TÜBİTAK

Original Article

Turk J Med Sci
2011; 41 (2): 219-226
© TÜBİTAK
E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-1008-994

A comparison of the effects of intrathecal ropivacaine and bupivacaine during cesarean section*

Nuray CAMGÖZ ERYILMAZ[1], Berrin GÜNAYDIN[2]

Aim: To compare the effects of intrathecal plain bupivacaine or ropivacaine with those of opioids on sensory and motor block characteristics during cesarean section (C/S).

Materials and methods: Fifty-two ASA I or II women were randomly allocated into 2 groups to administer either 10 mg of 0.5% plain bupivacaine (Group B), or 15 mg of 0.75% plain ropivacaine (Group R) with 25 µg fentanyl and 100 µg morphine for spinal anesthesia. Characteristics of the sensory and motor block were recorded.

Results: The time to achieve sensory block at T_6 was significantly faster in Group B than in Group R (2.7 ± 1.8 min vs. 4.2 ± 2.5 min). The time to reach maximum sensory block was significantly faster in Group B than in Group R (8.1 ± 4.1 min vs. 11.6 ± 5.6 min). The times of sensory block regression to T_{10} and L_1 dermatomes were significantly shorter in Group B (118.2 ± 24.2 min and 145.5 ± 28.1 min, respectively) than in Group R (135 ± 32.1 min and 162.5 ± 32.5 min, respectively). Motor block duration was significantly longer in Group B than in Group R (165.8 ± 32.5 min vs. 135.2 ± 45.7 min).

Conclusion: Intrathecal plain ropivacaine with opioids might be superior to bupivacaine in terms of a longer sensory block, and a shorter motor block duration for C/S.

Key words: Surgery, Cesarean section, anesthetic technique, spinal, local anesthetics, bupivacaine, ropivacaine

Sezaryenlerde intratekal ropivakain ve bupivakainin etkilerinin karşılaştırılması

Amaç: Sezaryenlerde intratekal izobarik ropivakain ve bupivakain ile opioidlerin motor ve duyusal blok özelliklerine etkilerinin karşılaştırılması amaçlandı.

Yöntem ve gereç: Elli iki gebe spinal anestezi için 25 µg fentanil + 100 µg morfin ile % 0,5 izobarik bupivakain 10 mg (Grup B) veya % 0,75 izobarik ropivakain 15 mg (Grup R) vermek üzere rastgele iki gruba ayrıldı. Duyusal ve motor blok özellikleri kaydedildi.

Bulgular: T_6'da duyusal blok elde etme zamanı Grup B'de Grup R'den anlamlı olarak hızlıydı (2,7 ± 1,8 ile 4,2 ± 2,5 dk). Maksimum duyusal blok seviyesine ulaşma süresi Grup B'de Grup R'den hızlı bulundu (8,1 ± 4,1 ile 11,6 ± 5,6 dk). Grup B'de T_{10} ve L_1 dermatomlarına gerileme süreleri (118,2 ± 24,2 ile 145,5 ± 28,1 dk, sırasıyla) Grup R'den daha kısaydı (135 ± 32,1 ile 162,5 ± 32,5 dk, sırasıyla). Motor blok süresi Grup B'de Grup R'den daha uzundu (165,8 ± 32,5 ile 135,2 ± 45,7 dk).

Sonuç: İntratekal izobarik ropivakain ile opioidler daha uzun duyusal blok ve daha kısa motor blok süresiyle sezaryenler için bupivakainden üstün olabilir.

Anahtar sözcükler: Cerrahi, sezaryen, anestezi tekniği, spinal, lokal anestezik, bupivakain, ropivakain

Received: 04.08.2010 – Accepted: 07.09.2010

[1] Nevşehir State Hospital, Nevşehir - TURKEY
[2] Department of Anesthesiology, Faculty of Medicine, Gazi University Ankara - TURKEY
Correspondence: *Berrin GÜNAYDIN, Department of Anesthesiology, Faculty of Medicine, Gazi University Ankara - TURKEY*
E-mail: gunaydin@gazi.edu.tr

* This work was presented at the Society of Obstetric Anesthesia and Perinatology (SOAP) 41st Annual Meeting in Washington DC, USA (2009).

