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Original Research Article

Comparative Study Between Ropivacaine with Fentanyl and Bupivacaine with Fentanyl Using Patient-Controlled Analgesia Pump (PCA Pump) Through an Epidural Catheter after Abdominal Surgery

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Abstract

Background: The inadequacy of current pain management techniques after abdominal surgery results in insufficient analgesia, prolonged hospital stays, delayed recovery, and elevated healthcare costs. Epidural analgesia with patient-controlled analgesia (PCA) pumps has progressively emerged as the preferred method for successful pain management. The local anesthetics comprise ropivacaine and bupivacaine. Few comparative studies have explicitly investigated these drugs in conjunction with fentanyl in PCA pumps for abdominal surgery.

Aim: This study is to evaluate the safety and effectiveness of administering ropivacaine and fentanyl via PCA pumps against bupivacaine and fentanyl for postoperative analgesia following abdominal surgery.

Methodology: An observational study was conducted with 60 individuals scheduled for abdominal operations. Patients were categorized into two categories. Group A got ropivacaine (0.15%) combined with fentanyl (2 µg/ml) intravenously using PCA pumps, whereas Group B was administered bupivacaine (0.1%) with fentanyl (2 µg/ml). Pain severity was assessed using the Visual Analog Scale (VAS), and side effects were meticulously recorded.

Results: Group A exhibited a significantly prolonged duration of analgesia (363.81 ± 16.9 hours) compared to Group B (230.07 ± 11.88 hours) ($p < 0.0001$). Pain ratings at important postoperative intervals (20 minutes and 20 hours) were much lower in Group A. Group A exhibited a lower incidence of adverse events, including bradycardia and motor blockade, whereas Group B experienced a higher frequency of problems, such as bradycardia, hypotension, and motor blockade.

Conclusion: The medication offers superior postoperative analgesia with few adverse effects and is clinically more effective than bupivacaine-fentanyl in patient-controlled analgesia pumps after abdominal surgery.

Keywords: Abdominal surgery, Bupivacaine, Fentanyl, Postoperative analgesia, Ropivacaine

Introduction

Abdominal surgery is a prevalent surgical procedure for several gastrointestinal problems. Nonetheless, efficient postoperative pain management remains a significant difficulty. Inadequate pain management results in consequences such as prolonged hospital stays, ileus, nausea and vomiting, delayed ambulation, and heightened healthcare expenses. Consequently, pain treatment is crucial not only for enhancing patient comfort but also for improving clinical results [1, 2]. The PCA has become a prevalent approach for postoperative pain management, enabling patients to self-administer predetermined doses of analgesic medications. Thus, it is seen to offer much more advantages than conventional intramuscular or intravenous injection techniques, including enhanced pain management, increased patient satisfaction, less sedation, and a lower incidence of postoperative complications [3]. PCEA is linked to enhanced pain relief following major abdominal surgery, characterized by increased regional analgesia, reduced sympathetic response, and expedited healing of the

gastrointestinal system [4]. PCEA allows patients to regulate infusions according to their pain levels, optimizing benefits by reducing adverse effects and enhancing comfort [5].

Epidural analgesia generally consists of a combination of local anesthetics and opioids [6]. Bupivacaine and ropivacaine are the two most often utilized local anesthetics for epidural analgesia [7]. Bupivacaine, a widely utilized long-acting amide local anesthetic, is effective but has elevated risks of cardiovascular and neurological damage [8]. Ropivacaine is a more contemporary alternative, exhibiting less toxicity and a lesser degree of motor blockade; hence, it may be a safer choice than bupivacaine for postoperative analgesia. Ropivacaine is significantly less potent than bupivacaine and is utilized in conjunction with an opioid, such as fentanyl, to provide analgesia [9]. It is a powerful synthetic opioid with a low molecular weight; it enhances the impact of a local anesthetic without substantially increasing the risk of motor block [10,11].

Despite several research comparing bupivacaine and ropivacaine, as well as opioids like fentanyl, direct comparisons of these combinations utilized in PCA pumps for postoperative pain management following abdominal surgery are limited [12]. Certain studies suggest that ropivacaine combined with fentanyl yields greater pain relief and reduced motor blockade compared to bupivacaine with fentanyl, despite a limited number of investigations into the comprehensive efficacy, safety profile, and incidence of complications associated with this combination. Many studies primarily concentrated on alternative methods of administration or did not address endpoints pertinent to PCA pump administration [13].

