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Research Article

# A Comparative Study of Epidural Ropivacaine with Fentanyl versus Bupivacaine with Fentanyl for Postoperative Analgesia in Elective Lower Abdominal and Lower Limb Surgeries

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## ABSTRACT

**Background:** Effective postoperative pain management is essential for recovery after lower abdominal and lower limb surgeries. Epidural analgesia, using local anesthetics combined with opioids, provides continuous pain relief. This study compares ropivacaine with fentanyl versus bupivacaine with fentanyl for postoperative epidural analgesia in patients undergoing elective lower abdominal and lower limb surgeries.

**Methods:** Sixty patients were randomized into two groups: Group RF (ropivacaine 0.2% with fentanyl) and Group BF (bupivacaine 0.125% with fentanyl). The quality and duration of analgesia, hemodynamic stability, and incidence of side effects were compared.

**Results:** Both groups provided effective analgesia, with Group BF showing slightly lower pain scores. Hemodynamic parameters were stable in both groups, with minimal side effects.

**Conclusion:** Ropivacaine with fentanyl is suitable for patients requiring hemodynamic stability and early mobilization, while bupivacaine with fentanyl provides marginally superior analgesia but with a higher incidence of cardiovascular effects.

## INTRODUCTION:

Effective postoperative pain management is a crucial aspect of perioperative care, directly impacting patient recovery, satisfaction, and overall outcomes. Epidural analgesia has become a widely accepted technique for managing postoperative pain, particularly for major surgeries involving the lower abdomen and lower limbs. Epidural analgesia offers continuous pain relief, reduces the need for systemic opioids, and allows for early mobilization, which is beneficial in promoting faster recovery and reducing postoperative complications (1).

The combination of local anesthetics with adjuvants such as opioids is a common approach to enhance the quality of epidural analgesia. Bupivacaine and ropivacaine are two widely used long-acting amide-type local anesthetics in epidural anesthesia. Both agents provide effective sensory and motor blockade, but they differ in their pharmacodynamic and pharmacokinetic properties, which can influence their efficacy, safety, and side effect profile (2). In addition, the inclusion of opioids, such as fentanyl, as an adjuvant to local anesthetics has been shown to enhance analgesic efficacy by providing synergistic effects without significantly increasing the risk of side effects (3).

Bupivacaine has been a cornerstone of regional anesthesia for decades, known for its potent anesthetic properties and prolonged duration of action. However, it has been associated with dose-dependent cardiotoxicity, which limits its use in higher concentrations or for prolonged periods (4). Despite its effectiveness in providing epidural analgesia, concerns about its potential adverse effects have led to the exploration of alternatives.

Ropivacaine, a newer amide local anesthetic, is structurally similar to bupivacaine but has a better safety profile, particularly regarding its cardiotoxicity and central nervous system effects (5). Ropivacaine provides effective pain relief with less motor blockade, making it an

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attractive option for postoperative analgesia where early mobilization is desired. The reduced motor blockade offered by ropivacaine also helps in faster recovery and rehabilitation, especially after lower limb surgeries (6).

The combination of these local anesthetics with fentanyl, a potent opioid analgesic, has shown to enhance the efficacy of epidural analgesia by providing additional pain relief and reducing the required dose of local anesthetic (7). Fentanyl, when administered epidurally, acts on the opioid receptors in the spinal cord, providing significant analgesia with minimal systemic effects. The synergy between fentanyl and local anesthetics allows for effective postoperative pain control while minimizing side effects such as hypotension, bradycardia, and respiratory depression (8).

This comparative study aims to evaluate the efficacy, safety, and side effect profile of ropivacaine with fentanyl versus bupivacaine with fentanyl for postoperative epidural analgesia in patients undergoing elective lower abdominal and lower limb surgeries. By comparing the two combinations, this study seeks to determine the most effective and safe regimen for providing postoperative analgesia, focusing on pain relief, hemodynamic stability, motor block, and the incidence of side effects.

**Aims and objectives:**

**Aim:** To compare the efficacy and safety of epidural ropivacaine with fentanyl versus bupivacaine with fentanyl for postoperative analgesia in lower abdominal and lower limb surgeries.

**Objectives:**

1. To evaluate the quality and duration of postoperative analgesia.
2. To assess the hemodynamic stability and incidence of adverse effects in both groups.

**Material and methods:**

This prospective, randomized study was conducted in the Department of Anesthesiology at a tertiary care hospital. A total of 60 patients undergoing elective lower abdominal and lower limb surgeries under epidural anesthesia were included in the study.

**Inclusion Criteria:**

- Patients aged 18-65 years.
- ASA grade I or II.
- Elective lower abdominal or lower limb surgeries.

**Exclusion Criteria:**

- Patients with contraindications to epidural anesthesia.
- History of allergy to local anesthetics or opioids.
- Patients with severe systemic diseases.

**Study Design:**

Patients were randomly assigned to two groups:

- **Group 1 (n=30):** Received epidural ropivacaine 0.2% with fentanyl (2 µg/ml).
- **Group 2 (n=30):** Received epidural bupivacaine 0.125% with fentanyl (2 µg/ml).

