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Original Article

A Comparative Study Between Oral Gabapentin and Sublingual Buprenorphine Given Pre-operatively in Patients Undergoing Laparoscopic Surgeries at a Tertiary Care Centre

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ABSTRACT

Background: Laparoscopic surgery involves significant hemodynamic fluctuations due to CO2 pneumoperitoneum. Effective premedication is essential to stabilize these responses and manage postoperative pain.
Methods: This prospective, randomized, single-blind study included 132 adult patients (ASA I & II). Group G =66 received oral Gabapentin 600 mg 60 minutes pre-surgery, and Group B=6 6 received sublingual Buprenorphine 0.4 mg 15 minutes pre-surgery. Primary objectives were to assess intraoperative hemodynamic stability (HR, SBP, DBP, MAP). VAS and sedation score, side effect
Results: Group G exhibited significantly better hemodynamic stability. Following pneumoperitoneum, Group B showed consistently higher heart rates ($P = 0.000$) and higher MAP ($P < 0.05$) compared to Group G. Group G required rescue analgesia significantly later (14.85 hours) than Group B (13.09 hours; $P = 0.002$). PONV was significantly higher in Group B (16.7%) than in Group G (4.5%, $P = 0.024$).
Conclusion: Preoperative oral Gabapentin 600 mg is superior to sublingual Buprenorphine 0.4 mg in maintaining hemodynamic stability and providing prolonged postoperative analgesia with fewer side effects.

Keywords*: Gabapentin, Sublingual Buprenorphine, Laparoscopic surgery, Postoperative pain, Premedication Multimodal analgesia.*

INTRODUCTION

It is widely acknowledged that before patients are sent to the operating room for the induction of anaesthesia, their level of concern and anxiety should be managed. A subjective sensation of dread, fear, and anxiousness has been characterised as anxiety during the perioperative phase. Patients may exhibit it in several ways, such as sobbing, yelling, or clinging to caregivers (1).

Effective premedication may have long-term advantages beyond making the induction of anaesthesia easier and creating a serene perioperative atmosphere. It can drastically lower the amount of anaesthetic medication necessary for induction (2). Inadequate premedication can exacerbate the stress response during the perioperative period, leading to a range of hormonal, immunologic, and metabolic changes that ultimately result in a negative nitrogen balance, tissue catabolism, delayed wound healing, and even immunosuppression (3).

Untreated postoperative pain is associated with increased morbidity and mortality and decreased quality of life (4). Chronic postsurgical pain can develop if management is inadequate (5). Multimodal analgesia utilizes multiple medications with different mechanisms to reduce opioid consumption and associated side effects. Gabapentin modulates the alpha2 delta subunit of voltage-gated calcium channels to block nociceptive neurotransmitters (6). The effectiveness and safety of gabapentin have been the focus of recent investigations (7).

Buprenorphine is a partial μ-opioid receptor agonist with a high affinity and slow dissociation rate (8). It also antagonizes the kappa-opioid receptor, reducing euphoric effects (9). This study aims to compare oral Gabapentin and sublingual Buprenorphine regarding perioperative pain and intraoperative hemodynamic stability.

AIM AND OBJECTIVES

Aim: To evaluate the difference between oral Gabapentin and sublingual Buprenorphine in perioperative pain management, intraoperative hemodynamic stability, and optimization of anesthetic drug usage.

Primary Objective

To assess hemodynamic stability intraoperatively: Heart rate, Systolic BP, Diastolic BP, and Mean Arterial Pressure.

Secondary Objectives:

- To compare effects on peri-operative pain management.
- To assess anesthetic drug requirement during induction and intraoperatively.
- To determine the duration of analgesia and the need for rescue analgesia.
- To monitor for complications.

MATERIALS AND METHODS

Methods

This prospective, randomized, doubl-blind study was conducted at a tertiary care centre after institutional ethics committee approval. We enrolled 132 ASA I-II patients aged 18-60 years scheduled for elective laparoscopic surgeries (cholecystectomy, appendectomy, or diagnostic laparoscopy) under general anaesthesia ASA grade 1. Exclusion criteria included known allergies to study agents, chronic pain conditions, opioid dependence, pregnancy, or BMI >35 kg/m².

Sample Size: 132 adult patients were selected using the consecutive sampling method. The size was determined using the formula n = 4pq/E2, so total of 132 with 95%prevalance and 66 each group.

