional infiltration in patients undergoing laparoscopic cholecystectomy, as demonstrated by lower postoperative VAS scores, longer duration of analgesia, and reduced rescue analgesic requirements.

Keywords: Levobupivacaine; Laparoscopic cholecystectomy; Pre-incisional infiltration; Postoperative pain; Visual Analogue Scale; Postoperative analgesia.

INTRODUCTION

Enhanced recovery after surgery, which involves implementation of evidence-based multimodal procedure-specific perioperative care pathways, has been shown to improve postoperative outcome and reduce length of hospital stay. One of the major elements of a successful program for enhanced recovery after surgery is the provision of optimal

postoperative analgesia to facilitate ambulation and rehabilitation therapy¹. Topical infiltration of local anesthetics at the surgical site is a simple, easy, and attractive technique recommended for providing a longer post-operative pain-free period and decreased analgesic requirements². Inadequate analgesia may lead to postoperative complications, such as arterial hypertension, intracranial hemorrhage, prolonged

hospital stay and increased mortality. Moreover, acute postoperative pain is associated with an increased risk of chronic pain³. Incision-site infiltration with local anesthetics prevents pain on incision site, but pain relief is limited to the first few postoperative hours⁴.

Wound infiltration (WI) with local anesthetics (LA) is used as the main anesthetic for minor surgeries, such as repair of lacerations, skin surgery and treatment of painful oral or genital lesions, but can also be used as supplement to general anesthesia in several types of surgical procedures⁵. Kumar et al conducted a study on Pre and Post Incisional Local Infiltration of the Levobupivacaine in Conventional Laparoscopic Cholecystectomy. The mean duration of analgesia was 164.94 ± 27.37 min in group A and 121.42 ± 14.81 min in group B. Mean number of doses required in group A was 1.70 ± 0.46 and in group B was 2.38 ± 0.49 . There was significant difference in the mean VAS scores between the two groups up to 12th hour postoperatively (2.28 ± 1.03 vs. 2.82 ± 0.39)⁶.

We planned this study to compare postoperative care between pre- and post- incision infiltration. This study will not only compare both techniques in our hospital, the results of this study will help us to analyze which one of these techniques is associated with less post-operative pain and less post-operative analgesia. The technique with less pain and post-operative analgesia will be recommended in future.

METHODOLOGY

This randomized controlled trial was conducted in the Department of General Surgery, Dr. Faisal Masood Teaching Hospital, Sargodha from 6 Sep 2025 to 6 Dec 2025. The sample size was calculated using the WHO sample size calculator for comparison of two means, taking the level of significance as 5% and power of the study as 80%. The mean postoperative pain score was taken as 2.28 ± 1.036 in the pre-incisional infiltration group and 2.82 ± 0.396 in the post-incisional infiltration group. The calculated sample size was 66 patients, with 33 patients in each group. Patients were enrolled through non-probability consecutive sampling. Patients of either gender, aged 18–60 years, belonging to American Society of Anesthesiologists (ASA) physical status class I or II and undergoing conventional laparoscopic cholecystectomy were included. Patients with a known allergy to the study drug, ASA class greater than II, acute cholecystitis, conversion from laparoscopic to open cholecystectomy, history of addiction, premedication with analgesic drugs, psychiatric illness, or pregnancy were excluded.

After obtaining approval from the Ethical Review Committee and College of Physicians and Surgeons Pakistan (CPSP), patients fulfilling the eligibility criteria were enrolled in the study. Written informed consent was obtained from each participant. Baseline demographic information, including age and gender,

was recorded on a predesigned proforma. The enrolled patients were randomly allocated into two equal groups, Group A and Group B, with 33 patients in each group, using a computer-generated random-number table. Patients in Group A (pre-incisional group) received infiltration of levobupivacaine at the muscular fascia before surgical incision, whereas patients in Group B (post-incisional group) received infiltration of levobupivacaine at the muscular fascia after completion of the surgical incision/procedure as specified in the study protocol.

