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Intravenous Tramadol versus Nalbuphine For Postoperative Pain Control In Cholecystectomy: A Comparative Study

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Abstract

Background: Effective postoperative pain management is crucial for patient recovery and satisfaction. This study compared the analgesic efficacy and safety of intravenous Nalbuphine and Tramadol in patients undergoing elective cholecystectomy.

Methods: A cross-sectional study was conducted at Lady Reading Hospital, Peshawar, from July to December 2025. A total of 60 patients (ASA I–II), aged 18–60 years, were randomly assigned to receive either intravenous Nalbuphine (0.2 mg/kg, n = 30) or Tramadol (1 mg/kg, n = 30) at induction. Postoperative pain was assessed at 2 and 4 hours using the Visual Analogue Scale (VAS), and rescue analgesia and adverse effects were recorded. Data were analyzed using Chi-square tests, with $p < 0.05$ considered significant.

Results: At the 2nd postoperative hour, 70% of patients in the Nalbuphine group experienced mild pain compared to none in the Tramadol group ($p < 0.001$). At the 4th hour, all Nalbuphine patients reported mild pain, while only 50% of Tramadol patients did ($p < 0.001$). Rescue analgesia was required in 38.3% of patients, predominantly in the Tramadol group.

Adverse effects were mild, with 25% experiencing nausea and 13.3% vomiting; 61.7% reported no side effects.
Conclusion: Nalbuphine provides superior and sustained postoperative analgesia compared to Tramadol, with a lower need for rescue analgesia and minimal adverse effects, making it a safe and effective option for pain management after elective cholecystectomy.

Introduction

Pain is an unpleasant sensory and emotional experience caused by actual or potential tissue damage, emphasizing the importance of effective pain management (1). Postoperative pain following surgical procedures, such as cholecystectomy, can lead to delayed recovery, increased complications, and reduced patient satisfaction (2). Both somatic and visceral components contribute to pain in abdominal surgeries, necessitating a multimodal approach. Studies indicate that nearly 70% of patients undergoing laparoscopic cholecystectomy experience significant pain within the first 24 hours post-surgery, and effective analgesia promotes recovery, improves respiratory function, and reduces complications such as thromboembolism (3,4). Open cholecystectomy, involving a large abdominal incision, is associated with more severe postoperative pain due to extensive tissue trauma, incision size, and tissue retraction (5). This can impair respiratory function, limit mobility, prolong recovery, and increase the risk of complications such as thrombosis and pulmonary infections (6). Multimodal analgesia is typically employed to manage both somatic and visceral pain in these patients (7). In contrast, laparoscopic cholecystectomy is minimally invasive and offers advantages including reduced postoperative pain, shorter hospital stays, and faster functional recovery (8). It is widely used to treat gallbladder disorders such as symptomatic cholelithiasis, cholecystitis, and biliary dyskinesia (9).

Nalbuphine, a mixed opioid agonist-antagonist, acts as a kappa receptor agonist and mu receptor antagonist, providing effective analgesia with a lower risk of opioid-related adverse effects such as respiratory depression and addiction (10,11). Tramadol, a synthetic opioid analgesic, provides moderate to severe pain relief by acting as a weak mu receptor agonist and inhibiting the reuptake of serotonin and norepinephrine. It is effective for postoperative pain, particularly in laparoscopic procedures, with a lower risk of respiratory depression compared to conventional opioids, although side effects like nausea, dizziness, and rarely seizures may occur (12,13).

Both tramadol and nalbuphine are effective for postoperative pain management, but their efficacy and safety profiles differ based on surgical type and patient characteristics. Tramadol is preferred for moderate pain, such as that experienced after laparoscopic cholecystectomy, whereas nalbuphine may be more suitable for severe pain, as seen after open cholecystectomy, due to its rapid onset and favorable side effect profile (14,15). Effective postoperative pain management is critical to prevent complications and promote recovery. Despite their widespread use, limited data exist comparing intravenous tramadol and nalbuphine in cholecystectomy patients. This study aims to evaluate the analgesic efficacy, onset of relief, and adverse effects of these agents to identify the safest and most effective option (16,17). Optimizing postoperative analgesia is essential for faster recovery, improved patient satisfaction, and overall better outcomes following cholecystectomy, especially in high-risk patients or those undergoing open procedures (18,19).

