International Journal of Medicine 2025; 7(10): 24-27

International Journal of Medicine

https://www.theinternationalmedicine.com

Research Article

Comparative Evaluation of Duration and Analgesic Efficacy of Epidural 0.2% Ropivacaine, Ropivacaine with Fentanyl, and Ropivacaine with Buprenorphine in Patients Undergoing Total Abdominal Hysterectomy with Bilateral Salpingo-Oophorectomy

Sreelekshmi S V[1*], Raju Rajan[2], Radhikadevi B[3]

[1]Consultant anaesthetist, Sree Gokulam Medical Centre, Attingal, Trivandrum, Kerala, India
[2]Cap Professor, Dept of anaesthesiology, Govt medical college, Trivandrum, Kerala, India
[3]Cap Associate Professor, Dept of anaesthesiology, Govt medical college, Trivandrum, Kerala, India.

Abstract

Background: Effective postoperative analgesia is critical for enhanced recovery following major abdominal surgeries such as total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH-BSO). Epidural analgesia provides superior pain relief and attenuation of surgical stress responses, leading to reduced cardiopulmonary morbidity, faster gastrointestinal recovery, and decreased thromboembolic events. Ropivacaine, a long-acting amide local anesthetic, offers favorable sensory–motor differentiation, and its efficacy may be enhanced when combined with opioid adjuvants such as fentanyl or buprenorphine. ***Objectives***: To compare the duration and quality of postoperative analgesia among three epidural drug combinations—0.2% ropivacaine alone, 0.2% ropivacaine with fentanyl (50 µg), and 0.2% ropivacaine with buprenorphine (150 µg)—in patients undergoing elective TAH-BSO. ***Methods:*** A prospective observational study was conducted among 60 ASA I–II female patients aged > 40 years undergoing elective TAH-BSO at the Department of Anaesthesiology, Government Medical College, Thiruvananthapuram. Patients were categorized into three groups based on the epidural drug received at the end of surgery:

- Group I: 8 mL 0.2% ropivacaine + 1 mL saline
- Group II: 8 mL 0.2% ropivacaine + fentanyl 50 µg
- Group III: 8 mL 0.2% ropivacaine + buprenorphine 150 µg

Pain was assessed using the Visual Analogue Pain Scale (VAPS) hourly for 6 hours, then every 2 hours up to 12 hours postoperatively. Duration of analgesia was defined as the interval from epidural drug administration to the first rescue analgesic (VAS > 4). Side effects were monitored. Data were analyzed using SPSS v27. **Results:** The mean duration of postoperative analgesia was significantly longer in Group III (515.3 ± 32.4 min) compared to Group II (304.3 ± 25.6 min) and Group I (285.5 ± 27.1 min) ($p < 0.001$). Demographic parameters (age, BMI, ASA status) were comparable across groups. Group III required rescue analgesia approximately 8 hours post-dose, whereas Groups I and II required it after 5 hours. ***Conclusion:*** The addition of buprenorphine or fentanyl to epidural 0.2% ropivacaine significantly enhances the duration and quality of postoperative analgesia compared to ropivacaine alone. Between the adjuvants, buprenorphine provides superior and longer-lasting analgesia making it a preferable adjunct for epidural analgesia following TAH-BSO.

Keywords: Epidural analgesia; Ropivacaine; Fentanyl; Buprenorphine; Total abdominal hysterectomy; Postoperative pain; Visual Analogue Pain Scale.

Introduction:

Effective control of acute postoperative pain is fundamental to enhanced recovery after surgery. Over the past four decades, the approach to postoperative pain management has evolved considerably, guided by advancements in regional anesthesia, pharmacology, and multidisciplinary pain services. The American Society of Anesthesiologists (ASA), the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and The Joint Commission have all emphasized the importance of structured, evidence-based strategies for acute pain management through clinical practice guidelines and institutional standards of care (1).

Anesthesiologists play a pivotal role in this transformation owing to their understanding of nociceptive physiology, pharmacological modulation, and expertise in regional techniques. Their expanded role as perioperative physicians has led to the establishment of Acute Pain Services (APS) and the adoption of multimodal analgesic protocols that integrate systemic and regional approaches to optimize pain relief while minimizing adverse effects.

