REDUCTION OF BUPIVACAINE DOSE IN SPINAL ANAESTHESIA FOR CAESAREAN SECTION MAY IMPROVE MATERNAL SATISFACTION BY REDUCING INCIDENCE OF LOW BLOOD PRESSURE EPISODES

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Abstract

Background: Spinal anaesthesia for caesarean section exposes to high incidence of arterial hypotension which can result in maternal and neonatal morbidity. We hypothesized that the reduction of this dose from 10 mg to 7.5 mg would minimize hypotension without altering pain relief.

Methods: In this double-blind prospective study, 80 ASA1 women scheduled for elective caesarean section were randomized into two groups A and B receiving respectively 10 and 7.5 mg of isobaric bupivacaine both with 25 μg of fentanyl and 100 μg of morphine in spinal anaesthesia. Intravenous ephedrine was administered for each episode of hypotension. We recorded sensory and motor block, intraoperative pain, nausea and vomiting. In postanaesthesia care unit, sensory and motor recoveries were measured and maternal satisfaction rate was assessed.

Results: In group A, a larger dose of ephedrine was needed (32±23 vs 19±16 mg; p=0.004). Incidence of sensory block above T4 (52 vs 10%; p<0.001), nausea (52 vs 22%; p = 0.005) and vomiting (25 vs 8%; p = 0.03) were all higher than in group B. Arterial hypotension was less frequent in group B (68 vs 88%; p = 0.03). The time required for recovery to T10 sensory level and motor regression were shorter than in group A (p <0.001) and the satisfaction rate was higher than in group A (excellent and good in 90% vs 67%; p = 0.03). There was no difference in pain relief.

Conclusion: A dose of 7.5 mg of isobaric bupivacaine reduced incidence of hypotension, nausea and vomiting and improved patient satisfaction.

Key Words: Caesarean delivery; Hypotension; Nausea; Regional anaesthesia; Spinal anaesthesia; Vomiting.

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Introduction

Spinal anaesthesia exposes patients scheduled for caesarean section (CS) to arterial hypotension more than any other anaesthesia technique. Hypotension has been reported in 55 to 100% of cases in various studies[1-6]. It can result in maternal morbidity (nausea, vomiting, dizziness, coma with aspiration risk) and can directly influence the neonate well being by reducing uteroplacental blood flow. The link between the extent of sympathetic block and the incidence of hypotension has led to numerous attempts at reducing the dose of local anaesthetics for CS[3-5,7-11] together with the addition of intrathecal opioids to maintain an adequate level of analgesia. Opioids act synergistically with local anaesthetics on the sensory block without increasing sympathetic block[12,13]. In spinal anaesthesia for CS, bupivacaine is the gold standard local anaesthetic used at a usual dose of ten mg. The lowest dose of bupivacaine necessary for CS has not been determined; the administration of excessively low doses of bupivacaine may decrease the incidence of low blood pressure episodes but also exposes to an increased risk of intraoperative pain[3,14,15].

In this study we hypothesized that the use of an intermediate dose of 7.5 mg of bupivacaine, in combination with opioids, would reduce the number of low blood pressure episodes, without altering pain relief.

Methods

This prospective double blind randomized study was carried out after the approval of the local Ethics Committee of our institution and after informed consent had been obtained from all parturients.

Patients included in the study were all ASA I, scheduled for elective CS. Parturients in active labor were not included.

In group A, women received 10 mg of isobaric bupivacaine 0.5% associated with 25 µg of fentanyl and 100 µg of morphine; the total volume was 2.6 ml. In group B, patients received 7.5 mg of the same bupivacaine solution, with identical doses of opioids and with the addition of saline to achieve the same final volume of 2.6 ml.

Standard monitoring was applied and all patients received an intravenous saline load of 15 $ml.kg^{-1}$ over 20 min before spinal injection. The latter was performed in sitting position with a 25 Gauge pencil-point needle at either the L3-L4 or L4-L5 interspace. The injections were performed at the rate of 1ml per 5 seconds. Afterwards, patients were placed in supine position with a wedge under the right hip. No preoperative sedation was used and no prophylactic ephedrine was given. An intraoperative infusion of 15 $ml\ kg^{-1}.h^{-1}$ of saline was maintained.

Arterial hypotension was defined as systolic blood pressure less than 95 mmHg and/or a decrease of more than 25% from the average baseline systolic blood pressure (3 measurements within 10 minutes before spinal puncture). Each episode of arterial hypotension was treated with six mg of ephedrine.

