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COMPARATIVE STUDY OF SUBHEPATIC VERSUS DIFFUSE INTRAPERITONEAL INFILTRATION OF LOCAL ANAESTHESIA FOR POSTOPERATIVE PAIN CONTROL IN LAPAROSCOPIC CHOLECYSTECTOMY: A RANDOMISED CONTROLLED TRIAL

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ABSTRACT

Background: Postoperative pain following laparoscopic cholecystectomy (LC) remains a significant determinant of patient morbidity, analgesic consumption, and hospital stay. Intraperitoneal local anaesthetic (IPLA) instillation is widely employed, yet the optimal anatomical distribution — subhepatic (SH) versus diffuse intraperitoneal (DIP) infiltration — has not been definitively established in a sufficiently powered randomised trial.

Aim: To compare the analgesic efficacy, postoperative opioid consumption, shoulder pain incidence, time to mobilisation, and duration of hospital stay between subhepatic and diffuse intraperitoneal bupivacaine infiltration in patients undergoing elective laparoscopic cholecystectomy.

Methods: This prospective, double-blind, randomised controlled trial enrolled 100 ASA Class I–II adult patients undergoing elective LC under general anaesthesia, equally allocated to Group SH (n=50, subhepatic instillation of 30 mL 0.25% bupivacaine) and Group DIP (n=50, diffuse intraperitoneal instillation). VAS pain scores were recorded at 1, 4, 8, 12, and 24 hours postoperatively. The chi-square test, Mann-Whitney U test, and independent t-test were used for statistical analysis ($p<0.05$).

Results: Severe pain (VAS ≥7) at 1 hour was significantly more frequent in Group SH at rest (46.9% vs. 18.0%; $p=0.001$) and on movement (65.3% vs. 30.0%; $p<0.001$). Shoulder pain at 1 hour was present in 34 (68.0%) Group SH patients versus 22 (44.0%) Group DIP patients ($p=0.012$). Rescue analgesia was required more frequently in Group SH (76.0% vs. 48.0%; $p=0.003$). Delayed ambulation (>8 hours) was significantly more common in Group SH (44.9% vs. 18.0%; $p=0.003$). Adverse events were comparable between groups.

Conclusion: Diffuse intraperitoneal bupivacaine instillation provides superior early postoperative analgesia with significantly lower rates of severe pain, shoulder pain, rescue analgesia requirement, and delayed mobilisation compared to subhepatic instillation alone. Diffuse IPLA should be the preferred technique in laparoscopic cholecystectomy.

KEYWORDS: Laparoscopic cholecystectomy; Intraperitoneal local anaesthesia; Bupivacaine; Subhepatic infiltration; Diffuse intraperitoneal infiltration; Postoperative pain; Shoulder pain; Opioid-sparing

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the gold standard surgical management for symptomatic cholelithiasis and is one of the most frequently performed elective general surgical operations worldwide, with over 750,000 procedures performed annually in the United States alone.1

Despite the well-recognised advantages of the minimally invasive approach — reduced operative morbidity, shorter hospital stay, and improved cosmesis compared to open cholecystectomy — postoperative pain remains a clinically significant and incompletely resolved challenge.2

The aetiology of pain following LC is multifactorial. Visceral pain arises from peritoneal stretch, diaphragmatic irritation due to residual carbon dioxide (CO_2) pneumoperitoneum, and inflammation at the gallbladder fossa. Somatic pain is principally attributable to trocar site incisions. The characteristic referred shoulder pain, occurring in up to 35–63% of patients, results from phrenic nerve irritation secondary to subdiaphragmatic CO_2 accumulation and is a particularly troublesome component of post-LC pain that often persists beyond the resolution of abdominal symptoms.3,4

Inadequately controlled postoperative pain following LC is associated with delayed mobilisation, prolonged hospital stay, increased analgesic consumption including opioid use with attendant side effects, and impaired patient satisfaction.5

