Research Article

Compare the efficacy of ropivacaine and bupivacaine with fentanyl for epidural labor analgesia

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ABSTRACT

Background: Attempts have been made to reduce or eliminate the pain associated with labor since ancient time. Obstetrics analgesia reached a new phase with lumbar epidural analgesia. We carried out a randomized study to evaluate and compare the analgesic efficacy of ropivacaine and bupivacaine with fentanyl on mother, on fetus and on the course of labor. **Objectives:** The aim of the present study was to evaluate and compare the analgesic efficacy of ropivacaine (0.125%) and bupivacaine (0.125%) with fentanyl on mother, fetus and on the course of labor, incidence of instrumental delivery, and the rate of cesarean section. **Materials and Methods:** Study was conducted in 60 term, primi or second gravida parturients with active phase of labor, with cervical dilatation 3-5 cm, with single fetus, vertex presentation belonging to American Society of Anesthesiology (ASA) Class I or II. The patients were randomly divided into two groups. After negative test dose, loading dose of 10 ml of 0.125% ropivacaine in Group R and 0.125% of bupivacaine in Group B with 2.5 μg/ml fentanyl in both groups was given as an initial dose for analgesia. Top up dose with 5 ml of 0.125% of ropivacaine in Group R and 0.125% bupivacaine in Group B were given when visual analog scale (VAS ≥3). For the second stage of labor 8 ml of 0.125% of ropivacaine in Group R and 0.125% of bupivacaine in Group B with 1.25 μg/ml fentanyl in both groups were given in sitting position to allow perineal analgesia. **Results:** In this study, we observed that maximum number of patients have developed sensory block up to T8, 50% in Group B and 53.3% in Group R, only 2 patients (6.7%) in Group B developed T6 level, and no patients in Group R. There was no significant difference in mean total dose of bupivacaine and ropivacaine ($P > 0.05$). In Group R total 22 patients and 3 in Group B developed Grade 0 motor blocked, which was statistically very significant. In Group B, 14 and 2 patients developed Grade 2 and Grade 3 motor blocked, respectively, compared to none of the patients in Group R which was statistically very significant. There was no significant difference in Apgar score and VAS scores between the groups at any time during the first and second stage of labor. **Conclusions:** Ropivacaine group patients required less number of top-up doses and developed significantly less motor block than bupivacaine group patients. We thus conclude that the combinations of 0.125% of ropivacaine with fentanyl and 0.125% bupivacaine with fentanyl is equally effective in producing excellent labor analgesia ensuring the safety of the mother and fetus.

KEY WORDS: Bupivacaine; Ropivacaine; Epidural; Fentanyl; Labor Analgesia

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INTRODUCTION

Labor, as the process of childbirth, is a painful experience for most of the women. The McGill pain questionnaire ranks pain in the upper part of pain scale between cancer and amputation of digit. Sir John Snow first administered chloroform to Queen Victoria for the birth of eighth

child. That was the much-needed impetus, which pushed obstetrics analgesia to the position it holds today. Attempts have been made to reduce or eliminate the pain associated with labor since ancient times. There is a documentary evidence of use of opioids, ayurvedic (hemp henbane, mandrake, etc.) in Chinese literature whereas some societies used alcohol. Inhalation agents and systemic agents waned in popularity due to their effects on mother and child. Subarachnoid local anesthetics cause severe hypotension and complete motor block. Caudal analgesia was quite popular until the numerous merits of lumbar epidural analgesia were noticed.[1]

The pain experienced during labor has multiple physiological and psychosocial dimensions, and its intensity can vary greatly from one woman to another. Pathopsychological responses occur in the body during pain. Un-relieved stress in labor increased plasma catecholamine concentration which decreases placental blood flow by 30-60% as well as the effects of hyperventilation on the oxygen supply to the fetus. The respiratory alkalosis in parturient further impairs gas exchange by shifting the oxyhemoglobin dissociation curve to the left and fall in fetus PaO2 up to 20-30%.[5]

Obstetrics analgesia reached a new phase with lumbar epidural analgesia. If performed with adequate care and skill, it is close to being an ideal technique as it satisfies the criteria below:

- It is safe and affordable,
- Provides good analgesia,
- A high technical success rate.