After the intrathecal injection, the blood pressure and heart rate were measured every minute for the first 15 minutes, then every 2 minutes until discharge from operating room. Level of sensory block was assessed using cold sensation (ether swabs) every 5 minutes. Motor block was assessed by the modified Bromage scale every 5 minutes. The definitions of the modified Bromage scale are: score 0: able to move hip, knee and ankle; score 1: unable to lift straight legs but able to flex knee and ankle; score 2: unable to flex knee but able to move ankle; score 3: unable to move hip, knee and ankle. Intraoperative pain was graded on a visual analog pain score (VAS) from 0 to 100 mm. No exteriorization of the uterus was observed during the study. The occurrence of nausea, vomiting and shivering was recorded. The Apgar score (first and fifth minute), the birth weight and the need for neonatal resuscitation were also recorded. In the post anaesthesia care unit, maternal satisfaction rate was recorded on a four point scale (from excellent to poor every 15 minutes until discharge). The cause of dissatisfaction was recorded (pain, nausea, vomiting, shivering). Times required for recovery to T10 sensory level and complete motor recovery were recorded.

Statistical Analysis

Using data from previous studies[1,16] in which a preload of 15 to 20 ml/kg had been used without addition of prophylactic ephedrine, the incidence of arterial hypotension was estimated at 80% with doses

of bupivacaine ≥10 mg. To show a reduction of the incidence of arterial hypotension in the 7.5 mg group to 45%, 34 patients in each group were required ($\alpha = 0.05$ and $\beta = 0.20$). Statistical analysis was carried out using the SPSS 10.0 software (SPSS Inc. 233 S. Wacker Drive Chicago, IL 60606). Chi square and Student's t test were used when appropriate; a value of $p < 0.05$ was considered significant. Data were expressed as mean ± SD, median [range], numbers of patients and percentages.

Results

Eighty consecutive ASA I patients scheduled for elective or semi urgent CS were included. Demographics data are presented in Table 1 and were similar between group A and B.

Table 1
Demographic Data

	Group A (n = 40)	Group B (n = 40)
Age, year	32 ± 5	33 ± 6
Weight, kg	77 ± 9	78 ± 10
Height, cm	158 ± 5	161 ± 6
Gravity	2 [1-6]	2 [1-5]
Parity	2 [1-6]	2 [1-4]
Gestation, weeks	38 ± 3	39 ± 2
Baseline SBP, mmHg	129 ± 14	124 ± 26
Baseline HR, beats/min	92 ± 11	91 ± 14
Duration of surgery, min	61 ± 17	66 ± 22
Birth weight, g	3269 ± 655	3333 ± 643
Premature neonates (n)	3	2

Values are given as mean ± SD except for gravity and parity given as median [range] and premature neonates given as number of patients. There were no significant differences between the two groups.
SBP = systolic blood pressure; HR = Heart rate.

Hemodynamic data are summarized in Table 2. The incidence of low blood pressure was markedly higher in the group A than in group B (88% vs 68%; $p = 0.03$) and the doses of ephedrine used were 30% larger in group A than in group B ($p = 0.004$).

Table 3 shows that the incidence of intraoperative pain tended to be higher in group B than in group A although the difference did not reach statistical significance (5 versus 2; $p = 0.24$). Table 3 also shows that intraoperative events such as nausea and vomiting were markedly lower in group B than in group A, while the incidence of shivering was very low and similar in both groups.

Table 3
Anesthetic Data

	Group A (n = 40)	Group B (n = 40)	*P*
Highest sensory level above T 4 (n)	21	4	<0.001
Maximum Bromage scale = 2 (n)	0	19	<0.001
Maximum Bromage scale = 3 (n)	40	18	<0.001
Patients with Bromage scale <3 (n)	0	22	<0.001
Intraoperative pain (VAS >30) (n)	2	5	NS
Intravenous fentanyl (n)	0	1	NS
Need for general anesthesia (n)	0	0	NS
Time to recovery of sensory block to T 10*, (min)	132 ± 26	108 ± 19	<0.001
Time to recovery of motor block*, (min)	136 ± 26	103 ± 21	<0.001
Nausea (n)	21	9	0,005
Vomiting (n)	10	3	0,03
Shivering (n)	2	1	NS

* Time of recovery of sensory level to T10 and time of total recovery of motor block are given as mean ± SD.
NS = not significant; VAS = visual analog pain score.

In the post-anaesthesia care unit, the overall satisfaction was better in group B than in group A: excellent-good-average-poor satisfaction (n): 20 – 16 – 3 – 1 vs 15 – 12 – 10 – 3 respectively; $p = 0.03$.

Table 2
Hemodynamic Variables

	Group A (n = 40) (10 mg bupivacaine)	Group B (n = 40) (7.5 mg bupivacaine)	*p*
Incidence of low BP episodes (%)	88 (73 – 96)*	68 (51 – 81)*	0.03
Number of IV bolus of ephedrine given	6 [0-15]	4 [0-10]	< 0.02
Total dose of IV ephedrine (mg)	32 ± 23	19 ±16	0.004
Dose of ephedrine ≥ 50 mg (n patients)	7	0	0,01

* 95% confidence interval.
The total dose of IV ephedrine is given as mean ± SD. The number of IV boluses of ephedrine is given as median [range]. BP = blood pressure; IV = intravenous.

Dissatisfaction (average and poor) of 13 patients in the group A was only due to nausea and/or vomiting while four parturients in group B expressed some dissatisfaction due to intraoperative pain (n = 2) and to nausea and/or vomiting (n = 2) (p = 0.03 when compared to group A).