A multimodal analgesic strategy incorporating non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol, trocar site infiltration, and IPLA instillation is widely advocated. Bupivacaine, a long-acting amide local anaesthetic, is the most commonly employed agent for intraperitoneal instillation following LC.6,7 The Cochrane systematic review by Rutherford et al. (2021), encompassing 70 randomised trials and 5,481 participants, confirmed that IPLA instillation reduces early postoperative pain scores after LC, albeit with very low-certainty evidence for several outcome domains.8 However, a critical and unresolved question persists: does the anatomical site of IPLA delivery determine its analgesic efficacy? Conventional subhepatic instillation targets the gallbladder fossa and hepatoduodenal ligament — the principal zones of surgical dissection — but may fail to adequately anaesthetise the diaphragmatic peritoneum, the primary source of shoulder pain. Diffuse intraperitoneal infiltration, encompassing the right hemidiaphragm, subhepatic space, and hepatic flexure, may provide broader peritoneal anaesthesia and superior shoulder pain control by blocking phrenic afferents more completely.9,10

Previous investigations comparing instillation techniques have yielded conflicting results, frequently limited by small sample sizes, heterogeneous anaesthetic concentrations, or inadequate blinding. The present study was designed to rigorously compare subhepatic versus diffuse intraperitoneal bupivacaine instillation in a prospective, double-blind, randomised controlled trial of 100 patients.11,12

MATERIALS AND METHODS

Study Design and Ethics

This prospective, double-blind, randomised controlled trial was conducted at the Department of General Surgery in collaboration with the Department of Anaesthesiology, Private Medical College from January 2025 to December 2025. Institutional Ethics Committee approval was obtained prior to study commencement. Written informed consent was obtained from all participants.

Participants

Adult patients aged 18–65 years, of ASA Physical Status Class I or II, scheduled for elective laparoscopic cholecystectomy under general anaesthesia for symptomatic cholelithiasis were eligible for enrolment. Exclusion criteria were: emergency LC or conversion to open surgery; known hypersensitivity to amide local anaesthetics; chronic opioid or analgesic therapy; hepatic or renal impairment; pregnancy or lactation; BMI >40 kg/m²; prior upper abdominal surgery; pre-existing chronic abdominal pain syndromes; and inability to provide informed consent.

Randomisation and Blinding

A computer-generated randomisation sequence was prepared by an independent statistician using block randomisation (block size 10) in a 1:1 allocation ratio. Sealed opaque envelopes were used to conceal allocation. Patients, anaesthetic staff, postoperative ward nurses, and the pain assessor were blinded to group allocation throughout the study period. The bupivacaine solution was prepared by pharmacy in identically labelled syringes to maintain double blinding.

Anaesthetic and Surgical Protocol

All patients underwent general anaesthesia with a standardised induction protocol: intravenous propofol (2 mg/kg), fentanyl (2 mcg/kg), and atracurium (0.5 mg/kg). Maintenance was achieved with isoflurane (0.8–1.2 MAC) in oxygen-air mixture (FiO_2 0.4). Pneumoperitoneum was established with CO_2 at 12–14 mmHg using a Veress needle. LC was performed using standard four-port technique. Trocar sites in all patients received 5 mL of 0.25% bupivacaine infiltration at skin closure.

Intervention

Following gallbladder extraction and prior to trocar removal, patients received 30 mL of 0.25% plain bupivacaine (total dose 75 mg) via an 18G laparoscopic irrigation catheter as follows:

Group SH (Subhepatic, n=50): The entire 30 mL volume was instilled exclusively into the subhepatic space, over the gallbladder fossa, and along the hepatoduodenal ligament under direct laparoscopic vision, with the patient in the reverse Trendelenburg position.

Group DIP (Diffuse Intraperitoneal, n=50): The 30 mL was distributed as follows: 10 mL over the right hemidiaphragm (Trendelenburg position), 10 mL into the subhepatic space and gallbladder fossa, and 10 mL into the right paracolic gutter and hepatic flexure peritoneum.

Pneumoperitoneum was deflated through active suction. Standard postoperative analgesic regimen consisted of intravenous paracetamol 1 g three times daily, intramuscular diclofenac 75 mg twice daily, and morphine sulphate 2 mg IV on patient request for VAS >4 as rescue analgesia.

Outcome Measures

The primary outcome was VAS pain score (0–10 cm) at rest and on movement at 1, 4, 8, 12, and 24 hours postoperatively. VAS scores were categorised as: Nil (0), Mild (1–3), Moderate (4–6), and Severe (7–10). Secondary outcomes included: shoulder pain incidence and severity; rescue analgesia requirement; total morphine consumption; time to first ambulation; length of hospital stay; and adverse events.

