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Comparison of Efficacy of Epidural Ropivacaine Vs Bupivacaine For Post-Operative Pain Relief in Abdominal Malignancy Surgeries

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Abstract

Background: Postoperative pain management is critical for recovery after abdominal malignancy surgeries. Epidural analgesia, using local anesthetics like bupivacaine and ropivacaine, is a common approach. This study compares the efficacy of epidural ropivacaine versus bupivacaine for postoperative pain relief in abdominal malignancy surgeries, focusing on pain scores, motor blockade, and adverse effects.

Methods: A prospective, randomized, double-blind controlled trial was conducted on 80 patients undergoing abdominal malignancy surgeries. Patients were divided into two groups: Group R (0.2% ropivacaine with fentanyl) and Group B (0.125% bupivacaine with fentanyl). Postoperative pain scores, motor blockade (using the Bromage Scale), rescue analgesia requirements, and adverse effects were assessed over 48 hours.

Results: Both groups demonstrated comparable pain relief, with no significant differences in Visual Analog Scale (VAS) scores at any time point ($p > 0.05$). However, ropivacaine was associated with significantly less motor blockade (Bromage Scale: 0.2 ± 0.4 vs. 0.7 ± 0.6, $p = 0.001$). Rescue analgesia requirements and epidural local anesthetic consumption were similar between groups. Adverse effects, including nausea, vomiting, and hypotension, were low and comparable, though ropivacaine showed a trend toward fewer hypotensive events (3% vs. 10%, $p = 0.21$).

Conclusion: Epidural ropivacaine and bupivacaine provide equivalent postoperative pain relief in abdominal malignancy surgeries. However, ropivacaine is associated with significantly less motor blockade, making it a preferable choice for enhanced recovery protocols. The trend toward fewer adverse effects further supports its use in clinical practice.

Keywords: Epidural analgesia, ropivacaine, bupivacaine, postoperative pain.

Introduction

Postoperative pain management is a critical aspect of patient care following abdominal malignancy surgeries. Inadequate pain control can lead to a cascade of adverse

outcomes, including delayed mobilization, increased risk of pulmonary complications, prolonged hospital stays, and diminished quality of life[1]. Effective analgesia, on the other hand, facilitates early ambulation, reduces stress responses, and improves overall patient satisfaction [1-2].

Epidural analgesia has long been a cornerstone of postoperative pain management, offering superior pain relief compared to systemic analgesics in many cases. By delivering local anesthetics directly to the spinal cord, epidural analgesia can effectively block pain signals without the systemic side effects associated with opioids[3]. Bupivacaine, a long-acting local anesthetic, has been widely used for epidural analgesia due to its efficacy and prolonged duration of action. However, concerns regarding its potential for cardiotoxicity and motor blockade have prompted the investigation of alternative agents[1,4].

Ropivacaine, a newer long-acting local anaesthetic, offers a potentially improved safety profile compared to bupivacaine. As a pure S(-)-enantiomer, ropivacaine is associated with a lower risk of cardiotoxicity and central nervous system toxicity[1,4]. Additionally, some studies suggest that ropivacaine may produce less motor blockade than bupivacaine at equipotent analgesic doses, potentially facilitating earlier mobilization[4-5]. This is particularly relevant in the context of abdominal surgery, where early mobilization is crucial for preventing complications such as deep vein thrombosis and pneumonia.

Several studies have compared the efficacy and safety of ropivacaine and bupivacaine for postoperative analgesia in various surgical settings. For instance, Ayyappan et al. compared ropivacaine and bupivacaine, with either fentanyl or dexmedetomidine, for post-operative analgesia in lower limb orthopaedic surgeries. Similarly, Mehta et al. compared 0.2% bupivacaine and 0.2% ropivacaine for postoperative epidural analgesia in major lower limb orthopedic surgery[2]. Bhat et al. compared the efficacy and safety of ropivacaine with bupivacaine for intrathecal anaesthesia for lower abdominal and lower limb surgeries. They found that ropivacaine had a faster onset and regression of sensory blockade [6]. While these studies provide valuable insights, there is a relative paucity of research specifically focusing on abdominal malignancy surgeries.