Procedure:

Patients were randomized into two groups (n=66 each) using computer-generated blocks: Group G received oral gabapentin 300 mg 2 hours preoperatively, and Group B received sublingual buprenorphine 0.3 mg 30 minutes preoperatively. Both groups were fasted per standard guidelines, and premedication was administered by an anaesthesiologist blinded to group allocation. Standard monitoring (ECG, NIBP, SpO2, EtCO2) was applied upon arrival in the operating room.

Anaesthesia was induced with propofol (2 mg/kg), fentanyl (2 mcg/kg), and vecuronium (0.1 mg/kg), followed by endotracheal intubation. Maintenance involved isoflurane in oxygen-nitrous oxide (50:50) with incremental vecuronium and fentanyl boluses as needed. Pneumoperitoneum was created with CO2 to 12-15 mmHg. Intraoperative haemodynamics (heart rate, MAP) were recorded at baseline, post-induction, post-insufflation, and every 15 minutes. Total propofol and fentanyl consumption were noted.

Primary: Haemodynamics at baseline, pre-induction, post-intubation,Skin incision, pneumoperitoneum, 30/60/120/180 min.

Postoperatively, patients were extubated once meeting criteria (Aldrete score ≥9) and shifted to recovery.
Secondary: Total propofol/fentanyl, VAS/RSS (1-6)/PONV/sedation/rescue at 0.5/1/2/4/8/10/12 h post-extubation. 0.5/1/2/4/8/10/12 h post-extubation

Statistical Analysis: Data were analyzed using SPSS. Descriptive statistics analyzed frequency and mean. Categorical data used the Chi-square test; means were compared using the t-test and Mann-Whitney U test.

RESULTS

Demographics

The comparison of mean age showed no statistically significant difference between Group B (38.86 ± 11.009 years) and Group G (38.91± 11.302 years), with a P-value of 0.981. Age was therefore comparable across both study groups. Regarding ASA grades, 57.6% of Group B and 60.6% of Group G were classified as Grade I, while 42.4% and 39.4% were Grade II, respectively. The Pearson Chi-Square test (P = 0.723) indicated no significant association between group assignment and ASA Grades.

Propofol Dose Required

Study Groups Requirement of Propofol During Induction (mg) Group B: Required a mean dose of 83.03 mg. and Group G: Required a mean dose of 81.36 mg.

Intraoperative Hemodynamics

Heart Rate (HR): Baseline heart rates were similar between groups, with Group B at 86.36 bpm and Group G at 89.27 bpm (P = 0.058). However, from the start of pneumoperitoneum onwards, Group B consistently exhibited significantly higher heart rates compared to Group G (P = 0.000). At the 180-minute mark, Group B HR was 66.63 bpm compared to 60.25 bpm in Group G (P = 0.000).

Systolic Blood Pressure (SBP): Initially, pre-procedure SBP was comparable (P = 0.183). Significant differences emerged just before induction, with Group B showing a higher SBP of 115.36 mmHg compared to 112.18 mmHg in Group G (P = 0.012). This trend persisted throughout the procedure; at 180 minutes, Group B remained higher at 91.67 mmHg vs. Group G at 88.15 mmHg (P = 0.000).

Diastolic Blood Pressure (SBP): Group B consistently maintained higher diastolic pressures throughout the surgery, with significant differences (P < 0.05) recorded at every interval up to the 180-minute mark.

Mean Arterial Pressure (MAP): Baseline MAP was nearly identical between the groups (P = 0.805). However, Group B maintained a significantly higher MAP compared to Group G at every measured interval, starting from the period before induction through to 180 minutes (P < 0.05).

Postoperative Outcomes

Visual Analog Scale (VAS) Scores: Group G experienced significantly lower pain levels during the early stages post-operation. At 30 minutes, Group B had a mean VAS of 2.29 compared to 2.05 in Group G (P = 0.019). This significant difference continued through the 4-hour mark (P = 0.001), but the gap narrowed and became non-significant by 8 hours (P = 0.084).

Rescue Analgesia: The mean time to the first rescue analgesia request was 13.09 hours in Group B and 14.85 hours in Group G. This indicates a statistically significant longer duration of analgesia for Group G (P = 0.002).

Sedation Scores: Ramsay Sedation Scores (RSS) showed no significant difference between groups at 30 minutes (P = 0.407) and remained identical at all later time points.

