Patient-controlled epidural analgesia after Caesarean section: levobupivacaine 0.15% versus ropivacaine 0.15% alone or combined with fentanyl 2 μg/ml: a comparative study

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Abstract

Introduction: The aim of this study was to compare the postoperative analgesic efficacy of epidural ropivacaine 0.15%, levobupivacaine 0.15% and ropivacaine 0.15% plus fentanyl 2 μg/ml, used with a patient-controlled epidural analgesia (PCEA) device after Caesarean section.

Material and methods: Sixty women undergoing elective Caesarean section under combined spinal-epidural anaesthesia were enrolled. Postoperatively, patients received PCEA with either ropivacaine or levobupivacaine 0.15% (basal rate 6 ml/h, bolus 5 ml/20 min), or ropivacaine 0.15% plus fentanyl 2 μg/ml (basal rate 6 ml/h, bolus 4 ml/20 min). Sympathetic and sensory level of analgesia, motor ability (Bromage 0-3), and pain scores at rest, movement and cough (VAS 0-10), haemodynamic parameters, oxygenation, side effects and total doses of local anaesthetic were documented every 6 h for 24 h. Patient satisfaction was assessed using a descriptive scale.

Results: No significant difference was observed in pain scores at all time intervals. A significantly higher sympathetic and sensory blockade occurred with levobupivacaine and ropivacaine 0.15% compared to ropivacaine 0.15% plus fentanyl, with no significant difference in total local analgesic consumption at 24 h ($p = 0.08$). Rescue analgesic requirements did not differ between the groups ($p = 0.8$) while patients' satisfaction was significantly higher in the ropivacaine 0.15% plus fentanyl group ($p = 0.02$). Haemodynamics, oxygenation, nausea, pruritus and numbness did not differ between the groups.

Conclusions: Dilute local anaesthetic solutions provided satisfactory postoperative analgesia after Caesarean section when used with a PCEA device. The combination of ropivacaine 0.15% with fentanyl 2 μg/ml appeared superior, since it provided higher patient satisfaction with statistically equal pain scores and local anaesthetic consumption.

Key words: postoperative epidural analgesia, local anaesthetics, opioids, postoperative pain management.

Introduction

The benefit of adequate postoperative pain relief is well established [1, 2]. Successful postoperative pain management is very important especially after Caesarean section delivery, since pain can interfere with the mother's breastfeed production or have an impact on the newborn [1, 2]. Many

methods have been used in order to manage postoperative pain after Caesarean section, such as systemic opioids alone or combined with non-steroidal anti-inflammatory drugs (NSAIDs), intravenous patient-controlled analgesia (ivPCA), intrathecal as well as epidural opioids and/or local anaesthetics, and mainly patient-controlled epidural analgesia (PCEA) [1-4], which is one of the preferred methods for postoperative pain relief. In addition, it is easy to establish, since combined spinal-epidural and single epidural anaesthesia are among the preferred techniques used for Caesarean section delivery today.

Bupivacaine is one of the most commonly used local anaesthetics in obstetric practice, but its use was correlated with significant motor blockade [5]. Levobupivacaine, its S-enantiomer, is less toxic than bupivacaine and though it has been used for epidural analgesia during labour, there are no available data regarding its use for post-Caesarean PCEA [6]. Ropivacaine is a local anaesthetic which has gained popularity in obstetrics, and has been used both during labour and post-Caesarean delivery PCEA, due to less motor blockade and less toxicity for the mother and baby [6-10].

The aim of this study was to compare the postoperative analgesic efficacy of levobupivacaine 0.15% with ropivacaine 0.15% alone or combined with fentanyl 2 µg/ml, when used epidurally with a patient-controlled analgesia device after Caesarean section delivery.

Material and methods

After approval from the Hospital's Ethics Committee and written informed consent, 60 pregnant women undergoing elective Caesarean section were enrolled in this study, randomized with the method of closed envelope, during the years 2006-2009. All participants were American Society of Anesthesiologists (ASA) physical status I or II, aged 18-45 years old, and had an uneventful singleton full-term pregnancy. Exclusion criteria included age < 18 years old, weight more than 120 kg, height < 158 cm or > 178 cm, any contra-indications to regional anaesthesia, known allergy to local anaesthetics and/or non-steroidal anti-inflammatory drugs (NSAIDs), ASA > II and patient refusal to receive epidural analgesia postoperatively.

