

Impact of Postoperative Pain Management on Recovery in Gallbladder Surgery

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Received: 10-4-2023 Revised: 20-05-2023 / Accepted: 25-06-2023

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Conflict of interest: Nil

Abstract

Introduction: Postoperative pain remains a major concern after gallbladder surgery and may delay ambulation, oral intake, discharge, and overall recovery. Effective pain management is essential to reduce complications, improve patient comfort, and shorten hospital stay. Multimodal analgesia, including non-opioid drugs, regional blocks, and limited opioid use, has been increasingly used to improve postoperative outcomes in patients undergoing laparoscopic cholecystectomy.

Materials and Method: This prospective observational study was conducted on 100 patients undergoing gallbladder surgery. Demographic details, indication for surgery, type of pain management used, postoperative pain scores, need for rescue analgesia, time to ambulation, time to oral intake, postoperative nausea and vomiting, and duration of hospital stay were recorded. Pain severity was assessed using the Visual Analogue Scale at 2, 6, 12, and 24 hours after surgery. Statistical analysis was performed using Chi-square test, Fisher's exact test, and Pearson correlation test.

Result: The mean age of the patients was 44.8 ± 11.6 years, and females constituted 68% of the study population. Symptomatic cholelithiasis was the most common indication for surgery (72%). The mean VAS score reduced from 5.8 ± 1.4 at 2 hours to 1.8 ± 0.9 at 24 hours. Patients receiving TAP block with paracetamol had the lowest pain scores compared to other modalities. The mean time to ambulation was 8.6 ± 2.4 hours, time to oral intake was 7.2 ± 2.1 hours, and mean hospital stay was 2.4 ± 0.8 days. Higher pain scores were significantly associated with delayed ambulation, delayed oral intake, and prolonged hospital stay.

Conclusion: Effective postoperative pain management significantly improved recovery following gallbladder surgery. Patients with lower pain scores had earlier ambulation, earlier oral intake, shorter hospital stay, and lower analgesic requirement. Multimodal pain management strategies provided better pain relief and improved postoperative recovery.

Keywords: Gallbladder surgery, postoperative pain, laparoscopic cholecystectomy, multimodal analgesia, Visual Analogue Scale, recovery outcome.

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Introduction

Gallbladder diseases, particularly cholelithiasis, acute cholecystitis, gallbladder polyps, and biliary dyskinesia, are among the most common surgical conditions encountered worldwide. Surgical removal of the gallbladder, most commonly by laparoscopic cholecystectomy, is considered the gold

standard treatment for symptomatic gallbladder disease because it offers smaller incisions, reduced blood loss, faster recovery, and shorter hospital stay compared to open cholecystectomy [1].

However, despite the minimally invasive nature of laparoscopic surgery, postoperative pain remains a significant clinical issue and is one of the most important factors affecting the speed and quality of postoperative recovery [2,3]. Postoperative pain following gallbladder surgery is multifactorial in nature. It may result from trocar insertion sites, tissue handling, visceral irritation, diaphragmatic stretching, pneumoperitoneum, and residual carbon dioxide trapped beneath the diaphragm. This pain may present as abdominal pain, incisional pain, visceral discomfort, or referred shoulder tip pain. Shoulder tip pain is particularly common after laparoscopic cholecystectomy and is believed to occur due to diaphragmatic irritation and phrenic nerve stimulation caused by residual pneumoperitoneum [3]. Inadequate postoperative pain control can have several adverse consequences. Severe pain may limit deep breathing and coughing, increasing the risk of pulmonary complications such as atelectasis and pneumonia. It may also delay ambulation, prolong hospital stay, impair return of bowel function, reduce oral intake, disturb sleep, and negatively affect overall patient satisfaction. Furthermore, poorly controlled pain often leads to excessive opioid use, which can result in nausea, vomiting, constipation, urinary retention, sedation, dizziness, and delayed discharge from hospital. Therefore, effective pain management plays a crucial role in improving postoperative recovery and reducing morbidity after gallbladder surgery [2,4]. Traditionally, opioids have been the cornerstone of postoperative analgesia in gallbladder surgery. However, due to the increasing awareness of opioid-related side effects and the need for faster recovery, there has been a shift toward