Accordingly, this study aims to compare the efficacy of epidural ropivacaine versus bupivacaine for postoperative pain relief in patients undergoing abdominal malignancy surgeries.

Materials and Methods

This prospective, randomized, double-blind controlled trial was conducted at Acharya Shri Chander College of Medical Sciences and Hospital, Jammu in the Surgical and Anaesthesia Departments for 01-year w.e.f January 2024 to December 2024. The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment.

The study was conducted on 80 patients enrolled for abdominal malignancy surgeries and were selected as per the following inclusion and exclusion criteria.

Inclusion Criteria: Eligible participants were adult patients (18-75 years of age), of ASA physical status I-III, undergoing elective abdominal surgery for malignancy, with an anticipated postoperative hospital stay of at least 48 hours.

Exclusion Criteria: Patients were excluded if they meet any of the following criteria: allergy or contraindication to local anesthetics or fentanyl, pre-existing neurological deficits, chronic pain conditions, opioid use within one month before surgery, Body Mass Index >35 kg/m2, pregnancy, coagulopathy or bleeding disorders, infection

at the site of epidural insertion, or inability to provide informed consent.

Methodology

Eligible patients were randomly assigned to one of two groups using a computer-generated randomization sequence:

- **Group B:** Epidural infusion of 0.125% bupivacaine with fentanyl 1 mcg/mL
- **Group R:** Epidural infusion of 0.2% ropivacaine with fentanyl 1 mcg/mL

Anesthetic Procedure

All patients received general anaesthesia for the surgical procedure. Standard monitoring was applied, including electrocardiography, non-invasive blood pressure, pulse oximetry, and end-tidal carbon dioxide monitoring. An epidural catheter was placed in the lumbar region (L2-L3 or L3-L4 interspace) before the induction of general anesthesia. Correct placement was confirmed by a loss-of-resistance technique and the absence of blood or cerebrospinal fluid on aspiration. A bolus dose of local anaesthetic (3-5ml) was administered to establish adequate block height (T6-T8 dermatome level).

Postoperative Analgesia

Following surgery, patients were transferred to the post-anesthesia care unit. The epidural infusion was initiated in the PACU and continued for 48 hours. The infusion rate was adjusted to maintain a visual analog scale pain score ≤ 3 (0 = no pain, 10 = worst imaginable pain). If the VAS score exceeds 3, a bolus dose of the assigned study drug (3-5 mL) was administered via the epidural catheter. If adequate pain relief is not achieved with bolus doses, intravenous morphine is administered as rescue analgesia. The total consumption of rescue analgesia was recorded.

Data Collection

The study involved the collection of various data points, including demographic information such as age, sex, weight, height, and ASA physical status. Intraoperative details encompass the type and duration of surgery as well as the consumption of opioids during the procedure. Postoperative pain was measured using Visual Analog Scale (VAS) scores recorded at multiple intervals: 1, 2, 4, 6, 12-, 24-, 36-, and 48-hours following surgery. Additionally, the total volume of either bupivacaine or ropivacaine infused over 48 hours was tracked to assess epidural local anesthetic consumption. The total dose of intravenous morphine given for rescue analgesia was also noted. Motor blockade was evaluated through the modified Bromage scale at the same times as pain scores, while sensory blockade was determined by assessing loss of pinprick sensation. Adverse effects, including nausea, vomiting, pruritus, hypotension, respiratory depression, and urinary retention, were recorded. Furthermore, the time to mobilization was measured from the end of surgery until the patient first walks more than 10 feet. Lastly, patient satisfaction was evaluated using a 5-point Likert scale at 48 hours postoperatively.

Statistical Analysis

Statistical analysis was performed using SPSS 22.0. Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as numbers and percentages. The primary outcome (postoperative pain scores) was compared between groups using appropriate statistical tests. A p-value of < 0.05 was considered statistically significant.