Bupivacaine continues to be the most widely used local anesthetic for labor epidural analgesia because it provides an excellent sensory block. However, limitation to its usefulness includes the potential for the motor blockade and central nervous system and cardiac toxicity. The pure enantiomer of bupivacaine such as ropivacaine and levobupivacaine nowadays used widely for its less cardiac toxicity and promising more sensory effects for various lower limb.[7]

Epidural injection of dilute local anesthetic solutions mixed with opioids such as fentanyl or sufentanil is one of the technique for pain relief during labor because both of these drugs act synergistically to provide effective and satisfactory labor analgesia.[8] It has been shown that the addition of fentanyl allows administration of smaller dose of local anesthetic, which should decrease the incidence of motor block and systemic local anesthetic toxicity. There are several reasons why it is desirable to minimize motor block during epidural analgesia in labor. A fall in muscle power has linked to reduce maternal satisfaction, increased instrumental deliveries and long-term backache following delivery. The uses of epidural opioids, especially lipid-soluble fentanyl allow a reduction in the dose of local anesthetic and consequently minimize the associated problems. Fentanyl has high lipid solubility and receptor affinity, and systemically it is potent too.

The aim of the present study was to evaluate and compare the analgesic efficacy of ropivacaine (0.125%) and bupivacaine (0.125%) with fentanyl on mother, fetus, and on the course of labor. We want to evaluate the pure enantiomer of bupivacaine such as ropivacaine and levobupivacaine for its promising effect for labor analgesia. We want to evaluate the incidence of instrumental delivery, the rate of caesarean section and the side effects using bupivacaine and ropivacaine with additive fentanyl. Simultaneously will note acceptance regarding epidural labor analgesia among parturients.

MATERIALS AND METHODS

After receiving permission from Institutional Review Board, the study was conducted in a tertiary care hospital during 2012-2013. Lumbar epidural analgesia is a widely practiced method of pain relief during labor. Dilute mixture of local anesthetics and opioids offer the advantage of maternal satisfaction by reducing the motor blockade and maintain hemodynamic stability.

The prospective randomized study was conducted to compare the analgesic efficacy of dilute concentration of bupivacaine and ropivacaine with fentanyl. The present study was conducted in 60 term, primi or second gravida parturients with active phase of labor, with cervical dilatation 3-5 cm, with single fetus, vertex presentation belonging to ASA Class I or II. Parturients with complicated obstetric history such as pre-eclampsia, preterm labor, multiple pregnancy, abnormal lie, and previous lower segment cesarean section with associated medical disease such as morbid obesity, bleeding disorder, on anticoagulant therapy, severe anemia, local infection at lumbar region and psychiatric or neurological disorder were excluded from the study.

After explaining the procedure written consent was taken from patient and relative. Intravenous (i.v) access was secured, and 500 ml of ringer lactate was started to preload the patients. Patients were pre-medicated with injection glycopyrrolate 0.2 mg i.v and injection ondansetron 4 mg i.v. Pre-procedure pulse, blood-pressure, visual analog scale (VAS) score, fetal heart rate, and obstetric parameters such as cervical dilatation, station, and effacement were noted. When cervical dilation was 3-5 cm patients were placed in the left lateral position. Under aseptic precaution, lumbar epidural procedure was performed at L3-L4 interspinous space with sterile 18G Tuohy's needle, and epidural space was identified using loss of resistance technique. The multiorifice epidural catheter was inspected for its patency and threaded through the needle gently till 3-4 cm length of the catheter was in

the epidural space. After fixing the catheter, the patient was turned supine.

The patients were randomly divided into two groups:
- Group B: 0.125% bupivacaine with fentanyl.
- Group R: 0.125% ropivacaine with fentanyl.

A test dose of 2 ml of 2% lignocaine with adrenaline was given through epidural catheter to exclude intravascular placement. After 5 min, loading dose of 10 ml of 0.125% ropivacaine in Group R and 0.125% of bupivacaine in Group B with 2.5 μg/ml fentanyl in both groups were given as an initial dose for analgesia. Top up dose with 5 ml of 0.125% of ropivacaine in Group R and 0.125% bupivacaine in Group B were given when VAS ≥3. For the second stage of labor 8 ml of 0.125% of ropivacaine in Group R and 0.125% of bupivacaine in Group B with 1.25 μg/ml fentanyl in both groups were given in sitting position to allow perineal analgesia.