All patients received combined spinal-epidural anaesthesia for Caesarean section, performed after pre-hydration with 6% hydroxyethyl starch 130/0.4 (Voluven, Fresenius Kabi France, F-27406 Louviers) 250 ml *i.v.*, in the sitting position at the L3-L4 spinal interspace. After recognition of the epidural space with a 18 G Tuohy epidural needle using the loss of resistance technique with air, a 27 G spinal needle was inserted through the Tuohy needle to the subarachnoid space. After successful cerebrospinal fluid recognition, 7.5-9 mg (height < 160 cm, 7.5 mg; 161-165 cm, 8 mg; 165-170 cm, 8.5 mg; > 170 cm, 9 mg) of isobaric bupivacaine 0.5% combined with 20 µg fentanyl were injected into the subarachnoid space. Then, the spinal needle was removed and the epidural catheter was inserted 4 cm further from the end of the Tuohy needle into the epidural space. The depth of the epidural space was documented, as well as the catheter's location (in cm) in order to manage subsequent problems with unilateral or inadequate anaesthesia. Once adequate anaesthesia to T4 dermatome (tested by pinprick) was achieved, the operation was allowed to begin. In patients who did not reach adequate levels of anaesthesia with the spinal dose of bupivacaine, the epidural catheter was used and a test dose of lidocaine 2% 3 ml was administered. If adequate anaesthesia was not achieved after 10 min, additional ropivacaine 0.75% in boluses of 3 ml were slowly administered until adequate anaesthesia to T4 dermatome. These patients were excluded from the study.

At the end of the procedure, patients were transferred to the post-anaesthesia care unit, and after achieving motor recovery in both limbs (Bromage 1) they were randomized (method of closed envelope) to receive PCEA with one of the following solutions: ropivacaine 0.15%, or levo-bupivacaine 0.15% (basal rate 6 ml/h, bolus dose 5 ml/20 min), or ropivacaine 0.15% plus fentanyl 2 µg/ml (basal rate 6 ml/h, bolus dose 4 ml/20 min). All solutions were prepared by a trainee anaesthesiologist using a strictly aseptic technique. Before initiation of PCEA, a test dose of 5 ml of the selected analgesic solution was administered epidurally, while a patient-controlled analgesia device type CADD-Legacy PCA, Model 6300 (Smiths Medical MD, St Paul, Minn.) was connected to all patients 5 min after confirmation of adequate epidural catheter placement. At the same time, a visual analogue scale with units from 0 to 10 was shown and explained to all patients, in order to familiarize them with the method of assessment.

All measurements and explanations were performed by the postoperative management team of our department, who were blinded as to the anaesthetic solution used in each case. The sympathetic level of analgesia (tested by loss of the patient's ability to discriminate temperature changes), the 6-h local anaesthetic consumption, as well as sensory level (tested by response to pinprick), motor ability (tested by Bromage scale 0-3, 0 – free movement of legs and feet, 1 – just able to flex knees with free movement of feet, 2 – unable to flex knees, but with free movement of feet and 3 – unable to move legs or feet), and pain scores at rest, during movement and during cough (tested by visual analogue scale 0-10) were

documented every 6 h after initiation of PCEA, during the first 24 h postoperatively. In addition, at the same time intervals systolic and diastolic blood pressure, heart rate, breathing rate, SpO_2, as well as reports of nausea and vomiting, pruritus, numbness, sedation and discomfort were also documented. Doses of local anaesthetic requested and given every 6 h, as well as total dose and volume of local anaesthetic administered, were recorded. In case of inadequate pain relief, the anaesthesiologist on call was informed, rescue paracetamol 1000 mg was administered, with documentation of the timing of the first analgesic dose given as well as the total daily dose of additional analgesics. If this was inadequate, additional diclofenac sodium 50 mg (supp) was administered and documented. The epidural catheter was removed 24 h after initiation of PCEA, while analgesia was maintained with paracetamol in addition to non-steroidal anti-inflammatory drugs. Neurological examination was performed 12 h and 24 h after epidural catheter removal. Overall patient satisfaction regarding postoperative analgesia was assessed following a four-point descriptive scale (1 – very satisfied, 2 – satisfied, 3 – not very satisfied, 4 – not satisfied).