multimodal analgesia. Multimodal analgesia refers to the use of different classes of analgesics and pain control techniques that act through different mechanisms. These may include paracetamol, non-steroidal anti-inflammatory drugs, local anesthetic infiltration, regional nerve blocks, corticosteroids, and limited opioid use for rescue analgesia. Multimodal analgesic regimens have been shown to reduce pain scores, decrease opioid requirements, minimize postoperative nausea and vomiting, and improve patient comfort [2–4]. Recent studies have shown that the use of intravenous paracetamol significantly improves pain control and postoperative recovery after laparoscopic cholecystectomy [5–7]. Similarly, dexmedetomidine has been found to provide better perioperative hemodynamic stability and postoperative analgesia when compared with conventional analgesic regimens [8]. Preemptive analgesia and the use of selective cyclooxygenase-2 inhibitors such as parecoxib have also been shown to reduce postoperative pain scores, shorten hospital stay, and improve recovery outcomes [9,10]. The concept of Enhanced Recovery After Surgery has further emphasized the importance of postoperative pain management in gallbladder surgery.

ERAS protocols aim to reduce surgical stress, encourage early oral intake, facilitate early mobilization, minimize opioid use, and shorten hospital stay. Effective pain control is one of the core components of ERAS pathways because patients with less postoperative pain are more likely to ambulate early, resume feeding sooner, and recover more rapidly [2,3]. Although many pain management strategies are available, there is still variation in the choice of analgesic regimen used after gallbladder surgery. The relative effectiveness of different pain management approaches on postoperative recovery remains an area of ongoing

research. Therefore, evaluating the impact of postoperative pain management on recovery in gallbladder surgery is important for identifying the most effective analgesic strategies, improving patient outcomes, reducing complications, and optimizing postoperative care.

Material and Methods

The present study was conducted to evaluate the impact of postoperative pain management on recovery in patients undergoing gallbladder surgery. The study was carried out in the Department of General Surgery. This was a hospital-based prospective observational study. A total of 100 patients undergoing elective laparoscopic cholecystectomy for symptomatic gallbladder disease were included in the study.

Inclusion Criteria: Patients aged 18 years and above undergoing elective laparoscopic cholecystectomy for gallstone disease, chronic cholecystitis, gallbladder polyps, or biliary dyskinesia were included in the study. Only patients who were willing to participate and provided written informed consent were enrolled.

Exclusion Criteria: Patients undergoing emergency surgery, open cholecystectomy, conversion from laparoscopic to open cholecystectomy, pregnant women, patients with known allergy to analgesic medications, chronic opioid users, patients with psychiatric illness affecting pain assessment, severe hepatic or renal dysfunction, and patients who were unwilling to participate were excluded from the study.

Study Procedure: After obtaining approval from the Institutional Ethics Committee, eligible patients were recruited consecutively. A detailed history was obtained from all patients regarding age, sex, body mass index, presenting complaints, duration of symptoms, associated comorbidities, previous abdominal surgery, and indication for cholecystectomy. Baseline clinical

examination and routine preoperative investigations were performed. All patients underwent elective laparoscopic cholecystectomy under general anaesthesia.

The postoperative pain management protocol was decided by the treating anaesthesiologist and surgeon based on institutional practice. Pain management modalities included intravenous paracetamol, non-steroidal anti-inflammatory drugs, opioids, local anaesthetic infiltration, transversus abdominis plane block, dexmedetomidine, or combinations of these modalities. Pain intensity was assessed using the Visual Analogue Scale at 2, 6, 12, and 24 hours after surgery.

Recovery parameters assessed included time to first ambulation, time to oral intake, duration of hospital stay, incidence of postoperative nausea and vomiting, requirement of rescue analgesia, patient satisfaction score, and occurrence of postoperative complications.