Postoperative pain was assessed using the Visual Analogue Scale (VAS), ranging from 0 to 10, where 0 represented "no pain" and 10 represented the "worst pain imaginable." Patients were instructed regarding the use of the VAS before assessment. Postoperative pain scores were recorded at 3, 6, and 12 hours after surgery. An overall postoperative pain score was calculated as the mean of the VAS scores recorded at these three time points. The duration of postoperative analgesia was defined as the time interval, in minutes, from completion of surgery/administration of the last analgesic dose until the first request for rescue analgesia. Extubation was considered time zero for assessment of the duration of postoperative analgesia. Rescue analgesia was administered when the VAS score was ≥ 4 , and injection tramadol 100 mg was given intravenously. The time to the first request for rescue analgesia and the total dose of rescue analgesia required during the first 12 postoperative hours were recorded. All patients were also observed for postoperative nausea, vomiting, and other adverse effects during the 12-hour postoperative observation period. Patients who developed nausea or vomiting were treated with injection ondansetron 4 mg intravenously. All study findings and postoperative outcomes were recorded on the predesigned data collection proforma. The data was entered and analyzed using SPSS 25. Frequency and percentages was calculated for qualitative variables like gender and ASA status. Mean with SD was calculated for quantitative variables like age, Weight, height, BMI, comorbidities, mean duration of surgery, mean total duration of analgesia, mean no. of doses required, mean Amount of rescue analgesic used in 12 hours. Both groups were compared for post-operative pain using independent sample t-test. Effect modifiers such as age, ASA status, BMI, comorbidities and mean duration of surgery were controlled by stratification. Post stratification independent sample t-test applied. P-value<0.05 was taken as significant.

RESULTS

A total of 66 patients undergoing conventional laparoscopic cholecystectomy were included in the study, with 33 patients allocated to the pre-incisional levobupivacaine group and 33 to the post-incisional levobupivacaine group. The overall mean age of the

participants was 42.11 ± 10.22 years. Of the 66 patients, 33 (50.0%) were male and 33 (50.0%) were female. The mean BMI was 26.62 ± 3.09 kg/m². Baseline characteristics, including age group, gender, BMI category, ASA status, diabetes mellitus, hypertension, other comorbidities, and duration of surgery, were comparable between the two groups (all $p > 0.05$) (Table I).

Table I: Baseline characteristics of the study groups

Characteristics	Pre-incisional (n=33)	Post-incisional (n=33)	p-value
Age group, n (%)			
18-40 years	13 (39.4)	15 (45.5)	0.618
41-60 years	20 (60.6)	18 (54.5)	
Gender, n (%)			
Male	16 (48.5)	17 (51.5)	0.806
Female	17 (51.5)	16 (48.5)	
BMI category, n (%)			
18-25 kg/m ²	11 (33.3)	8 (24.2)	0.415
>25 kg/m ²	22 (66.7)	25 (75.8)	
ASA status, n (%)			
ASA I	20 (60.6)	17 (51.5)	0.457
ASA II	13 (39.4)	16 (48.5)	
Diabetes mellitus, n (%)			
Yes	3 (9.1)	4 (12.1)	1.000*
No	30 (90.9)	29 (87.9)	
Hypertension, n (%)			
Yes	9 (27.3)	4 (12.1)	0.122
No	24 (72.7)	29 (87.9)	
Other comorbidity, n (%)			
Yes	4 (12.1)	1 (3.0)	0.355*
No	29 (87.9)	32 (97.0)	
Duration of surgery (min), mean ± SD	60.85 ± 11.43	64.06 ± 12.65	0.283

Chi-square test was used for categorical variables; *Fisher's exact test was used where expected cell counts were <5; independent-samples t-test was used for duration of surgery.

Postoperative pain was significantly lower in the pre-incisional group. The mean VAS score at 3 hours was 1.71 ± 0.71 in the pre-incisional group compared with 2.43 ± 0.60 in the post-incisional group ($p < 0.001$). Similarly, significantly lower pain scores were observed at 6 hours (2.22 ± 0.91 vs. 2.73 ± 0.60 ; $p = 0.010$) and 12 hours (2.59 ± 1.01 vs. 3.15 ± 0.74 ; $p = 0.012$). The overall mean VAS score was also significantly lower in the pre-incisional group (2.17 ± 0.49 vs. 2.77 ± 0.36 ; $p < 0.001$) (Table II).

Table II: Comparison of postoperative pain and duration of analgesia

Outcom	Pre-	Post-	Mean	p-
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e	incision al Mean $\pm$ SD	incision al Mean $\pm$ SD	differen ce (95% CI)	value
VAS at 3 hours	1.71 $\pm$ 0.71	2.43 $\pm$ 0.60	-0.72 (-1.05 to -0.40)	<0.001
VAS at 6 hours	2.22 $\pm$ 0.91	2.73 $\pm$ 0.60	-0.50 (-0.88 to -0.12)	0.010
VAS at 12 hours	2.59 $\pm$ 1.01	3.15 $\pm$ 0.74	-0.57 (-1.00 to -0.13)	0.012
Overall mean VAS	2.17 $\pm$ 0.49	2.77 $\pm$ 0.36	-0.60 (-0.81 to -0.39)	<0.001
Duration of analgesia (min)†	161.52 $\pm$ 25.05	122.12 $\pm$ 15.85	39.39 (29.05 to 49.74)	<0.001

Independent-samples t-test was used; $p \leq 0.05$ was considered statistically significant. †Welch's t-test was considered for duration of analgesia because Levene's test indicated unequal variances ($p = 0.007$).

