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Effectiveness of Various Post-Operative Pain Management Modalities Among Patients Undergoing Laparoscopic Surgery an Observational Study

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ABSTRACT: Postoperative pain remains a clinical challenge even after minimally invasive laparoscopic surgery, delaying recovery, prolonging hospital stay, and reducing patient satisfaction, and comparative real-world evidence on analgesic modalities is limited. This prospective observational study was conducted at SRM Medical College Hospital and Research Centre, Kattankulathur, Tamil Nadu, India, from February 2025 to February 2026. A total of 272 adults undergoing laparoscopic surgery were categorised by the analgesic modality received: multimodal intravenous (IV) analgesia (n = 71), port site infiltration (PSI; n = 134), or transversus abdominis plane (TAP) block (n = 67). Postoperative pain over 24 hours (least, worst, and overall) was assessed with the Visual Analogue Scale (VAS), and patient satisfaction with the ASSIST questionnaire. Data were analysed using the Kruskal-Wallis test, Dunn's post-hoc test with Bonferroni correction, Pearson's Chi-square test, and Spearman's correlation coefficient; $p < 0.05$ was considered significant. The TAP block group had significantly lower pain scores than the multimodal IV and PSI groups. Least pain scores were lower with TAP block (median 1.0, IQR 1–2) than with multimodal IV (3.0, IQR 2–3) and PSI (2.0, IQR 1–3) ($p < 0.001$). Patient satisfaction was significantly higher with TAP block (median 8.0) than in the other groups ($p < 0.001$), and pain scores were inversely correlated with satisfaction. TAP block provides superior postoperative analgesia and higher patient satisfaction than multimodal IV analgesia and PSI in patients undergoing laparoscopic surgery, and incorporating it into multimodal analgesic protocols may improve postoperative recovery and outcomes.

1. INTRODUCTION

Postoperative pain is an unpleasant sensory and emotional experience associated with actual or potential tissue injury following surgical intervention [1]. Effective management of postoperative pain remains a critical component of perioperative care because inadequate pain control can adversely affect physiological functions, delay mobilisation, prolong hospital stay, and reduce patient satisfaction [2–4]. Despite significant advances in surgical and anaesthetic techniques, postoperative pain continues to remain inadequately managed in many healthcare settings [5].

Laparoscopic surgeries are widely preferred due to their minimally invasive nature, smaller incisions, reduced tissue trauma, and shorter hospital stay. However, postoperative pain following laparoscopic procedures still remains clinically significant [2,6]. The pain associated with laparoscopic surgery is multifactorial in origin and includes somatic pain from trocar insertion sites, visceral pain due to manipulation of intra-abdominal organs, and referred shoulder pain caused by diaphragmatic irritation from carbon dioxide pneumoperitoneum [6,7].

Several pain management modalities are currently available, including systemic analgesics, local infiltration techniques, and regional anaesthesia approaches [6,8]. Multimodal analgesia has emerged as an effective strategy that combines different analgesic agents and techniques targeting multiple pain pathways [9,10]. Among regional techniques, the Transversus Abdominis Plane (TAP) block has gained popularity because of its effectiveness in reducing somatic postoperative pain after abdominal surgeries [11–13].

Although numerous analgesic strategies are used in routine clinical practice, limited observational data are available comparing their real-world effectiveness in patients undergoing laparoscopic surgeries [14]. Therefore, the present study was undertaken to evaluate and compare the effectiveness of various postoperative pain management modalities in terms of pain control and patient satisfaction among patients undergoing laparoscopic surgeries.

The aim of this study was to evaluate the effectiveness of various postoperative pain management modalities among patients undergoing laparoscopic surgeries. The primary objective was to compare patient satisfaction scores among the modalities. The secondary objectives were to assess postoperative pain using the Visual Analogue Scale (VAS), to compare pain scores among the analgesic modalities, to evaluate the relationship between pain scores and patient satisfaction, and to assess the effectiveness of regional analgesic techniques in postoperative pain management.

