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Comparative Evaluation of Epidural Ropivacaine and Bupivacaine for Labor Analgesia: A Retrospective Study

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Abstract

Background

Labor pain is one of the most intense experiences for a woman. Effective pain relief is essential for maternal comfort and smooth delivery. Epidural analgesia is widely used for labor pain but the choice of the best local anesthetic remains debated. Bupivacaine provides effective pain relief but has a higher risk of motor blockade and potential cardiotoxicity. Ropivacaine is a newer alternative believed to offer better sensory-motor differentiation with reduced systemic toxicity. This study compares the efficacy, motor effects, and safety of ropivacaine (0.2%) and bupivacaine (0.125%) for epidural labor analgesia.

Methods

A total of 60 parturients were included. 30 received ropivacaine (0.2%) and 30 received bupivacaine (0.125%) via epidural infusion. The primary endpoint was pain relief measured using the Visual Analog Scale (VAS) at 15 minutes post-administration. Secondary outcomes included motor blockade, obstetric outcomes, and adverse effects. Data were analyzed using SPSS v.26 with $p<0.05$ considered significant.

Results

The ropivacaine group showed better pain relief (VAS <3 in 86.7% vs. 60%, $p=0.032$). Motor function was better preserved with 73.3% showing no blockade versus 53.3% in the bupivacaine group ($p=0.041$). Obstetric outcomes including spontaneous vaginal delivery, instrumental delivery, and cesarean section rates were similar ($p>0.05$). Adverse effects were slightly lower in the ropivacaine group though not statistically significant.

Conclusion

Ropivacaine (0.2%) provided superior analgesia with less motor blockade making it a better option for labor epidural analgesia. With comparable obstetric outcomes and fewer side effects, it is an effective alternative to bupivacaine. Further randomized trials are needed to confirm these findings.

Keywords: Epidural analgesia, Ropivacaine, Bupivacaine, Labor pain, Motor blockade, Obstetric outcomes

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Introduction

In obstetrics, managing labor pain is still a major concern. The gold standard for effectively reducing pain while preserving maternal awareness and involvement during birthing is epidural analgesia. The comparison of ropivacaine with bupivacaine for labor epidural analgesia has gained attention because to the quest for the perfect local anesthetic that strikes a compromise between strong analgesia and few adverse effects.[1] Because of its strength and length of action, buprevacaine, a long-acting local anesthetic, has been utilized extensively in obstetric anesthesia. However, research into substitutes has been spurred by worries about its degree of motor blockage and possible cardiotoxicity. [2] Ropivacaine has a distinct stereoisomeric structure that results in reduced lipid solubility, making it a potentially safer alternative. Theoretically, this characteristic results in less systemic toxicity and better sensory-motor differential blocking, which may increase the mother's movement during birth.[3] Without affecting the course of labor or raising the risk of instrumental or caesarean births, the optimal local anesthetic for labor epidural analgesia should have a quick onset, sufficient pain relief, little motor blocking, and a good safety profile for both mother and fetus. [4] Although ropivacaine and bupivacaine have been compared in a number of trials, the results have been mixed, making the best option debatable. By contrasting the efficacy, safety, and obstetric results of epidural ropivacaine (0.2%) with bupivacaine (0.125%) for labor analgesia, this study seeks to advance this crucial field of obstetric anesthesia. In comparison to bupivacaine, we predict that ropivacaine will produce better analgesia with less motor blockage and fewer side effects. We want to offer insightful information that can direct clinical judgment and improve parturient pain management techniques by examining pain scores, motor blockage, delivery method, and side effects. This comparison analysis could help us improve our approach to managing labor pain, which would eventually improve obstetric outcomes and maternal satisfaction as we work to improve the quality of treatment in obstetric anesthesia.

Material and Methods

This retrospective observational study aimed to assess and compare the efficacy of epidural ropivacaine (0.2%) and bupivacaine (0.125%) for labor analgesia. Sixty parturients who underwent epidural analgesia were included in the analysis. Patients were selected according to established criteria to maintain consistency and reliability in the study results. Patient data were collected from hospital records during a defined timeframe.

The study population included women aged 18 to 40 years who were at term gestation with singleton pregnancies. Eligibility was restricted to parturients classified as ASA Grade I or II. Participants with cervical dilatation of 3–5 cm at the time of epidural placement were included to ensure consistency in labor progression. Patients with multiple gestations, a history of allergy to local anesthetics, or underlying neurological or coagulation disorders were excluded from the study. Furthermore, individuals experiencing significant maternal complications, including placental abruption or eclampsia, were excluded from consideration.