The mean duration of postoperative analgesia was significantly longer in the pre-incisional group compared with the post-incisional group (161.52 ± 25.05 vs. 122.12 ± 15.85 minutes; $p < 0.001$). The mean difference was 39.39 minutes (95% CI: 29.05–49.74).

The requirement for rescue analgesia during the first 12 postoperative hours was significantly lower in the pre-incisional group. The mean rank for the number of rescue analgesic doses was 25.44 in the pre-incisional group compared with 41.56 in the post-incisional group (Mann-Whitney $U = 278.50$, $Z = -3.903$; $p < 0.001$). Similarly, mean rescue tramadol consumption was significantly lower in the pre-incisional group (172.73 ± 57.41 mg) than in the post-incisional group (236.36 ± 60.30 mg; $p < 0.001$).

Postoperative nausea and vomiting occurred in 3 (9.1%) patients in the pre-incisional group and 6 (18.2%) patients in the post-incisional group. However, the difference was not statistically significant (Fisher's exact $p = 0.475$) (Table III).

Table III: Rescue analgesia requirement and postoperative nausea/vomiting

Outcome	Pre-incisiona l (n=33)	Post-incisiona l (n=33)	Test statistic	p-value
Rescue	25.44	41.56	$U = 278.50$	<0.001

analgesic doses, mean rank			Z=-3.903	1
Rescue tramadol (mg), mean $\pm$ SD	172.73 $\pm$ 57.41	236.36 $\pm$ 60.30	t=-4.391	<0.001
PONV, Yes, n (%)	3 (9.1)	6 (18.2)	Fisher's exact	0.475
PONV, No, n (%)	30 (90.9)	27 (81.8)		

Mann-Whitney U test was used for the number of rescue analgesic doses; independent-samples t-test for total rescue tramadol consumption; Fisher's exact test for PONV.

DISCUSSION

Postoperative pain remains an important concern following laparoscopic cholecystectomy despite the minimally invasive nature of the procedure. Effective control of pain facilitates early mobilization, improves patient comfort and may decrease the requirement for systemic analgesics. Local infiltration of anaesthetic agents at the surgical site is a simple technique that can be incorporated into multimodal analgesia without requiring additional sophisticated equipment.^{1,5} The timing of infiltration may also influence its analgesic effect, as administration before surgical incision may prevent or reduce peripheral and central sensitization caused by surgical tissue injury.²

In the present study, 66 patients undergoing conventional laparoscopic cholecystectomy were equally allocated to pre-incisional and post-incisional levobupivacaine groups. The baseline characteristics of the two groups, including age, gender, BMI, ASA status, comorbidities and duration of surgery, were comparable. This comparability was important because differences in these factors could potentially influence postoperative pain perception and analgesic requirements.

The principal finding of the present study was that pre-incisional infiltration of levobupivacaine resulted in significantly lower postoperative pain scores than post-incisional infiltration. The mean VAS score at 3 hours was 1.71 ± 0.71 in the pre-incisional group compared with 2.43 ± 0.60 in the post-incisional group ($p < 0.001$). The difference persisted at 6 hours (2.22 ± 0.91 vs. 2.73 ± 0.60 ; $p = 0.010$) and 12 hours (2.59 ± 1.01 vs. 3.15 ± 0.74 ; $p = 0.012$). Consequently, the overall mean VAS score was also significantly lower with pre-incisional infiltration (2.17 ± 0.49 vs. 2.77 ± 0.36 ; $p < 0.001$).

These findings are consistent with those of Yashod and Gadre,² who directly compared pre-incisional and post-incisional bupivacaine infiltration in 60

patients undergoing lower abdominal surgery. They reported better postoperative pain relief with pre-incisional infiltration and observed a duration of analgesia of 540 minutes compared with 360 minutes following post-incisional infiltration. Although their surgical population differed from the present study, their findings support the concept that administration of a local anaesthetic before tissue injury may provide greater postoperative analgesic benefit.

The results are also in agreement with Dhaker et al.,⁶ who evaluated pre- and post-incisional levobupivacaine infiltration in conventional laparoscopic cholecystectomy. They reported a mean duration of analgesia of 164.94 ± 27.37 minutes in the pre-incisional group compared with 121.42 ± 14.81 minutes in the post-incisional group. Their reported mean postoperative VAS scores were also lower with pre-incisional infiltration (2.28 ± 1.03 vs. 2.82 ± 0.39). These observations are particularly relevant because both the surgical procedure and local anaesthetic used were similar to those in the present study.