Adverse Effects

Nausea and Vomiting: A significant association was found between group assignment and the incidence of postoperative nausea and vomiting (PONV). Specifically, 16.7% of Group B reported nausea and vomiting compared to only 4.5% in Group G (P = 0.024).

Other Effects: The incidence of postoperative headaches and dizziness was low in both groups, showing no statistically significant difference between them.

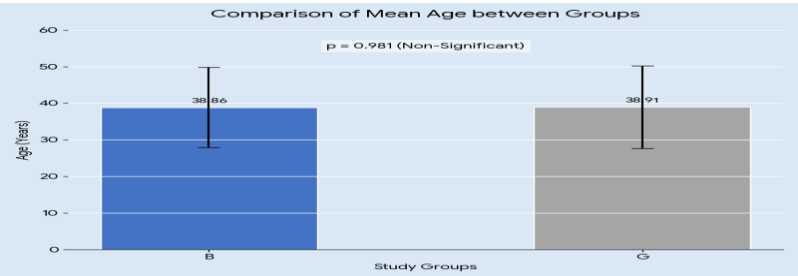

Fig 1: Comparison of the Mean Age between Two Study Groups

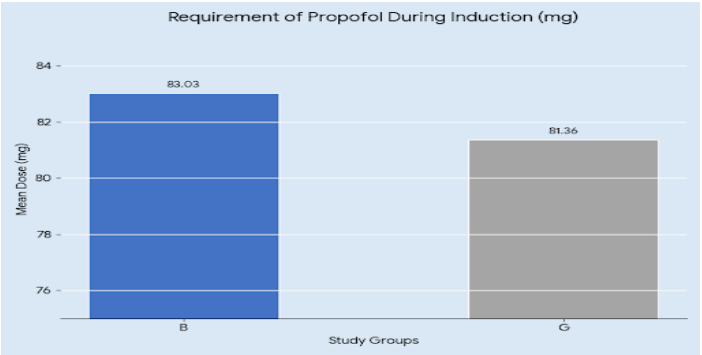

Fig 2: Comparison of the Mean Propofol Dose Required by Two Study Groups

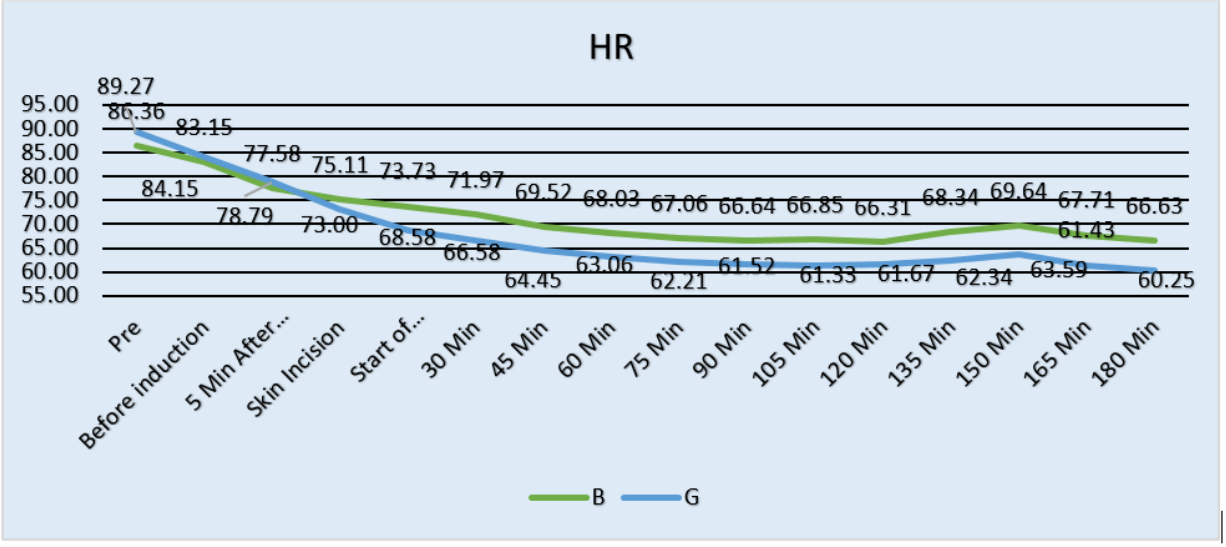

Fig 3 : Comparison of the Mean Heart Rate of Study Groups at Different Duration