Maternal vital parameters were monitored at regular interval of time. Analgesia was assessed using 10 points VAS, motor blockade by Bromage scale, cephalad level of sensory blockade by temperature sensation changes using spirit swab and neonatal outcome by Apgar score. The total number of top-ups were recorded in both groups. Duration of each stage was recorded. Duration of injection of bolus dose to delivery was also recorded. Mode of delivery was noted. Maternal adverse drug reaction and parturient acceptance regarding the quality of analgesia were also recorded.

In this study, results were presented as mean ± standard deviation (SD) for quantitative data. For comparison between groups un-paired *t*-test and for qualitative data, Chi-square test was applied. Difference was considered statistically significant if $P < 0.05$. Microsoft Excel was used for mean and SD calculation and open Epi software for calculation of *P* value.

RESULTS

In this study, there was no significant difference between the groups in age, height, weight, parity, gestational age, or cervical dilatation at the beginning of epidural analgesia (Table 1).

About 10 patients in Group R and 5 patients in Group B did not require any (0) top-up dose, which was not statistically significant ($P > 0.05$). 8 patients in Group R and 14 patients in Group B required more than 2 top-up doses. Hence, we observed that Group B required more no of top-up doses than Group R, but it was not statistically significant ($P > 0.05$) (Table 2).

There was no significant difference between two groups in the total dose requirement ($P > 0.05$) (Table 3).

Table 1: Demographic data

Parameters	Group B (*n*=30)	Group R (*n*=30)	*P*
Age in years (mean±SD)	21.80±1.65	21.86±2.60	>0.05
Weight in kg (mean±SD)	53.53±5.49	50.80±5.93	>0.05
Height in cm (mean±SD)	155±4.15	154.3±4.38	>0.05
Parity (no.) primi/second gravida	27/3	26/4	>0.05
Gestational age in weeks (mean±SD)	38.18±1.17	38.07±1.41	>0.05
Cervical dilatation at start of epidural (cm)	3.30±0.46	3.43±0.50	>0.05

SD: Standard deviation

Table 2: Total number of top-ups

Number of top-up doses	Group B (*n*=30) (%)	Group R (*n*=30) (%)	*P*
0	5 (16.7)	10 (33.3)	>0.05
1	7 (23.3)	5 (16.7)	>0.05
2	4 (13.3)	7 (23.3)	>0.05
3	4 (13.3)	1 (3.3)	>0.05
4	9 (30.3)	6 (20)	>0.05
5	1 (3.3)	1 (3.3)	>0.05

Table 3: Mean total dose requirement

Drug	Total dose (mg)	*P*
Total dose of bupivacaine (mg)	36.66±9.97	>0.05
Total dose of ropivacaine (mg)	32.63±10.5	

SD: Standard deviation

Table 4: Parturients acceptance

Parturients acceptance	*n* (%)		
	Group B (*n*=28)*	Group R (*n*=28)*	*P*
Grade 0 (failure)	0 (0)	0 (0)	
Grade1 (incomplete)	0 (0)	0 (0)	
Grade 2 (good)	6 (21.43)	5 (17.86)	>0.05
Grade 3 (excellent)	22 (78.57)	23 (82.14)	>0.05

*Two patients in Group B and in Group R were delivered by lower segment cesarean section

The quality of analgesia was assessed after 24 h of delivery. Table summarizes all the parturients accepted the procedure as with excellent to good grading. There was no significant difference between the two groups in patient's assessment of the quality of analgesia ($P > 0.05$) (Table 4).

DISCUSSION

Lumbar epidural analgesia is the most versatile and most commonly employed technique because it can be used for

pain relief for the first stage of labor as well as analgesia and anesthesia for subsequent vaginal delivery or cesarean section, if necessary. Higher concentration of bupivacaine (0.25%) was used as an intermittent bolus dose in the past which resulted in fairly higher incidence of motor block causing pelvic muscle relaxation and maternal inability to push and a higher incidence of instrumental delivery. With the discovery of opioid receptors in spinal cord it opens the door for opioids for spinal anesthesia. In this study, we have added the opioid fentanyl to check efficacy with older bupivacaine and its pure newer enantiomer ropivacaine.[4] Here in our study total dose requirement was comparable in both the groups. In this study, the mean duration of the active phase of first stage of labor and second stage of labor in primi and second gravida is comparable in both the groups.