Table 4 summarizes the effects of the spinal anaesthesia on the neonates. All the babies were live-born. No neonate required tracheal intubation and none died during the study. The baby whose mother had received intraoperative intravenous fentanyl, had 1' and 5' Apgar scores at 9 and 10 respectively.

Table 4
Neonatal data

	Group A (n = 40)	Group B (n = 40)
1'Apgar score < 8 (n)	3	4
5'Apgar score < 9 (n)	1	1
Resuscitated neonates *(n)	3	2

There were no significant differences between the two groups.
* All Resuscitated neonates were premature.

Discussion

The major finding of the present study is the lower incidence of arterial hypotension when the dose of bupivacaine was reduced from 10 to 7.5 mg in spinal anaesthesia for CS. In addition, reduction in bupivacaine spinal dose markedly reduced intraoperative nausea and vomiting while patient's satisfaction was improved.

The incidence of an upper level block above T4 was higher in group A (10 mg of bupivacaine) than in group B (7.5 mg of bupivacaine). Fifteen patients in group A (38%) had a T2 sensory level versus 4 patients in group B (10%). The sympathetic block generally spreads few segments higher than the sensory level[17]. The risk of severe arterial hypotension from cardiac sympathetic blockade is greater with sensory levels at or above T2. The risk of developing a total spinal block and respiratory muscle weakness also increases when the block spreads above this level[17].

Ben David et al. used the lowest dose of local anaesthetic for CS[3]. They compared 10 mg of isobaric bupivacaine to 5 mg of the same local anaesthetic with addition of 25 μg of fentanyl. The results of their study were impressive. The study group had a lower incidence of arterial hypotension than the control group (31% vs 94% respectively; p <0.001).

In an editorial, Finucane[15] described the problems that can result from the use of progressively smaller doses of local anaesthetic in the spinal anaesthesia for CS. High doses (15 mg or more of bupivacaine) can be complicated by total spinal anaesthesia, severe arterial hypotension and shock. Excessively small doses may result in spinal anaesthesia failure. Either situation may result in conversion to general anaesthesia.

The incidence of intraoperative pain tended to be higher in group B than in group A, but the difference between the groups was not significant. In group B only one patient needed an intravenous bolus of fentanyl at the end of intervention, with disappearance of pain. Four other patients in group B had brief and moderate pain (VAS <40) during extraction. Those patients had sensory level below T4.

In Ben David study[3], overall satisfaction rate was excellent in both groups. But authors describe eight patients from the 5 mg group (50%) who expressed brief and moderate intraoperative pain. This incidence of intraoperative pain is very high and unacceptable. In our study, the use of a dose of bupivacaine superior (7.5 mg) to Ben David study dose (5 mg) allowed to avoid this problem.

Choi et al[4] compared 6 groups of 20 parturients scheduled for CS. They received one of 3 different doses of hyperbaric bupivacaine (8, 10 and 12 mg) with or without 10 μg of intrathecal fentanyl. The incidence of intraoperative pain varied from 20% to 35% respectively in 10 mg and 8 mg groups without fentanyl and no pain in the other four groups. They showed that 12 mg of bupivacaine was equivalent to 8 mg when given with intrathecal fentanyl, with the advantage of reduced risk of sensory block above T1.

In our study reducing the dose of bupivacaine from 10 mg to 7.5 mg reduced the incidence of nausea by 57% and of vomiting by 70%. The arterial hypotension rate reduction as well as the sympathetic block reduction and its gastro-intestinal tract effects had probably played an important role[18].

Because of the distress caused by nausea and vomiting[19], such a result is a significant gain in comfort and reduction of complications of spinal anaesthesia.

The present study is the first study which confirms that patient's satisfaction in spinal anaesthesia for CS is related more to the nausea and vomiting than to the sensory level and pain.

In our study, all the patients in group A had complete motor block compared with 18 patients in group B (45%, $p < 0.001$) and block regression was faster in group B than in group A. This has been suggested to allow earlier mobilization and diminution in the postanaesthesia care unit length of stay[20].

Robson et al[2] showed that the effect of arterial hypotension on the neonate status is proportional to its degree. By reducing the doses of bupivacaine from 10 to 7.5 mg, we have been able to decrease the incidence of low blood pressure episodes, but have not shown any benefit for the neonate. The Apgar scoring system is specific but not very sensitive and fails to detect small fetal effects of maternal arterial hypotension[2,7,21,22].

In summary, our study showed that the reduction of isobaric 0.5% bupivacaine dose from 10 to 7.5 mg in spinal anaesthesia for CS, associated with 25 μg of fentanyl and 100 μg of morphine, markedly minimized the incidence of low blood pressure episodes without impairment in pain relief. In addition, it reduced intraoperative nausea and vomiting improving patient's satisfaction. The present study confirms that patient's satisfaction in spinal anaesthesia for CS is related more to the nausea and vomiting than to the sensory level and pain.

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