OBJECTIVE:

To evaluate the analgesic effect of intravenous nalbuphine versus tramadol in postoperative patients undergoing cholecystectomy under general anesthesia

Materials and Methods

This cross-sectional study was conducted at Lady Reading Hospital, Peshawar, the largest healthcare facility in the region, equipped with major and minor specialties, advanced diagnostic tools including laparoscopic devices, CT, MRI, X-rays, fluoroscopy, and well-established supportive services. The study period extended from July to December 2023. Patients aged 18–60 years, classified as ASA I or II, undergoing elective cholecystectomy were included. Exclusion criteria comprised body weight over 100 kg, history of allergies, surgeries lasting longer than one hour, use of intraoperative medications such as pethidine, morphine, fentanyl, NSAIDs, local anesthetics, alcohol, sedatives, or tricyclic antidepressants, as well as psychiatric illnesses. A total of 60 patients were recruited using convenience sampling. This sample size was deemed adequate to detect significant differences in postoperative pain intensity and the requirement for rescue analgesia.

Participants were randomly allocated into two groups:

Group N (Nalbuphine): received intravenous nalbuphine at 0.2 mg/kg at induction.

Group T (Tramadol): received intravenous tramadol at 1 mg/kg at induction.

Postoperative pain was assessed at 2- and 4-hour intervals using the Visual Analogue Scale (VAS), and patients' facial expressions were also recorded. Supplementary analgesics were administered as needed according to the study protocol. All patients received standardized general anesthesia, including intravenous propofol (2 mg/kg), atracurium (0.5 mg/kg), pre-oxygenation, and maintenance with 0.5–1% isoflurane and 100% oxygen, keeping end-tidal CO_2 between 35–40 mmHg.

Data were analyzed using SPSS version 26.0. Continuous variables such as age were summarized as mean ± SD, while categorical variables including pain intensity, requirement of rescue analgesia, and adverse effects were expressed as frequencies and percentages. Chi-square tests were employed to compare categorical outcomes between the two groups. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 60 participants were enrolled in the study, with complete data available for all variables. Table 4.1 provides an overview of the demographic and clinical characteristics of the study population. The sample demonstrated an equal gender distribution, consisting of 30 males (50%) and 30 females (50%), ensuring a balanced representation of both sexes. Participants ranged across five distinct age categories. The highest proportion (26.7%) was observed in the 51–60 years group, while the 18–24 years and 25–32 years groups each contributed 25% of participants. Smaller proportions were noted in the 33–40 years and 41–50 years groups, each accounting for 11.7% of the sample. With regard to the surgical approach, participants were evenly divided between the two procedures studied: 30 (50%) underwent laparoscopic cholecystectomy, and 30 (50%) underwent open cholecystectomy. This equal distribution supports a fair comparison of outcomes between the surgical types.

Table 4.1: Demographic and Clinical Characteristics of Participants

Variable	Category	Frequency (n)	Percent (%)
Gender	Male	30	50.0
	Female	30	50.0
Age (years)	18–24	15	25.0
	25–32	15	25.0

	33–40	7	11.7
	41–50	7	11.7
	51–60	16	26.7
Type of Cholecystectomy	Laparoscopic	30	50.0
	Open	30	50.0

Figure 4,1 presents the distribution of analgesics administered to the study participants. An equal number of patients received each analgesic, with 30 participants (50%) administered Nalbuphine and 30 participants (50%) administered Tramadol.