In our study, we have observed that maximum number of patients developed sensory block up to T8, 50% in Group B and 53.3% in Group R, and only 2 patients in Group B developed T6 level and none in Group R (Figure 1). Eddleston et al.[9] observed median upper level of sensory block was T8 in both the groups. Meister (2000) et al.[14] observed that ropivacaine (0.125%) group developed mean T7 level and bupivacaine(0.125%) group developed mean T8 level. For the relief of pain during labor, the upper level of sensory block required is up to T10 dermatome. In the first stage of labor initially, involvement of T11, T12 segments are required, and as the labor progresses, T10 and L1 segments are required to be block, whereas pain relief using the second stage of labor requires neural blockade at T10-S4 level. So for the second stage of labor drugs were given in sitting position to allow perineal analgesia in both groups.[2]

There was no significant difference in VAS scores between the groups at any time during the first and second stage of labor. Baseline mean VAS score was 8.4 ± 0.85 in Group B and 7.7 ± 0.89 in Group R, which was comparable. After 30 min, mean VAS score was 0.37 ± 0.93 in Group B and 0.41 ± 0.63 in Group R, which was comparable. Similarly, during the second stage of labor also VAS score was comparable at any time. Meister et al.[14] and Clément et al.[11] observed that VAS score was comparable in both the groups throughout the labor. In this study, Apgar score was between 7 and 10 in most of the neonates, 93.33% in Group B and in 100% in Group R at 1 min and at 5 min and 6.67% neonates in Group B and no neonate in Group R had Apgar score between 5 and 6 at 1 min and at 5 min. Neonatal status in both groups was comparable ($P > 0.05$). Halpern et al.[17] observed that there was no significant difference in neonatal outcomes between groups. The time course of systolic blood pressure, heart rate and respiratory rate during epidural analgesia was similar for bupivacaine and ropivacaine. 6.7% patients in Group B and 6.7% in Group R developed hypotension, which was not significantly low and treated with administration of fluid bolus. None of the patient required vasopressor for the treatment of hypotension. In our study, no patients developed bradycardia or respiratory depression in either group. Campbell et al.[13] observed that there was no incidence of hypotension in either group (bupivacaine (0.08%)/fentanyl vs. ropivacaine (0.08%)/fentanyl) whereas Fernández-Guisasola et al.[6] compared the 0.0625% bupivacaine with 0.1% ropivacaine with fentanyl as an epidural infusion and observed 2 patients in bupivacaine group and 1 patient in ropivacaine group required ephedrine for hypotension. In this study, there was no incidence of pruritus in either group. Chua et al.[16] observed that none of the patients in either group (bupivacaine 0.125% and ropivacaine 0.125%) developed pruritus whereas Meister et al.[14] observed that 56% patients of ropivacaine/fentanyl group and 52% patients of bupivacaine/fentanyl group complained of pruritus, which did not require any treatment. In this study, 10% of patients in Group B and 6.7% in Group R had intrapartum urinary retention (patients catheterized with K-90 catheter). Campbell et al.[13] observed that ropivacaine (0.08%)/fentanyl group did not experienced urinary retention but 35% patients of bupivacaine (0.08%)/fentanyl group experienced urinary retention.

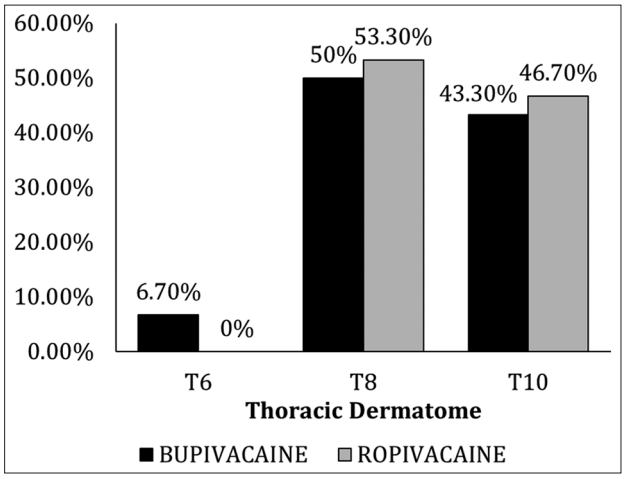

Figure 1: Sensory block (thoracic dermatome)

