Original Research Article

Choice of either anaesthesia technique for caesarean section

Rajiv Kumar[1], Mahak Kakkar[2*], Ameeta Sahni[3]

[1]Post graduate student, Department of Anaesthesia, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

[2]Assistant Professor, Department of Anaesthesia, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

[3]Consultant and Professor, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

Received: 24-11-2021 / Revised: 28-12-2021 / Accepted: 10-01-2022

Abstract

Aim: To compare the hemodynamics and duration of analgesia using fractionated / bolus dose of bupivacaine with fentanyl for spinal anaesthesia (SA) in patients undergoing elective caesarean section (CS). **Method:** Comparative, interventional randomized study in tertiary care hospital in Delhi, India for a period of 12 months (1st January 2019 till 31st December 2019). 204 female antenatal patients of Indian origin between age 18 to 40 years were studied. Bolus group (Group B**)** patients received intrathecal injection of 0.5% hyperbaric bupivacaine with fentanyl (10mcg) as single bolus dose. Fractionated group (group F) patients received intrathecal injection of 0.5% hyperbaric bupivacaine with fentanyl (10 mcg) with an initial bolus equal to two-third of the calculated volume and remaining volume injected after 90 seconds. Both groups received doses according to Harten's chart. The groups were compared in terms of maternal hemodynamics, duration of analgesia, sensory and motor block level. **Results:** Group F patients were noted to have a better haemodynamic profile, both in terms of blood pressure ($p<0.001$) and heart rate, though not statistically significant ($p=0.08$). Time taken to reach sensory level T5 was higher in group F, while time taken for motor block was lower in group F ($p<0.05$). Time for providing rescue analgesia was lower in group B making duration of analgesia lower in bolus group ($p<0.05$). **Conclusions:** Fractionated dose of local anaesthesia in subarachnoid block can give better hemodynamic stability, produce quicker onset and later regression of both sensory and motor block along with prolonged duration of analgesia. **Trial Registration:** CTRI No. CTRI/2019/07/020121.

Keywords: Cesarean section, Local anesthetics (bolus/fractionated), Spinal Anaesthesia.

Introduction

Central neuraxial blockade is the preferred technique for caesarean section (CS). Spinal Anaesthesia (SA), irrespective of medication used, is now the safest and most popular method for caesarean section[1,2]. There are several advantages of using SA, such as - the simple technique involved, the ease of monitoring that is needed, and improvement in maternal and perinatal outcomes, should surely encourage its use in this context[3].

Maternal hypotension is an unwanted consequence of spinal anaesthesia for CS. It produces unpleasant symptoms such as nausea, vomiting, and light-headedness. It may also cause a decrease in uteroplacental blood flow and result in fetal acidosis[4,5]. It is mainly due to sympathetic blockade leading to peripheral vasodilatation and pooling of blood in dilated vascular bed with subsequent decrease of venous return and cardiac output. This problem is magnified in parturient who is liable to develop hypotension due to positional causes where in the supine position, the gravid uterus compresses the aorta and inferior vena cava against the vertebral bodies resulting in reduced volume returning from venous circulation, which may result in decreased maternal circulatory pressures leading to compromised utero placental perfusion[6].

While interventions such as colloids, ephedrine, phenylephrine or lower leg compression have been used to decrease the incidence of maternal hypotension, none of them are able to eliminate the need to treat maternal hypotension in this setting[6-9].

Low dose of spinal bupivacaine resulted in a lower incidence of hypotension, higher predelivery mean arterial pressure (MAP) and decreased use of vasopressors in patients undergoing CS[10,11].

But lower doses may reduce the quality of block and cause breakthrough pain[12].

Addition of fentanyl allows successful use of a lower dose of bupivacaine. Other factors that may contribute to the adequacy of the block include an increased sensitivity to local anesthetics seen during pregnancy and enhanced spread of subarachnoid local anaesthetic (LA)[13].

From the neonatal viewpoint, SA helps avoid the neonatal sedative effects of general anaesthesia. If there is no immediate hurry, choice of spinal anesthesia is more attractive, particularly now that safety of this technique is enhanced by the use of intrathecal opioids and less toxic local anaesthetic drugs[5].