Introduction

Single shot spinal anesthesia is now the most commonly used anesthetic technique for cesarean delivery (1). Although the local anesthetic of choice is typically bupivacaine in obstetric anesthesia practice, ropivacaine, which has gained increased popularity due to its lower motor block effect, rather than bupivacaine has been used for spinal anesthesia during elective cesarean delivery (2-4).

The spread of the block is thought be influenced by the mass of the local anesthetic rather than the concentration or volume, as well as factors such as the coadministration of neuraxial opioids. Thereby, the combination of intrathecal local anesthetics with opioids provides a high quality sensory block with optimal pain control, and decreases the incidence of adverse effects related to local anesthetics (1). When intrathecal bupivacaine and ropivacaine, combined with 10 μg fentanyl and 200 μg morphine, were used for cesarean sections, the median effective dose 50% of recipients (ED_{50}) and ED_{95} of 0.5% isobaric bupivacaine were 7.25 mg and 13 mg, respectively, whereas ED_{50} and ED_{95} of isobaric ropivacaine were 16.7 mg, and 26.8 mg, respectively (3,5). However, the equipotent doses of intrathecal ropivacaine and bupivacaine are still controversial (6,7). Therefore, this study aimed to compare the effects of intrathecal plain bupivacaine or ropivacaine with fentanyl and morphine on maternal hemodynamic parameters, the amount of ephedrine used, the sensory and motor block characteristics, Apgar scores, and the side effects in parturients scheduled to undergo cesarean section (C/S) under spinal anesthesia.

Materials and methods

After obtaining the approval of the institutional ethics committee and written informed consent from each patient, the 52 American Society of Anesthesiologists (ASA) physical status I or II, term parturients with weight under 100 kg and height between 150 cm and 180 cm, scheduled to undergo elective C/S under spinal anesthesia, were enrolled in the study. Parturients having psychiatric, neurologic, cardiac, hematologic disease, diabetes, multiple gestation, preeclampsia, eclampsia, bleeding or coagulation disorder, gestational age smaller than 37 weeks, or fetal compromise or contraindication to spinal anesthesia were not included in this study.

All women were fasted overnight and received ranitidine 50 mg intravenous (IV), half an hour before the spinal anesthesia. After routine infusion of lactated Ringer's solution (10 mL/kg), spinal anesthesia was performed with a 27 G Whitacre spinal needle (B-Braun, Melsungen) using the midline approach between the L3-4 intervertebral space in the sitting position.

According to computer generated random group names as B or R enclosed, parturients were randomly allocated into 2 groups to receive either intrathecal plain bupivacaine (Group B), or ropivacaine (Group R). Two milliliters of 0.5% plain bupivacaine 10 mg (Marcaine® 0.5%, 20 mL flacon, Astra Zeneca) in Group B, and 2 mL of 0.75% isobaric ropivacaine 15 mg (Naropin® 7.5 mg/mL, 10 mL injection, Astra Zeneca) in Group R were combined with 25 μg fentanyl plus 100 μg morphine. The total volume of solutions in each group was 3 mL.

The study drug solutions were prepared by one of the anesthesiologist who did not perform the spinal block, and was not involved in data collection. The other anesthesiologist performed the spinal block, and collected pre- and postoperative data. After observing the free flow of cerebrospinal fluid (CSF), spinal anesthesia was induced by injecting 1 of these 2 solutions over 30 s. Thereafter, the patient was turned to supine with left uterine displacement provided by tilting the operation table approximately 15° to the left. Afterwards, a urinary catheter was placed.

Hemodynamic parameters like heart-rate (HR), ECG, noninvasive blood pressure (BP), and peripheral oxygen saturation (SpO_2) were measured every 2 min during the first 10 min after performing the spinal block, then every 5 min in the first h, and every 10 min until the patient moved to the recovery unit. Hypotension was defined as ³ 20% decrease from baseline mean blood pressure (MBP) and treated with IV ephedrine of 10 mg. The amount of ephedrine used was recorded. A grading was used to assess nausea (0 = none, 1 = nausea, 2 = retching, 3 = vomiting) and if nausea was not related to hypotension, it was treated with metoclopramide 10 mg IV.