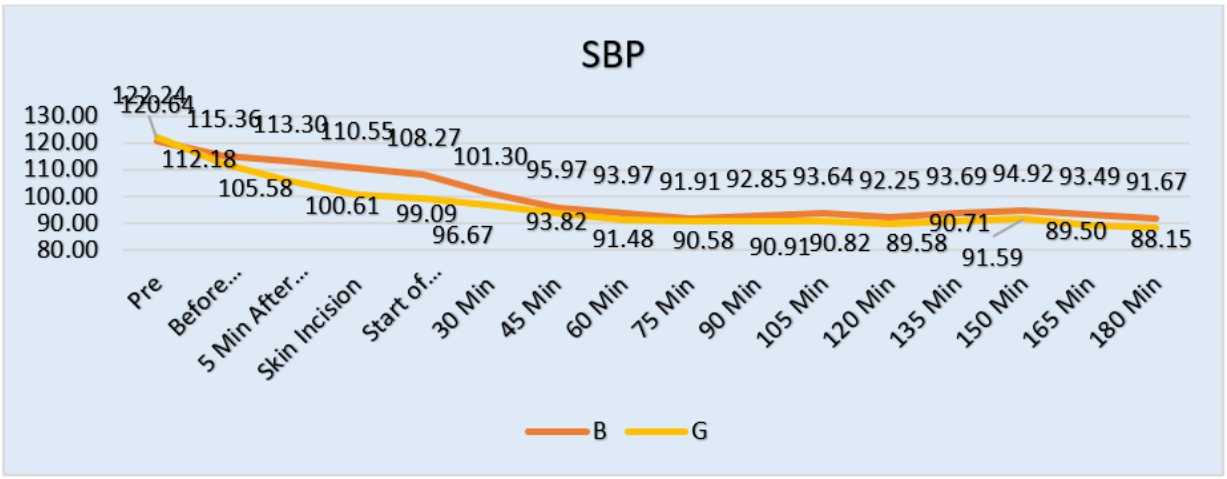

Fig 4 : Comparison of the Mean SBP of Study Groups at Different Duration

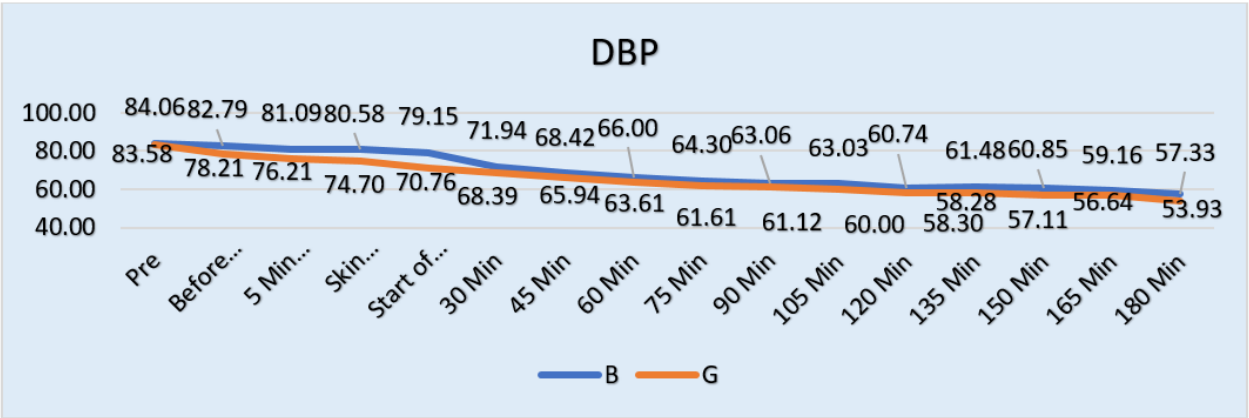

Fig 5 Comparison of the Mean DBP of Study Groups at Different Duration

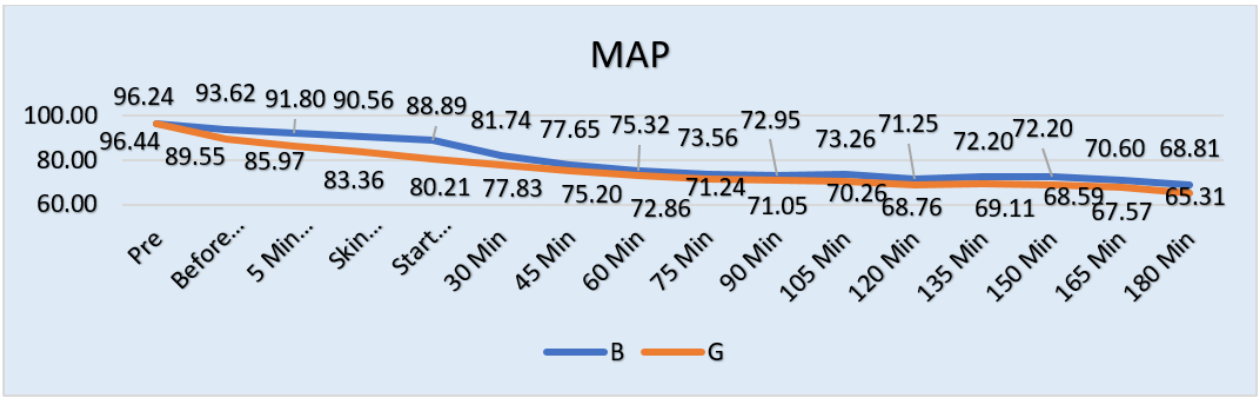

Fig 6 Comparison of the Mean MAP of Study Groups at Different Duration