Statistical analysis

Statistical analysis was performed using descriptive statistics, as well as analysis of variance (ANOVA), in addition to comparisons of each pair using Student's *t*-test for inter-group differences. *Post hoc* analysis with Bonferroni correction was also performed in cases where a significant difference was observed. All data were analysed using SPSS 13.0 for Windows Software (Statistical Package for the Social Sciences, SPSS, Chicago Inc. USA). Values are expressed as mean ± standard deviation. A $p < 0.05$ was considered statistically significant, while post hoc power analysis (1-β) revealed 0.58 (for VAS during rest), 0.71 (for total local anaesthetic dose given) and 0.87 (for overall patient satisfaction) at the end of the study period (24 h).

Results

Sixty patients were included in the study, aged 23-41 years, ASA physical status I and II. Weight and height of patients were within 65-114 kg and 158-178 cm respectively. Epidural space location ranged between 3 cm and 7.5 cm. Mean dosage of intrathecal bupivacaine was 8.3 (1.1) mg plus 20 μg fentanyl. Somatometric characteristics and details of anaesthetic management of patients in each group are summarized in Table I.

At 6 h after initiation of PCEA, no significant difference was observed regarding local anaesthetic requirements, VAS scores at rest, movement and cough, as well as doses requested/given through the pump (Table II). On the other hand, a significantly higher sympathetic and sensory blockade was observed in levobupivacaine 0.15% and ropivacaine 0.15% groups compared to the ropivacaine 0.15% plus fentanyl group, in addition to slightly denser motor blockade, as recorded by the difference in Bromage scales. Numbness, nausea/vomiting and pruritus did not differ significantly between the groups.

The same results were observed 12 h after initiation of PCEA, with the addition of a significant difference in the doses given, and the total dose of local anaesthetic administered in the levobupivacaine 0.15% group compared to ropivacaine 0.15% plus fentanyl, but not with the ropivacaine 0.15% group (Table III). At 18 h after initiation of PCEA, this difference in local anaesthetic consumption between the levobupivacaine 0.15% group and ropivacaine 0.15% plus fentanyl remained significant, in addition to higher sympathetic and sensory blockade. Bromage scales did not differ significantly between the groups at 18 h (Table IV).

Finally, 24 h after initiation of PCEA, levobupivacaine and ropivacaine 0.15% groups differed significantly regarding sympathetic and sensory blockade compared with the ropivacaine plus fentanyl group, while motor blockade was also denser in the levobupivacaine group (Table V). However, total local analgesic consumption during

Table I. Somatometric characteristics and details of epidural technique and local anaesthetic administered intrathecally in each group

Parameters	Lev/ne 0.15%	Rop/ne 0.15%	Rop/ne + fent	Value of *p*
Age [years]	31.6 (4.8)	30.3 (3.6)	30.4 (4.0)	0.5
Weight [kg]	82.2 (14.7)	82.2 (12.1)	74.3 (9.3)	0.07
Height [cm]	166.2 (4.9)	164.5 (8.7)	161.5 (8.4)	0.1
Epidural depth [cm]	5.2 (1.0)[a]	5.5 (0.8)[a]	4.4 (0.6)[b]	0.001*
Epidural catheter [cm]	10.1 (1.8)[a]	11.1 (1.5)[a]	9.5 (1.2)[b]	0.01*
LA dose [mg]	8 (1.3)	8.4 (1.0)	8.6 (1.1)	0.23

*Data are presented as mean (SD) or as %. Groups not connected with the same letter (a, b, c) are statistically different. *Statistical significance, p < 0.05, LA – local anaesthetic*