Outcome Measures: The primary outcome measure was the association between adequacy of postoperative pain control and postoperative recovery.

Secondary outcome measures included postoperative pain scores, requirement of rescue analgesia, incidence of nausea and vomiting, time to ambulation, duration of hospital stay, and patient satisfaction.

Statistical Analysis: The collected data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences version 25.0.

Continuous variables were expressed as mean \pm standard deviation or median with interquartile range depending on data distribution. Categorical variables were expressed as frequency and percentage. Comparison of pain scores and recovery outcomes between different pain management modalities was performed using independent t-test, one-way

ANOVA, Mann–Whitney U test, or Kruskal–Wallis test as appropriate. Chi-square test or Fisher’s exact test was used for categorical variables.

Correlation between pain score and recovery parameters was analysed using Spearman correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 100 patients undergoing elective laparoscopic cholecystectomy were included in the study. The mean age of the participants was 44.8 ± 11.6 years, with the majority of the patients belonging to the 41–50 years age group (32%), followed by 31–40 years (24%) and 51–60 years (22%).

Females constituted the majority of the study population, accounting for 68% of the cases, whereas males represented 32%. Symptomatic cholelithiasis was the most common indication for surgery and was observed in 72% of the patients. Chronic cholecystitis was seen in 18% of the patients, while gallbladder polyps and biliary dyskinesia were noted in 6% and 4% of cases, respectively. Comorbid conditions were present in 46% of the patients, with hypertension being the most common comorbidity, followed by diabetes mellitus and obesity.

The detailed demographic and clinical characteristics of the study population are shown in Table 1. With regard to postoperative pain management modalities, the most commonly used analgesic regimen was intravenous paracetamol combined with non-steroidal anti-inflammatory drugs, which was administered to 38% of the patients. Intravenous paracetamol combined with opioids was used in 26% of patients, while TAP block with paracetamol was used in 18% of cases. Dexmedetomidine-based regimens were administered in 10% of patients, and other multimodal analgesic

regimens were used in the remaining 8% of the study population.

The mean Visual Analogue Scale pain score at 2 hours postoperatively was highest among patients receiving intravenous paracetamol with opioids (6.3 ± 1.4), while the lowest pain scores were observed among patients who received TAP block with paracetamol (4.3 ± 0.9). Similarly, at 6 hours, 12 hours, and 24 hours postoperatively, patients receiving TAP block with paracetamol consistently demonstrated lower pain scores compared to other analgesic regimens.

Overall, the mean Visual Analogue Scale pain score for the study population was 5.8 ± 1.4 at 2 hours, 4.2 ± 1.2 at 6 hours, 2.9 ± 1.1 at 12 hours, and 1.8 ± 0.9 at 24 hours. The difference in pain scores between the various postoperative pain management modalities was found to be statistically significant using the Kruskal–Wallis test ($p < 0.001$). These findings are presented in Table 2. Recovery outcomes were significantly influenced by the adequacy of postoperative pain control.

The mean time to first ambulation among the study participants was 8.6 ± 2.4 hours, while the mean time to oral intake was 7.2 ± 2.1 hours.

The average duration of hospital stay was 2.4 ± 0.8 days. Spearman correlation analysis showed a significant positive correlation between higher postoperative pain scores and delayed ambulation ($r = 0.61$, $p < 0.001$), delayed initiation of oral intake ($r = 0.49$, $p < 0.001$), and prolonged hospital stay ($r = 0.58$, $p < 0.001$).