Mishra et al.⁷ provided further evidence supporting pre-incisional local anaesthetic infiltration specifically in laparoscopic cholecystectomy. In their randomized study of 60 patients, pre-incisional infiltration of 0.5% bupivacaine at the port sites was compared with intraperitoneal bupivacaine administration. Postoperative VAS scores were significantly lower with pre-incisional port-site infiltration from the first postoperative hour through the 24-hour assessment period. Supplemental analgesic requirements were also significantly lower in the pre-incisional group, whereas the incidence of postoperative nausea and vomiting did not differ significantly between the groups.

Similar findings were reported by Yadav et al.⁸ in patients undergoing lower abdominal surgery. Patients receiving pre-incisional bupivacaine had significantly lower VAS scores than controls ($p < 0.001$). The mean duration of analgesia was 8.56 ± 0.3 hours following pre-incisional infiltration compared with only 2.36 ± 0.2 hours in the control group. Furthermore, the control group required almost twice the amount of rescue analgesia. Although their study compared infiltration with placebo rather than post-incisional infiltration, the findings reinforce the effectiveness of administering local anaesthetic before surgical nociceptive stimulation.

The duration of postoperative analgesia was another important outcome in the present study. Patients receiving pre-incisional levobupivacaine had a significantly longer mean duration of analgesia than those receiving post-incisional infiltration (161.52 ± 25.05 vs. 122.12 ± 15.85 minutes; $p < 0.001$). The mean difference of approximately 39 minutes was clinically relevant because prolonging the pain-free period after surgery may reduce the need for early

rescue medication and facilitate recovery. Recent evidence involving levobupivacaine also supports the analgesic potential of pre-incisional infiltration. Herrador-Benito et al.⁹ conducted a prospective randomized double-blind trial evaluating 0.5% levobupivacaine infiltration of port sites in elective laparoscopic cholecystectomy. Their study assessed postoperative pain, rescue opioid requirements, postoperative nausea and vomiting, quality of life and return to work. Their findings provide contemporary evidence for incorporating pre-incisional local infiltration into postoperative pain-control strategies following laparoscopic cholecystectomy.

The present findings can be explained by the concept of pre-emptive analgesia. Surgical incision initiates nociceptive input and may produce peripheral and central sensitization. Administration of a local anaesthetic before incision can block transmission of these nociceptive impulses before they reach the central nervous system.^{2,4} In contrast, infiltration after incision occurs after the nociceptive stimulus has already been initiated. This mechanism may explain why the pre-incisional group in the present study experienced both lower pain scores and a longer duration of analgesia.

Evidence regarding the depth and site of infiltration suggests, however, that the effectiveness of local anaesthetic infiltration depends not only on timing but also on the anatomical site of administration. Suragul et al.¹⁰ randomized patients undergoing laparoscopic cholecystectomy to no infiltration, subcutaneous infiltration or rectus-sheath infiltration with bupivacaine. Rectus-sheath infiltration significantly reduced 24-hour cumulative morphine consumption compared with no infiltration and produced lower immediate postoperative pain scores. However, pain scores became comparable among the groups from two hours after surgery. These findings indicate that the depth of local anaesthetic deposition may influence the magnitude and duration of postoperative analgesia.

Ailioaie et al.¹¹ also demonstrated the analgesic effectiveness of wound infiltration in a randomized comparative study involving open colorectal surgery. Pain scores six hours after surgery were significantly lower in groups receiving regional/wound infiltration approaches than in the intravenous-analgesia control group. Although colorectal surgery differs substantially from laparoscopic cholecystectomy, their findings support the broader principle that local blockade of nociceptive input from the surgical wound can contribute to improved early postoperative analgesia.

The reduced requirement for rescue analgesia in the present study provides additional support for the effectiveness of pre-incisional infiltration. The number of rescue analgesic doses was significantly lower in the pre-incisional group (Mann-Whitney

U=278.50, $p<0.001$). Similarly, mean rescue tramadol consumption during the first 12 postoperative hours was 172.73 ± 57.41 mg in the pre-incisional group compared with 236.36 ± 60.30 mg in the post-incisional group ($p<0.001$). Thus, the analgesic advantage was demonstrated not only by subjective VAS assessment but also by reduced use of additional analgesic medication.