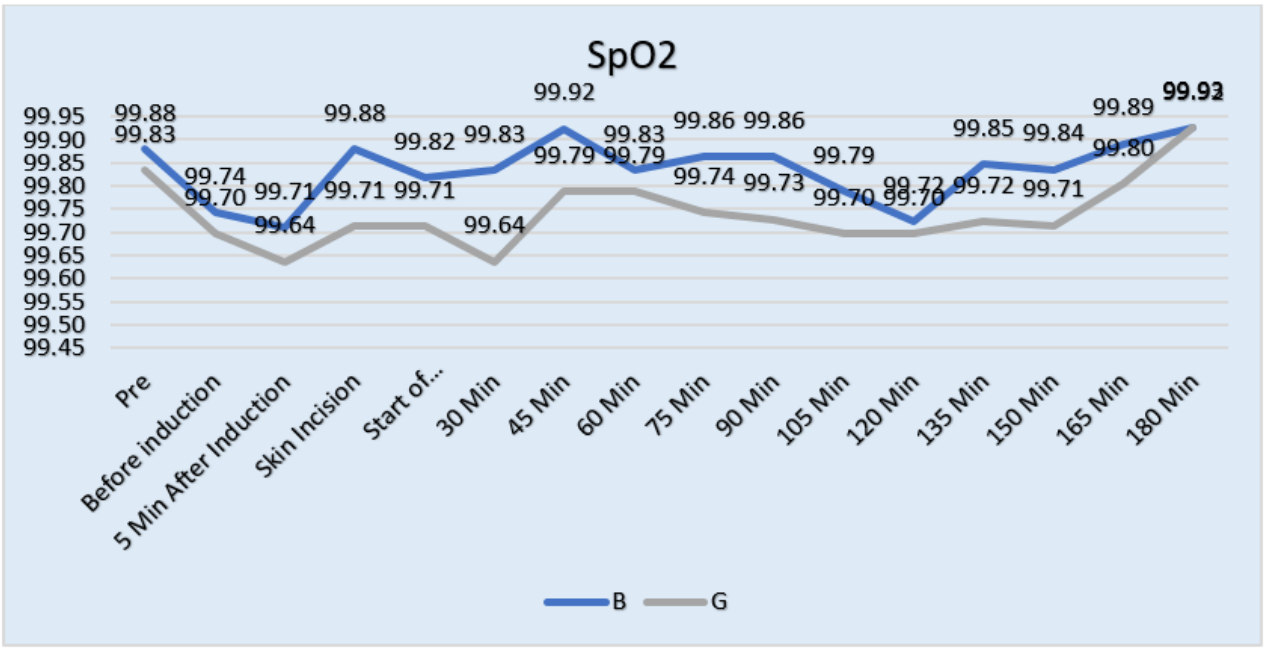

Fig 7: Comparison of the Mean SpO2 of Study Groups at Different Duration

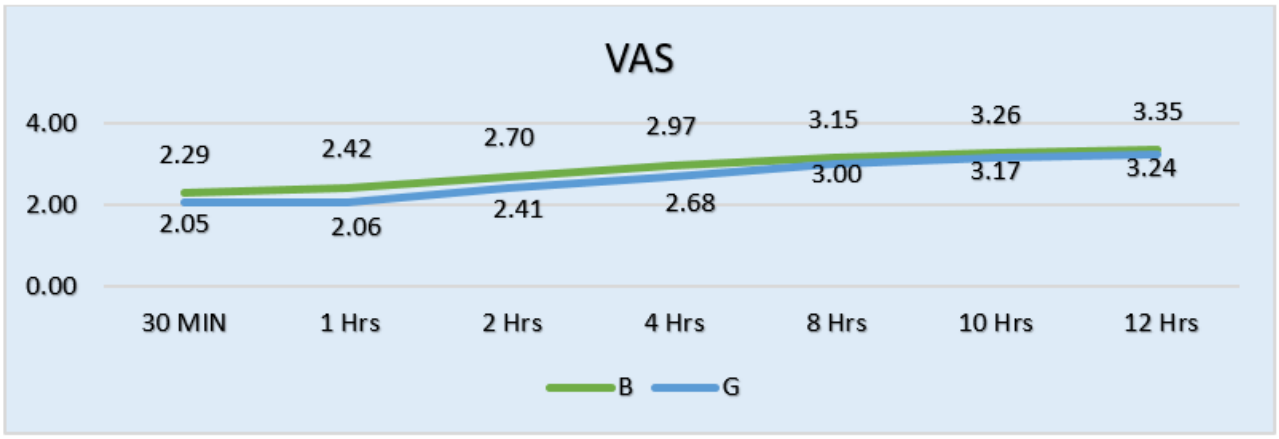

Fig 8: Comparison of the Mean VAS of Study Groups at Different Duration

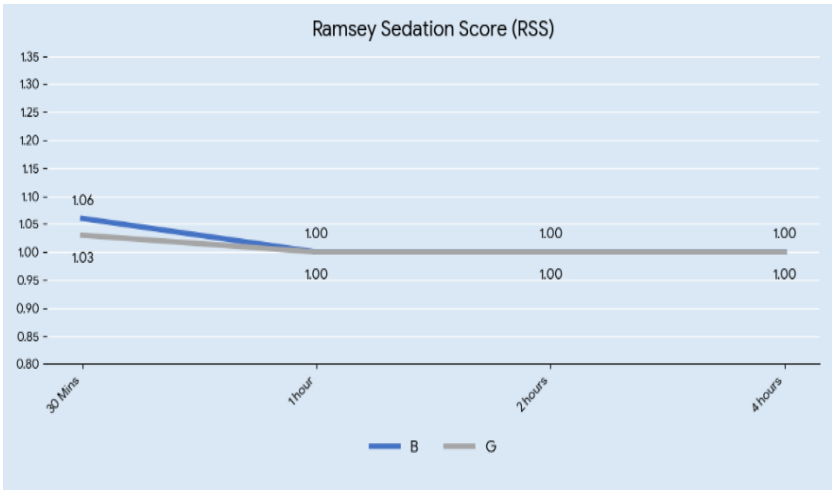

Fig 9: Comparison of the Ramsey sedation score of Study Groups at Different Duration