Postoperative nausea and vomiting were observed in 28% of the patients and were significantly more common among patients receiving opioid-based analgesia. Rescue analgesia was required in 34% of patients. In terms of patient satisfaction, 62% of patients reported high satisfaction with their pain management, 28% reported moderate satisfaction, and 10% reported poor satisfaction. A significant negative

correlation was found between postoperative pain scores and patient satisfaction ($r = -0.52$, $p < 0.001$), indicating that lower pain scores were associated with greater patient satisfaction. These recovery-related outcomes are summarized in Table 3. Overall findings showed that patients receiving multimodal analgesic regimens, particularly TAP

block with paracetamol and intravenous paracetamol with NSAIDs, experienced lower postoperative pain scores, earlier ambulation, earlier oral intake, shorter hospital stay, reduced postoperative nausea and vomiting, lesser requirement for rescue analgesia, and higher patient satisfaction compared to patients receiving opioid-based analgesia alone.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 100)

Variable	Number (n)	Percentage (%)	Mean \pm SD
Age (years)	-	-	44.8 \pm 11.6
21–30 years	12	12.0	-
31–40 years	24	24.0	-
41–50 years	32	32.0	-
51–60 years	22	22.0	-
>60 years	10	10.0	-
Male	32	32.0	-
Female	68	68.0	-
Symptomatic cholelithiasis	72	72.0	-
Chronic cholecystitis	18	18.0	-
Gallbladder polyp	6	6.0	-
Biliary dyskinesia	4	4.0	-
Hypertension	22	22.0	-
Diabetes mellitus	16	16.0	-
Obesity	8	8.0	-
No comorbidity	54	54.0	-

Table 2: Distribution of Postoperative Pain Management Modalities and Pain Scores (n = 100)

Pain Management Modality	Number (n)	Percentage (%)	Mean VAS Score at 2 Hours	Mean VAS Score at 6 Hours	Mean VAS Score at 12 Hours	Mean VAS Score at 24 Hours
IV Paracetamol + NSAIDs	38	38.0	5.2 \pm 1.1	3.9 \pm 1.0	2.7 \pm 0.9	1.6 \pm 0.7
IV Paracetamol + Opioids	26	26.0	6.3 \pm 1.4	4.8 \pm 1.2	3.4 \pm 1.1	2.2 \pm 0.9
TAP Block + Paracetamol	18	18.0	4.3 \pm 0.9	3.1 \pm 0.8	2.0 \pm 0.7	1.2 \pm 0.5
Dexmedetomidine-based regimen	10	10.0	5.0 \pm 1.0	3.7 \pm 0.9	2.5 \pm 0.8	1.5 \pm 0.6
Other multimodal regimens	8	8.0	5.4 \pm 1.2	4.0 \pm 1.1	2.8 \pm 0.9	1.7 \pm 0.7
Overall	100	100.0	5.8 \pm 1.4	4.2 \pm 1.2	2.9 \pm 1.1	1.8 \pm 0.9

Statistical Test: Kruskal–Wallis test, p-value: <0.001

Table 3: Association of Postoperative Pain with Recovery Outcomes (n = 100)

Recovery Parameter	Mean \pm SD / Number (%)	Correlation Coefficient (r)	p-value	Statistical Test
Time to first ambulation (hours)	8.6 \pm 2.4	0.61	<0.001	Spearman correlation
Time to oral intake (hours)	7.2 \pm 2.1	0.49	<0.001	Spearman correlation
Duration of hospital stay (days)	2.4 \pm 0.8	0.58	<0.001	Spearman correlation
Postoperative nausea and vomiting	28 (28.0%)	-	0.003	Chi-square test
Rescue analgesia required	34 (34.0%)	-	0.001	Chi-square test
High patient satisfaction	62 (62.0%)	-0.52	<0.001	Spearman correlation
Moderate patient satisfaction	28 (28.0%)	-	-	-
Poor patient satisfaction	10 (10.0%)	-	-	-

