

A COMPARISON OF MOTOR BLOCK BETWEEN ROPIVACAINE AND BUPIVACAINE FOR CONTINUOUS LABOR EPIDURAL ANALGESIA

The aim of the present study was to compare the amount of motor block produced by different loading doses of ropivacaine and bupivacaine when delivered in a dilute solution with added opioid. Sixty-eight healthy term primigravid parturients were randomized to receive an initial bolus dose of 10 mL of 1 of the following: 0.25% bupivacaine (high bupivacaine), 0.25% ropivacaine (high ropivacaine), 0.125% bupivacaine (low bupivacaine), or 0.125% ropivacaine (low ropivacaine). Each loading dose had 10 µg of sufentanil added to it. All groups received a continuous infusion of a 0.1% study drug infusion with 0.6 µg/mL of sufentanil at a rate of 8 to 14 mL/h to maintain analgesia. Supplemental doses of 10 mL of a 0.125% study solution with 10 µg of sufentanil were given as needed.

Pain scores and a modified Bromage scale were used to assess analgesia and motor block. A statistically significant greater percentage of parturients receiving bupivacaine had motor block than those who received ropivacaine, with a marked decrease in the occurrence of motor block in the low ropivacaine group. The pain relief seemed to be less satisfactory in the ropivacaine groups, but the difference was not statistically significant. Ropivacaine produced significantly less motor block than bupivacaine in the 0.25% and the 0.125% loading doses, with the greatest difference seen in the lower concentration loading dose of ropivacaine.

Key words: Bupivacaine, epidural, local anesthetics, motor block, ropivacaine.

Introduction

One of the newer long-acting amide local anesthetics, ropivacaine is the stereoisomer of bupivacaine and has been shown in earlier animal studies to have less central nervous system toxicity and less cardiotoxicity than bupivacaine.¹⁻⁴ In human volunteers, ropivacaine has been shown to be less toxic than bupivacaine when injected intravenously.⁵ In the clinical setting, the use of ropivacaine in epidurals with nonpregnant patients was associated with a reduced intensity of motor block compared with bupivacaine.⁶ When used for cesarean delivery, 0.5% epidural ropivacaine and 0.5% epidural bupivacaine each produced adequate and equivalent sensory anesthesia, with ropivacaine resulting in slower onset and shorter duration of motor block.⁷ Other clinical studies comparing ropivacaine with bupivacaine in concentrations of 0.25%, without added opioids for postoperative pain relief, have concluded that there is less motor block with ropivacaine.⁸⁻¹⁰

Local anesthetic solutions in very low doses with added opioids are now being used to produce labor analgesia while attempting to preserve motor strength and, therefore, the ability to use the pelvic musculature for delivery. The aim of the present study was to compare the motor block produced by 2 different loading dose concentrations of ropivacaine and bupivacaine when followed by a dilute continuous 0.1% solution of the local anesthetic with sufentanil added. The effects of both drugs on pain relief, neonatal outcomes, and the incidence of instrumental deliveries and cesarean deliveries also were evaluated.

Materials and methods

After institutional review board approval of the study, 70 healthy term primigravid parturients who were determined by their obstetric physician to be in active labor, had a minimum cervical dilatation of 3 cm, and who requested epidural analgesia, gave their consent and entered the study.

The study population included 70 ASA physical status I or II primigravid parturients, aged 18 years or older, with a height greater than 150 cm, weight less than 110 kg, a full-term pregnancy (36-42 weeks), a single fetus, vertex presentation, and estimated fetal weight greater than 2,500 g. Parturients whose fetus had any known anomaly were excluded from the study.

The participants were randomized by double-blind design to receive 1 of 2 initial doses of the local anesthetics being studied. The pharmacy used a random number system to assign a study patient number to each 30-mL bottle of either ropivacaine or bupivacaine. Each bottle was labeled only with the concentration (0.5%) of the drug and the study patient number. The key for the drug used was maintained in the pharmacy until the completion of the study. I performed the drug dilution in the institution's childbirth unit (the hospital did not have a 24-hour pharmacy), and the loading dose concentration given was determined by the random number on the case record form assigned to the patient study number.

The initial epidural dose was a bolus of 10 mL with one of the following drugs: 0.25% bupivacaine (high bupivacaine), 0.25% ropivacaine, (high ropivacaine), 0.125% bupivacaine (low bupivacaine), or 0.125% ropivacaine (low ropivacaine). All initial doses had 10 µg of sufentanil added. After the loading dose, all groups received a con-

tinuous infusion of 0.1% of the study drug, with 0.6 µg/mL of sufentanil added, at a rate of 8 to 14 mL/h to maintain analgesia.

The participants were given an intravenous preload of 500 mL of lactated Ringer's solution. The epidural catheter was inserted in a midlumbar intervertebral space with the participant in the left lateral decubitus position, leaving 4 to 5 cm in the epidural space. A test dose of 1.5% lidocaine with epinephrine 1:200,000, 3 mL, was given through the epidural catheter. After the test dose, the 10-mL loading dose of the previously assigned study drug and drug concentration was given. The continuous infusion mixture was started 15 minutes after the loading dose, provided there was adequate analgesia. Supplemental epidural doses of 10 mL of the 0.125% study solution with 10 µg of sufentanil were given as needed to maintain analgesia.