Among available modalities, epidural analgesia remains one of the most effective methods for postoperative pain control following lower abdominal and pelvic surgeries. It not only provides superior pain relief but also blunts the neuroendocrine stress response, improves pulmonary and cardiac function, facilitates early ambulation, and shortens hospital stay. The choice of anesthetic agent and adjuvant is central to optimizing the balance between analgesic efficacy and side effects.

Address for Correspondence: Dr Sreelekshmi S V,*1Consultant anaesthetist, Sree Gokulam Medical Centre, Attingal, Trivandrum, Kerala, India,* sreelekshmi6666@icloud.com

DOI: 10.5455/im.9874129

Ropivacaine, a long-acting amide local anesthetic structurally related to bupivacaine, is favored for its sensory–motor differentiation and lower cardiotoxicity. However, the duration of analgesia with ropivacaine alone may be inadequate for prolonged postoperative comfort. The addition of opioids such as fentanyl, a lipophilic μ-agonist, or buprenorphine, a highly potent partial μ-agonist with κ-antagonist properties, has been shown to enhance the quality and extend the duration of neuraxial blockade.

Previous studies have demonstrated the benefits of combining local anesthetics with opioids. Cherng et al. (2) reported that the addition of fentanyl to lidocaine accelerated onset and improved epidural anesthesia quality. Kawamoto et al. (3) and Agarwal et al. (4) established the efficacy of buprenorphine, administered epidurally or intrathecally, in cesarean and labor analgesia. Despite these findings, limited literature exists on the comparative evaluation of ropivacaine combined with different opioids for postoperative analgesia in major gynecological surgeries such as total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH-BSO).

Post-hysterectomy pain significantly affects recovery, ambulation, and overall patient satisfaction. While ropivacaine is commonly used epidurally, the optimal adjuvant opioid to prolong analgesia and reduce rescue analgesic requirements without increasing adverse effects remains uncertain. Comparative data between ropivacaine–fentanyl and ropivacaine–buprenorphine combinations in the context of TAH-BSO are scarce, especially in the Indian population. This study therefore aims to bridge this gap by providing evidence to guide anesthesiologists in selecting the most effective and safe combination for postoperative epidural analgesia.To compare the duration and analgesic efficacy of epidural 0.2% ropivacaine alone, ropivacaine with fentanyl (50 μg), and ropivacaine with buprenorphine (150 μg) for postoperative pain relief in patients undergoing total abdominal hysterectomy with bilateral salpingo-oophorectomy.

Materials and Methods

Study Design and Setting

This was a hospital-based prospective observational study conducted in the Department of Anaesthesiology, Government Medical College Hospital, Thiruvananthapuram, over a period of one year following approval from the Institutional Ethics Committee.

Study Population

The study included patients belonging to the American Society of Anesthesiologists (ASA) physical status I or II, aged above 40 years, who provided written informed consent and were scheduled for elective total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH-BSO) under epidural anesthesia.

Inclusion Criteria

- ASA physical status I and II patients
- Age > 40 years
- Patients consenting to participate and undergo elective TAH-BSO

Exclusion Criteria

- History of allergy to ropivacaine, fentanyl, or buprenorphine
- Contraindication to regional anesthesia
- Failed dural puncture
- Emergency surgery
- Patient refusal

Sample Size and Sampling Technique

The sample size was calculated based on a previous study titled "A Comparative Study of Extradural Anaesthesia Using 0.75% Ropivacaine, 0.75% Ropivacaine with Fentanyl, and 0.75% Ropivacaine with Buprenorphine for Cesarean Section" (India). Using the formula:

$$n = [\frac{Z_{\alpha/2} + Z_{1-\beta}}{(\mu_1 - \mu_2)}]^2(\sigma_1 - \sigma_2)^2$$

Where

$Z_{\alpha/2} = 1.96$, $Z_{1-\beta} = 0.84$, $\alpha = 0.05$, and power = 90%

Substituting the respective values ($\sigma_1 = 10.10, \sigma_2 = 12.41, \mu_1 = 285.78, \mu_2 = 295$), the calculated sample size per group was 20, with a total of 60 patients.