Statistical Analysis

Data were analysed using IBM SPSS version 26.0. Categorical variables were expressed as frequencies and percentages and compared using Pearson's chi-square test or Fisher's exact test. Continuous variables were expressed as mean ± SD; the independent samples t-test was used for normally distributed data and the Mann-Whitney U test for non-parametric data. Statistical significance was defined as $p<0.05$ (two-tailed).

RESULTS

One hundred patients were enrolled and randomised (Group SH: n=50; Group DIP: n=50). All 100 patients completed the study. No conversions to open cholecystectomy occurred. One patient in Group SH was excluded from pain score analysis due to intraoperative fentanyl supplementation exceeding protocol; outcomes are reported for 99 evaluable patients (SH n=49; DIP n=50) for pain data and all 100 for other variables.

Table 1: Demographic and Baseline Characteristics of the Study Population (n = 100)

Variable	SH (n=50)	%	DIP (n=50)	%	p-value
Age Group (years)					
18–29 years	8	16.0	9	18.0	0.963
30–39 years	14	28.0	15	30.0	
40–49 years	16	32.0	15	30.0	
≥50 years	12	24.0	11	22.0	
Sex					
Female	32	64.0	33	66.0	0.831
Male	18	36.0	17	34.0	
BMI Category (kg/m²)					
Normal (18.5–24.9)	19	38.0	18	36.0	0.976
Overweight (25.0–29.9)	20	40.0	21	42.0	
Obese (≥30.0)	11	22.0	11	22.0	
ASA Physical Status					
Class I	31	62.0	30	60.0	0.832
Class II	19	38.0	20	40.0	
Co-morbidities					
Diabetes mellitus	9	18.0	8	16.0	0.783
Hypertension	7	14.0	8	16.0	
None	35	70.0	36	72.0	
Symptom Duration					
< 6 months	18	36.0	19	38.0	0.979
6–12 months	21	42.0	20	40.0	
> 12 months	11	22.0	11	22.0	
Operative Duration					
≤ 45 minutes	24	48.0	26	52.0	0.893
46–60 minutes	18	36.0	17	34.0	
> 60 minutes	8	16.0	7	14.0	
Intraoperative Fentanyl Dose					
≤ 100 mcg	9	18.0	10	20.0	0.964
101–150 mcg	29	58.0	28	56.0	
> 150 mcg	12	24.0	12	24.0	

SH = Subhepatic; DIP = Diffuse Intraperitoneal; BMI = Body Mass Index; ASA = American Society of Anesthesiologists.

A total of 100 patients were enrolled and equally distributed between Group SH (n=50) and Group DIP (n=50). The two groups were well matched for all baseline demographic and operative characteristics (Table 1). The most common age group was 40–49 years (32.0% in SH, 30.0% in DIP), and female sex predominated in both cohorts (64.0% and 66.0% respectively), consistent with the known female predilection for symptomatic cholelithiasis. The majority of patients were either overweight or obese. ASA Class I predominated in both groups (62.0% and 60.0%). Diabetes mellitus was the most frequent co-morbidity (18.0% and 16.0%). Operative duration and intraoperative fentanyl dosing were comparable. No statistically significant difference was identified in any baseline variable between groups.

Table 2: Distribution of VAS Pain Score Categories at Rest and on Movement at Each Time Point (n = 99)

Time Point	VAS Category	VAS at Rest SH n (%)	VAS at Rest DIP n (%)	VAS on Movement SH n (%)	VAS on Movement DIP n (%)	p-value
1 Hour Postoperatively	No pain	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	<0.001*
	Mild	11 (22.4)	23 (46.0)	4 (8.2)	14 (28.0)	
	Moderate	15 (30.6)	18 (36.0)	13 (26.5)	21 (42.0)	
	Severe	23 (46.9)	9 (18.0)	32 (65.3)	15 (30.0)	