The level of sensory block was evaluated by loss of pinprick sensation using the short beveled end of a needle with a blunt tip, and the absence of cold sensation from an alcoholic swab at the mid-clavicular level bilaterally every 2 min during the first 10 min, every 5 min during the first hour, every 10 min until discharged from the recovery unit, then every 15 min until the regression of the sensory block to L1. The motor block was assessed immediately after the sensory block assessment using a modified Bromage scale (0 = no paralysis, 1 = unable to raise extended leg, 2 = unable to flex knee, 3 = complete paralysis) every 2 min during the first 10 min, every 5 min during the first hour, and every 10 min until complete recovery.

The induction of spinal anesthesia was considered successful when at least the T6 dermatome was anesthetized. The duration of the surgery, the amount of time to achieve sensory block at T6, the maximum cephalad spread of the sensory block, the time of the sensory block to regress to T10 and L1, the amount of time to achieve the maximum motor block, the duration of motor block, the first analgesic requirement (duration of analgesia), Apgar scores (1 min and 5 min), and the incidence of maternal side effects were all noted. The satisfaction rates of patients and surgeons from the anesthesia regimen were assessed as "very good", "good", "moderate", "bad", or "very bad" on the first postoperative day.

The surgery was allowed to start when the sensory block reached T4. The surgical technique was uniform, including exteriorization of the uterus, for all patients. Oxytocin 20 IU in 1000 mL of lactated Ringer's solution was administered by infusion after delivery. After recording the time of first analgesic request of the patient, intravenous tenoxicam 20 mg, and/or paracetamol 1 g were used for postoperative analgesia.

Statistical analysis

When 26 subjects per group were enrolled, the power analysis revealed an 80% power and type I error of 0.05 using PASS/NCSS-2000 Package Program. Results were expressed as n, median (range), frequency (%), or mean ± standard deviation (mean ± SD) where appropriate. After descriptive statistics, data including maternal demographics, gestation age (week), newborn weight, the duration of the operation, upper sensory block level, the time to reach the maximum sensory block, the time to achieve sensory block at T6, the sensory block regression time to T10 and L1 dermatomes, and the duration of motor block were analyzed using Mann-Whitney U test between the groups. Data regarding newborn Apgar scores (1 min and 5 min), motor block degree, ephedrine requirement, satisfaction rate of patients and surgeons, and side effects were compared using a chi square test between the groups. Heart rate, mean blood pressure, peripheral oxygen saturation, and motor block data within the dependent groups and between the independent groups were compared with Wilcoxon signed rank test and Mann-Whitney U test, respectively. A P value of less than 0.05 was considered significant.

Results

There were no significant differences in the demographic properties of the parturients or the duration of the surgery between the groups (Table 1).

The times to achieve sensory block at T6 and the maximum sensory block were significantly shorter with intrathecal plain bupivacaine than those with intrathecal plain ropivacaine (Group B: 2.7 ± 1.8 min vs. Group R: 4.2 ± 2.5 min, and Group B: 8.1 ± 4.1 min vs. Group R: 11.6 ± 5.6 min, respectively) ($P < 0.05$). The times of the sensory block regression to T_{10} and L_1 dermatomes were significantly shorter in Group B (118.2 ± 24.2 min, and 145.5 ± 28.1 min, respectively) than in Group R (135 ± 32.1 min and 162.5 ± 32.5 min, respectively) ($P < 0.05$). The motor block duration was significantly longer in Group B

Table 1. Demographic properties and duration of surgery (mean ± SD).

	Group B (n = 26)	Group R (n = 26)
Age (year)	31.3 ± 4.5	32.1 ± 4.5
Height (cm)	161.8 ± 6.1	162.2 ± 5.1
Weight (kg)	75.7 ± 10.8	78.1 ± 9.2
Gestational age (week)	38.5 ± 0.7	38.7 ± 0.6
Duration of surgery (min)	35.2 ± 12.0	31.6 ± 8.4

(165.8 ± 32.5 min) than in Group R (135.2 ± 45.7 min) (Table 2) (P < 0.05).