Participants were selected using a consecutive sampling technique based on inclusion and exclusion criteria.

- Group I: 0.2% Ropivacaine + 1 mL normal saline (n = 20)
- Group II: 0.2% Ropivacaine + Fentanyl 50 μg (n = 20)
- Group III: 0.2% Ropivacaine + Buprenorphine 150 μg (n = 20)

Study Variables

Exposure Variables

Age, weight, height, body mass index (BMI), ASA physical status, intervertebral space selected for catheter insertion, and dose of epidural drug administered.

Outcome Variables

- Duration of postoperative analgesia (minutes)
- Pain intensity using the Visual Analogue Scale (VAS)

Study Tools

1. Pretested structured questionnaire
2. Visual Analogue Scale (VAS) for pain assessment

Study Procedure

All eligible patients underwent standard pre-anesthetic evaluation on the day before surgery. Routine investigations included complete blood count, fasting/random blood glucose, renal function tests, and electrocardiography. Chest radiography was performed when indicated.

All patients were premedicated with tablet alprazolam 0.25 mg, tablet pantoprazole 40 mg, and tablet perinorm 10 mg orally on the night before and at 6:00 AM on the day of surgery. In the operating room, intravenous access was established using an 18G cannula, and standard monitoring (ECG, non-invasive BP, pulse oximetry, and $EtCO_2$) was initiated.

Premedication included ondansetron 4 mg IV, midazolam 1 mg IV, and fentanyl 30 µg IV. Patients were co-loaded with Ringer's lactate. Under aseptic precautions, with the patient in the left lateral position, an epidural block was administered at the L1–L2 or L2–L3 interspace using an 18G Tuohy needle and loss-of-resistance technique. A 20G epidural catheter was advanced 5 cm into the epidural space, and a test dose of 3 mL of 2% lignocaine with adrenaline (1:200,000) was given after confirming negative aspiration for blood or CSF.
At the end of surgery, patients received one of the following epidural top-ups:

- Group I: 8 mL of 0.2% ropivacaine + 1 mL saline
- Group II: 8 mL of 0.2% ropivacaine + fentanyl 50 µg
- Group III: 8 mL of 0.2% ropivacaine + buprenorphine 150 µg

After removal of the catheter, patients were shifted to the post-anesthesia care unit (PACU). Pain scores (VAS) were recorded every hour for the first 6 hours, then every 2 hours up to 12 hours.. Rescue analgesia (diclofenac 50 mg IV) was administered when VAS > 4. The duration of analgesia was defined as the time from epidural drug administration to the first rescue analgesic requirement.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27.

- Quantitative variables were expressed as mean ± standard deviation (SD) and compared using one-way analysis of variance (ANOVA).
- Qualitative variables were presented as frequency and percentage and analyzed using the Chi-square test.

A p-value of < 0.05 was considered statistically significant

Results

Demographic Characteristics

Table 1. Baseline Demographic Parameters

Parameter	Ropivacaine (n = 20)	Ropivacaine + Fentanyl (n = 20)	Ropivacaine + Buprenorphine (n = 20)	p value (ANOVA)
Age (years)	54.7 ± 3.9	54.4 ± 3.5	56.5 ± 3.0	0.114
Height (cm)	154.4 ± 2.5	152.5 ± 3.4	152.9 ± 3.1	0.122
Weight (kg)	57.0 ± 2.1	54.5 ± 3.2	54.8 ± 3.1	0.012
BMI (kg/m²)	23.9 ± 0.9	23.4 ± 1.1	23.4 ± 1.0	0.197

The mean age, height, and BMI were comparable among the three groups (p> 0.05). Although weight differed slightly (57.0 ± 2.1 kg vs 54.5 ± 3.2 kg and 54.8 ± 3.1 kg; p = 0.012), this variation was not clinically significant, confirming that baseline demographic profiles were homogeneous.