Table II. Patient-controlled epidural analgesia assessment 6 h after initiation

	Lev/ne 0.15%	Rop/ne 0.15%	Rop/ne + fent	Value of *p*
Requested doses	8.3 (9.4)	5.4 (6.9)	4 (2.4)	0.1
Given doses	4.8 (3.4)	3.3 (3.4)	3.4 (0.7)	0.2
Total volume [ml]	56.2 (18.5)	52.3 (17.4)	50.3 (7.3)	0.46
Total dose LA [mg] **Fentanyl [µg]**	87.6 (26.7)	78.4 (26.1)	75.4 (10.9) 100.6 (14.6)	0.21
VAS at rest	3.3 (1.9)	2.1 (1.9)	1.9 (2.5)	0.1
VAS during movement	4.9 (2.2)	4 (2.4)	3.7 (2.5)	0.3
VAS during cough	4.5 (3.3)	4.3 (2.2)	3.7 (2.5)	0.5
Sympathetic block, upper dermatome [%]	T4 17[a]	T4 –[b]	T4 –[c]	< 0.001*
	T5 8	T5 6	T5 –	
	T8 8.5	T8 12	T8 –	
	T9 8.5	T9 –	T9 –	
	T10 33	T10 6	T10 –	
	T11 8	T11 –	T11 –	
	T12 –	T12 35	T12 –	
	L1 17	L1 41	L1 56	
	L2 –	L2 –	L2 39	
	L3 –	L3 –	L3 5	
Pinprick upper level, dermatome [%]	T4 8.5[a]	T4 –[b]	T4 –[c]	< 0.001*
	T5 25	T5 6	T5 –	
	T8 8.5	T8 6	T8 –	
	T10 25	T10 –	T10 –	
	T12	T12 18	T12 –	
	L1 33	L1 65	L1 –	
	L2 –	L2 –	L2 50	
	L3 –	L3 6	L3 39	
	L4 –	L4 –	L4 11	
Bromage	0.3 (0.6)[a]	0.6 (0.8)[a]	0 (0)[b]	0.009*
Numbness, yes/no [%]	22/78	31/69	61/38	0.08

*Data are presented as mean (SD) or as %. Groups not connected with the same letter (a, b, c) are statistically different. *Statistical significance, p < 0.05, LA – local anaesthetic, VAS – visual analogue scale*

the study period (24 h) was 288 (57) mg for levobupivacaine, 263.2 (48.1) mg for plain ropivacaine and 255.7 (32.6) mg for the ropivacaine plus fentanyl group, without a significant difference between the three groups (Figure 1), while rescue analgesic requirements also did not differ between the 3 groups ($p = 0.8$). On the other hand, patient's satisfaction about postoperative analgesia was significantly better in the ropivacaine 0.15% plus fentanyl group, with a mean value of 1.3 (0.4) compared to 1.6 (0.5) for levobupivacaine 0.15% and 1.7 (0.5) for ropivacaine 0.15% ($p = 0.03$, Figure 2). Haemodynamic parameters, oxygenation (breathing rate and SpO_2), nausea, pruritus and numbness also did not differ between the three groups at all time points studied, although 5% of patients who received ropivacaine 0.15% plus fentanyl reported minor pruritus.

Discussion

Nowadays, the newer amide local anaesthetics ropivacaine and levobupivacaine, alone or combined with opioids, are mostly used for epidural analgesia. Studies investigating the influence of type of local anaesthetic used, its concentration, the combination of neuraxially administered opioids, as well as the PCEA settings such as the volume of the PCEA bolus, the lockout interval, and the use of background infusion, on PCEA efficacy have yielded conflicting results [6, 11-19]. In the present study,

Table III. Patient-controlled epidural analgesia assessment 12 h after initiation

	Lev/ne 0.15%	Rop/ne 0.15%	Rop/ne + fent	Value of *p*
Requested doses	26.9 (46.7)	8.5 (9.7)	5.3 (5)	0.07
Given doses	8.5 (6.8)[a]	5.1 (4.5)[b]	3.7 (1.2)[b]	0.02*
Total volume [ml]	109.5 (31.1)[a]	96.8 (21.7)[a,b]	91 (8.9)[b]	0.03*
Total dose LA [mg]	164.2 (46.6)[a]	145.2 (32.6)[a,b]	136.6 (13.3)[b]	0.03*
Fentanyl [µg]	0	0	182 (26.6)	
VAS at rest	3 (2.1)	3.1 (1.8)	2.3 (2.7)	0.5
VAS during movement	5.2 (2.1)	4.9 (2.1)	4.4 (2.4)	0.5
VAS during cough	5.2 (2.3)	5.3 (1.8)	4.4 (2.4)	0.5
Sympathetic block, upper dermatome [%]	T5 12.5[a,b]	T5 –[b]	T5 –[c]	0.02*
	T8 –	T8 8	T8 –	
	T9 12.5	T9 –	T9 –	
	T10 12.5	T10 –	T10 –	
	T11	T11 8.5	T116	
	T12 25	T12 42	T12 –	
	L1 12.5	L1 33	L1 53	
	L2 12.5	L2 8.5	L2 35	
	L3 12.5	L3 –	L3 6	
Pinprick upper level, dermatome [%]	T5 12.5[a,b]	T5 –[b]	T5 –[c]	< 0.001*
	T8 –	T8 8	T8 –	
	T9 12.5	T9 –	T9 –	
	T10 –	T10 –	T10 –	
	T11 –	T11 8	T11 –	
	T12 25	T12 25	T12 –	
	L1 25	L1 42	L1 –	
	L2 12.5	L2 17	L2 47	
	L3 –	L3 –	L3 41	
	L4 12.5	L4 –	L4 12	
Bromage	0.4 (0.7)	0.5 (0.7)	0.1 (0.3)	0.1