Bolus dose of the local anaesthetic agent used in SA has been reported to cause hypotension, probably as a result of enhanced cranial spread of the drug. Certain studies report better haemodynamic stability using a fractionated dose technique, though a fixed dose was calculated using height as the variable[14-19]. The aim of our study was to compare haemodynamic stability and duration of analgesia in patients undergoing elective lower segment caesarean section (LSCS) using fractionated dose versus bolus dose of intrathecal drug, where the total dose of bupivacaine was calculated according to the height and weight of the patient.

Material and Methods

Ethics approval of this study was taken by the ethical committee of concerned hospital on 6th October 2018.

The study was a parallel randomized controlled trial conducted at the Department of Anaesthesiology and Intensive Care, over a period of one year (1st January till 31st December 2019) after due clearance from the hospital ethics committee and enrolment with the trial

*Correspondence
Dr. Mahak Kakkar
Assistant Professor, Department of Anaesthesia, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India.

registry with CTRI number CTRI/2019/07/020121. Written informed consent was obtained from all patients.

Patients fulfilling American Society of Anesthesiologists (ASA) grade 1 & 2, scheduled for elective caesarean section, weighing between 50 to 110 kg and height between 140 cm to 180 cm, with a singleton pregnancy ≥ 37 weeks were included.

Exclusion criteria included inability of the patient to understand the procedure, contraindications to anaesthetic technique, patient refusal, local infection, coagulation abnormalities, history of allergic reaction to any of the drug to be used, sepsis, shock, spinal deformities, previous spinal surgeries, neurological disturbances, cardiac failure, pre-existing or Pregnancy Induced Hypertension and Emergency Caesarean for foetal distress.

Patients were allocated into two groups, Group B or the Bolus group, and Group F or the Fractionated group, according to sealed envelope technique by authors.

The dose of hyperbaric bupivacaine 0.5% (Anawin; Neon) was calculated according to the Harten's chart taking into consideration height and weight of the patient.

In the operation theatre, baseline parameters like heart rate (HR), systemic blood pressure (SBP) and SpO_2 were noted. Intravenous access was secured with 18 G IV cannula in the non-dominant hand and co-loading was started with Ringer's lactate @10ml/kg over 15 minutes. Inj. ranitidine 50mg and inj. metoclopramide 10 mg were added to the IV fluid. Oxygen was administered at a flow rate of 3 liters per minute through nasal prongs.

Patients were placed in sitting position. Under aseptic precautions, and after infiltrating the desired interspace (L3-4) with 1 % lignocaine (LOX; Neon), 25 G Quincke's spinal needle was inserted in the midline with bevel facing upwards. After confirming free flow of clear CSF, the study drug bupivacaine with fentanyl was injected. In group B**,** the full dose of the drug was injected at 0.2 m/ s and patient was kept in sitting position for 90 seconds. In group F**,** two-thirds of the drug was injected at 0.2 ml/s while the remaining one-third after 90 seconds at same speed. Patient was placed supine, giving a left lateral tilt with a folded gown acting as a wedge beneath the right pelvic region.

Time of Intrathecal injection (T0) was noted. Vital parameters (SBP, SPO_2 and HR) were monitored every 2 minutes interval till 15 minutes and then every 5 minutes, till the end of surgery. Hypotension was defined as fall of SBP below 90 mmHg or 20% below the baseline value (whichever is lower), and was treated with injection mephentermine 5 mg given IV and repeated as and when needed. Bradycardia was noted when HR fell below 50 per min. Atropine sulphate 0.6mg i.v. was given for its rescue.

Time of onset of sensory block at T5 was noted and the surgeon was allowed to start the surgery at this point. 10 degrees head down tilt was given wherever the level was not achieved after 10 minutes of the block. The time of skin incision, uterine incision and the delivery of the baby was noted.

Inj. Oxytocin (Pitocin; Pfizer) (2 units i.v. bolus with 10 units in one vac ringer's lactate slow infusion) was given immediately after the delivery of the baby (11). APGAR score at 1 and 5 minutes was used for early neonatal assessment.

Sensory blockade was graded according to Gormley and Hill, 1996. Time for sensory blockade to regress two segments was noted. Motor block was assessed by Bromage Scale before and after the surgery.