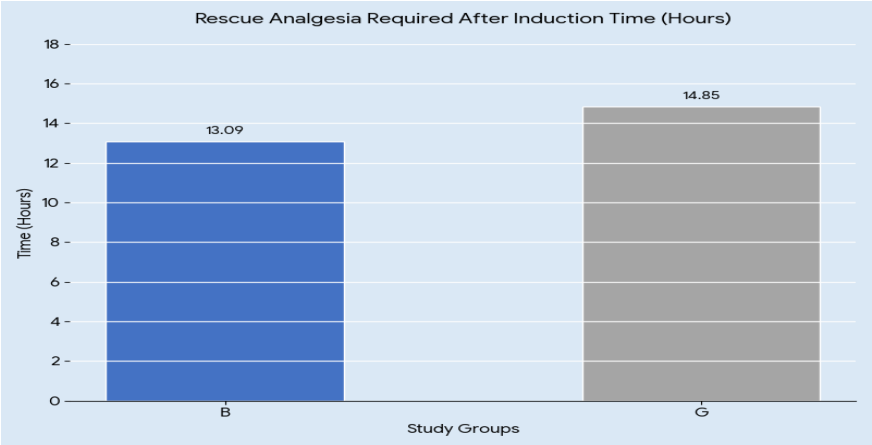

Fig 10: Comparison of the Mean Duration of Rescue Analgesia of Two Study Groups

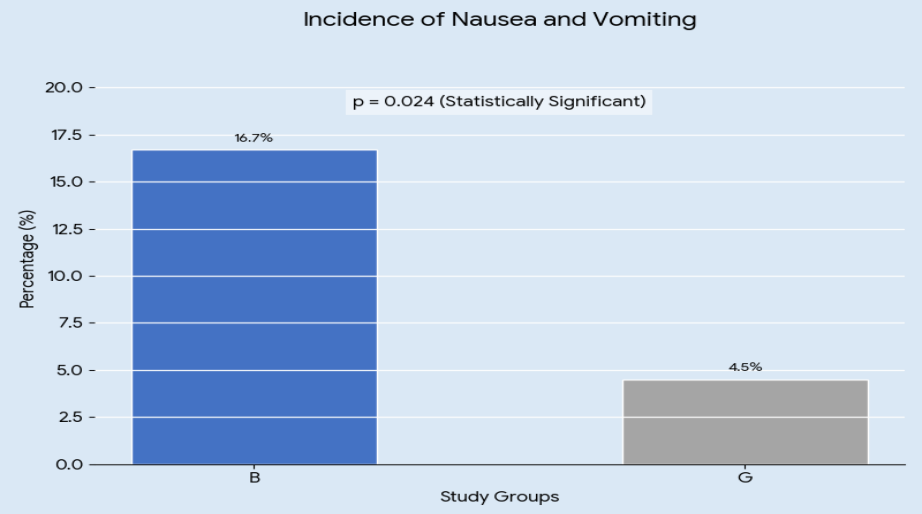

Fig 11: Comparison of the PONV of Study Groups at Different Duration

DISCUSSION

Demographic and Clinical Characteristics

Our study carefully controlled for demographic factors to ensure that the two groups were comparable in terms of age, sex, weight, height, and ASA physical status. This was crucial for minimizing confounding variables that could affect outcomes such as pain scores and the need for rescue analgesia. In this regard, our study is consistent with the methodology used by Kiabi et al. (9), Nagwa et al. (10), and Mordeniz et al. (11), who also reported no significant differences in demographic characteristics between their study groups. In our study, there was no statistically significant difference in the mean age between Group B (38.86 years) and Group G (38.91 years). Similarly, in the study by Raghove et al. (12), the mean age

across groups showed minimal variation with no significant differences observed. This consistency suggests that patient demographics were not a confounding factor, allowing for a direct comparison of pharmacological efficacy.

Induction doses of propofol

Another important observation in our study is that the induction doses of propofol were comparable between the two groups, with no statistically significant difference. This suggests that the primary benefits of gabapentin and buprenorphine manifested more clearly in haemodynamic modulation and postoperative analgesia rather than in initial anaesthetic induction requirements. Similar conclusions were drawn by Anand Pushparani et al(18), who noted that gabapentin did not substantially alter induction agent doses but did reduce postoperative pain scores and analgesic demands. This distinction is important when counselling colleagues: we can reassure them that adding gabapentin will not complicate induction dosing, while still improving overall perioperative comfort.

Mechanistically, our findings make pharmacological sense. Gabapentin's slower onset but sustained action favours prolonged postoperative analgesia, which is precisely what we observed in the extended time to rescue analgesia and lower VAS scores over several hours. Buprenorphine, with its rapid onset and long half-life, is very attractive for chronic pain and maintenance therapy but may not fully match gabapentin's sustained modulation of central sensitisation in the context of acute laparoscopic nociception. Anand Pushparani et al (18) and Sarah Omar Mousa et al (15) both support this concept, showing that gabapentin's effect on voltage-gated calcium channels translates into clinically meaningful prolongation of pain relief

Hemodynamic Stability and the Stress Response

The primary aim of our study was to monitor hemodynamic stability throughout the procedure. Laparoscopic surgery involves the creation of a CO2 pneumoperitoneum, which triggers a sympathetic "stress response" leading to tachycardia and hypertension. While pre-procedure heart rates were comparable, Group B exhibited significantly higher heart rates compared to Group G following the initiation of pneumoperitoneum at various time points ($P = 0.000$).