This study aimed to compare the effectiveness and safety of ropivacaine + fentanyl against bupivacaine + fentanyl delivered by a PCA pump in patients having abdominal surgery. Consistent with the research hypothesis, ropivacaine combined with fentanyl will yield superior postoperative analgesia with less side effects, particularly motor block, in comparison to bupivacaine combined with fentanyl. This study aims to furnish additional data regarding the most efficacious analgesic strategy for postoperative pain management in patients after abdominal surgery by evaluating pain severity using the Visual Analog Scale and analyzing the frequency of adverse effects.

Methodology

Study Area

This prospective observational study was conducted for 2 years in the Department of Anaesthesiology and Critical Care at Darbhanga Medical College & Hospital, Laheriasarai, Darbhanga, Bihar, India. Approval from the institutional ethics committee was obtained before the commencement of the inquiry.

Sample Size

The total sample size consisted of 60 patients in this study.

Inclusion and Exclusion Criteria

The study encompassed patients of both genders, aged 30 to 70 years, categorized as ASA Grade I, II, or III, and slated for abdominal surgery. The exclusion criteria included patients who declined participation, those with contraindications to regional anesthetic such as coagulopathy, localized infection at the epidural insertion site, or significant spinal abnormalities that might impede catheter implantation. Individuals having a prior history of allergic responses to bupivacaine, ropivacaine, or fentanyl, as well as those with a history of opioid or drug misuse, were excluded. Furthermore, those designated as ASA Grade IV or above, signifying serious systemic illness with heightened surgical or anesthetic risks, were excluded to enhance patient safety and reduce potential problems throughout the trial.

Intervention

Group	Intervention
Group A	Received a solution containing Ropivacaine (0.15%) + Fentanyl (2 microgram/ml)
Group B	Received a solution containing Bupivacaine (0.1%) + Fentanyl (2 microgram/ml)

Procedure

All individuals had preoperative preparation that included a nil per os (NPO) period of 6 to 8 hours before surgery, with no premedication provided. After adhering to conventional preoperative protocols, patients were transferred to the operating room, where aseptic and antiseptic precautions were meticulously implemented in preparation for regional anesthetic. Epidural anesthesia was utilized in every instance. During the operation, a loading dose of 10 mL of 0.5% bupivacaine was provided to each patient. Consequently, based on the designated

group, patients in Group A were administered a continuous infusion of 0.15% ropivacaine combined with fentanyl 2 µg/mL at a rate of 5 mL/hr, whereas patients in Group B got a continuous infusion of 0.1% bupivacaine with fentanyl 2 µg/mL, likewise at a rate of 5 mL/hr.

Postoperatively, same medication concentrations were set into the Patient-Controlled Analgesia (PCA) pump, which was linked to the epidural catheter. The PCA pump delivered a continuous baseline infusion at a rate of 4 mL/hr, allowing patients to self-administer bolus dosages of 3 mL, regulated by a lockout interval of 15 minutes. This approach facilitated patient-controlled analgesia while guaranteeing safety and proper analgesic administration. Intraoperative and postoperative monitoring conformed to normal ASA guidelines, encompassing continuous evaluation of heart rate, non-invasive blood pressure (NIBP), oxygen saturation (SpO2), body temperature, electrocardiogram (ECG), and Glasgow Coma Scale (GCS) scores. Monitoring measures were upheld throughout both the intraoperative and postoperative phases to guarantee maximum patient safety and analgesic efficacy throughout the trial duration.

Statistical Analysis

Data were displayed in tables with Microsoft Excel 365 and analyzed with SPSS version 24. Continuous variables, including VAS ratings, onset and duration of action, blood pressure, and heart rate, were presented as mean ± SD and analyzed between Group A (Ropivacaine + Fentanyl) and Group B (Bupivacaine + Fentanyl) utilizing an unpaired t-test. Categorical characteristics such as age, gender, kind of operation, and side effects were presented as frequencies and percentages, and analyzed using the chi-square test. A p-value of less than 0.05 was deemed statistically significant.

Results

Table 1 delineates a comparison of demographic features between Group A and Group B, including age, gender, weight, height, BMI, and ASA status. Statistical analysis indicated no significant differences between the two groups for these characteristics, since all p-values above the 0.05 level. The mean age, weight, height, and BMI were comparable amongst the groups, with no significant differences noted. Moreover, the gender distribution and ASA status classification were almost equal among the groups. The data suggest that the demographic features of the two groups are analogous, exhibiting no statistically significant variations in the analyzed parameters.