Table 1: Demographic and Intraoperative Data

Parameter	Ropivacaine Group (n=40)	Bupivacaine Group (n=40)	p-value
Age (years)	62 ± 10	65 ± 8	0.32
Sex (Male/Female)	25/15	22/18	0.65
Weight (kg)	75 ± 12	78 ± 10	0.45
Height (cm)	170 ± 8	168 ± 7	0.28
ASA Physical Status (I/II/III)	10/20/10	8/22/10	0.78
Duration of Surgery (minutes)	180 ± 45	190 ± 50	0.56
Intraoperative Opioid Consumption (mcg fentanyl equivalents)	150 ± 50	160 ± 60	0.62

Table 1 summarizes the demographic and intraoperative characteristics of patients in the Ropivacaine and Bupivacaine groups. The mean age was 62 ± 10 years for Ropivacaine and 65 ± 8 years for Bupivacaine (p = 0.32). Gender distribution included 25 males and 15 females in Ropivacaine vs. 22 males and 18 females in Bupivacaine (p = 0.65). Average weight was 75 ± 12 kg (Ropivacaine) and 78 ± 10 kg (Bupivacaine) (p = 0.45), while mean height was 170 ± 8 cm and 168 ± 7 cm, respectively (p = 0.28). ASA Physical Status (I/II/III) was 10/20/10 for Ropivacaine and 8/22/10 for Bupivacaine (p = 0.78). Surgery duration averaged 180 ± 45 minutes for Ropivacaine and 190 ± 50 minutes for Bupivacaine (p = 0.56). Intraoperative opioid use was 150 ± 50 mcg for Ropivacaine and 160 ± 60 mcg for Bupivacaine (p = 0.62). No significant differences were found in demographic or intraoperative parameters between the groups.

Table 2: Postoperative Pain Scores

Time (hours)	Ropivacaine Group (Mean ± SD)	Bupivacaine Group (Mean ± SD)	p-value
1	2.5 ± 1.0	2.3 ± 0.9	0.65
2	2.8 ± 1.1	2.5 ± 1.0	0.54
4	2.2 ± 0.8	2.0 ± 0.7	0.48
6	2.0 ± 0.7	1.8 ± 0.6	0.51
12	1.5 ± 0.5	1.3 ± 0.4	0.42
24	1.2 ± 0.4	1.0 ± 0.3	0.38
36	1.0 ± 0.3	0.8 ± 0.2	0.45
48	0.7 ± 0.2	0.6 ± 0.2	0.68

Table 2 outlines the postoperative pain scores for both groups at various time points over 48 hours. At 1-hour post-surgery, Ropivacaine had a mean pain score of 2.5 ± 1.0, while Bupivacaine was at 2.3 ± 0.9 (p = 0.65). Scores at 2 hours were 2.8 ± 1.1 for Ropivacaine and 2.5 ± 1.0 for Bupivacaine (p = 0.54). By 4 hours, scores decreased to 2.2 ± 0.8 and 2.0 ± 0.7 (p = 0.48), respectively. Further reductions were seen at 6, 12, 24, 36, and 48 hours, with the final scores at 0.7 ± 0.2 for Ropivacaine and 0.6 ± 0.2 for Bupivacaine (p = 0.68). Overall, there were no significant differences in pain

scores between the groups, indicating similar pain relief from both local anesthetics.