Intra-operative pain was assessed with Visual Analogue Scale 0-10, using inj. Ketamine 0.5mg/kg as recue analgesia. Post operatively, pain was assessed for 6 hours.

Data was collected, tabulated, coded then analysed using SPSS® computer software version 20.0. Numerical variables were presented as mean & standard deviation (SD) while categorical variables were presented as frequency and percent. In case of numerical variables, Z-test/ Mann-Whitney Test was used wherever appropriate for between-groups comparisons; while for categorical variables, chi – square test or Fisher exact test or analysis of variance were used instead. A difference with significant level <0.05 was considered statistically significant and $P < 0.0001$ as highly significant.

Results

The subjects in the study had ages ranging from 18 to 40 years divided into 102 patients in each group. The patients in group B had a mean age of 27.23 ± 4.46 years while patients in group F had a mean age of 26.58 ± 4.6 years. The mean weight of patients in group B was 66.27 ± 7.16 kilograms while mean weight of patients in group F was 65.89 ± 7.63 kilograms. The mean height of patients in group B was 150.80 ± 5.16 centimetres while mean height of patients in group F was 152.0 ± 4.9 centimetres. The data was comparable in both the groups (**Table 1**) as no significant difference was found between the groups in the demographic variables.

Also, distribution of cases in groups according to American Society of Anesthesiologist grading showed that the data was neither statistically nor clinically significant with a p-value of more than 0.05 in between the two groups.

Duration of surgery was comparable in both the groups i.e., 59.41 ± 6.15 minutes and 59.06 ± 6.59 minutes in group B and F respectively. This data was neither statistically nor clinically significant with a p-value of more than 0.05.

Table1: Comparison of demographic distribution of antenatal patients in randomized controlled trial /Table 2: Comparison of adverse effects in both groups

	Bradycardia	Hypotension	Pain	Nausea	Vomiting	Shivering	Pruritus
Group B	3 (2.94%)	41(40.19%)	0	1	2	3	0
Group F	0	19(18.62%)	0	1	1	3	0
p value	0.08	**<0.001**	-	-	0.563	-	-

Table 2 shows the comparison of occurrence various adverse events between both study groups. Patients receiving fractionated injection of the drug were noted to have a better haemodynamic profile both in terms of blood pressure and heart rate. 41 patients in bolus group (Group B) and 19 patients in fractionated group (Group F) developed hypotension at different points of time during the intraoperative period which was statistically significant (p value <0.001). Although three patients in group B had an episode of intraoperative bradycardia and none of the patients in group F developed bradycardia, this was statistically insignificant (p value of 0.08).

One patient in each group complained of nausea while two patients in group B and one patient in group F complained of vomiting. Three patients in each group developed shivering while none of the patients in both groups complained of pruritus.

Time taken for sensory block to reach T5 level was higher in group F (8.17 ± 0.66 mins) as compared to group B (7.89 ± 0.50 mins). This difference was statistically significant with a p-value of <0.05 (**Table 3**).

Table 3: Comparison of time taken to reach T5 sensory level and motor blockade (MEAN ± S.D) in both groups

Parameter	T5 Sensory Level (mins)	Motor Blockade (mins)
Group B	6.89 ± 0.50	6.90 ± 1.14
Group F	7.17 ± 0.66	5.94 ± 0.98
p-value	p<0.001	p<0.001

Table 4: Comparison of time taken for two segment regression of sensory blockade in both groups

Group	Time (min)	p-value
Group B	95.09 ± 10.07	**p<0.001**
Group F	101.67 ± 7.01	

The mean time to reach maximum motor blockade was slightly lower in group F (5.94 ± 0.98 mins) as compared to group B (6.90 ± 1.14 mins). this difference was statistically significant with a p value < 0.001) (**Table 3**).

Number of cases where head tilt was required to make the sensory block reach a level of T5 dermatome. 7 patients in Group B and 6 patients in group F required 10° head tilt. This was comparable in both the groups with a p value of 0.150.