*Data are presented as mean (SD) or as %. Groups not connected with the same letter (a, b, c) are statistically different; *statistical significance, p < 0.05, LA – local anaesthetic, VAS – visual analogue scale*

we tested the postoperative analgesic effect of three different analgesic solutions of local anaesthetics, using a background infusion plus a demand bolus dose via an epidural catheter. Based on the study of Polley *et al.* [20], which found that ropivacaine and levobupivacaine seem to have similar potencies when used epidurally during labour, we evaluated the analgesic efficacy of equal concentrations of these two local anaesthetics given epidurally with the same PCEA settings. In the third group, the combination of ropivacaine 0.15% and fentanyl was adjusted at a slightly lower bolus dose based on the fact that fentanyl has been reported to have a sparing effect on the dose of the local anaesthetic with which it is combined [5, 11]. The dose of fentanyl that we selected (2 µg/ml) was based on other studies performed with the same dose, mostly during labour [21, 22] and also following Caesarean section [9, 23].

In our study, plain ropivacaine and levobupivacaine solutions in a concentration of 0.15% proved to be of equal analgesic efficacy, with equal total analgesic consumption during the first 24 h after Caesarean section. Levobupivacaine is not widely studied regarding postoperative analgesia, and it is interesting that at all time points studied patients had more analgesic requirements and more bolus epidural doses were given, leading to higher sensory levels of analgesia, although not always statistically significant. Additionally, patients who received levobupivacaine had more motor weakness compared to ropivacaine at all time

Table IV. Patient-controlled epidural analgesia assessment 18 h after initiation

	Lev/ne 0.15%	Rop/ne 0.15%	Rop/ne + fent	Value of *p*
Requested doses	25.3 (50.5)	9 (12.3)	7 (4.4)	0.13
Given doses	9.07 (7.6)[a]	5.3 (6.2)[a,b]	3.9 (1.4)[b]	0.04*
Total volume [ml]	151.5 (36.1)	139 (27.9)	131.3 (18.5)	0.08
Total dose LA [mg] **Fentanyl [µg]**	227.3 (54.2)[a]	208.6 (41.9)[a,b]	192.8 (18.5)[b] 262.6 (37)	0.03*
VAS at rest	3 (2.1)	3.1 (1.8)	2.3 (2.7)	0.09
VAS during movement	5.2 (2.1)	4.9 (2.1)	4.4 (2.4)	0.28
VAS during cough	5.2 (2.3)	5.3 (1.8)	4.4 (2.4)	0.27
Sympathetic block, upper dermatome [%]	T8 11[a]	T8 10[a]	T8 –[b]	< 0.001*
	T10 33	T10 –	T10 –	
	T11 11.5	T11 –	T11 –	
	T12 33	T12 50	T12 6	
	L1 –	L1 30	L1 53	
	L2 –	L2 –	L2 35	
	L3 11.5	L3 10	L3 6	
Pinprick upper level, dermatome [%]	T9 11[a]	T9 –[a]	T9 –[b]	< 0.001*
	T10 22.5	T10 10	T10 –	
	T11 11	T11 –	T11 –	
	T12 22.5	T12 40	T12 –	
	L1 11	L1 40	L1 –	
	L2 11	L2 –	L2 53	
	L3 11	L3 10	L3 35	
	L4	L4 –	L4 12	
Bromage	0.3 (0.6)	0.2 (0.5)	0.05 (0.2)	0.22
Nausea, yes/no [%]	0/100	0/100	0/100	1
Numbness, yes/no [%]	21/79	30/70	35/65	0.07