Table 1. Demographic Characteristics

Parameters	Group A	Group B	P-Value
Age in years	47.07 ± 11.28	44.04 ± 13.38	0.3469
Gender			
Male	17	18	>0.99
Female	13	12	
Weight in kg	62.72 ± 8.87	64.53 ± 7.58	0.399
Height in meter	1.65 ± 0.71	1.67 ± 0.84	0.921
BMI in kg/m2	23.59 ± 3.00	23.48 ± 2.63	0.8805
ASA Status			
ASA I	14	13	>0.99
ASA II	16	17	

The table 2 contrasts post-operative analgesia between Group A (Ropivacaine) and Group B (Bupivacaine) across three criteria: onset of analgesia, time to peak analgesia, and duration of analgesia. The initiation of analgesia was comparable across the two groups, with a mean of 7.74 ± 2.92 minutes for Group A and 8.27 ± 2.51 minutes for Group B; the p-value of 0.454 signifies no significant difference. Group A attained peak analgesia at 22.6 ± 5.43 minutes, but Group B achieved it somewhat earlier at 20.02 ± 4.53 minutes, with a p-value of 0.0504 indicating a borderline significant difference. The primary distinction was in the length of analgesia, with Group A (Ropivacaine) exhibiting a considerably prolonged duration (363.81 ± 16.9 hours) in contrast to Group B (Bupivacaine), which lasted 230.07 ± 11.88 hours, yielding a very significant p-value of <0.0001. This signifies that Ropivacaine offers markedly prolonged analgesia in comparison to Bupivacaine.

Table 2. Comparison of Post-operative Analgesia between Group A (Ropivacaine) and Group B (Bupivacaine)

Parameters	Group A	Group B	P Value
Postop analgesia: Onset in Mins	7.74 ± 2.92	8.27 ± 2.51	0.454
Time of Peak analgesia in Mins	22.6 ± 5.43	20.02 ± 4.53	0.0504
Duration of analgesia in Hrs	363.81 ± 16.9	230.07 ± 11.88	<0.0001

The table 3 illustrates the post-operative Visual Analog Scale (VAS) pain scores of Group A and Group B at different time intervals. At 0, 10, 30, 4, 8, and 24 hours, no significant differences exist between the groups, as shown by p-values over 0.05. Notable disparities in pain levels are seen at 20 minutes, 12 hours, 16 hours, and 20 hours, with Group A often indicating lower pain scores than Group B ($p < 0.05$). Significant differences are seen at 20 minutes ($p < 0.0001$) and 20 hours ($p < 0.0001$), demonstrating that Group A experienced markedly reduced pain at these intervals. Group A exhibits reduced pain ratings at many critical periods, especially throughout the later stages of the post-operative period.

Table 3. Comparison of Post Operative Visual Analogue Scale between Group A (Ropivacaine) and Group B (Bupivacaine)

Post Operative Time	VAS in mean ± SD		P Value
	Group A	Group B	
0 Minutes	2.9 ± 1.06	3.17 ± 1.31	0.3838
10 Minutes	0.95 ± 1.2	1.46 ± 1.09	0.0902
20 Minutes	1.4 ± 0.54	0.77 ± 0.45	<0.0001
30 Minutes	0.6 ± 0.55	0.39 ± 0.59	0.1592
4 Hours	3.02 ± 1.6	3.27 ± 1.39	0.5208
8 Hours	3.15 ± 1.75	3.33 ± 1.54	0.6739
12 Hours	2.17 ± 1.66	3.11 ± 1.6	0.0294
16 Hours	1.91 ± 1.04	2.93 ± 1.81	0.0097
20 Hours	1.26 ± 0.77	3.21 ± 1.52	<0.0001
24 Hours	2.39 ± 1.67	3.18 ± 1.97	0.0992

The table 4 depicts the heart rates of Group A and Group B at different post-operative intervals. At 0 minutes, the groups exhibit no significant difference ($p = 0.3019$). Notable disparities arise from the 10-minute mark, with Group B continuously exhibiting lower heart rates than Group A at all subsequent intervals ($p < 0.0001$ at 10, 20, 30 minutes, and 4 hours; $p < 0.0001$ at 8, 16, and 24 hours; $p = 0.0045$ at 12 hours). Significant disparities are noted at 10, 20, 30, and 40 hours, with Group B exhibiting much lower heart rates. Group A consistently exhibits a greater heart rate than Group B over the post-operative period, with notable disparities recorded at various intervals.