Verbal scores for pain relief and a modified Bromage scale to assess motor block were checked at 5-minute intervals after each dose for a total of 30 minutes and at 30-minute intervals thereafter until delivery. I did nearly all of the recording except when required to be with another patient. When this occurred, the obstetric nurse caring for the patient did the recording with explicit instructions from me.

The continuous infusion solution of 0.1% of the study drug was delivered using a syringe pump at a rate of 8 to 14 mL/h. Additional doses of 5 mL of a 0.125% concentration of the study drug with 10 µg of sufentanil were given as needed. The epidural infusion was continued until the completion of the second stage of labor. The participants were maintained in a lateral recumbent or sitting position throughout labor.

The participants' vital signs, fetal heart rate, cervical dilatation, pain relief, and motor block were assessed at 5-minute intervals for 30 minutes after each dose of medication. Pain relief was assessed using a verbal scale of from 0 to 4 (Table 1). These scores also were used to determine the need for an additional dose.

Motor block of the lower limbs was assessed using

Table 1. Visual analog scale for pain

No pain relief = 4
A little pain relief = 3
A lot of pain relief = 2
Only slight pain = 1
Complete pain relief = 0

Table 2. Modified Bromage scale for motor block

No movement = 4
Unable to raise the extended leg or bend the knees = 3
Unable to raise the extended leg, but able to bend the knees = 2
Able to move the feet, but not able to bend the knees = 1
Complete leg and foot movement = 0

a modified Bromage scale (Table 2). Motor and sensory testing were performed until the discontinuation of the continuous epidural infusion. Apgar scores for the neonate were recorded at 1 and 5 minutes after birth. The mode of delivery was recorded as spontaneous, vacuum extraction, forceps, or cesarean section.

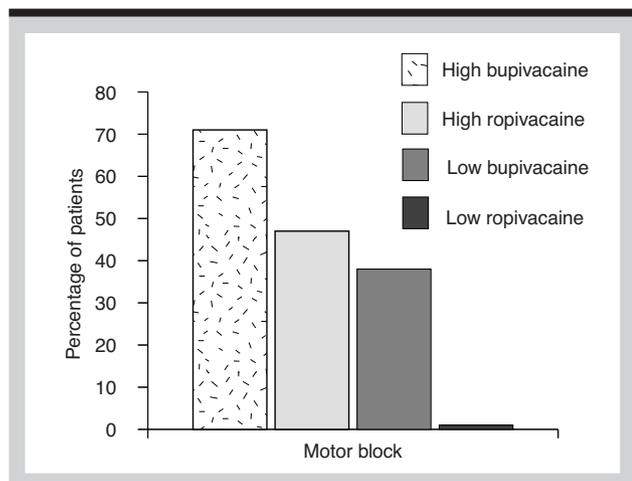
The labor management was routine. Participants who required extra analgesia beyond that permitted with the additional doses allowed, or in whom the epidural infusion extended beyond 24 hours, were withdrawn from the study. Oxytocin was administered at any time during labor, if necessary.

Descriptive statistics were used to analyze all univariate variables using SPSS 7.5 (SPSS, Inc, Chicago, Ill) and Epi Info (Centers for Disease Control and Prevention, Atlanta, Ga) statistical software. Cross tabulations and chi-square tests were done for categorical variables. The Fisher exact test was used for chi-square tests with cell values of less than 5. Analysis of variance

Table 3. Characteristics of patients

	High bupivacaine (n = 17)	High ropivacaine (n = 19)	Low bupivacaine (n = 16)	Low ropivacaine (n = 16)
Mean age	31	26	28	28
Mean weight (kg)	83	81	79	79
Mean height (cm)	175	178	179	174

Figure 1. Motor block by drug and loading dose



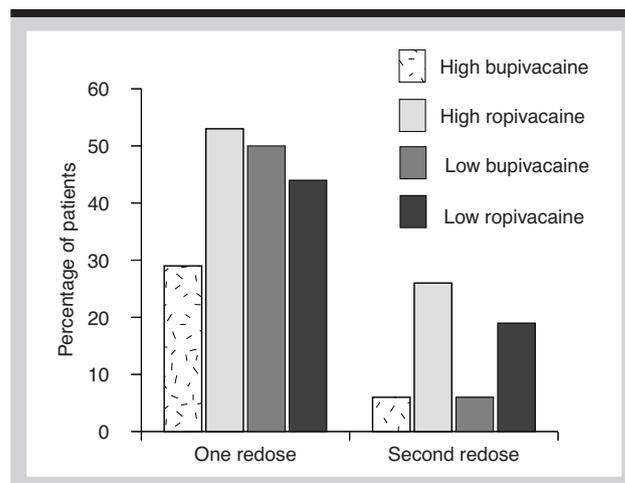
was used to compare demographic variables between the 4 drug groups. $P < .05$ was considered significant.