2. MATERIALS AND METHODS

2.1 Study Design, Setting, and Duration

This was a prospective observational study conducted in the Department of Anaesthesiology, SRM Medical College Hospital and Research Centre, Kattankulathur, Tamil Nadu, India, over a period of one year, from February 2025 to February 2026.

2.2 Ethical Approval

Institutional Ethics Committee approval was obtained prior to commencement of the study (IEC No: SRMIEC-ST0925-2872). The study was registered with the Clinical Trials Registry – India (CTRI/2026/02/103133). Informed consent was obtained from all participants.

2.3 Study Population and Sample Size

Adult patients undergoing elective laparoscopic surgeries under general anaesthesia were included. A total of 272 patients were enrolled.

2.4 Study Procedure

After obtaining informed consent, eligible patients undergoing laparoscopic surgeries were included in the study. Baseline demographic details including age, sex, ASA status, and type of surgical procedure were recorded. Patients received postoperative analgesia according to institutional clinical practice and were categorised into three groups based on the analgesic modality used: multimodal intravenous (IV) analgesia, port site infiltration (PSI), and transversus abdominis plane (TAP) block.

Postoperative pain intensity was assessed over 24 hours using the VAS. Least pain, worst pain, and overall pain scores were recorded. Patient satisfaction with pain management was assessed using the ASSIST patient satisfaction questionnaire.

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2.5 Statistical Analysis

Data were entered in Microsoft Excel and analysed using Python statistical libraries. Continuous variables were expressed as mean ± standard deviation or median with interquartile range as appropriate. The Kruskal-Wallis test was used for comparison among groups. Post-hoc analysis was performed using Dunn's test with Bonferroni correction. Pearson's Chi-square test was used for categorical variables. Correlation between pain scores and patient satisfaction was assessed using Spearman's rank correlation coefficient. A p-value <0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1 Results

A total of 272 patients were included in the study. Among them, 71 patients received Multimodal IV analgesia, 134 patients received Port Site Infiltration, and 67 patients received TAP block.

No statistically significant differences were observed among the groups with respect to age, sex distribution, and duration of surgery. However, differences in ASA physical status and surgical procedure distribution were statistically significant.

Table 1. Baseline characteristics by analgesic group

Variable	Multimodal IV	PSI	TAP block	p-value
Age (years)	44.2 ± 16.5	46.6 ± 15.6	43.6 ± 15.7	0.351
Duration of surgery (min)	96.5 ± 25.1	90.3 ± 23.4	96.0 ± 19.7	0.107

Values are expressed as mean ± standard deviation. IV: intravenous; PSI: port site infiltration; TAP: transversus abdominis plane.

The TAP block group demonstrated significantly lower postoperative pain scores compared to the other groups. Least pain scores were significantly lower in the TAP block group (median 1.0) compared to the Multimodal IV group (median 3.0) and PSI group (median 2.0) ($p < 0.001$).

Table 2. Visual Analogue Scale pain scores across analgesic groups

VAS measure	Multimodal IV	PSI	TAP block	p-value
Least pain	3.0 (2–3)	2.0 (1–3)	1.0 (1–2)	<0.001
Worst pain	4.0 (4–5)	4.0 (4–5)	4.0 (4–4)	0.031
Overall pain	3.0 (2–3)	3.0 (2–3)	2.0 (2–3)	0.049

Values are expressed as median (interquartile range). VAS: Visual Analogue Scale; IV: intravenous; PSI: port site infiltration; TAP: transversus abdominis plane.

Patient satisfaction scores were significantly higher in the TAP block group compared to the Multimodal IV and PSI groups ($p < 0.001$).

Table 3. Patient satisfaction scores among analgesic groups

Group	Median (IQR)	Mean ± SD
Multimodal IV	7.0 (6–8)	6.97 ± 1.52
PSI	7.0 (6–8)	6.72 ± 1.49
TAP block	8.0 (7.5–9)	7.99 ± 0.79

IQR: interquartile range; SD: standard deviation; IV: intravenous; PSI: port site infiltration; TAP: transversus abdominis plane.