Table 4. Comparison of Heart Rate between Group A (Ropivacaine) and Group B (Bupivacaine)

Time	Herat Rate in mean ± SD		P Value
	Group A	Group B	
0 Minutes	98.57 ± 8.86	95.75 ± 11.89	0.3019
10 Minutes	98.28 ± 6.23	84.67 ± 13.2	<0.0001
20 Minutes	98.13 ± 8.37	83.77 ± 13.34	<0.0001
30 Minutes	97.73 ± 10	83.85 ± 9.07	<0.0001
4 Hours	96.94 ± 10.29	83.06 ± 10.51	<0.0001
8 Hours	95.09 ± 10.22	84.33 ± 1.91	<0.000
12 Hours	94.38 ± 11.85	86.08 ± 9.8	0.0045
16 Hours	94.86 ± 8.18	82.63 ± 10.96	<0.0001
20 Hours	94.64 ± 8.33	84.27 ± 11.48	0.0002
24 Hours	95 ± 9.13	82.94 ± 10.79	<0.0001

The table 5 explores the systolic blood pressure (SBP) of Group A and Group B at many post-operative intervals. At 0, 10, 20, and 30 minutes, no significant variations in SBP were observed across the groups ($p > 0.05$). Notable disparities arise at 12, 16, 20, and 24 hours, with Group A consistently demonstrating elevated SBP relative to Group B ($p < 0.0001$). Significant differences are seen at 20 hours ($p < 0.0001$), with Group A exhibiting a pronounced elevation in SBP. Group A has elevated SBP levels compared to Group B in the latter post-operative phase.

Table 5. Comparison of SBP between Group A (Ropivacaine) and Group B (Bupivacaine)

Time	SBP (mmHg) in mean ± SD		P Value
	Group A	Group B	
0 Minutes	110.5 ± 9.54	113.62 ± 10.17	0.2253
10 Minutes	112.88 ± 11.24	112.88 ± 11.24	0.8736
20 Minutes	112.16 ± 9.2	112.04 ± 10.31	0.9622
30 Minutes	113.8 ± 8.37	113.74 ± 5.14	0.9734
4 Hours	124.02 ± 5.05	125.05 ± 5.21	0.1309
8 Hours	123.65 ±4.93	123.92 ± 6.05	0.8504
12 Hours	124.88 ± 4.51	116.48 ± 4.87	<0.0001
16 Hours	124.83 ± 5.27	113.57 ± 7.23	<0.0001
20 Hours	126.14 ± 5.12	113.18 ± 8.07	<0.0001
24 Hours	125.79 ± 3.89	115.1 ± 7.28	<0.0001

The table 6 evaluates diastolic blood pressure (DBP) between Group A and Group B at different post-operative intervals. At 0 minutes, Group A exhibits a markedly elevated DBP (79.16 ± 8.98) in contrast to Group B (73.68 ± 6.77), with a p-value of 0.0099. Nonetheless, no substantial changes were seen at 10, 30, 4 hours, and 20 hours ($p > 0.05$). Notable differences are seen at 20 minutes ($p = 0.0252$), 8 hours ($p = 0.0331$), 12 hours ($p = 0.0375$), and 16 hours ($p = 0.0373$), with Group A continually exhibiting elevated DBP levels. At 24 hours, the disparity in DBP remains substantial ($p = 0.0099$), but the results are more comparable (Group A: 76.73 ± 7.19, Group B: 75.32 ± 7.19). Group A consistently exhibits greater diastolic blood pressure (DBP) than Group B, with notable differences recorded at many time intervals.

Table 6. Comparison of DBP between Group A (Ropivacaine) and Group B (Bupivacaine)

Time	DBP (mmHg) in mean ± SD		P Value
	Group A	Group B	
0 Minutes	79.16 ± 8.98	73.68 ± 6.77	0.0099
10 Minutes	75.62 ± 11.3	74.42 ± 6.64	0.6179
20 Minutes	77.07 ± 9.7	72.2 ± 6.37	0.0252
30 Minutes	75.79 ± 9.96	72.5 ± 5.6	0.1202
4 Hours	75.46 ± 9.5	73.57 ± 6.14	0.3662
8 Hours	77.02 ± 8.28	73.1 ± 5.31	0.0331
12 Hours	77.33 ± 9.04	73.13 ± 5.92	0.0375
16 Hours	77.01 ± 7.79	73.03 ± 6.63	0.0373
20 Hours	76.8 ± 8.26	73.66 ± 7.44	0.1273
24 Hours	76.73 ± 7.19	75.32 ± 7.19	0.0099