4 Hours Postoperatively	No pain	0 (0.0)	1 (2.0)	0 (0.0)	0 (0.0)	0.003*
	Mild	16 (32.7)	27 (54.0)	7 (14.3)	20 (40.0)	
	Moderate	20 (40.8)	18 (36.0)	24 (49.0)	24 (48.0)	
	Severe	13 (26.5)	4 (8.0)	18 (36.7)	6 (12.0)	
8 Hours Postoperatively	No pain	2 (4.1)	3 (6.0)	0 (0.0)	1 (2.0)	0.026*
	Mild	20 (40.8)	28 (56.0)	13 (26.5)	24 (48.0)	
	Moderate	21 (42.9)	17 (34.0)	26 (53.1)	21 (42.0)	
	Severe	6 (12.2)	2 (4.0)	10 (20.4)	4 (8.0)	
12 Hours Postoperatively	No pain	5 (10.2)	6 (12.0)	2 (4.1)	3 (6.0)	0.116
	Mild	29 (59.2)	34 (68.0)	22 (44.9)	30 (60.0)	
	Moderate	13 (26.5)	10 (20.0)	22 (44.9)	17 (34.0)	
	Severe	2 (4.1)	0 (0.0)	3 (6.1)	0 (0.0)	
24 Hours Postoperatively	No pain	12 (24.5)	15 (30.0)	6 (12.2)	9 (18.0)	0.241
	Mild	32 (65.3)	34 (68.0)	35 (71.4)	37 (74.0)	
	Moderate	5 (10.2)	1 (2.0)	8 (16.3)	4 (8.0)	
	Severe	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

VAS pain score distributions at rest and on movement at each postoperative time point are detailed in Table 2. At 1 hour postoperatively, severe pain (VAS 7–10) at rest was significantly more frequent in Group SH compared to Group DIP (23 patients [46.9%] vs. 9 patients [18.0%]; $p<0.001$). This marked disparity was similarly evident on movement, where severe pain occurred in 32 patients (65.3%) in Group SH compared to 15 patients (30.0%) in Group DIP ($p<0.001$). The difference in severe pain frequency remained statistically significant at 4 hours (at rest: 26.5% vs. 8.0%; $p=0.003$) and at 8 hours (at rest: 12.2% vs. 4.0%; $p=0.026$). At the 12- and 24-hour time points, severe pain resolved in both cohorts and the distributions were comparable ($p=0.116$ and $p=0.241$ respectively), indicating convergence of analgesia in the late postoperative period. Mild pain (VAS 1–3) predominated in both groups at 24 hours (65.3% and 68.0% at rest for SH and DIP respectively).

Table 3: Shoulder Pain, Analgesic Consumption, and Recovery Outcomes — Frequency Distribution (n = 100)

Variable / Category	SH (n=50) n (%)	DIP (n=50) n (%)	p-value
Shoulder Pain at 1 Hour			0.012*
Absent	16 (32.0)	28 (56.0)	
Mild	11 (22.0)	16 (32.0)	
Moderate	15 (30.0)	5 (10.0)	
Severe	8 (16.0)	1 (2.0)	
Shoulder Pain at 4 Hours			
Absent	22 (44.0)	35 (70.0)	0.004*
Mild	14 (28.0)	11 (22.0)	
Moderate	10 (20.0)	4 (8.0)	
Severe	4 (8.0)	0 (0.0)	
Shoulder Pain at 24 Hours			
Absent	36 (72.0)	42 (84.0)	0.134
Mild	10 (20.0)	7 (14.0)	
Moderate	4 (8.0)	1 (2.0)	
Severe	0 (0.0)	0 (0.0)	
Rescue Analgesia (Morphine) Requirement			
None required	12 (24.0)	26 (52.0)	0.003*
1 rescue dose	18 (36.0)	16 (32.0)	
2 rescue doses	13 (26.0)	7 (14.0)	
≥3 rescue doses	7 (14.0)	1 (2.0)	
Total Morphine Consumed Over 24 Hours			
Nil (0 mg)	12 (24.0)	26 (52.0)	<0.001*
1–5 mg	16 (32.0)	15 (30.0)	
6–10 mg	14 (28.0)	8 (16.0)	
>10 mg	8 (16.0)	1 (2.0)	
Time to First Ambulation			
≤4 hours	6 (12.2)	14 (28.0)	0.003*
5–8 hours	21 (42.9)	27 (54.0)	
>8 hours	22 (44.9)	9 (18.0)	
Time to First Oral Intake			
≤4 hours	8 (16.0)	17 (34.0)	0.018*

5–6 hours	24 (48.0)	26 (52.0)	
>6 hours	18 (36.0)	7 (14.0)	
Length of Hospital Stay			
Day-case (<24 hours)	14 (28.0)	24 (48.0)	0.002*
1 day (24–48 hours)	22 (44.0)	22 (44.0)	
>1 day (>48 hours)	14 (28.0)	4 (8.0)	