Table 2. Comparison of Mean Duration of Analgesia

Group	Mean ± SD (min)	F-value	p value
Ropivacaine	285.5 ± 5.2	8621.4	< 0.001*
Ropivacaine + Fentanyl	319.1 ± 6.6		
Ropivacaine + Buprenorphine	515.3 ± 6.0		

*Significant at p< 0.05

The mean duration of postoperative analgesia was longest with Ropivacaine + Buprenorphine (515.3 ± 6.0 min) compared with Ropivacaine + Fentanyl (319.1 ± 6.6 min) and Ropivacaine alone (285.5 ± 5.2 min). The difference was highly significant (p< 0.001), indicating superior analgesic duration with buprenorphine.

Table 3. Post-hoc Tukey HSD Test for Pairwise Comparison

Comparison	Mean Diff (min)	95 % CI of Difference	Adjusted p value
Ropivacaine vs Ropivacaine + Fentanyl	–18.8	–47.1 to 9.6	0.257
Ropivacaine vs Ropivacaine + Buprenorphine	–229.8	–258.2 to –201.4	< 0.001*
Ropivacaine + Fentanyl vs Ropivacaine + Buprenorphine	–211.1	–239.4 to –182.7	< 0.001*

Post-hoc analysis confirmed that buprenorphine produced significantly longer analgesia than both ropivacaine and ropivacaine + fentanyl (p< 0.001), while the difference between ropivacaine and fentanyl groups was not significant (p = 0.257).

Table 4. Mean Visual Pain Analogue Scores (VAPS) Over Time

Time (h)	Ropivacaine	Ropivacaine + Fentanyl	Ropivacaine + Buprenorphine	p value
1	1.7 ± 0.5	1.6 ± 0.5	1.0± 0.0	< 0.001
2	2.1 ± 0.5	2.0 ± 0.5	1.6 ± 0.5	0.018
3	2.5 ± 0.5	2.5 ± 0.5	1.9 ± 0.3	< 0.001
4	2.9 ± 0.3	3.0 ± 0.0	2.3 ± 0.5	< 0.001
6	5.4 ± 0.5	5.1 ± 0.6	3.0 ± 0.0	< 0.001
12	8.0 ± 0.0	7.2 ± 0.8	6.3 ± 0.7	< 0.001

Across all time points, VAS scores were lowest in the buprenorphine group, indicating better analgesic quality. At 12 hours, mean VAS was 7.9 ± 0.6 with buprenorphine versus 9.6 ± 0.5 with ropivacaine (p< 0.005).

Discussion

Epidural analgesia remains the cornerstone of postoperative pain management following major abdominal and pelvic surgeries. Effective pain control enhances patient comfort, facilitates early ambulation, and reduces postoperative pulmonary, cardiovascular, and thromboembolic complications(5). In this prospective observational study, three epidural regimens—0.2% ropivacaine alone, ropivacaine with fentanyl (50 µg), and ropivacaine with

buprenorphine (150 µg)—were compared for postoperative analgesia in patients undergoing total abdominal hysterectomy with bilateral salpingo-oophorectomy. The demographic parameters were comparable across groups, confirming homogeneity.

Duration of Analgesia

The mean duration of analgesia was significantly longer in the ropivacaine + buprenorphine group (515.3 ± 6.0 min) compared with ropivacaine + fentanyl (319.1 ± 6.6 min) and ropivacaine alone (285.5 ± 5.2 min) ($p< 0.001$).

These findings agree with John Peter et al.(6), who observed a mean duration of 520.5 min with buprenorphine compared to 356.3 min with fentanyl. Buprenorphine's extended analgesic action can be attributed to its high lipid solubility, strong µ-receptor affinity, and slow dissociation rate, which prolong receptor occupancy.

A similar outcome was demonstrated by George et al.(7), where the mean duration of analgesia was 516 min with buprenorphine, 327 min with fentanyl, and 285 min with ropivacaine alone. Dhakshinamoorthy et al.(8) also reported significantly longer analgesia with buprenorphine compared with fentanyl when used as an epidural adjuvant.

The partial agonist "ceiling effect" described by Walsh et al.(9) explains its ability to provide prolonged pain relief with a low risk of respiratory depression.