The table 7 displays the respiratory rate (RR) of Group A and Group B at different post-operative intervals. At 0, 10, 20, 30 minutes, and 24 hours, no significant variations in RR were observed across the groups ($p > 0.05$). A notable disparity is seen at 4 hours, with Group A exhibiting a higher RR (12.00 ± 0.87) than Group B (11.42 ± 1.21), yielding a p-value of 0.0373. Although Group A regularly exhibits somewhat elevated RR values compared to Group B at various time intervals, including 8 hours ($p = 0.0764$) and 12 hours ($p = 0.1162$), none of these discrepancies reach statistical significance. The respiratory rate exhibits negligible change among the groups, with the sole significant difference observed at 4 hours.

Table 7. Comparison of Respiratory Rate between Group A (Ropivacaine) and Group B (Bupivacaine)

Time	RR in mean ± SD		P Value
	Group A	Group B	
0 Minutes	11.84 ± 1.51	12.67 ± 2.05	0.0794
10 Minutes	11.84 ± 1.25	12.02 ± 1.28	0.5837
20 Minutes	11.95 ± 1.1	11.75 ± 1.38	0.5372
30 Minutes	12.23 ± 1.42	11.75 ± 1.46	0.2019
4 Hours	12 ± 0.87	11.42 ± 1.21	0.0373
8 Hours	12.17 ± 0.93	11.63 ± 1.35	0.0764
12 Hours	12.24 ± 1.37	11.62 ± 1.63	0.1162
16 Hours	11.9 ± 1.48	11.63 ± 1.74	0.5199
20 Hours	12.03 ± 1	11.93 ± 1.22	0.7297
24 Hours	11.92 ± 1.16	12.14 ± 0.99	0.4327

The table 8 displays the occurrence of adverse events in Group A and Group B. No individuals in Group A exhibited bradycardia, but 4 participants (13.33%) in Group B encountered the condition. Hypotension was seen in 3 participants (10%) in Group A and 6 participants (20%) in Group B. Nausea and vomiting occurred uniformly in all groups, with 3 participants (10%) in each group reporting these symptoms. Respiratory depression occurred more frequently in Group B (2 participants, 6.67%) than in Group A (1 person, 3.33%). Pruritus was uniformly distributed, with one individual (3.33%) in each group affected. Motor obstruction occurred in 1 individual (3.33%) in Group A and in 3 participants (10%) in Group B. Group B had a greater prevalence of adverse events, notably bradycardia, hypotension, and motor blockade.

Table 8. Comparison of Adverse Events between Group A (Ropivacaine) and Group B (Bupivacaine)

Adverse Events	Group A	Group B
Bradycardia	0	4 (13.33%)
Hypotension	3 (10%)	6 (20%)
Nausea/Vomiting	3 (10%)	3 (10%)
Respiratory Depression	1 (3.33%)	2 (6.67)
Puritus	1 (3.33%)	1 (3.33%)
Motor Blockage	1 (3.33%)	3 (10%)

Discussion

In this prospective, randomized, interventional, single-blinded study, we assessed the postoperative analgesic efficacy and usability of epidural ropivacaine with fentanyl administered via PCA pump, compared to epidural bupivacaine with fentanyl via PCA pump. The findings of this study indicated that ropivacaine is a superior anesthetic agent, providing appropriate anesthetic conditions, enhanced hemodynamic stability, reduced sedation or respiratory depression, and prolonged analgesic duration. The evidence supporting these findings is given below.

In our study, the majority of patients were male, aged 41-50 years, and classified as ASA II. “No significant difference was seen between the ropivacaine and bupivacaine groups regarding the onset of post-operative analgesia. The time to peak analgesia and the duration of analgesia were considerably longer in the ropivacaine group. The quantity of top-ups was markedly higher in the bupivacaine group. VAS values were markedly reduced in the bupivacaine group at the 20-minute mark. Nevertheless, VAS ratings were much lower in the ropivacaine group after 16 and 20 hours. The heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were considerably lower in the bupivacaine group compared to the ropivacaine group. The respiratory rate was markedly reduced in the bupivacaine group compared to the ropivacaine group at the 4-hour mark. A much higher level of sedation was observed in the bupivacaine group at 20 minutes, 4 hours, 16 hours, and 24 hours.