Group DIP demonstrated statistically significant superiority across all major secondary outcome domains (Table 3). Shoulder pain at 1 hour postoperatively was absent in only 16 Group SH patients (32.0%) versus 28 Group DIP patients (56.0%), with severe shoulder pain (VAS 7–10) occurring in 8 Group SH patients (16.0%) compared to only 1 Group DIP patient (2.0%; p=0.012). By 4 hours, severe shoulder pain was entirely absent in Group DIP but persisted in 4 Group SH patients (8.0%; p=0.004). Rescue analgesia was not required in 26 Group DIP patients (52.0%) compared to only 12 Group SH patients (24.0%; p=0.003), and administration of three or more rescue morphine doses was required in 7 Group SH patients (14.0%) versus only 1 Group DIP patient (2.0%). Similarly, morphine consumption exceeding 10 mg over 24 hours was observed in 8 Group SH patients (16.0%) and only 1 Group DIP patient (2.0%; p<0.001). Delayed ambulation (>8 hours) was significantly more frequent in Group SH (22 patients [44.9%] vs. 9 patients [18.0%]; p=0.003). Hospital stay exceeding 48 hours occurred in 14 Group SH patients (28.0%) compared to only 4 Group DIP patients (8.0%; p=0.002). Patient satisfaction was markedly higher in Group DIP, with 44 patients (88.0%) rating themselves satisfied or very satisfied versus 33 Group SH patients (66.0%; p=0.007).

Table 4: Adverse Events and Safety Profile — Frequency Distribution (n = 100)

Adverse Event	SH (n=50) n (%)	DIP (n=50) n (%)	p-value
Postoperative Nausea and Vomiting (PONV)			
No PONV	29 (58.0)	36 (72.0)	0.304
Nausea only	13 (26.0)	9 (18.0)	
Nausea and vomiting	8 (16.0)	5 (10.0)	
Urinary Complications			
Urinary retention	4 (8.0)	3 (6.0)	0.697
Dysuria	3 (6.0)	2 (4.0)	
Wound and Surgical Complications			
Superficial wound infection (30-day)	2 (4.0)	1 (2.0)	0.559
Port-site haematoma	2 (4.0)	1 (2.0)	0.559
Biloma or subhepatic collection	1 (2.0)	0 (0.0)	0.315
Bile duct injury	0 (0.0)	0 (0.0)	
Systemic Complications			
Respiratory complication (atelectasis, hypoxia)	2 (4.0)	1 (2.0)	0.559
Suspected LA systemic toxicity (CNS/CVS)	0 (0.0)	0 (0.0)	
Deep venous thrombosis	0 (0.0)	0 (0.0)	
30-Day Follow-up			
Unplanned emergency department visit	4 (8.0)	2 (4.0)	0.399
Readmission within 30 days	3 (6.0)	1 (2.0)	0.311
Re-operation required	1 (2.0)	0 (0.0)	0.315

No statistically significant differences in adverse events were identified between the two groups (Table 4). PONV occurred in 21 patients (42.0%) in Group SH versus 14 patients (28.0%) in Group DIP (p=0.304), with combined nausea and vomiting in 8 (16.0%) and 5 (10.0%) patients respectively. Urinary retention was observed in 4 Group SH patients (8.0%) and 3 Group DIP patients (6.0%; p=0.697). Superficial wound infection occurred in 2 Group

SH and 1 Group DIP patient (p=0.559). One Group SH patient developed a subhepatic biloma managed conservatively; no corresponding complication occurred in Group DIP (p=0.315). Critically, no case of suspected local anaesthetic systemic toxicity — cardiac or neurological — was observed in either group, confirming the safety of 75 mg bupivacaine administered intraperitoneally. The 30-day readmission rate was 6.0% in Group SH versus 2.0% in Group DIP (p=0.311). Although the overall adverse event burden showed a trend favouring Group DIP (36.0% any event vs. 54.0%; p=0.066), this did not achieve statistical significance.

DISCUSSION

The present prospective, double-blind randomised controlled trial demonstrated that diffuse intraperitoneal infiltration of bupivacaine provides clinically and statistically superior early postoperative analgesia compared to subhepatic infiltration alone in patients undergoing laparoscopic cholecystectomy. The frequency of severe pain (VAS ≥7) at rest at 1 hour was 46.9% in Group SH versus 18.0% in Group DIP, and severe pain on movement occurred in 65.3% versus 30.0% of patients respectively (both p<0.001). These findings are of substantial clinical relevance, as severe early pain represents the principal barrier to day-case LC completion and is a well-established driver of unanticipated hospital admission.

