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Original Research Article

A Comparative Study of Epidural Butorphanol and Epidural Fentanyl as Adjuvants to Bupivacaine in Lower Abdominal Surgeries

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Conflict of interest: Nil

Abstract:

Background: Optimising epidural anaesthesia in lower abdominal surgery often involves adding an opioid to bupivacaine to enhance analgesia, onset, and duration, while balancing side-effects. The mixed κ-agonist/μ-antagonist opioid butorphanol and the pure μ-agonist fentanyl represent two commonly used adjuvants, but direct comparisons remain limited.

Aim: To compare epidural butorphanol vs fentanyl as adjuvants to 0.5% bupivacaine in elective lower abdominal surgeries regarding onset and duration of block, analgesic quality, haemodynamic parameters, and adverse-effects.

Methods: A prospective, randomised study at Government Medical College, Vizianagaram (December 2025–January 2026) enrolled 60 ASA I–II patients aged 20–60 yrs undergoing elective lower abdominal surgery. Patients were allocated to Group BB (0.5% bupivacaine 18 mL + 1 mg butorphanol + 1 mL saline) or Group BF (0.5% bupivacaine 18 mL + 100 μg fentanyl in 2 mL) via epidural catheter. Onset of analgesia, time to maximum dermatomal level, duration of analgesia (to VAS 5), sedation score, VAS hourly for 8 hrs, vital signs, and complications (pruritus, nausea, urinary retention, respiratory depression) were recorded. Statistical analysis used independent-samples t-test, chi-square, and repeated-measures ANOVA; $p < 0.05$ was significant.

Results: Onset of block was faster in the fentanyl group (8.1 ± 1.5 min vs 9.4 ± 1.8 min; $p = 0.001$). Duration of analgesia was significantly longer in the butorphanol group (263.4 ± 28.7 min vs 228.6 ± 25.1 min; $p < 0.001$). Quality of analgesia was similar. Pruritus incidence was significantly higher in the fentanyl group (20% vs 3.3%; $p = 0.04$). Sedation scores were higher in the butorphanol group. Haemodynamic parameters remained stable in both groups.

Conclusions: Epidural bupivacaine plus butorphanol offers longer-lasting analgesia and fewer pruritus events compared to bupivacaine plus fentanyl, though with a slightly slower onset and higher sedation. Choice of adjuvant should reflect clinical priorities.

Keywords: Epidural Analgesia, Butorphanol, Fentanyl, Bupivacaine, Lower Abdominal Surgery.

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Introduction

Effective postoperative analgesia after lower abdominal surgery is essential to attenuate the stress response, facilitate early mobilisation, and improve overall outcome. Epidural anaesthesia with bupivacaine supplemented by opioids provides superior segmental analgesia and haemodynamic stability compared with systemic opioids alone [1]. Butorphanol, a mixed κ-agonist/μ-antagonist, offers good visceral analgesia with a ceiling effect on respiratory depression, whereas fentanyl, a highly lipophilic μ-agonist, produces rapid onset, intense analgesia but is associated with pruritus, nausea, and potential respiratory depression [2, 3]. Comparative trials suggest that combining bupivacaine with epidural fentanyl significantly improves postoperative pain relief after major abdominal or thoracic surgery without major haemodynamic compromise [2]. Epidural butorphanol–bupivacaine has also been shown to provide effective postoperative analgesia after abdominal hysterectomy with acceptable side-effect profile [4].

More recently, direct comparisons of epidural butorphanol and fentanyl as adjuvants to bupivacaine in lower abdominal surgery have demonstrated comparable quality of block and

haemodynamic stability, with differences in duration of analgesia and adverse-effect profiles [5]. Broader evidence on neuraxial opioids indicates that both lipophilic and lipophobic agents, when combined with local anaesthetics, enhance block characteristics and prolong analgesia, while their differing receptor profiles and pharmacokinetics influence side-effect patterns [3]. The present prospective randomized study is designed to compare epidural butorphanol and epidural fentanyl as adjuvants to bupivacaine in lower abdominal surgeries, with the aim of evaluating onset and duration of sensory and motor block, quality of intra-operative and postoperative analgesia, haemodynamic stability, and incidence of adverse effects, in order to identify the more suitable adjuvant for routine clinical use in this setting.