Although the time to achieve sensory block at T6 was significantly slower with intrathecal ropivacaine, both local anesthetics provided adequate block quality for surgery. The median sensory block values that were evaluated at 2 min, 4 min, and 6 min after the spinal block in Group B were significantly higher than in Group R (Figure 1).

Complete motor block occurred in both groups, except for in one patient in Group R. The median degree of motor block was higher at 2 min, 4 min, 6 min, 10 min, and 15 min after the spinal block in Group B with respect to Group R according to the Bromage scale (Table 3).

No significant differences were found in Apgar scores (1 min and 5 min), and the incidence of pre- and postoperative side effects between the groups (Table 4).

Regarding hemodynamic parameters of the parturients, the mean HR values were comparable between the groups (Figure 2). As for MBP, significant reductions, with respect to baseline measurements, were observed between 4 min and 10 min after the spinal block in both groups. When the 2 groups were compared, the MBP decreased significantly 10 min and 20 min after the spinal block in the ropivacaine group when compared to the bupivacaine group (Figure 3).

There were no significant differences in the ephedrine requirement, the duration of analgesia or the first analgesic requirement, mobilization time, or the onset of intestinal activity between the groups (Table 5).

The satisfaction rate of patients was comparable between the groups. However, the satisfaction rate of surgeons as "very good" was significantly higher in Group B than in Group R (P < 0.05) (Table 6).

Table 2. Sensory and motor block characteristics (mean ± SD).

	Group B (n = 26)	**Group R (n = 26)**
Upper sensory block level (dermatome)	T 3 (T6-T1)	T 3 (T6-T1)
Time to reach maximum sensory block (min)	8.1 ± 4.1*	11.6 ± 5.6
Time to achieve sensory block at T6 (min)	2.7 ± 1.8*	4.2 ± 2.5
Sensory block regression time to T10 dermatome (min)	118.2 ± 24.2*	135 ± 32.1
Sensory block regression time to L1 dermatome (min)	145.5 ± 28.1*	162.5 ± 32.5
Duration of motor block (min)	165.8 ± 32.5*	135.2 ± 45.7

*P < 0.05 between the groups

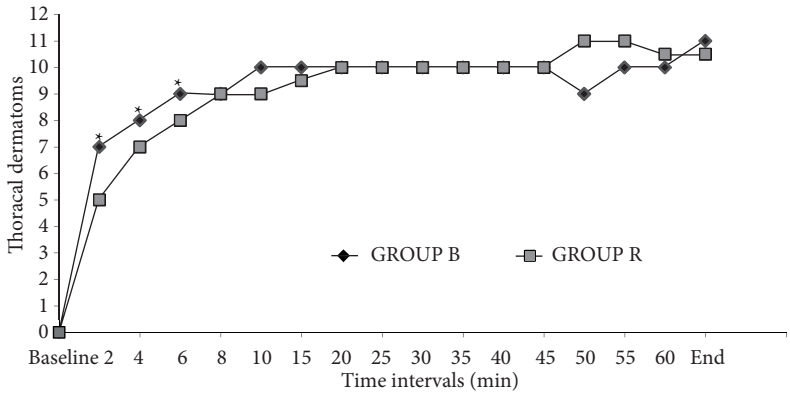

Figure 1. Sensory block versus time. *P < 0.05 between the groups.

Table 3. Motor block degree versus time [(median) (range)].

	Group B (n = 26)	Group R (n = 26)
Baseline	0	0
2 min	2 (1-3)*	1 (0-3)
4 min	2 (1-3)*	2 (0-3)
6 min	2.5 (2-3)*	2 (0-3)
8 min	3 (2-3)	2.5 (1-3)
10 min	3 (2-3)*	3 (1-3)
15 min	3 (3-3)*	3 (2-3)
20 min	3 (3-3)	3 (2-3)
25 min	3 (3-3)	3 (2-3)
30 min	3 (3-3)	3 (2-3)
35 min	3 (3-3)	3 (2-3)
40 min	3 (3-3)	3 (2-3)
45 min	3 (3-3)	3 (2-3)
50 min	3 (3-3)	3 (2-3)
55 min	3 (3-3)	3 (2-3)
60 min	3 (3-3)	3 (2-3)
End of the operation	3	3 (3-3)

*P < 0.05 (between the groups)

Table 4. Apgar scores (median), incidence of preoperative (preop.) and postoperative (postop.) side effects (n).