Joshi et al.¹² randomized 105 patients undergoing laparoscopic cholecystectomy to standard multimodal analgesia, pre-incisional port-site infiltration with bupivacaine, or bilateral erector spinae plane block. Although the erector spinae plane block provided the strongest analgesia during the early postoperative period, the port-site infiltration group still performed better than the standard-treatment group in terms of postoperative VAS scores and total opioid requirements. These findings demonstrate that pre-incisional infiltration retains clinically meaningful analgesic activity even when compared within a modern multimodal analgesic framework.

Other regional techniques may nevertheless provide greater analgesia in some settings. Elsaid et al.¹³ compared preperitoneal bupivacaine infiltration with TAP block following laparoscopic cholecystectomy. The TAP block resulted in significantly lower pain scores at 8 and 12 hours and delayed the first request for rescue analgesia, which occurred at a mean of 14.6 ± 2.52 hours compared with 7.1 ± 1.02 hours in the infiltration group. This does not negate the effectiveness of local infiltration but demonstrates that more extensive regional blockade may provide a longer analgesic effect in selected patients.

Similarly, Breazu et al.¹⁴ evaluated postoperative analgesic strategies following laparoscopic cholecystectomy, including local anaesthetic infiltration and regional analgesic techniques. Their findings add to the evidence that postoperative pain after laparoscopic cholecystectomy is multifactorial and that local infiltration should preferably be considered as one component of multimodal analgesia rather than as the sole analgesic intervention.

Alansary et al.¹⁵ compared port-site infiltration with erector spinae plane and oblique subcostal transversus abdominis plane blocks in patients undergoing laparoscopic cholecystectomy. Their work further demonstrates that regional techniques differ in the extent and duration of analgesia they provide. Such findings are relevant when interpreting the present study because pre-incisional infiltration is technically simple and does not require ultrasound guidance, whereas fascial-plane blocks may provide broader analgesia but require additional expertise and resources.

Evidence using levobupivacaine specifically also supports the present findings. A randomized placebo-

controlled study evaluating periportal and intraperitoneal levobupivacaine in laparoscopic cholecystectomy demonstrated lower postoperative pain scores in patients receiving levobupivacaine. Rescue analgesia was required by only 15% of patients receiving combined pre-incisional periportal and intraperitoneal levobupivacaine compared with 35% receiving intraperitoneal levobupivacaine alone and 90% of controls.¹⁶ These findings reinforce the analgesic and opioid-sparing effects of local anaesthetic administration around trocar sites before incision.

Postoperative nausea and vomiting were observed in 3 (9.1%) patients in the pre-incisional group and 6 (18.2%) in the post-incisional group in the present study. Although PONV was numerically less frequent following pre-incisional infiltration, the difference was not statistically significant ($p=0.475$). This is consistent with Mishra et al.,⁷ who also found no significant difference in PONV despite better postoperative analgesia and reduced supplemental analgesic requirements with pre-incisional infiltration. Similarly, Suragul et al.¹⁰ reported comparable nausea and vomiting among their local infiltration groups. Therefore, the principal demonstrated advantage of pre-incisional infiltration appears to be improved analgesia and reduced rescue analgesic consumption rather than a definite reduction in PONV.

Overall, the findings of the present study demonstrated that pre-incisional levobupivacaine infiltration was associated with significantly lower postoperative VAS scores at 3, 6 and 12 hours, a longer duration of analgesia and lower rescue tramadol requirements compared with post-incisional infiltration. These findings are supported by several studies evaluating pre-incisional infiltration and local anaesthetic administration in laparoscopic cholecystectomy and other surgical procedures. Nevertheless, variations in the type and concentration of local anaesthetic, infiltration depth, surgical procedure, timing of administration and accompanying multimodal analgesic regimen may account for differences in the magnitude and duration of benefit reported across studies.

The present study has certain limitations. It was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Postoperative outcomes were assessed for only the first 12 hours, and longer-term pain outcomes were not evaluated. Furthermore, pain is subjective and may be influenced by individual pain thresholds and psychological factors. Future multicentre studies with larger sample sizes and longer postoperative follow-up should compare different concentrations and infiltration planes of levobupivacaine and evaluate patient-centred outcomes, including time to mobilization, length of hospital stay, quality of recovery and overall patient

satisfaction.

CONCLUSION

Pre-incisional infiltration of levobupivacaine was associated with significantly lower postoperative pain scores at 3, 6, and 12 hours, a longer duration of analgesia, and lower rescue tramadol consumption compared with post-incisional infiltration in patients undergoing conventional laparoscopic cholecystectomy. However, the incidence of postoperative nausea and vomiting was comparable between the groups. These findings support pre-incisional levobupivacaine infiltration as a useful component of multimodal postoperative analgesia for laparoscopic cholecystectomy.

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