Methods

This prospective, comparative clinical study was conducted in the Department of Anaesthesiology, Government Medical College, Vizianagaram, over a two-month period from December 2025 to January 2026. After obtaining Institutional Ethical Committee approval and written informed consent, 60 adult patients aged 20–60 years, weighing 40–70 kg, belonging to ASA physical status I and II, and scheduled for elective lower abdominal surgeries under epidural anaesthesia were enrolled. Patients of both sexes were included. Exclusion criteria consisted of pregnancy, known cardiac or respiratory disease, hepatic or renal impairment, history of seizures or neurological deficits, spinal deformities, psychiatric disorders, ASA grade III–IV status, coagulopathies, and local infection at the puncture site. All patients underwent detailed pre-anaesthetic evaluation and routine investigations a day prior to surgery. They were educated on the Visual Analogue Scale (VAS) for postoperative pain assessment using the 0–10 scoring system. Standard premedication with tablet alprazolam 0.25 mg and tablet ranitidine 150 mg was administered the night before surgery.

On the day of surgery, patients were transferred to the operating room and connected to multi-parameter monitors. Baseline heart rate, blood pressure, mean arterial pressure, respiratory rate, and SpO_2 were recorded. A large-bore 18G IV cannula was secured, and preloading with Ringer lactate 10 mL/kg was done over 15–30 minutes. Under strict aseptic precautions, the patient was positioned in right lateral decubitus, the L3–L4 interspace was identified, and the epidural space was located using an 18G Tuohy needle with the loss-of-resistance to air technique. A 19G epidural catheter was threaded 5 cm into the epidural space and secured. After administering a test dose of 3 mL of 1.5% lignocaine with adrenaline (1:200,000) to rule out intravascular or intrathecal placement, patients were randomized into two equal groups (n=30 each).

Group BB received 18 mL of 0.5% bupivacaine + 1 mg butorphanol (1 mL) + 1 mL normal saline to make a total of 20 mL.
Group BF received 18 mL of 0.5% bupivacaine + 100 µg fentanyl (2 mL).
The study drug was injected at approximately 1 mL/sec, and oxygen at 5 L/min was provided via face mask. No intravenous analgesics or sedatives were administered intraoperatively. The onset of analgesia, time to achieve maximum dermatome level, duration of analgesia (onset to VAS 5), and quality of analgesia (graded as good, fair, or poor) were recorded. Vital parameters were monitored every 5 minutes for the first 15 minutes, then every 15 minutes intraoperatively, and every 30 minutes for 2 hours postoperatively. Hypotension was treated with fluids and titrated doses of ephedrine or mephentermine, and bradycardia was treated with atropine. Sedation scores were recorded using a standard sedation scale.

Postoperatively, VAS pain scores were assessed hourly for 8 hours. The time to first rescue analgesia (VAS $\geq$5) was noted, after which the patient was excluded from further study assessment. Adverse effects such as nausea, vomiting, pruritus, urinary retention, headache, and respiratory depression were recorded and managed appropriately. Statistical analysis was performed using SPSS version 22.0. Continuous variables such as onset and duration of analgesia were expressed as mean ± standard deviation and compared between groups using the independent samples t-test. Categorical variables such as quality of analgesia and incidence of adverse effects were analysed using the Chi-square test or Fisher's exact test where appropriate. Repeated measures such as HR and BP trends were analysed using repeated-measures ANOVA. A p-value <0.05 was considered statistically significant.

Results

A total of 60 patients completed the study, with 30 patients in each group. As shown in Table 1, both groups were comparable with respect to age, weight, sex distribution, and ASA physical status, with no statistically significant differences, confirming effective randomization. The onset of analgesia was significantly faster in the fentanyl group (BF), whereas the butorphanol group (BB) demonstrated a slightly slower onset ($p = 0.001$), as detailed in Table 2. Similarly, the time required to reach the maximum dermatome level was shorter in Group BF compared with Group BB ($p = 0.004$), although the highest sensory level achieved (T6–T8) was similar in both groups. The quality of analgesia was predominantly "good" in both groups, with Group BF showing a marginally higher proportion of optimal responses.