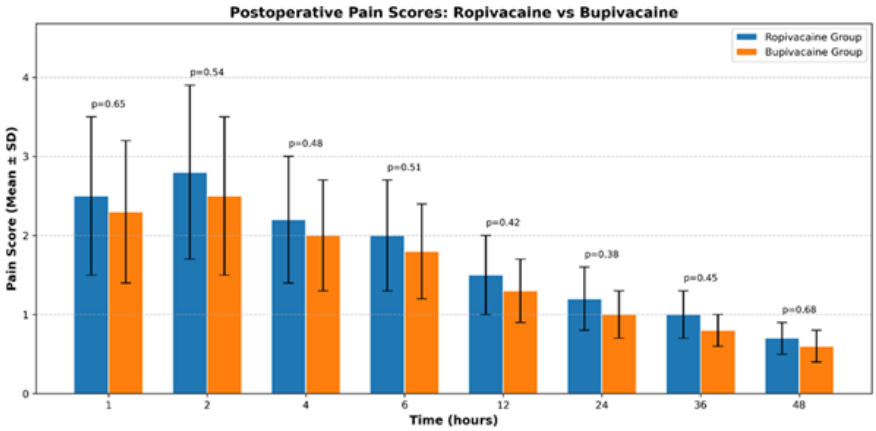

Figure 1 : Post-operative Pain Scores

Table 3: Postoperative Analgesia and Motor Blockade

Parameter	Ropivacaine Group (Mean ± SD)	Bupivacaine Group (Mean ± SD)	p-value
Epidural Local Anesthetic Consumption (mL)	350 ± 50	360 ± 60	0.58
Rescue Analgesia (mg Morphine)	5 ± 3	6 ± 4	0.61
Motor Blockade (Bromage Scale, 48 hours)	0.2 ± 0.4	0.7 ± 0.6	0.001

Table 3 compares postoperative analgesia and motor blockade between the Ropivacaine and Bupivacaine groups. Epidural local anesthetic consumption was similar: 350 ± 50 mL for Ropivacaine and 360 ± 60 mL for Bupivacaine ($p = 0.58$). Rescue analgesia requirements were also comparable: 5 ± 3 mg in the Ropivacaine group versus 6 ± 4 mg in the Bupivacaine group ($p = 0.61$). However, the Ropivacaine group showed significantly less motor blockade at 48 hours, with a Bromage Scale score of 0.2 ± 0.4 compared to 0.7 ± 0.6 for Bupivacaine ($p = 0.001$). This suggests Ropivacaine has advantages in maintaining motor function while providing similar analgesia.

Table 4: Other Outcomes and Adverse Effects

Parameter	Ropivacaine Group	Bupivacaine Group	p-value
Sensory Blockade	Similar	Similar	N/A
Nausea	5%	8%	0.67
Vomiting	3%	7%	0.52
Pruritus	2%	5%	0.71
Hypotension	3%	10%	0.21
Respiratory Depression	0%	0%	1.00
Urinary Retention	5%	8%	0.67
Time to Mobilization (hours)	28 ± 8	30 ± 10	0.55
Patient Satisfaction	4.2 ± 0.6	4.0 ± 0.7	0.49

Table 4 summarizes outcomes and adverse effects in both groups. Sensory blockade was similar with no p-value provided. Nausea occurred in 5% of the Ropivacaine group versus 8% in the Bupivacaine group (p = 0.67), while vomiting was reported in 3% versus 7% (p = 0.52). Pruritus rates were 2% for Ropivacaine and 5% for Bupivacaine (p = 0.71). Hypotension was less frequent in the Ropivacaine group (3%) compared to 10% in Bupivacaine (p = 0.21). No cases of respiratory depression occurred (p = 1.00). Urinary retention rates were 5% and 8% (p = 0.67), respectively. Mean time to mobilization was 28 ± 8 hours for Ropivacaine and 30 ± 10 hours for Bupivacaine (p = 0.55). Patient satisfaction scores were similar: 4.2 ± 0.6 for Ropivacaine and 4.0 ± 0.7 for Bupivacaine (p = 0.49). Overall, the safety profiles and secondary outcomes of both anesthetics were comparable.