Significant inverse correlations were observed between pain scores and patient satisfaction, indicating that higher pain scores were associated with lower patient satisfaction.

3.2 Discussion

The present study compared the effectiveness of various postoperative pain management modalities among patients undergoing laparoscopic surgeries. The findings demonstrated that the TAP block provided superior postoperative analgesia and significantly improved patient satisfaction compared to Multimodal IV analgesia and Port Site Infiltration.

The TAP block group consistently demonstrated lower postoperative pain scores, particularly for least pain scores over the first 24 postoperative hours. These findings are consistent with previous studies that reported the effectiveness of TAP block in reducing postoperative pain and opioid consumption following abdominal surgeries [11,12,15]. Meta-analyses restricted to laparoscopic cholecystectomy have likewise reported lower pain scores and reduced opioid consumption with TAP block than with standard analgesia without a block [6,16]. However, the differences in worst and overall pain scores in the present study were small (median difference of one point or less), and a statistically significant difference does not necessarily indicate a clinically important one; a change of roughly 1.65 points on an 11-point scale has been proposed as the threshold for clinically meaningful change in pain [17,18].

Port Site Infiltration also demonstrated beneficial effects in reducing postoperative pain when compared to systemic analgesia alone, although the magnitude of analgesic benefit was lower than that observed with TAP block. The efficacy of local anaesthetic infiltration at the port sites depends on the application method and dose [19,20]. The evidence comparing TAP block with PSI is, however, not uniform. A meta-analysis of randomised trials found no significant reduction in pain intensity with ultrasound-guided TAP block compared with PSI after laparoscopic cholecystectomy [16], whereas another meta-analysis reported superior analgesia with TAP block over wound infiltration [21], and recent randomised trials of laparoscopy-assisted TAP block reported lower pain scores than PSI after laparoscopic cholecystectomy and appendicectomy [22,23].

Higher patient satisfaction observed in the TAP block group may be attributed to improved pain relief and reduced postoperative discomfort. The inverse relationship between pain scores and patient satisfaction further supports the importance of effective postoperative pain control in enhancing overall patient recovery experience [3,5].

The present study highlights the importance of incorporating regional anaesthesia techniques into multimodal postoperative analgesic protocols. Regional techniques not only improve analgesic efficacy but also reduce opioid requirements and associated side effects [6,9,12]. Because the TAP block mainly provides somatic analgesia of the anterior abdominal wall and generally does not affect visceral pain, it is best used as one component of multimodal analgesia rather than as a sole technique [6,7]. Beyond pain scores, TAP block has also been evaluated for its effects on quality of recovery and pulmonary function after laparoscopic cholecystectomy [24,25], and newer fascial plane blocks such as the erector spinae plane block are being compared with it [2].

3.3 Limitations

This study had certain limitations. It was observational in design and lacked randomisation, and it was conducted at a single tertiary care centre, which may limit the generalisability of the findings. Pain assessment using the VAS is inherently subjective, and variability in analgesic practices among clinicians may have influenced the outcomes. Additionally, long-term postoperative outcomes were not evaluated in this study.

4. CONCLUSIONS

The present study demonstrates that postoperative pain remains an important concern even after minimally invasive laparoscopic surgeries. Among the analgesic modalities evaluated, TAP block provided superior postoperative analgesia and significantly higher patient satisfaction compared to Multimodal IV analgesia and Port Site Infiltration.

The findings support the incorporation of TAP block as part of multimodal postoperative pain management protocols in laparoscopic surgeries. Effective postoperative pain control using regional anaesthesia techniques may contribute to enhanced recovery, improved patient comfort, and better perioperative outcomes.

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AUTHOR CONTRIBUTIONS

All authors contributed equally to the study.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICS STATEMENT

The study was approved by the Institutional Ethics Committee, SRM Medical College Hospital and Research Centre (IEC No: SRMIEC-ST0925-2872) and registered with the Clinical Trials Registry – India (CTRI/2026/02/103133). Informed consent was obtained from all participants.

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