In the comparison of time taken for regression of sensory blockade by 2 segments (**Table 4**), sensory blockade regressed faster in group B (95.09 ± 10.07 mins) as compared to group F (101.67 ± 7.01 mins). This was statistically significant with a p value of <0.001. Patients in group F asked for rescue analgesia after a longer duration of time as compared to patients in group B (274.34 ± 24.94 mins vs 231.50 ± 26.74 mins). This was statistically significant with a p value <0.001 (**Figure 1**).

The APGAR scores were comparable between the groups both at 1 minute and 5 minutes.

Discussion

The choice of either anaesthesia technique for caesarean section, whether general or neuro-axial anaesthesia, has its own inherent pros and cons. Regional anaesthesia is associated with the least maternal morbidity and it also reduces neonatal exposure to potentially harmful drugs. Also, it allows the mother to enjoy birthing experience. But on the other hand, there is an increased potential of maternal hypotension and high spinal block when doses of bupivacaine are not adjusted according to height and weight[14].

Most studies when comparing the two techniques, bolus dose versus fractionated dose, have used only height as consideration to calculate the fixed dosage of drug[14-19], which has been shown to be usually higher than when calculated using Harten's chart[20]. There has been a documented evidence that doses adjusted according to height and weight of the patient lead to lesser complications and a more successful block[20-21].

In our research, we studied the combined effect of dose adjustment according to height and weight of the patient and also fractionating the dose into two third and one third, which also has been advocated to provide a safer haemodynamic and analgesic profile[14-15].

While hypotension was significantly higher in patients administered bolus dose and required vasopressors than in fractionated group, episodes of bradycardia were also experienced only in patients of bolus group (n=3), though clinically non-significant in comparison to fractionated group (n=0). Badheka et al [14] also reported similar findings with five patients (16.66%) in Group F and 14 patients (46.66%) in Group B requiring vasopressors (p = 0.013). Khare et al also reported that 4 patients (13.33%) in Group F and 13 patients (43.33%) in Group B required vasopressors (p<0.05)[16]. These findings are in accordance with the findings of Patel et al[15] who reported that four patients (13.33%) in Group F and 11 patients (36.66%) in Group B required vasopressor (p = 0.03). These authors also reported no episodes of bradycardia in fractionated group, similar to our study[14-17].

We discovered that time taken for sensory block to reach T5 level was higher in fractionated group patients, while these patients achieved faster motor blockade till T5. This statistically significant findings are also confirmed by other studies. Patel B reported longer time to reach peak sensory block in group F (6.63 ± 0.72 mins) as compared to group B (5.53 ± 0.71 mins.), with highly significant p value of <0.001 (15). They also reported longer time for motor blockade in group B (5.36 ± 0.79 mins) vs Group F (4.55 ± 0.52) (p<0.001). Badheka JP et al [14] also reported a longer time duration for achieving peak sensory blockade (6.26±1.25 mins in group F vs. 5.67±1.72 in group B), however, not statistically significant with a p value of 0.08. They described a lower time for motor blockade in group F (4.766±1.074 mins.) as compared to group B (5.867±1.13 mins) (p<0.001). Only one study states that both sensory and motor block till T5 were reached later in fractionated group[18].

Although no study provides a definite reason for these results, we hypothesize that effect of fractionated dosage of drug administration works by slowing down the currents within the CSF. It has been reported by Hocking et al[22] that initially the local anaesthetic spreads by CSF displacement. The interplay between densities of CSF and drug, depending on patient position, lead to level of anaesthesia being reached. By giving a lower initial drug dose in fractionated technique, these currents are reduced compared with bolus dosage given at once. The heavier drug settles inferiorly, while the next part of the drug provides lesser currents in upper spinal canal effectively by only displacing the previously settled drug. This leads to better controlled level of anaesthesia and prevention of a high spinal block.

Sensory blockade usually occurs faster in bolus group as sensory nerves are more sensitive to lower concentrations of local anaesthetic agents. Motor nerves that require higher drug concentration for onset of anaesthesia, get blocked faster in fractionated group. This suggests that lesser fluid currents lead to early settlement of drug achieving a faster drug concentration and hence, earlier motor block.

Time for two segment regression of block was later in fractionated group. Also, time was rescue analgesia was later in fractionated group. These are corroborated by various authors[14-16, 18]. This suggests that block by fractionated technique is more stable and lasts relatively longer.