Sedation scores were higher among patients receiving butorphanol, reflecting its inherent sedative effect, as presented in Table 3. The duration

of analgesia showed a clear and statistically significant difference between the groups, with Group BB demonstrating a longer analgesic duration (263.4 ± 28.7 min) compared with Group BF (228.6 ± 25.1 min) ($p < 0.001$), also shown in Table 3. Assessment of postoperative adverse effects revealed that pruritus was significantly more frequent in the fentanyl group ($p = 0.04$), consistent with the known μ-opioid side-effect profile, as summarized in Table 4. Other adverse effects such as nausea, vomiting, and urinary retention occurred with similar frequency in both groups, and no patient experienced respiratory depression. Overall, the findings indicate that butorphanol provided a longer duration of postoperative analgesia with acceptable sedation, while fentanyl offered a faster onset of block but was associated with a higher incidence of pruritus.

Table 1: Demographic and baseline characteristics of the study patients

Parameter	Group BB	Group BF	p-value
Age	42.3 ± 10.6	41.8 ± 11.2	0.84
Weight	57.4 ± 6.3	56.8 ± 6.1	0.67
Gender (M/F)	16/14	15/15	0.79
ASA Grade (I/II)	18/12	19/11	0.79

Table 2: Onset and characteristics of epidural block among the study groups

Parameter	Group BB	Group BF	p-value
Onset of analgesia (min)	9.4 ± 1.8	8.1 ± 1.5	**0.001**
Time to maximum dermatome level (min)	18.6 ± 3.1	16.2 ± 2.7	**0.004**
Maximum level achieved	T6–T8	T6–T8	—
Quality of analgesia (Good/Fair/Poor)	25/4/1	28/2/0	0.32

Table 3: Duration of analgesia and sedation scores among the study groups

Parameter	Group BB	Group BF	p-value
Duration of analgesia (min)	263.4 ± 28.7	228.6 ± 25.1	<0.001
Mean sedation score	3.1 ± 0.9	2.2 ± 0.8	0.001

Table 4: Adverse effects among the study patients in groups; n (%)

Adverse effect	Group BB	Group BF	p-value
Nausea/Vomiting	3 (10)	4 (13.3)	0.68
Pruritus	1 (3.3)	6 (20)	0.04
Urinary retention	2 (6.7)	1 (3.3)	0.55

Discussion

In our prospective, randomised comparison of epidural 0.5% bupivacaine combined with either 1 mg butorphanol (Group BB) or 100 μg fentanyl (Group BF) for elective lower abdominal surgery at RIMS Srikakulam (Dec 2025–Jan 2026), several salient findings emerged that allow meaningful contextualisation in the existing literature. First, although onset of analgesia was significantly faster in the fentanyl group ($p=0.001$), the duration of postoperative analgesia was significantly longer in the butorphanol group ($p<0.001$). These observations reflect the pharmacologic distinctions between a mixed κ-agonist/μ-antagonist such as butorphanol and a pure μ-agonist such as fentanyl. Butorphanol's κ-receptor activity may confer prolongation of visceral analgesia with a ceiling on respiratory depression; whereas fentanyl's high lipophilicity translates into rapid penetration and onset but possibly shorter effective duration when used as a single bolus. Previous studies of epidural butorphanol–bupivacaine combinations have shown prolongation of analgesia compared with either agent alone [4, 6]. Bharti & Chari found that adding 2 mg butorphanol to 0.125% bupivacaine prolonged analgesia (9.82 h vs 4.35 h for butorphanol alone) in hysterectomy patients [2]. Thus, our results align well with that evidence, reinforcing the choice of butorphanol when prolonged postoperative block is desired.

Second, the faster onset with fentanyl is consistent with the known pharmacokinetics of lipophilic opioids. Fentanyl rapidly diffuses across epidural fat and dura to bind spinal μ-opioid receptors, producing a quicker onset of analgesia. In contrast, butorphanol, with mixed κ-agonist/μ-antagonist properties, may require longer to achieve optimal segmental blockade when administered epidurally, explaining the slightly delayed onset observed in our butorphanol group. This pattern has also been demonstrated by Kaur and Bajwa, who reported a significantly faster onset with epidural fentanyl compared with butorphanol in lower abdominal surgeries [5]. Although the time-to-maximum dermatome level difference in our study was modest, it remained statistically significant ($p = 0.004$).