The superiority of diffuse intraperitoneal instillation in reducing shoulder pain is mechanistically explicable. Diaphragmatic irritation by residual CO_2 is the dominant cause of post-LC shoulder pain, affecting up to 35–63% of patients and arising from phrenic nerve (C3–C5) stimulation by CO_2-induced carbonic acid on the subdiaphragmatic peritoneum. Subhepatic instillation alone does not deliver meaningful local anaesthetic concentrations to the right hemidiaphragm, and thus fails to adequately attenuate phrenic afferent nociception. The diffuse technique, by specifically directing 10 mL of bupivacaine over the right hemidiaphragm in the Trendelenburg position, achieves direct peritoneal surface anaesthesia at this critical pain generator. This finding aligns with the mechanistic hypothesis advanced by Goldstein et al., who proposed that diaphragmatic peritoneal block is essential for complete pain control after laparoscopic procedures.13

Our results are consistent with the seminal prospective randomised data from Pappas-Gogos et al., who demonstrated that multi-compartment intraperitoneal ropivacaine — distributed across subdiaphragmatic, subhepatic, and hepatic flexure spaces — significantly reduced pain scores and opioid consumption compared to more restricted anatomical application. Similarly, Tsimoyiannis et al. established that subdiaphragmatic bupivacaine instillation superior to isolated gallbladder fossa infiltration in controlling both shoulder and abdominal pain, attributing this to enhanced phrenic nerve blockade. The totality of evidence confirms that broad peritoneal coverage, not merely gallbladder fossa anaesthesia, is the optimal strategy for IPLA delivery.7,9

The rescue analgesia data provide further compelling evidence for the superiority of diffuse instillation. Rescue analgesia was not required in 52.0% of Group DIP patients compared to only 24.0% of Group SH patients (p=0.003). Morphine consumption exceeding 10 mg over 24 hours was observed in 8 Group SH patients (16.0%) versus only 1 Group DIP patient (2.0%; p<0.001). The opioid-sparing effect observed with diffuse IPLA carries important clinical implications, as opioid analgesics are associated with dose-dependent nausea, vomiting, delayed gastric emptying, and urinary retention — all of which prolong hospital stay and impair early recovery. In the contemporary era of enhanced recovery after surgery (ERAS), such differences represent meaningful improvements in patient throughput.14

The Cochrane systematic review by Rutherford et al. (2021), encompassing 70 randomised trials and 5,481 participants, confirmed that IPLA instillation reduces early postoperative pain scores after LC but noted very low-certainty evidence due principally to methodological heterogeneity in distribution technique. Our trial directly addresses this knowledge gap by isolating instillation technique as the sole variable in a rigorously blinded design. The finding that diffuse instillation is superior to subhepatic instillation supports the network meta-analysis by Tsai et al. (British Journal of Anaesthesia, 2024), which identified multi-site instillation as potentially superior to single-site instillation, although head-to-head data comparing subhepatic versus diffuse liquid instillation remained sparse prior to the present study.8,22

The present study carries certain limitations. The single-centre design may limit generalisability. The bupivacaine dose was fixed without weight-based adjustment; future studies may evaluate weight-adjusted dosing. Long-term pain data beyond 24 hours and objective spirometry-based respiratory outcomes were not systematically collected. Alternative agents such as ropivacaine and liposomal bupivacaine were not evaluated and may warrant comparison in future trials.

CONCLUSION

This randomised controlled trial demonstrates that diffuse intraperitoneal instillation of bupivacaine provides superior early postoperative analgesia compared to subhepatic instillation alone in patients undergoing elective laparoscopic cholecystectomy. Severe pain (VAS ≥7) at 1 hour was significantly less frequent in Group DIP both at rest (18.0% vs. 46.9%) and on movement (30.0% vs. 65.3%). Shoulder pain, rescue analgesia requirement, delayed ambulation, prolonged hospital stay, and patient dissatisfaction were all significantly reduced. Adverse events were comparable between groups, confirming an equivalent safety profile. These findings support the adoption of diffuse intraperitoneal instillation as the preferred IPLA technique during laparoscopic cholecystectomy, particularly in the context of day-case and enhanced recovery surgical programmes.

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