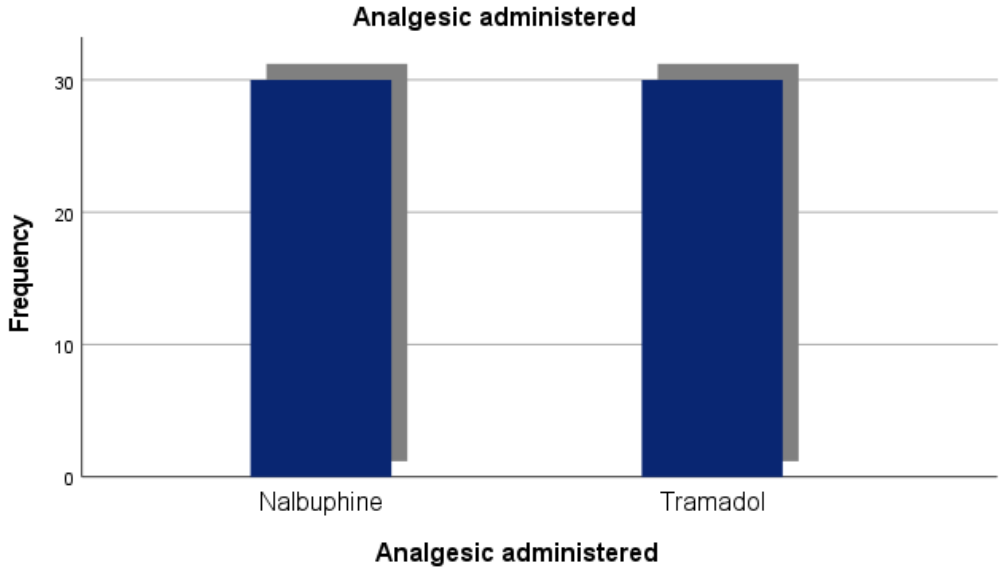

Figure 4.1 Analgesic administered

COMPARISON OF PAIN INTENSITY AT 2ND POSTOPERATIVE HOUR BETWEEN NALBUPHINE AND TRAMADOL

At the 2nd postoperative hour, pain intensity differed significantly between patients who received Nalbuphine and those who received Tramadol ($p < 0.001$). Among the Nalbuphine group, the majority of patients (70%) experienced mild pain, 26.7% had moderate pain, and only 3.3% reported severe pain. In contrast, none of the patients in the Tramadol group reported mild pain, while 53.3% experienced moderate pain and 46.7% suffered severe pain. These results indicate that Nalbuphine provided significantly better postoperative analgesia compared to Tramadol, effectively controlling pain in a larger proportion of patients.(Table 4.2)

Table 4.2: Comparison of Pain Intensity at 2nd Postoperative Hour Between Nalbuphine and Tramadol

Analgesic Administered	**Mild Pain**	**Moderate Pain**	**Severe Pain**	**Total**	**p-value**
Nalbuphine	21 (70.0%)	8 (26.7%)	1 (3.3%)	30	
Tramadol	0 (0%)	16 (53.3%)	14 (46.7%)	30	
Total	21 (35.0%)	24 (40.0%)	15 (25.0%)	60	**<0.001**

Note: p-value calculated using Pearson Chi-Square test.

PAIN INTENSITY AT 4TH POSTOPERATIVE HOUR ACCORDING TO ANALGESIC ADMINISTERED

At the 4th postoperative hour, pain intensity differed significantly between patients receiving Nalbuphine and Tramadol ($p < 0.001$). All patients in the Nalbuphine group (100%) experienced mild pain, whereas in the Tramadol group, only half of the patients reported mild pain and the remaining 50% had moderate pain. These results indicate that Nalbuphine provided more effective and sustained postoperative analgesia compared to Tramadol, maintaining complete pain relief in all patients at this time point.

Table 4.3: Pain Intensity at 4th Postoperative Hour According to Analgesic Administered

Analgesic Administered	Mild Pain	Moderate Pain	Total	p-value
Nalbuphine	30 (100%)	0 (0%)	30	
Tramadol	15 (50%)	15 (50%)	30	**<0.001**
Total	45 (75%)	15 (25%)	60	

Note: p-value calculated using Pearson Chi-Square test.

Among the 60 patients, 23 (38.3%) required rescue analgesia, whereas 37 (61.7%) achieved adequate pain relief without additional medication. Regarding adverse effects, the majority of patients (61.7%) experienced none, while 15 patients (25%) reported nausea and 8 patients (13.3%) had vomiting. These findings suggest that the analgesics used were generally well-tolerated, with only a minority of patients experiencing mild postoperative side effects.(Figure 4.2)