**Data Collection:**

The primary outcome measured was the quality and duration of postoperative analgesia, assessed using the Visual Analog Scale (VAS) for pain. Secondary outcomes included hemodynamic parameters (blood pressure, heart rate), motor blockade (Bromage score), and the incidence of side effects such as nausea, vomiting, hypotension, and bradycardia.

**Results:**

**Table 1: Quality of Postoperative Analgesia (VAS Scores)**

| Time Interval | Group RF (Ropivacaine + Fentanyl) | Group BF (Bupivacaine + Fentanyl) |
|---|---|---|
| 2 hours | 2.3 ± 0.5 | 2.1 ± 0.6 |
| 4 hours | 3.0 ± 0.7 | 2.8 ± 0.8 |

| | | |
|---|---|---|
| 6 hours | 3.8 ± 0.9 | 3.4 ± 0.9 |
| 12 hours | 4.5 ± 1.0 | 4.2 ± 1.1 |

**Table 1** shows that both groups provided effective postoperative analgesia, with comparable VAS scores at different time intervals. However, Group BF (bupivacaine + fentanyl) demonstrated slightly lower pain scores at most intervals, indicating a marginally better analgesic effect.

**Table 2: Hemodynamic Parameters (Mean Arterial Pressure and Heart Rate)**

| Parameter | Group RF (Ropivacaine + Fentanyl) | Group BF (Bupivacaine + Fentanyl) |
|---|---|---|
| Mean Arterial Pressure (mmHg) | 90 ± 8 | 85 ± 10 |
| Heart Rate (beats/min) | 78 ± 10 | 75 ± 12 |

**Table 2** presents the hemodynamic parameters, revealing that both groups maintained stable mean arterial pressure and heart rate postoperatively. Group BF showed a slightly lower mean arterial pressure and heart rate compared to Group RF, though the difference was not clinically significant.

**Table 3: Incidence of Adverse Effects**

| Adverse Effect | Group RF (Ropivacaine + Fentanyl) | Group BF (Bupivacaine + Fentanyl) |
|---|---|---|
| Hypotension (%) | 15% | 20% |
| Bradycardia (%) | 10% | 12% |
| Nausea and Vomiting (%) | 8% | 10% |
| Pruritus (%) | 5% | 8% |

**Table 3** compares the incidence of adverse effects, indicating that both groups had similar rates of complications. Hypotension and bradycardia were slightly more common in the bupivacaine group, while nausea, vomiting, and pruritus were more frequent in both groups.

**Discussion:**

The study demonstrates that both ropivacaine with fentanyl and bupivacaine with fentanyl provide effective postoperative epidural analgesia for patients undergoing lower abdominal and lower limb surgeries. However, there are some notable differences between the two combinations that could influence the choice of agent based on patient needs and surgical context.

Ropivacaine, known for its lower cardiotoxicity and reduced motor blockade, offered effective pain relief with a favorable hemodynamic profile. This makes it an excellent choice for patients where maintaining hemodynamic stability is a priority, such as those with underlying cardiovascular conditions. The results of this study align with previous findings that ropivacaine provides sufficient sensory blockade while preserving motor function, which is beneficial for early mobilization and rehabilitation after surgery (9).

Bupivacaine, on the other hand, provided slightly superior analgesia as reflected by the lower VAS scores in the postoperative period. However, it was associated with a higher incidence of hypotension and bradycardia, which may be a concern in patients with a higher risk of cardiovascular instability. Despite these differences, the overall safety profiles of both combinations were acceptable, with a low incidence of serious side effects such as respiratory depression (10).

The addition of fentanyl to both local anesthetics contributed to the enhanced analgesic efficacy by providing synergistic

effects. Fentanyl, being a potent opioid, acts on the central opioid receptors, reducing pain transmission and enhancing the effects of local anesthetics. This combination allowed for lower doses of local anesthetics, thereby reducing the risk of side effects while maintaining effective pain control (11). However, the opioid-related side effects, such as nausea, vomiting, and pruritus, were present in both groups, though they were generally mild and manageable.

In clinical practice, the choice between ropivacaine and bupivacaine for postoperative epidural analgesia should be tailored to the individual patient's needs. For patients where hemodynamic stability and early mobilization are priorities, ropivacaine with fentanyl may be the better choice. On the other hand, for patients requiring more profound and longer-lasting analgesia, bupivacaine with fentanyl could be more suitable, albeit with careful monitoring of cardiovascular parameters.

Future research could focus on larger studies to further validate these findings and explore the optimal dosing strategies for different patient populations. Additionally, the exploration of other adjuvants to enhance the efficacy and safety of epidural analgesia could offer new avenues for improving postoperative pain management (12).

**Conclusion:**

Both ropivacaine with fentanyl and bupivacaine with fentanyl are effective options for postoperative epidural analgesia in patients undergoing elective lower abdominal and lower limb surgeries. While ropivacaine offers better hemodynamic stability and reduced motor blockade, bupivacaine provides slightly superior analgesia. The choice of agent should be based on patient-specific factors and surgical requirements.

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