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The main objective of the study was to evaluate the duration and quality of analgesia, with pain relief quantified through the VAS score at different time intervals. Secondary parameters comprised motor blockade, assessed via the Modified Bromage Scale, and obstetric outcomes, specifically the mode of delivery. Adverse effects, including hypotension, nausea, vomiting, and pruritus, were documented and analyzed.

Data collection was subjected to statistical analysis utilizing SPSS version 26. Numerical variables were presented as mean ± standard deviation (SD) and analyzed using unpaired t-tests for comparison. Categorical data were analyzed utilizing either the Chi-square test or Fisher's exact test, contingent upon the expected frequencies. Statistical significance was determined with a p-value of less than 0.05.

Results

This retrospective study examined data from 60 parturients who received epidural labor analgesia, comprising 30 patients in the R Group (ropivacaine 0.2%) and 30 in the B Group (bupivacaine 0.125%). Pain relief, motor blockade, and obstetric outcomes were evaluated utilizing the Visual Analog Scale (VAS) and the Modified Bromage Scale.

Table 1: Demographic Characteristics of Parturients Receiving Epidural Analgesia with Ropivacaine and Bupivacaine

Parameter	Ropivacaine (n=30)	Bupivacaine (n=30)	P-value
Age (Mean ± SD)	29.4 ± 3.5	30.1 ± 3.8	0.418
Weight (kg)	65.2 ± 5.4	66.1 ± 5.7	0.512
Gender (M/F)	14/16	15/15	0.817

This retrospective study examined the demographic profiles of 60 parturients who underwent epidural analgesia, comprising 30 patients in the ropivacaine (0.2%) group and 30 in the bupivacaine (0.125%) group. The average age in the ropivacaine group was 29.4 years (± 3.5), whereas in the bupivacaine group, it was 30.1 years (± 3.8). The difference was not statistically significant (p=0.418), suggesting that the age distribution in both groups was comparable. The mean weight in the ropivacaine group was 65.2 ± 5.4 kg, compared to 66.1 ± 5.7 kg in the bupivacaine group, with no significant difference observed (p=0.512). The gender distribution was similar, comprising 14 males and 16 females in the ropivacaine group, and 15 males and 15 females in the bupivacaine group (p=0.817).

Table 2: Comparison of Pain Scores (VAS) at 15 Minutes Between Ropivacaine and Bupivacaine Groups

VAS Score	Ropivacaine (n=30)	Bupivacaine (n=30)	P-value

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<3 (Satisfactory Analgesia)	26 (86.7%)	18 (60%)	0.032
>3 (Unsatisfactory Analgesia)	4 (13.3%)	12 (40%)	

Pain relief, evaluated with the Visual Analog Scale (VAS) at 15 minutes, showed a significant benefit in the ropivacaine group. In the ropivacaine group, 86.7% (n=26) of parturients reported satisfactory analgesia (VAS <3), while only 60% (n=18) in the bupivacaine group achieved comparable pain relief. The difference was statistically significant (p=0.032), indicating a more effective and rapid onset of analgesia with ropivacaine. In contrast, 40% (n=12) of patients in the bupivacaine group reported moderate pain (VAS >3), whereas only 13.3% (n=4) of those in the ropivacaine group did. The findings suggest that ropivacaine is more effective than bupivacaine in providing early pain relief.

Table 3: Motor Blockade Assessment Using Modified Bromage Scale in Patients Receiving Ropivacaine and Bupivacaine

Bromage Score	Ropivacaine (n=30)	Bupivacaine (n=30)	P-value
0 (No Block)	22 (73.3%)	16 (53.3%)	0.041
1 (Partial Block)	6 (20%)	10 (33.3%)	0.092
2 (Moderate Block)	2 (6.7%)	4 (13.3%)	0.154
3 (Complete Block)	0 (0%)	0 (0%)	-

The Modified Bromage Scale was utilized to assess motor blockade, indicating that ropivacaine produced significantly less motor impairment than bupivacaine. A significant proportion of patients in the ropivacaine group (73.3%) exhibited no motor block (Bromage score 0), whereas only 53.3% of patients in the bupivacaine group maintained complete motor function. The observed difference was statistically significant (p=0.041), indicating that ropivacaine facilitated enhanced mobility. In the ropivacaine group, partial motor block (Bromage score 1) occurred in 20% of patients, whereas in the bupivacaine group, the incidence was 33.3% (p=0.092). Moderate motor block (Bromage score 2) occurred in 6.7% of patients in the ropivacaine group and 13.3% in the bupivacaine group; however, this difference was not statistically significant (p=0.154). No instances of complete motor blockade (Bromage score 3) were observed in either group, underscoring the safety and appropriateness of both medications for labor analgesia.