	Group B (n = 26)	Group R (n = 26)
Apgar 1 min / 5 min (median)	9/10	9/10
Preop./Postop. Nausea (n)	12/6	10/6
Preop./Postop. Vomiting (n)	5/3	2/3
Preop./Postop. Itching (n)	5/13	4/17
Postspinal Headache (n)	0	0

Discussion

It was demonstrated that the significantly faster onset and regression of sensory block resulted in significantly higher surgeon satisfaction with intrathecal bupivacaine and opioids, however, a significantly shorter motor block duration with intrathecal plain ropivacaine, fentanyl, and morphine might be advantageous for elective C/S under spinal anesthesia, because it allowed a faster discharge, and/or early recognition of neurologic complications in the present study.

The comparison of intrathecal plain ropivacaine versus plain bupivacaine has been studied in non-obstetric and obstetric surgery under spinal anesthesia (2,4,6-8). Intrathecal 15 mg of ropivacaine provided faster motor block recovery, and the duration of sensory block was similar when compared to 10 mg of bupivacaine during minor lower extremity surgery (7). The cephalad spread of sensory block was higher with intrathecal 10 mg of bupivacaine than with intrathecal 15 mg of ropivacaine, but the onset of anesthesia at T10, which was adequate for transurethral resection of

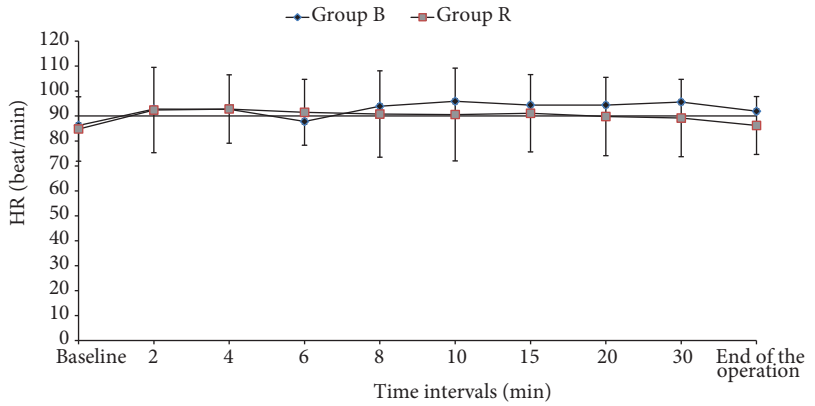

Figure 2. Heart rate (HR) versus time.

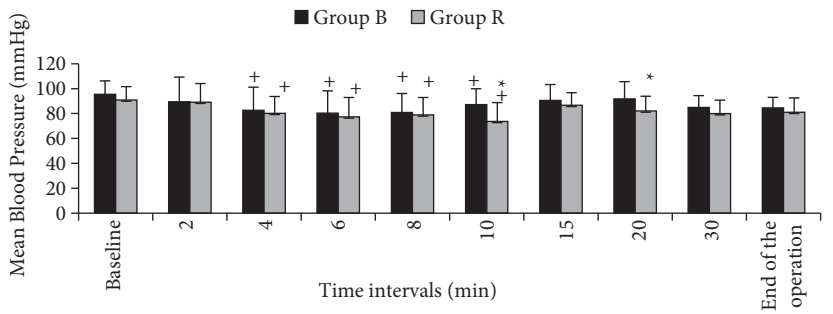

Figure 3. Mean blood pressure (MBP) versus time.

Table 5. Ephedrine requirement, duration of analgesia (first analgesic requirement time), and mobilization time (mean ± SD).