Clinically, this suggests that when rapid blockade is required such as in time-sensitive procedures fentanyl may hold an advantage. Nevertheless, the onset times noted in our trial remain well within acceptable limits for elective surgical settings.

Third, the adverse-effect profile requires careful interpretation. We found pruritus significantly more frequent in the fentanyl group (20%) compared to the butorphanol group (3.3%) ($p = 0.04$). This observation mirrors the well-documented association of pure μ-opioid agonists with pruritus, an effect attributed to central μ-receptor activation in the spinal dorsal horn and trigeminal nucleus, as previously highlighted by Agrawal et al. [3]. In contrast, butorphanol because of its μ-antagonist/partial agonist and κ-agonist activity tends to attenuate itch responses, which explains the lower incidence observed in our study. Additionally, sedation was more common in the butorphanol group, which aligns with the pharmacodynamic profile described by Bharti and Chari [4], who reported higher sedation scores with epidural butorphanol–bupivacaine combinations. Importantly, no patient in either study arm developed respiratory depression. Overall, the findings suggest that while butorphanol offers a longer duration of analgesia with fewer pruritus events, the trade-off is increased sedation, which necessitates caution in patients where rapid postoperative recovery and alertness are essential.

Fourth, our findings should be viewed against the backdrop of analgesic quality and haemodynamic stability. Both groups achieved high rates of "good" analgesia, with no statistically significant difference ($p=0.32$). Vital parameters were stable in both groups, and incidences of nausea/vomiting or urinary retention were comparable. This equilibrium underlines that both adjuvant regimens — when paired with 0.5% bupivacaine 18 mL — deliver acceptable analgesic performance and safety in elective lower abdominal surgery. Literature on epidural adjuvant opioids often emphasises this balance: improved block quality and duration without undue haemodynamic or respiratory compromise. For example, recent studies of epidural local-anesthetic plus opioid regimens emphasise minimal motor blockade, stable haemodynamics, and high patient satisfaction [7 – 9].

Fifth and finally, we consider the implications for clinical practice and future research. In elective lower abdominal surgery settings where minimising opioid-related adverse effects such as pruritus and nausea while prolonging postoperative pain-free interval is desirable, epidural butorphanol may represent a superior adjuvant to fentanyl. This observation is supported by the comparative work of Kaur and Bajwa**,** who reported fewer opioid-related side effects and acceptable analgesic profiles with epidural butorphanol [5]. Conversely, in scenarios requiring a rapid onset of blockade such as urgent modification of surgical plans or in patients where excessive sedation may impede early mobilization or neurological assessment, fentanyl may remain advantageous due to its faster onset kinetics. Previous evidence from Bharti and Chari, demonstrating prolonged analgesia and increased sedation with butorphanol, also reinforces the need for individualized agent selection [4]. Further large-scale, multicentre randomized controlled trials evaluating different doses and combinations of these adjuvants across varied surgical populations are warranted. Such research should also assess recovery milestones, motor block resolution, patient satisfaction, and cost-effectiveness. Broader perioperative literature, including the review by Moraca et al**.**, highlights the impact of optimized epidural analgesia on surgical outcomes and recovery, underscoring the clinical importance of refining adjuvant choice [1]. Mechanistic studies exploring κ- versus μ-opioid receptor interactions in the epidural space would further clarify the neuropharmacological basis for tailored clinical use.

Conclusion

In elective lower abdominal surgeries among ASA I–II patients, epidural bupivacaine combined with 1 mg butorphanol provided a significantly longer duration of analgesia and a lower incidence of pruritus compared with bupivacaine plus 100 μg fentanyl, whereas the latter achieved a faster onset. Both regimens were haemodynamically stable and delivered good analgesic quality. Choice of adjuvant should be guided by priority between rapid onset (fentanyl) versus prolonged analgesia with fewer pruritus events (butorphanol).

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