Table 4: Mode of Delivery Outcomes in Patients Receiving Epidural Analgesia with Ropivacaine and Bupivacaine

Outcome	Ropivacaine (n=30)	Bupivacaine (n=30)	P-value
Spontaneous Vaginal Delivery	17 (56.7%)	14 (46.7%)	0.381
Instrumental Delivery	9 (30%)	11 (36.7%)	0.462
Cesarean Section	4 (13.3%)	5 (16.6%)	0.637

Obstetric outcomes, including the mode of delivery, were similar between the two groups. Spontaneous vaginal delivery was observed in 56.7% of the ropivacaine group and 46.7% of the bupivacaine group, with no statistically significant difference (p=0.381). Instrumental

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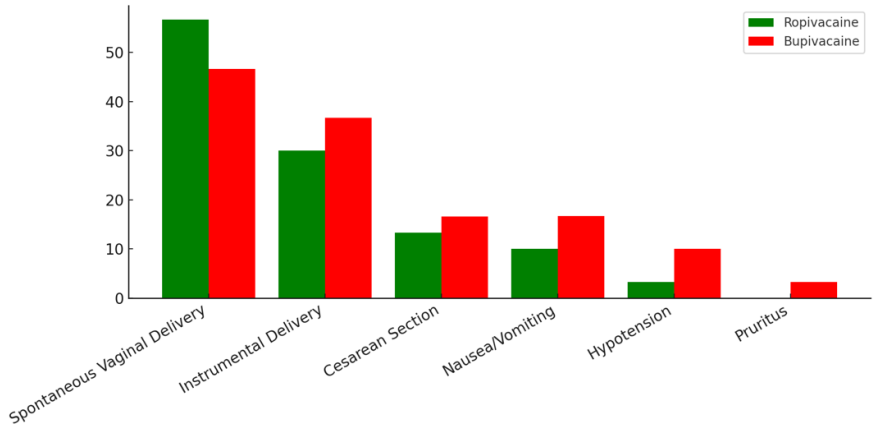
delivery was necessary in 30% of patients administered ropivacaine and in 36.7% of those given bupivacaine (p=0.462). Cesarean section rates were comparable, recorded at 13.3% for the ropivacaine group and 16.6% for the bupivacaine group (p=0.637). The findings suggest that neither anesthetic agent significantly affected delivery outcomes, thereby affirming their safety and efficacy for labor analgesia.

Table 5: Incidence of Adverse Effects in Patients Receiving Epidural Ropivacaine and Bupivacaine for Labor Analgesia

Adverse Effect	Ropivacaine (n=30)	Bupivacaine (n=30)	P-value
Nausea/Vomiting	3 (10%)	5 (16.7%)	0.324
Hypotension	1 (3.3%)	3 (10%)	0.214
Pruritus	0 (0%)	1 (3.3%)	0.398

Both groups exhibited minimal adverse effects, with no statistically significant differences identified. Nausea and vomiting occurred in 10% of the ropivacaine group and 16.7% of the bupivacaine group (p=0.324), suggesting a marginally higher incidence among bupivacaine recipients. Hypotension occurred in 3.3% of patients receiving ropivacaine and 10% of those receiving bupivacaine (p=0.214), indicating that ropivacaine may offer a more stable hemodynamic profile. Pruritus occurred infrequently, with a single case (3.3%) noted in the bupivacaine group, while no instances were reported in the ropivacaine group (p=0.398). The results indicate that both agents are safe; however, ropivacaine exhibits a marginally superior tolerability profile, characterized by reduced incidences of hypotension and nausea.

Figure 1: Comparison of Obstetric Outcomes and Adverse Effects in Epidural Labor Analgesia



Discussion

Several significant findings from this retrospective study that contrasts bupivacaine (0.125%) and epidural ropivacaine (0.2%) for labor analgesia advance our knowledge of the best pain control techniques in obstetric anesthesia.

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For labor analgesia, a study comparing ropivacaine and bupivacaine with fentanyl found that both provided efficient pain reduction with negligible changes in motor blockage or pain scores. [5] Similar results were reported by Chora and Hussain, who showed that both medications produced sufficient analgesia without causing appreciable motor impairment. [6] Roprivacaine was reported by Polley et al. to be roughly 60% as effective as bupivacaine, requiring a slightly larger dose to produce the same level of pain alleviation. [7] In patient-controlled epidural analgesia, Kuthiala observed that ropivacaine produced comparable pain control but noticeably less motor blockage.[3] There were no discernible variations in the duration of analgesia between the two medications, according to Campbell et al.

This study supports those findings by demonstrating that a greater percentage of parturients (86.7% vs. 60%) experienced adequate pain reduction (VAS <3) with ropivacaine after 15 minutes. Roprivacaine is a preferred option due to its improved early analgesia and speedier onset, especially in labor situations where it is advantageous to preserve mobility.