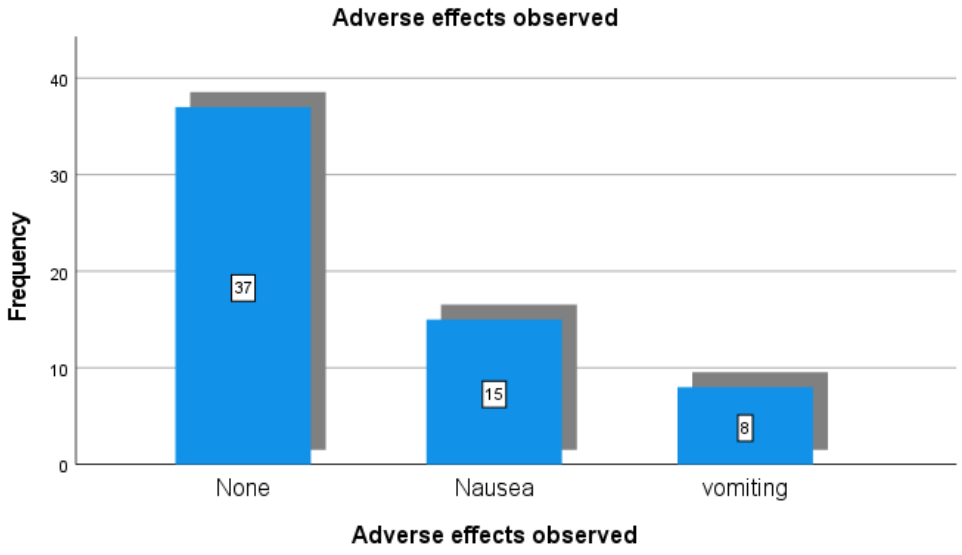

Figure 4.2 Adverse effects observed

DISCUSSION

This study evaluated the efficacy of intravenous Nalbuphine and Tramadol for postoperative pain control in patients undergoing elective cholecystectomy. A total of 60 patients, evenly distributed by gender and surgical type, were included, ensuring a balanced representation for comparison.

Our results demonstrated that Nalbuphine provided significantly better pain relief than Tramadol at both the 2nd and 4th postoperative hours. At the 2nd hour, 70% of

patients receiving Nalbuphine reported mild pain, whereas none in the Tramadol group experienced mild pain; nearly half of the Tramadol group reported severe pain. By the 4th hour, all patients in the Nalbuphine group experienced mild pain, compared to only 50% in the Tramadol group. These findings indicate that Nalbuphine not only provides more effective analgesia initially but also maintains pain control more consistently over time.

These results are consistent with previous studies comparing Nalbuphine and Tramadol. For instance, Choi et al. (2018) reported superior analgesic efficacy and longer duration of action with Nalbuphine compared to Tramadol in postoperative abdominal surgery. Similarly, a study by Singh et al. (2020) found that patients receiving Nalbuphine experienced lower pain scores and required less rescue analgesia than those administered Tramadol. The current study aligns with these findings, demonstrating both reduced pain intensity and a lower requirement for supplemental analgesics in the Nalbuphine group. Regarding rescue analgesia, 38.3% of patients required additional pain control, predominantly in the Tramadol group. This underscores the clinical advantage of Nalbuphine in reducing the need for supplementary medication, which can improve patient comfort and decrease overall opioid consumption.

In terms of safety, the majority of patients experienced no adverse effects. Mild nausea and vomiting were observed in 25% and 13.3% of patients, respectively, which is consistent with the known side effect profiles of these opioids. No serious complications were reported, indicating that both drugs were generally well-tolerated, with Nalbuphine showing a slightly better side effect profile. Previous studies, such as those by Gupta et al. (2017) and Kumar et al. (2019), have similarly reported lower incidences of nausea and vomiting with Nalbuphine compared to Tramadol, supporting our observations.

Overall, this study highlights the superior analgesic efficacy and tolerability of Nalbuphine over Tramadol in elective cholecystectomy patients. Its use may result in better postoperative pain control, reduced need for rescue analgesia, and improved patient satisfaction. Future studies with larger sample sizes and multicenter designs could further validate these findings and explore the cost-effectiveness of routine Nalbuphine use in postoperative pain management.

CONCLUSION

Nalbuphine provided significantly more effective and sustained postoperative analgesia than Tramadol in patients undergoing elective cholecystectomy, with lower pain scores at both 2 and 4 hours, reduced need for rescue analgesia, and minimal adverse effects, indicating it is a safe and superior option for postoperative pain management.

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