	Group B (n = 26)	**Group R (n = 26)**
Ephedrine requirement (mg)	23.7 ± 14.1	28.3 ± 19.0
Analgesia duration (min)	348.1 ± 246.7	437.0 ± 222.6
Mobilization time (h)	12.0 ± 4.8	9.8 ± 2.9
Onset of intestinal activity (h)	20.7 ± 5.3	21.8 ± 4.7

Table 6. Satisfaction rate of patients and surgeons (n).

Satisfaction Rate	**Very good**	**Good**	**Moderate**	**Bad**	**Very bad**
Patient					
Group B	14 (53.8)	11 (42.3)	1 (3.8)	0 (0)	0 (0)
Group R	16 (61.5)	10 (38.5)	0 (0)	0 (0)	0 (0)
Surgeon					
Group B	18 (69.2)*	8 (30.8)	0 (0)	0 (0)	0 (0)
Group R	11 (42.3)	14 (53.8)	1 (3.8)	0 (0)	0 (0)

*P < 0.05 between the groups

prostate (TUR), was comparable between ropivacaine and bupivacaine (8). Since these 2 studies have not been done in the obstetric population, and intrathecal opioids have not been added to local anesthetics, it is not appropriate to compare them with our present results. However, several studies have been done in the obstetric population comparing block characteristics of intrathecal plain ropivacaine and bupivacaine with morphine and/or sufentanil during C/S. Therefore, our study has been the first to demonstrate the comparative effects of intrathecal plain ropivacaine, and bupivacaine coadministered with both fentanyl and morphine.

According to the study by Gautier et al. (4), when intrathecal bupivacaine 8 mg or ropivacaine 12 mg was coadministered with intrathecal sufentanil, the time to reach maximum cephalad spread, and the time of regression to T10 was comparable between bupivacaine and ropivacaine, but the duration of motor block and the first analgesic requirement were significantly shorter with ropivacaine (4). In contrast to that study, it was found that the time to reach maximum cephalad spread and the amount of time to regression to T10 were significantly shorter with bupivacaine 10 mg than ropivacaine 15 mg, but the first analgesic requirement was similar between ropivacaine and bupivacaine groups in the present study. The only similar finding was the duration of motor block, which was significantly shorter with ropivacaine. The diversity in these results could be due to the different intrathecal dose used, and the different opioid added, with respect to our study.

In another study, although higher intrathecal doses of bupivacaine, and ropivacaine (15 mg of each local anesthetic) with a morphine addition were used, the time to reach the maximum sensory block level and 2 segment regression times were similar; however, the duration of motor block and the amount of ephedrine used were significantly less with ropivacaine than with bupivacaine (2). These results were also different than ours, because the same doses of local anesthetics were used, though a potency ratio of 0.6 has been described by Polley et al. between bupivacaine and ropivacaine in 1999 (9). Therefore, we selected bupivacaine 10 mg versus ropivacaine 15 mg based on that potency ratio of 0.6, in order to make a valid and relevant comparison. We demonstrated that an intrathecal equipotent dose of bupivacaine and ropivacaine plus opioids provided satisfactory surgical anesthesia and postoperative properties, including similar analgesia duration, mobilization time, and the onset of intestinal activity. Although the sensory and motor block characteristics significantly varied between bupivacaine and ropivacaine, both local anesthetics did not result in significant changes in the ephedrine requirement.

Intrathecal 10 mg of plain bupivacaine resulted in the higher cephalad spread of sensory block than that of intrathecal 15 mg of plain ropivacaine (T4 versus T6) during spinal anesthesia for TUR (8). In contrast to that study, the mean maximum sensory block level was found to be T3 with both local anesthetics, though the time to achieve sensory block at T6 was significantly shorter with bupivacaine than ropivacaine in the present study.

The motor blocking potencies of intrathecal local anesthetics in parturients undergoing elective cesarean delivery with combined spinal-epidural (CSE) anesthesia have been investigated (10,11). The median effective dose (ED50) for motor block with intrathecal ropivacaine, levobupivacaine, and bupivacaine were 5.79 mg, 4.83 mg, and 3.44 mg, respectively (11). In the present study, spinal anesthesia was preferred instead of CSE, using 10 mg of plain bupivacaine and 15 mg ropivacaine both with fentanyl and morphine according to previously determined ED95 for each local anesthetic, as well as the potency ratio between them. We observed a motor block degree of 2 (corresponding unable to flex knee) occurred 2 min after the spinal block and reached 3 (corresponding to complete paralysis) within 10 min after the spinal block with intrathecal bupivacaine. The median motor block degree due to intrathecal bupivacaine was significantly higher than intrathecal ropivacaine, between 2 min and 15 min following the spinal block. Similarly, results of the present study also demonstrated that intrathecal bupivacaine and ropivacaine displayed a high and low clinical profile of potency for motor block, respectively.