Our findings supporting the benefit of ropivacaine in maintaining motor function are consistent with a number of previous research studies. In labor analgesia, studies have shown that ropivacaine causes less motor blockage than bupivacaine.[8] Hughes et al. discovered that intrathecal ropivacaine (5%) had noticeably lower rates of detectable motor block than bupivacaine (40%, $p<0.05$). [9] Roprivacaine was linked by the COMET Study Group UK to fewer instrumental deliveries, most likely as a result of improved preservation of motor function. [10] The pharmacological characteristics of ropivacaine—lower lipophilicity, increased sensory-motor differentiation, and stereoselective qualities that favor sensory over motor fiber blockade—are responsible for these results. The therapeutic importance of ropivacaine's decreased motor blockage may vary depending on concentration and individual circumstances, but it may improve maternal mobility and maybe shorten the duration of labor. [3]

Mixed findings have been found in studies comparing the obstetric outcomes of ropivacaine and bupivacaine for labor analgesia. Low-dose methods, such as ropivacaine, increased the rates of normal vaginal deliveries by 7.6-7.8%, according to the COMET Study Group UK. [11] However, a thorough comparison of ropivacaine and bupivacaine in labor analgesia is provided by a meta-analysis by meta-analysis, which demonstrates that the likelihood of a spontaneous vaginal delivery is not significantly impacted by the decision between these two local anesthetics.[12] The concentration of ropivacaine and the incidence of instrumental delivery and the concentration of bupivacaine and the incidence of cesarean delivery were found to be positively correlated in a meta-analysis.[13] These disparate findings demonstrate how difficult it is to compare obstetric outcomes because variables like drug concentration, adjuvants, and institutional procedures may have an impact on results.

Our study's trend toward fewer side effects with ropivacaine is consistent with findings from other studies. The most frequent adverse response rates for ropivacaine and bupivacaine were hypotension (32%), nausea (17%), and vomiting (7%), according to a pooled study of controlled clinical trials (n=1,661).[13] According to a meta-analysis, ropivacaine had a considerably lower risk of nausea and vomiting than bupivacaine (RR 1.526 for nausea and RR 1.542 for vomiting, $p < 0.05$). [14] A study found that ropivacaine reduced motor block, which might increase patient comfort. [15] The consistent trend across studies points to a possible clinical benefit of ropivacaine in terms of patient comfort and satisfaction, which is

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consistent with its pharmacological profile of lower systemic toxicity and reduced cardiovascular effects, even though Kuthiala did not find any significant differences in the incidence of side effects.[3]

According to the study's findings, 0.2% ropivacaine may be superior than 0.125% bupivacaine in terms of a quicker onset of analgesia and maintenance of motor function without sacrificing safety or obstetric results. These advantages might result in increased mother satisfaction and even make it easier for women to actively participate in childbirth. However, the decision between these two medications should be tailored to each patient's unique needs, institutional policies, and analgesic objectives. Although it was not statistically significant in our trial, the trend toward fewer side effects with ropivacaine should be something to think about for patients who are more likely to experience difficulties. To sum up, this research contributes to the increasing amount of data demonstrating the effectiveness of ropivacaine in labor epidural analgesia. Although ropivacaine and bupivacaine are both safe and effective, ropivacaine's potential benefits in terms of analgesic onset, maintenance of motor function, and adverse effect profile should be taken into account in clinical practice. To determine the best option for labor analgesia and investigate the possible long-term advantages of these anesthetic regimens, more research is required.

It is important to take into account the many limitations of this study. Our findings may not be as broadly applicable as they could be due to the retrospective approach and limited sample size. Furthermore, the study did not evaluate patient satisfaction ratings or long-term results, which could offer important information about the general efficacy of these anesthetic regimens. To validate these results, future studies should concentrate on prospective, randomized controlled trials with bigger sample numbers. The best option between ropivacaine and bupivacaine for labor analgesia would be better understood if studies included patient-reported outcomes, long-term follow-up, and cost-effectiveness evaluations.

Conclusion:

Ropivacaine at 0.2% demonstrated superior analgesic efficacy with a quicker onset and reduced motor blockade compared to 0.125% bupivacaine. Ensuring better maternal mobility without compromising labor progression. The difference in obstetric outcomes was not statistically significant, indicating that both anesthetics are safe choices for epidural labor analgesia. Ropivacaine showed a trend toward fewer adverse effects particularly lower incidences of hypotension & nausea. Making it a more favorable option in certain clinical settings. These findings lead to growing preference for ropivacaine as a reliable alternative to bupivacaine in obstetric anesthesia.

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