In this study, as shown in Figure 2 motor blocked was significantly less in Group R compares to Group B. 22 patients in Group R and 3 patients in Group B developed Grade 0 motor blocked, which was statistically very significant. In Group B, 14 and 2 patients developed Grade 2 and Grade 3 motor blocked, respectively, compare to none of the patients in Group R which was statistically very significant. Writer et al.[15] observed 12% patients in ropivacaine group and 20% patients in bupivacaine group developed Grade 2 motor block. Hence, maximum degree of motor block was significantly low in ropivacaine group. In our study, there was no significant difference in the modes of delivery shown in Figure 3. 26 (86.7%) patients in the Group B and 27 (90%) patients in the Group R were delivered by spontaneous vaginal delivery and 2 patients (6.7%) in each group were

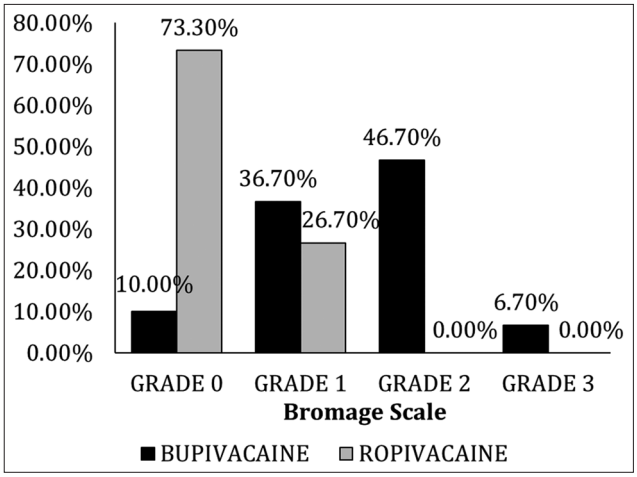

Figure 2: Motor block (Bromage scale)

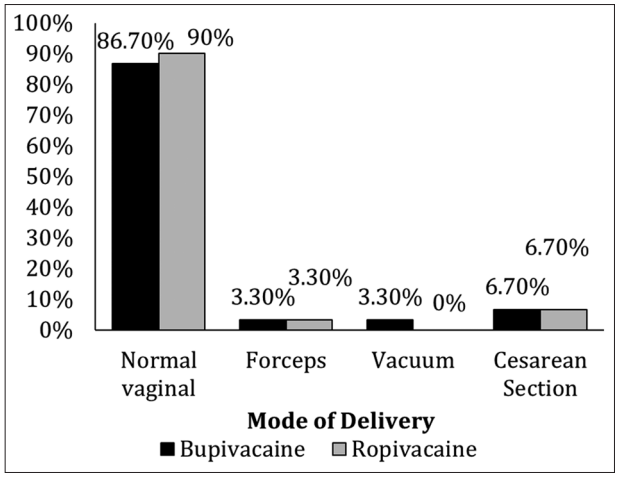

Figure 3: Mode of delivery

delivery by cesarean section. Two patients in Group B and one patient in Group R were delivered by instrumental delivery. Dresner et al.[12] compared bupivacaine (0.1%) and ropivacaine (0.2%) with fentanyl 2 μg/ml. They observed there was no difference between the groups for mode of delivery. Limitation of our study is sample size which is 60. Hence, before generalizing the results, further study with more patients is needed. The further study can focus on the progress of labor and mode of delivery.

CONCLUSION

The addition of opioid to low dose of local anesthetics greatly improves the quality of labor analgesia, without prolonging first or second stage of labor, without affecting mode of delivery as well as neurobehavioral status of the newborn. Furthermore, reduces the side effects of the parturients. Ropivacaine group patients required less number of top-up doses and developed significantly less motor block than bupivacaine group patients. We thus conclude that the combinations of 0.125% of ropivacaine with fentanyl and 0.125% bupivacaine with fentanyl is equally effective in producing excellent labor analgesia ensuring the safety of the mother and fetus.

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