*Data are presented as mean (SD) or as %. Groups not connected with the same letter (a, b) are statistically different; *statistical significance, p < 0.05, LA – local anaesthetic, VAS – visual analogue scale*

points, although Bromage scores remained generally low in all groups. Studies are lacking about levobupivacaine's profile in postoperative epidural analgesic techniques, especially if used for more than 24 h. In one study by Dernedde *et al.* [12] two different concentrations of levobupivacaine (0.15% and 0.5%) for postoperative epidural analgesia were tested after major abdominal surgery. The authors found no significant differences regarding analgesic efficacy, and they report a consistently low motor blockade even after 48 h (Bromage < 1) which is in agreement with our findings at 24 h (mean Bromage with levobupivacaine 0.6), although epidural catheter placement in our patients occurred at the lumbar region in proximity to motor innervation of the lower extremities (a fact which could increase the risk of motor weakness). In addition, although plain levobupivacaine and ropivacaine were equally effective regarding analgesia, the levobupivacaine group asked for more local anaesthetic at all time intervals studied and had continuously higher sensory levels of analgesia. This is in contrast with the findings of Wang *et al.*, who tested multiple concentrations of ropivacaine and levobupivacaine for labour analgesia, but did not observe any differences regarding sympatheticolytic levels achieved, as well as motor weakness [24].

The combination of local anaesthetics and opioids appears to have the benefit of achieving postoperative analgesia without significant motor blockade, which is extremely important after Caesarean section in order for the mother to take care of her baby. In the study by Hodson *et al.* [11], very low concentrations of ropivacaine and bupivacaine (0.05% and 0.1%) with fentanyl 4 µg/ml were used in PCEA after abdominal surgery, and analgesia was found to be equivalent, with the

Table V. Patient-controlled epidural analgesia assessment at 24 h

	Lev/ne 0.15%	Rop/ne 0.15%	Rop/ne + fent	Value of *p*
Requested doses	17.6 (22.6)	9.3 (11)	9 (3.4)	0.12
Given doses	7.8 (6.1)	5.6 (6.7)	9 (2.7)	0.12
Total volume [ml]	192 (38)	175.5 (32)	170.4 (21.7)	0.08
Total dose LA [mg] **Fentanyl [µg]**	288 (57)	263.2 (48.1)	255.7 (32.6) 340.8 (65.2)	0.08
VAS at rest	1.7 (1.6)	1.7 (1.7)	1 (0.5)	0.58
VAS during movement	3.2 (1.9)	3.1 (1.3)	2.7 (2)	0.80
VAS during cough	3.3 (2.4)	3.4 (1.5)	2.7 (2)	0.72
Sympathetic block, upper dermatome [%]	T4 9[a]	T4 –[b]	T4 –[c]	0.01*
	T9 9	T9 –	T9 –	
	T10 9	T10 –	T10 –	
	T11 9	T11 29	T11 –	
	T12 36	T12 29	T12 –	
	L1 –	L1 42	L1 40	
	L2 9	L2 –	L2 40	
	L3 19	L3 –	L3 10	
	L4 –	L4 –	L4 10	
Pinprick upper level, dermatome [%]	T11 10[a]	T11 –[a]	T11 –[c]	0.002*
	T12 18	T12 29	T12 –	
	L1 18	L1 29	L1 –	
	L2 18	L2 42	L2 40	
	L3 18	L3 –	L3 40	
	L4 18	L4 –	L4 20	
Bromage	0.6 (0.8)[a]	0.1 (0.3)[a,b]	0 (0)[b]	0.01*

*Data are presented as mean (SD) or as %. Groups not connected with the same letter (a, b, c) are statistically different; *statistical significance, p < 0.05, LA – local anaesthetic, VAS – visual analogue scale*

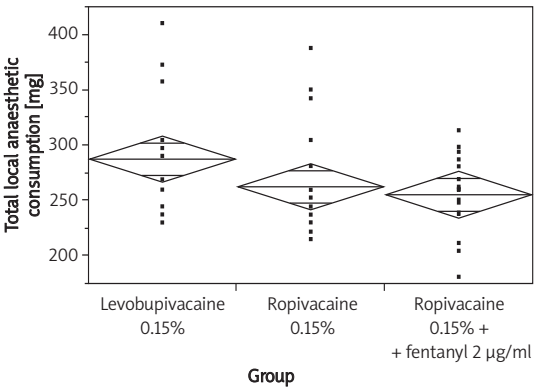

Figure 1. Total (24 h) local anaesthetic consumption in the 3 groups

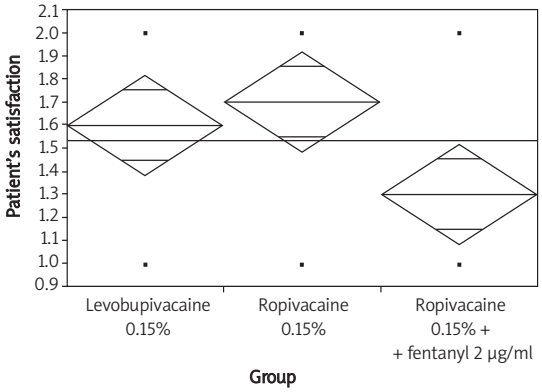

Figure 2. Patient's satisfaction about postoperative analgesia measured 24 h after initiation of PCEA in the 3 groups (1 – very satisfied, 2 – satisfied, 3 – not very satisfied, 4 – not satisfied)