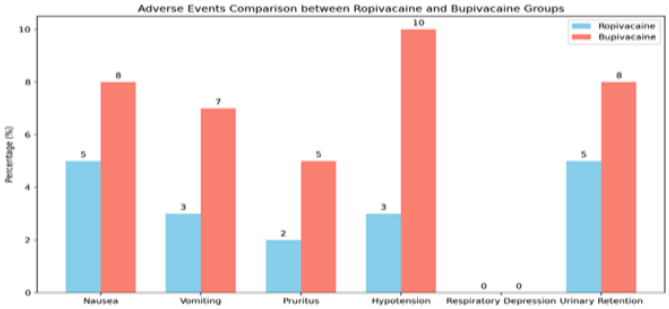

Figure 2: Comparison of Adverse Effects

Discussion

This study compared the efficacy of epidural ropivacaine and bupivacaine for postoperative pain relief in patients undergoing abdominal malignancy surgeries. The results demonstrated that both local anesthetics provided comparable pain relief over the 48-hour postoperative period, with no significant differences in pain scores or rescue analgesia requirements. However, ropivacaine was associated with significantly less motor blockade, suggesting potential advantages in terms of early mobilization and reduced motor impairment. These findings align with and expand upon previous studies comparing ropivacaine and bupivacaine for epidural analgesia.

The demographic and intraoperative characteristics of the two groups were well-matched, with no significant differences in age, gender, weight, height, ASA status, duration of surgery, or intraoperative opioid consumption. Similar baseline characteristics have been reported in previous studies comparing ropivacaine and bupivacaine, the work by Graf et al. (2002), also found no significant differences in demographic or intraoperative parameters between the two groups[7].

The postoperative pain scores were comparable between the ropivacaine and bupivacaine groups at all measured time points. Both agents provided effective analgesia, with pain scores decreasing progressively over the 48 hours. These results are consistent with studies by Capdevila et al. (1999) and Zaric et al. (2006), which reported similar analgesic efficacy between ropivacaine and bupivacaine in epidural anesthesia [8-9].

While both local anesthetics provided similar pain relief, a significant difference was observed in motor blockade. The ropivacaine group had a significantly lower Bromage Scale score at 48 hours (0.2 ± 0.4) compared to the bupivacaine group (0.7 ± 0.6, p = 0.001). This finding is consistent with the known pharmacological profile of ropivacaine, which has a greater sensory-motor dissociation compared to bupivacaine (Whiteside JB et al., 2003)[10]. The reduced motor blockade associated with ropivacaine is particularly advantageous in the context of enhanced recovery after surgery (ERAS) protocols, as it facilitates early mobilization and reduces the risk of complications such as deep vein thrombosis and pulmonary embolism (Scott DB et al., 1995)[11].

The incidence of adverse effects, including nausea, vomiting, pruritus, hypotension, and urinary retention,

was low in both groups, with no statistically significant differences. However, there was a trend toward fewer adverse effects in the ropivacaine group, particularly for hypotension (3% vs. 10%, p = 0.21). This trend aligns with previous studies, such as those by Whiteside et al. (2003) and Scott et al. (1995), which reported a lower incidence of hypotension and cardiovascular toxicity with ropivacaine compared to bupivacaine[10-11]. The comparable safety profiles of the two agents, combined with the reduced motor blockade observed with ropivacaine, suggest that ropivacaine may be a preferable choice for epidural analgesia in certain clinical scenarios.

Our findings are consistent with previous research comparing ropivacaine and bupivacaine for epidural analgesia. For instance, a study by Casati et al. (2000) found that ropivacaine provided comparable analgesia to bupivacaine but with less motor blockade, supporting our results[12]. Similarly, a meta-analysis by McClellan and Faulds (2000) concluded that ropivacaine and bupivacaine were equally effective for postoperative pain relief, but ropivacaine was associated with a lower risk of motor block and cardiovascular toxicity[13]. These studies, along with our findings, highlight the potential advantages of ropivacaine in terms of reduced motor impairment and a favourable safety profile.

Conclusion

This study demonstrates that epidural ropivacaine and bupivacaine provide comparable postoperative pain relief in patients undergoing abdominal malignancy surgeries. However, ropivacaine is associated with significantly less motor blockade, making it a preferable choice in clinical scenarios where early mobilization is a priority. The trend toward fewer adverse effects with ropivacaine further supports its use in epidural analgesia.

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