Bradycardia, hypotension, respiratory depression, and motor blockade occurred with greater frequency in the bupivacaine group. Epidural analgesia provides preemptive analgesia, which mitigates central sensitization, decreases the necessity for several drugs, facilitates physiotherapy, and promotes early mobilization. [14] Local anesthetics, along with lipophilic opioid analgesics, have attained considerable popularity. Recently, there has been an increasing amount of research on ropivacaine, a new local anesthetic. Ropivacaine is considered to be less toxic and safer than bupivacaine, while retaining comparable pharmacological properties. [15,16]

Ropivacaine is a local anesthetic characterized by its excellent purity in the S-enantiomer form and prolonged efficacy. It possesses a high pKa, indicating its ionization constant, along with limited lipid solubility. Ropivacaine predominantly obstructs the nerve fibers that convey pain, specifically A delta and C fibers, rather than those associated with motor function, namely A-beta

fibers. Consequently, it exhibits similarities to bupivacaine regarding pain relief, although it has a reduced probability of inducing motor blockade at minimal doses. Furthermore, ropivacaine has a reduced duration of motor blockade. The medicine demonstrates reduced cardiotoxicity relative to comparable doses of bupivacaine, although possesses a markedly higher threshold for central nervous system (CNS) toxicity in comparison to bupivacaine. [17]

Virmani et al. established that continuous infusion, as opposed to intermittent boluses, enhanced pain relief both at rest and during activity, while sustaining a stable level of analgesia. [18] Wheatley et al. performed a thorough review of four studies and discovered that the cohort receiving a "continuous epidural infusion of a combination of local anesthetic and lipophilic opioid" showed significantly enhanced dynamic relief compared to those administered either medication alone [19]. We select for opioids because they reduce the necessity for local anesthetics, mitigate future complications, and enhance analgesia [20]. A lipophilic opioid, like fentanyl, is optimal because to its fast degradation in the spinal cord and surrounding blood vessels. As a result, there is a rapid decrease in the content of cerebrospinal fluid and a diminishment in its distribution towards the cranial region [21]. As a result, the probability of encountering delayed respiratory depression is diminished.

Respiratory depression may arise if the epidural catheter displaces into the subarachnoid space or intravenous system. Furthermore, continuous medication infusion results in increased protein binding, particularly to "α1-acid glycoprotein," alongside a reduction in drug clearance. [22,23] Moreover, the general decline in condition and severe surgical interventions may contribute to respiratory insufficiency. Our investigation revealed that the average medication requirement during postoperative recovery was greater in the bupivacaine group than in the control group, aligning with the findings of Korula et al. [24] The essential aspect of good postoperative analgesia via a local anesthetic is to ensure pain relief while maintaining motor function. Facilitating physiotherapy, encouraging early mobility, and preventing deep vein thrombosis is essential.

Ropivacaine demonstrates superior distinction between motor and sensory inhibition. This can be ascribed to its less lipophilicity relative to bupivacaine, leading to a decreased probability of obstructing large, myelinated nerve fibers. Nonetheless, the motor block that arises is often not incapacitating and does not impede the patient's capacity to move in bed or engage in physiotherapy. Brodner et al. noted a bromage score over zero just in the bupivacaine group [20]. The ropivacaine group showed improved mobilization capabilities. Jørgensen et al. indicated that the incidence of motor blockade was 7% in the ropivacaine group compared to 15% in the bupivacaine group [25]. Berti et al. and Paddalwar et al. both found similar findings [26].

Investigations by Casati et al., Pouzeratte et al., Jørgensen et al., and Surabathuni et al. demonstrated that the demand for enhanced analgesia was greater in the ropivacaine cohort than in the bupivacaine cohort [27,28]. The hazards or bad responses associated with "continuous epidural infusion" of local anesthetics and opioids may have resulted from technical complications during the installation of the epidural catheter, including trauma, hematoma, and nerve root damage. The negative effects may have resulted from the drugs' parasympathetic blockade, hemodynamic disturbance, or excessive absorption of the drug into the bloodstream.

Conclusion

This study demonstrated that ropivacaine combined with fentanyl is superior than bupivacaine with fentanyl in providing postoperative analgesia for patients who had abdominal surgery, particularly in terms of extended analgesic duration and reduced motor blockage. Both regimens provided superior analgesia. Ropivacaine exhibited fewer adverse effects, such as bradycardia, hypotension, and motor blockage, resulting in improved recovery throughout the postoperative phase. The results indicate that ropivacaine, delivered by a PCA pump, constitutes a safer and more effective alternative to traditional postoperative pain treatment after abdominal surgery, yielding superior patient outcomes with reduced complications. Consequently, further study is necessary to ascertain the implications of these findings.

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