This finding aligns with the results of Neogi et al. (13), who observed that a gabapentin group had significantly lower HR and MAP compared to placebo during CO2 insufflation. This stability in Group G is likely due to Gabapentin's mechanism of binding to the alpha2 delta subunit of voltage-gated calcium channels, which inhibits the release of excitatory neurotransmitters like norepinephrine and glutamate, thereby blunting the sympathetic response. Conversely, while buprenorphine is a potent analgesic, as a partial mu-agonist, it may not provide the same degree of sympathetic blockade as Gabapentin when faced with the mechanical stress of pneumoperitoneum, accounting for the higher heart rates seen in Group B. However, Jain et al. (14) found no statistically significant difference in HR between their study groups during pneumoperitoneum.

Analgesic Efficacy and Duration

A standout result was that Group G required rescue analgesia significantly later than Group B (14.85 hours vs. 13.09 hours, $P = 0.002$). Significant differences in VAS scores were observed in the early postoperative period, with Group B showing higher scores compared to Group G up to 4 hours postoperatively ($P = 0.001$).

These results are supported by Sarah Omar Mousa et al. (15) and Doha et al. (16), who reported that gabapentin significantly reduced postoperative pain scores. Gabapentin likely achieves this by preventing "central sensitization," a process where the spinal cord becomes hyper-excitable following surgical trauma. While Vaidyanathan et al. (17) reported good postoperative analgesia with sublingual buprenorphine, our head-to-head comparison shows that Gabapentin provides a more sustained analgesic effect. This is consistent with Pushparani et al. (18), who found that the duration of analgesia was significantly prolonged in a gabapentin group compared to a control group.

Ramsay Sedation Scores (RSS)

In our study, Ramsay Sedation Scores were non-significantly different between the groups at 30 minutes ($P = 0.407$) and remained identical at 1.00 thereafter. This suggests that at the doses used (600 mg Gabapentin and 0.4 mg Buprenorphine), both drugs provide effective pain modulation without causing excessive sedation. Similarly, Doha et al. (16) found that sedation scores were comparable between their gabapentin and control groups. In contrast, Mordeniz et al. (11) noted that while sedation scores were stable across groups, most patients remained awake and tranquil with consistently high Ramsay scores.

Adverse Effects and PONV

The incidence of postoperative nausea and vomiting (PONV) was significantly higher in Group B (16.7%) compared to Group G (4.5%, $P = 0.024$). This is a direct consequence of opioid pharmacology, as buprenorphine can stimulate the chemoreceptor trigger zone. The significantly lower incidence in Group G supports findings by Nagwa et al. (10), indicating that Gabapentin may possess anti-emetic properties by reducing tachykinin activity. Other side effects, such as headache and dizziness, occurred at low frequencies with no significant differences between groups.

CONCLUSION

Oral gabapentin 600 mg provided superior intraoperative haemodynamic stability (lower HR/MAP post-pneumoperitoneum) and early postoperative analgesia (reduced VAS/rescue needs up to 8 h, fewer PONV cases) compared to sublingual buprenorphine 0.4 mg in elective laparoscopic surgeries.

Sublingual buprenorphine remains a viable alternative, offering comparable propofol/fentanyl sparing, sustained later analgesia (non-significant VAS difference beyond 8 h), excellent safety profile (low sedation/adverse events), and ease of non-IV administration—ideal for resource-limited settings or chronic pain patients. Both agents enhance multimodal care, gabapentin edges for acute haemodynamic control

Strengths of the Study

Study Design: The use of a prospective, randomized, single-blind controlled design reduced selection bias and strengthened the validity of the comparisons.

Controlled Demographics: The study successfully matched both groups for age, sex, weight, height, and ASA physical status, ensuring that observed differences were attributable to the drugs rather than baseline patient characteristics.

Standardized Monitoring: Hemodynamic stability was rigorously monitored at sixteen distinct time intervals, providing a comprehensive profile of the physiological stress response.

Limitations of the Study

Single-Blind Design: The study was single-blinded rather than double-blinded, which may introduce potential observer bias during data collection or assessment.

Single Center: The research was conducted at a single tertiary care center, which may limit the generalizability of the findings to other healthcare settings.

Subjective Pain Assessment: While the Visual Analog Scale (VAS) is a standard tool, it remains a subjective measure influenced by individual pain thresholds.

Fixed Dosing: The study utilized specific doses (600 mg Gabapentin and 0.4 mg Buprenorphine); results might vary with different dosage regimens or combinations.

Conflict of Interest: There are no reported conflicts of interest. The study was conducted for scientific purposes with data kept strictly confidential.

Financial Disclosure: The study participants bore no expenses for investigations or treatments related to the study.

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