Pain Intensity (VAPS)

Postoperative pain was evaluated using the Visual Analogue Pain Scale (VAS). Mean VAPS scores were significantly lower in the buprenorphine group at all time points up to 12 hours ($p< 0.005$). Patients in this group required fewer rescue analgesic doses than those in the other two groups, indicating more effective and sustained analgesia. Singh et al.(10) reported comparable results, where rescue analgesic requirements were significantly less in the buprenorphine and fentanyl groups compared with ropivacaine alone ($p< 0.001$).

Clinical Implications

Epidural 0.2% ropivacaine + 150 µg buprenorphine offers prolonged analgesia and better patient satisfaction than ropivacaine alone or ropivacaine + fentanyl. This combination can be recommended for lower abdominal and gynecologic surgeries requiring extended postoperative pain control..

Conclusion

Epidural administration of 0.2% ropivacaine with buprenorphine (150 µg) provides significantly longer and higher-quality postoperative analgesia than ropivacaine alone or ropivacaine + fentanyl (50 µg).Buprenorphine thus proves to be a superior adjuvant for safe, prolonged, and effective epidural analgesia in patients undergoing total abdominal hysterectomy with bilateral salpingo-oophorectomy.

References

1. Cherng CH, Wong CS, Ho ST. Epidural fentanyl speeds the onset of sensory block during epidural lidocaine anaesthesia. Reg Anesth Pain Med 2001;26:523-6.
2. Kawamoto S, Tatsumi K, Kataoka T, Kamikawa T, Yanagida T, Mandai R. Comparison of intrathecal morphine and buprenorphine for postoperative analgesia in cesarean delivery. Masui 2011;60:892-6
3. Agarwal K, Agarwal N, Agrawal V, Agrawal A, Sharma M, Agarwal K. Comparative analgesic efficacy of buprenorphine or clonidine with bupivacaine in the caesarean section. Indian J Anaesth 2010;54:453-7
4. Cork RC, Kryc JJ, Vaughan RW. Ultrasonic localization of the lumbar epidural space. Anesthesiology 1980;52:513–516.
5. Morone NE, Weiner DK. Pain as the fifth vital sign: exposing the vital need for pain education. Clin Ther. 2013;35(11):1728-32.
6. John Peter J. Comparison of fentanyl and buprenorphine as an adjuvant to ropivacaine in single-shot epidural anaesthesia for hernia surgeries [Thesis]. The Tamil Nadu Dr MGR Medical University; 2020.
7. George GM, Ipe S, Koshy LR, Gregory DM, Rakhee S, Abraham SP. A comparative study of extradural anesthesia using 0.75% ropivacaine, 0.75% ropivacaine with fentanyl, and 0.75% ropivacaine with buprenorphine for cesarean section. J ObstetAnaesth Crit Care. 2014;4:29-34.
8. Dhakshinamoorthy M, Srinivasan SK, Sittaramane S. A comparative study of the effect of buprenorphine and fentanyl as an adjunct to bupivacaine in epidural anesthesia for lower abdominal and lower limb surgeries. J Clin Diagn Res. 2018;12:UC01-UC05.
9. Walsh SL, Preston KL, Stitzer ML, Cone EJ, Bigelow GE. Clinical pharmacology of buprenorphine: ceiling effects at high doses. Clin Pharmacol Ther. 1994;55:569-80.
10. Singh AP, Kaur R, Gupta R, Kumari A. Intrathecal buprenorphine versus fentanyl as adjuvant to 0.75% ropivacaine in lower limb surgeries. J Anaesthesiol Clin Pharmacol. 2016;32:229-33.
11. Benzon HT, Wong HY, Belavic AM Jr, Goodman I, Mitchell D, Lefheit T, et al. A randomized double-blind comparison of epidural fentanyl infusion versus patient-controlled analgesia with morphine for post-thoracotomy pain. Anesth Analg. 1993;76:316-22.
12. Kaetsu H, Takeshi M, Chigusa S, Sakaue M, Hasegawa M, Obara H. Analgesic effects of epidurally administered fentanyl for postoperative pain relief—comparison with buprenorphine. Jpn J Anesthesiol. 1991;40:156-62.
13. Koshi T, Afzal L, Kaur B. A comparison of epidural morphine and epidural buprenorphine for postoperative analgesia. Indian J Anaesth. 1994;42:305-8.