0.05% solution resulting in less local anaesthetic consumption and earlier ambulation of patients. In our study, the addition of fentanyl 2 µg/ml to ropivacaine 0.15% resulted in equally effective analgesia compared to plain solutions of ropivacaine and levobupivacaine 0.15% with the advantage of less motor weakness at all time points studied and less local analgesic consumption

(although not always statistically significant). However, sensory blockade was higher with plain local anaesthetic solutions (especially levobupivacaine resulted in a sympathetic blockade up to T4, 6 h after initiation of PCEA, lowering to T9 at 24 h, while no patient in the ropivacaine plus fentanyl group had a sensory blockade up to L1 during the first measurement at 6 h). The difference observed regarding the depth of the epidural space in the last group could interfere with these observations, but since the length of the epidural catheter inserted within the epidural space was similar in all parturients and no unilateral block was observed, the above hypothesis is not supported. The fact that PCEA with the combined ropivacaine-fentanyl solution produced the same analgesic effect compared to the two other groups, despite the lower sensory blockade observed, indicates the supportive analgesic effect of neuraxially administered lipophilic opioids. Epidural opioid and local anaesthetic administration coincide with a sparing effect on local anaesthetic dose and subsequently improved motor strength in the lower extremities.

The main limitations of this study are the rather small sample size and the small differences exhibited between the groups, showing us that further studies are needed in order to define the exact role of PCEA in postoperative pain relief after Caesarean section, with various doses of local anaesthetics and opioids. In addition, further research is needed to assess the necessity of background infusion in epidurals used for postoperative analgesia, as well as the efficacy of different bolus doses of local anaesthetic solutions with or without the addition of opioids.

Patient satisfaction was proved to be significantly higher in the ropivacaine 0.15% plus fentanyl 2 µg/ml group, a fact that is really important since there is a lack of studies regarding patient satisfaction, especially with PCEA after Caesarean section. The addition of opioids to local anaesthetics was overall accompanied with less motor weakness, less total analgesic consumption and better pain scores throughout the whole study period, although those differences were not always statistically significant.

In conclusion, dilute local anaesthetic solutions of levobupivacaine 0.15%, ropivacaine 0.15% and ropivacaine 0.15% plus fentanyl 2 µg/ml provide satisfactory postoperative analgesia after Caesarean section when used with a patient-controlled analgesia device. This study supports the combination of ropivacaine 0.15% plus fentanyl 2 µg/ml for postoperative epidural analgesia after Caesarean section, since it appears to have the advantage of higher patient satisfaction with statistically equal local anaesthetic consumption.