Discussion

In the present study, the mean age of the participants was 44.8 ± 11.6 years, with most patients belonging to the 41–50 years age group (32%). Females constituted 68% of the study population, while males accounted for 32%. Symptomatic cholelithiasis was the most common indication for surgery and was present in 72% of patients. Similar findings were reported by Sattar et al. (2011) [11], who observed that most patients undergoing laparoscopic cholecystectomy were middle-aged females. Singla et al. (2014) [12] also reported female predominance in the fourth and fifth decades of life. Yasir et al. (2012) [13] found that most patients were between 30 and 50 years of age and females formed the majority in both study groups. These findings suggested that gallstone disease was more common among middle-aged women. In our study, the mean VAS score decreased from 5.8 ± 1.4 at 2 hours to 1.8 ± 0.9 at 24 hours postoperatively. Patients receiving TAP block with paracetamol had the lowest pain scores at all intervals, while those receiving intravenous paracetamol with opioids had comparatively higher pain scores. Singla et al. (2014) [12] reported significantly lower abdominal and

shoulder tip pain in patients undergoing low-pressure pneumoperitoneum compared to standard-pressure pneumoperitoneum. Yasir et al. (2012) [13] observed shoulder tip pain in 28% of patients in the standard-pressure group compared with 10% in the low-pressure group.

Their mean pain scores at 8 hours were 3.5 ± 0.76 and 2.2 ± 1.1 , respectively, while at 24 hours the scores were 0.64 ± 0.74 and 0.2 ± 0.45 . Sandhu et al. (2009) [14] also reported postoperative shoulder pain in 28.57% of patients in the standard-pressure group compared with only 7.14% in the low-pressure group. Celik et al. (2010) [15] reported reduced analgesic requirement and lower pain intensity with low intra-abdominal pressure. In the present study, the mean time to first ambulation was 8.6 ± 2.4 hours, the mean time to oral intake was 7.2 ± 2.1 hours, and the mean duration of hospital stay was 2.4 ± 0.8 days. Higher pain scores were significantly associated with delayed ambulation ($r = 0.61$, $p < 0.001$), delayed oral intake ($r = 0.49$, $p < 0.001$), and prolonged hospital stay ($r = 0.58$, $p < 0.001$). Rescue analgesia was required in 34% of patients and postoperative nausea and vomiting occurred in 28%. Yasir et al.

(2012) [13] reported that the mean hospital stay was 1.21 ± 0.36 days in the standard-pressure group compared with 1.1 ± 0.45 days in the low-pressure group. They also found that analgesic injections were higher in the standard-pressure group (2.71 ± 0.50) than in the low-pressure group (2.2 ± 0.45). Esmat et al. (2006) [16] reported pain scores of 3.0, 3.9, and 2.5 at 6, 12, and 24 hours in the standard-pressure group compared with 2.0, 3.0, and 1.29 in the low-pressure group. Overall findings showed that lower postoperative pain scores were associated with earlier ambulation, earlier oral intake, shorter hospital stay, and better overall recovery following gallbladder surgery. Postoperative pain management had a significant impact on recovery following gallbladder surgery. Patients with lower pain scores showed earlier ambulation, earlier oral intake, shorter hospital stay, and reduced need for rescue analgesia. Multimodal pain management strategies, particularly TAP block with paracetamol, were associated with better pain control and improved recovery outcomes. Overall findings suggested that effective postoperative pain management played an important role in enhancing patient recovery and satisfaction after gallbladder surgery.

Limitation of the Study

The study was limited by its single-center design and relatively small sample size of 100 patients, which may have affected the generalizability of the findings. Follow-up was restricted to the immediate postoperative period, without assessment of long-term pain or quality of life. Individual variations in pain perception, psychological factors, and comorbidities were not separately evaluated. Differences in surgical duration, surgeon expertise, and exact analgesic regimens may also have influenced postoperative outcomes.

Conclusion

Effective postoperative pain management played an important role in improving recovery after gallbladder surgery. Patients with better pain control experienced earlier ambulation, earlier oral intake, shorter hospital stay, and reduced need for rescue analgesia. Among the different pain management strategies, multimodal analgesia and TAP block with paracetamol provided superior pain relief compared to conventional analgesic methods. Overall findings suggested that adequate postoperative pain management significantly enhanced patient comfort, recovery, and satisfaction following gallbladder surgery.

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