There were significant reductions with respect to baseline measurements in MBP between 4 min and 10 min after the spinal block in both groups and parturients were treated with ephedrine. Although the MBP significantly decreased with ropivacaine

rather than with bupivacaine 10 min and 20 min after the spinal block, they were within clinically acceptable limits. Ultimately, we did not find any significant difference in the amount of ephedrine used between the groups.

In conclusion, even though intrathecal plain bupivacaine with fentanyl and morphine provided a faster sensory block onset and a regression with a longer motor block duration than that with ropivacaine, the hemodynamic deterioration in blood pressure requiring vasopressor treatment was similar. Therefore, intrathecal plain ropivacaine with fentanyl and morphine might be superior for cesarean delivery, because of a longer sensory block regression with a shorter time of motor block duration allowing the recognition, if any, of possible neurological complications as early as possible in busy labor units where early patient discharge is required.

References

1. Tsen L. Anesthesia for Cesarean Delivery. In: Chestnut DH, Polley LS, Tsen LC, Wong CA, editors. Chestnut's Obstetric Anesthesia Principals and Practice. 4th ed. Philadelphia: Mosby Elsevier; 2009. p. 521-74.
2. Ogun CO, Kirgiz EN, Duman A, Okesli S, Akyurek C. Comparison of intrathecal isobaric bupivacaine-morphine and ropivacaine-morphine for Caesarean delivery. Br J Anaesth 2003; 90: 659-64.
3. Khaw KS, Ngan Kee WD, Wong M, Ng F, Lee A. Spinal ropivacaine for cesarean section: a dose-finding study. Anesthesiology 2001; 95: 1346-50.
4. Gautier P, Kock MD, Huberty L, Demir T, Izydorczic M, Vanderick B. Comparison of the effects of intrathecal ropivacaine, levobupivacaine, and bupivacaine for caesarean section. Br J Anaesth 2003; 91: 684-9.
5. Carvalho B, Durbin M, Drover DR, Cohen SE, Ginosar Y, Riley ET. The ED50 and ED95 of intrathecal isobaric bupivacaine with opioids for cesarean delivery. Anesthesiology 2005; 103: 606-12.
6. Danelli G, Fanelli G, Berti M, Cornini A,Lacava L, Nuzzi M, Fanelli A. Spinal ropivacaine or bupivacaine for cesarean delivery: a prospective, randomized, double-blind comparison. Reg Anesth Pain Med 2004; 29: 221-6.
7. Kallio H, Snall ET, Kero MP, Rosenberg PH. A comparison of intrathecal plain solutions containing ropivacaine 20 or 15 mg versus bupivacaine 10 mg. Anesth Analg 2004; 99: 713-7.
8. Malinovsky JM, Charles F, Kick O, Lepage JY, Malinge M, Cozian A, Bouchet O, Pinaud M. Intrathecal anesthesia: Ropivacaine versus bupivacaine. Anesth Analg 2000; 91; 1457-60.
9. Polley LS, Columb MO, Naughton NN, Wagner DS, Van de Ven CJ. Relative analgesic potencies of ropivacaine and bupivacaine for epidural analgesia in labor: implications for theurapeutic indexes. Anesthesiology 1999; 99: 944-50.
10. Camorcia M, Capogna G, Lyons G C, Columb MO. The relative motor block potencies of intrathecal ropivacaine: Effects of concentration. Anesth Analg 2004; 98: 1779- 82.
11. Camorcia M, Capogna G, Berritta C, Columb MO. The relative potencies for motor block after intrathecal ropivacaine, levobupivacaine, and bupivacaine. Anesth Analg 2007; 104: 904-7.