References

1. Pan PH. Post caesarean delivery pain management: multimodal approach. Int J Obst Anesth 2005; 15: 185-8.
2. Gadsden J, Hart S, Santos A. Post-Caesarean delivery analgesia. Anesth Analg 2005; 101: S62-9.
3. Vercauteren M, Vereecken K, La Malfa M, Coppejans H, Adriaensen H. Cost-effectiveness of analgesia after Caesarean section. A comparison of intrathecal morphine and epidural PCA. Acta Anesthesiol Scand 2002; 46: 85-9.
4. Parris-Piper T. Post caesarean delivery pain management: do not dismiss pethidine. Int J Obstet Anesth 2008; 17: 78-96.
5. Meister GC, D'Angelo R, Owen M, Nelson KE, Gaver R. A comparison of epidural analgesia with 0.125% ropivacaine with fentanyl versus 0.125% bupivacaine with fentanyl during labor. Anesth Analg 2000; 90: 632-7.
6. Halpern SH, Carvalho B. Patient-controlled epidural analgesia for labor. Anesth Analg 2009; 108: 921-8.
7. Scott DB, Lee A, Fagan D, Bowler GM, Bloomfield P, Lundh R. Acute toxicity of ropivacaine compared with that of bupivacaine. Anesth Analg 1989; 69: 563-9.
8. Fischer C, Blanie P, Jaouen E, Vayssiere C, Kaloul I, Coltat JC. Ropivacaine 0.1% plus sufentanil 0.5 microg/ml, versus bupivacaine 0.1% plus sufentanil 0.5 microg/ml using patient-controlled epidural analgesia for labor: a double blind comparison. Anesth Analg 2003; 96: 1173-7.
9. Matsota P, Markantonis S, Fousteri MZ, et al. Excretion of ropivacaine in breast milk during patient-controlled epidural analgesia after caesarean delivery. Reg Anesth Pain Med 2009; 34: 126-9.
10. Kostopanagiotou G, Matsota P, Batistaki C, Souliotis A, Pandazi A, Markantonis S. Ropivacaine plasma concentrations after thoracic epidural. Arch Med Sci 2008; 4: 300-4.
11. Hodgson PS, Liu SP. A comparison of ropivacaine with fentanyl to bupivacaine with fentanyl for postoperative patient controlled epidural analgesia. Anesth Analg 2001; 92: 1024-8.
12. Dernedde M, Stadler M, Bardiau F, Boogaerts JG. Comparison of 2 concentrations of levobupivacaine in postoperative patient-controlled epidural analgesia. J Clin Anesth 2005; 17: 531-6.
13. Dernedde M, Stadler M, Bardiau F, Seidel L, Boogaerts JG. Low vs high concentration of levobupivacaine for postoperative epidural analgesia: influence of mode of delivery. Acta Anaesthesiol Scand 2006; 50: 613-21.
14. Kopacz DJ, Sharrock NE, Allen HW. A comparison of levobupivacaine 0.125%, fentanyl 4 microg/ml or their combination for patient controlled epidural analgesia after orthopedic surgery. Anesth Analg 1999; 89: 1497-503.
15. Finucane BT, Ganapathy S, Carli F, et al. Prolonged epidural infusions of ropivacaine (2 mg/ml) after colonic surgery: the impact of adding fentanyl. Anesth Analg 2001; 92: 1276-85.
16. Scott DA, Blake D, Buckland M, et al. A comparison of epidural ropivacaine infusion alone and in combination with 1, 2, and 3 microg/ml fentanyl for seventy-two hours of postoperative analgesia after major abdominal surgery. Anesth Analg 1999; 88: 857-4.
17. Lim Y, Ocampo C, Supandjii M, Teoh W, Sia A. A randomized controlled trial of three patient controlled epirural analgesia regimens for labor. Anesth Analg 2008; 107: 1968-972.
18. Smet I, Vlamincki E, Vercauteren M. Randomized controlled trial of patient-controlled epidural analgesia

after orthopaedic surgery with sufentanil and ropivacaine 0.165% or levobupivacaine 0,125%. BJA 2007; 100: 99-103.
19. Berti A, Casati A, Fanelli G. 0.2% ropivacaine with or without fentanyl for patient controlled epidural analgesia after major abdominal surgery: a double blind study. J Clin Anesth 2000; 12: 292-7.
20. Polley LS, Columb MO, Naughton NN, Wagner DS, Van de Ven CJM, Goralski KH. Relative analgesic potencies of levobupivacaine and ropivacaine for epidural analgesia in labor. Anesthesiology 2003; 99: 1354-8.
21. Le Guen H, Roy D, Branger B, Ecoffey C. Comparison of fentanyl and sufentanil in combination with bupivacaine for patient-controlled epidural analgesia during labor. Anesth 2001; 13: 98-102.
22. Lilker S, Rofaeel A, Balki M, Carvalho JC. Comparison of fentanyl and sufentanil as adjuncts to bupivacaine fro labor epidural analgesia. J Clin Anesth 2009; 21: 108-12.
23. Buggy DJ, Hall NA, Shah J, Brown J, Williams J. Motor block during patient-controlled epidural analgesia with ropivacaine or ropivacaine/fentanyl after intrathecal bupivacaine for caesarean section. Br J Anaesth 2000; 85: 468-70.
24. Wang LZ, Chang XY, Liu X, Hu XX, Tang BL. Comparison of bupivacaine, ropivacaine and levobupivacaine with sufentanil for patient-controlled epidural analgesia during labor: a randomized clinical trial. Chin Med J 2010; 132: 178-83.