Results

Two of the study parturients were eliminated from the study because of a prior history of a cesarean birth and a labor extending beyond 24 hours in each case. There was a total of 17 parturients in the high bupivacaine group, 19 in the high ropivacaine group, 16 in the low bupivacaine group, and 16 in the low ropivacaine group. Demographic data are displayed in Table 3.

In all of the 4 groups, the participants who experienced any motor block had only a Bromage level 1 block; ie, they could not raise either one or both of their knees. The differences in motor block between the groups are shown in Figure 1. Regardless of the loading dose, a greater proportion of participants receiving bupivacaine had motor block than did those who received ropivacaine. The incidence of motor block was 12 (71%) in the high bupivacaine group, 9 (47%) in the high ropivacaine group, 9 (38%) in the low bupivacaine group, and only 1 (0.06%) in the low ropivacaine group. The greatest difference in motor block was seen in the higher doses compared with the lower loading doses of either drug. The overall odds

Figure 2. Percentage of patients requiring additional doses



ratio between the higher loading doses of either bupivacaine or ropivacaine and the lower loading doses of either drug was 3.93, indicating that the higher loading dose participants had nearly a 4-fold chance of having some motor block ($P = .0326$). The greatest difference is seen when comparing the high bupivacaine group with the low ropivacaine group. Only 1 patient in the low ropivacaine group had any motor block, and this occurred after the continuous epidural had been in place for more than 2 hours. The odds ratio for motor block occurring with the higher loading dose of bupivacaine was 9.0, indicating that there was a 9-times-greater chance for having motor block than with the lower loading dose of ropivacaine ($P = .022$).

The comparisons for pain relief were not statistically significant (Figure 2), although more supplemental doses were given to the ropivacaine groups. This was particularly evident in the number of patients who required a second dose for adequate pain relief soon (within one-half hour) after the initial loading dose.

There was no significant difference in the number of patients who required instrumental deliveries or cesarean sections (Table 4). Labor was induced in 5

Table 4. Types of deliveries

	High bupivacaine (n = 17)	High ropivacaine (n = 19)	Low bupivacaine (n = 16)	Low ropivacaine (n = 16)	Total (N = 68)
Cesarean	4	4	6	3	17 (25%)
Instrumental	3	5	1	4	13 (19%)
Vaginal	10	9	9	9	38 (56%)

patients in each group. There were no differences in the Apgar scores, incidence of maternal or fetal heart rate problems, or maternal hypotension in any of the groups.

Discussion

A study¹¹ using ropivacaine without any added opioid concluded that 0.1% ropivacaine given alone does not offer adequate pain relief for initiation of an epidural anesthetic during labor and delivery. Another study¹² added fentanyl (2 µg/mL) to 0.1% ropivacaine or 0.1% bupivacaine and found that more parturients who received the ropivacaine-fentanyl infusion had no motor block compared with those who received bupivacaine-fentanyl.

A recent study¹³ compared 0.125% ropivacaine and 2 µg/mL of fentanyl with 0.125% bupivacaine and 2 µg/mL of fentanyl. After a loading dose of 15 mL of the 0.125% study solution, it was demonstrated that the ropivacaine mixture provided labor analgesia that was clinically indistinguishable from the bupivacaine mixture but with less motor block. The study also concluded that adding 2 µg/mL of fentanyl reduced the ropivacaine requirements during labor by 28%.

Previous studies and review articles¹⁴⁻¹⁷ have indicated that epidural analgesia may increase obstetric intervention rates. All of these studies used higher concentrations of local anesthetics than the present study without the addition of opioids. One study¹⁸ demonstrated that a high-volume solution containing a low concentration of bupivacaine (less than 0.25%) combined with an opioid can be used to establish satisfactory analgesia via the epidural route while decreasing motor block and the total dose of the drug. Another similar study¹⁹ with ropivacaine indicated that the addition of fentanyl substantially prolongs the duration of analgesia and will allow a lower concentration of ropivacaine to be used. According to a study by Norman and Jenkins,²⁰ the use of low-dose epidurals may actually reduce the cesarean delivery rate by allowing patients to mobilize during labor and push more effectively during delivery.

At the time of the present study, no published articles had compared the potencies of these 2 drugs. However, one recent study by Polley et al²¹ determined that ropivacaine is less potent than bupivacaine, with a potency ratio of 0.57 (95% CI = 0.40 – 0.74). This would mean that ropivacaine is only about 60% as potent as bupivacaine. If this finding is borne out in future studies, it could well account for the differences in pain relief between the 2 drugs at the dosages given.

In conclusion, lowering the concentration of ropivacaine in both the loading dose and the continuous

infusion dose will produce less motor block in the laboring parturient. More studies are needed on the possible potency differences between the 2 drugs in order to obtain desired analgesia while continuing to reduce motor block and to optimize the progress of labor and the outcome for the parturient.

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