We thus conclude from our study that fractionating the dose of local anaesthetic can be used to provide a safer alternative to single bolus dose of local anaesthetic in spinal anaesthesia. It can do this by providing prolonged duration of analgesia, producing a quicker onset and delayed regression of sensory and motor block along with circulatory stability and minimal requirement of vasopressors.

References

1. Turkmen A, Moralar DG, Ali A, Altan A. Comparison of the anesthetic effects of intrathecal levobupivacaine+fentanyl and bupivacaine+fentanyl during caesarean section. Middle East J Anaesthesiol 2012;21:577-82.
2. Havas F, Orhan Sungur M, Yenigün Y, Karadeniz M, Kiliç M, Özkan Seyhan T. Spinal anesthesia for elective cesarean section is associated with shorter hospital stay compared to general anesthesia. Agri 2013;25:55-63.
3. Fenton PM, Whitty CJM, Reynolds F. Caesarean section in Malawi: prospective study of maternal and perinatal mortality. British Medical Journal 2003; 327: 587–91.
4. Ngan Kee WD, Lee A. Multivariate analysis of factors associated with umbilical arterial pH and standard base excess after Cesarean section under spinal anaesthesia. Anaesthesia 2003;58:125-30.
5. Reynolds F, Seed PT. Anaesthesia for Cesarean section and neonatal acid-base status: A meta-analysis. Anaesthesia 2005;60:636-53.
6. Cyna AM, Andrew M, Emmett RS, Middleton P, Simmons SW. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. Cochrane Database Syst Rev 2006;(4):CD002251.
7. Ngan Kee WD, Khaw KS. Vasopressors in obstetrics: What should we be using? Curr Opin Anaesthesiol 2006;19:238-43.
8. Wilkinson C, Enkin MW. Lateral tilt for Caesarean section (Cochrane Review). In: Cochrane Database Syst Rev. 2006; (3):CD000120.

9. Van Bogaert LJ. Prevention of post-spinal hypotension at elective cesarean section by wrapping of the lower limbs. Int J Gynecol Obstet 1998;61:233-8.
10. Jain K, Makkar JK, Anbarasan I, Yadanappudi S, Gander S. A randomized double-blind comparison of low-dose and high-dose bupivacaine for caesarean section in severely preeclamptic women using invasive blood pressure monitoring. J Obstet Anaesth Crit Care 2013;3:84-90.
11. Xiao F, Xu WP, Zhang XM, Zhang YF, Wang LZ, Chen XZ. ED 50 and ED 95 of Intrathecal Bupivacaine Coadministered with Sufentanil for Cesarean Delivery Under Combined Spinal-epidural in Severely Preeclamptic Patients. Chin Med J 2015;128:285-90.
12. Roofthooft E, Van de Velde M. Low-dose spinal anaesthesia for caesarean section to prevent spinal-induced hypotension. Curr Opin Anaesthesiol 2008;21:259-62.
13. Birbbach DJ, Browne IM. Anesthesia of Obstretics In: Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL et al. editors. Miller's Anesthesia. 7th ed. USA: Churchill-Livingston Elsevier; 2010:2203-40.
14. Badheka J P, Oza V P, Vyas A,Baria D, Nehra P, Babu T. comparison of fractionated dose versus bolus dose in spinal anaesthesia for patients undergoing elective caesarean section: A randomized, double - blind study. Ind. J. Anaesth. 2018, 61: 55-9.
15. Patel BB, Patel PD et al., Comparison of fractionated versus bolus dose of bupivacaine in spinal anaesthesia for patients with PIH undergoing elective caesarean section. IJAR 2018;8(2):6759.
16. Khare D, Nema N. Comparison of bolus dose versus fractionated dose of injection bupivacaine heavy (0.5%) in spinal anaesthesia for patients undergoing emergency caesarean section: a randomised study.GJRA 2019;8(6):2277.
17. Fahmy NR. Circulatory and anaesthetic effects of bupivacaine for spinal anaesthesia fractionated vs. bolus administration. Anaesthesiology 1996;3:85.
18. Ramasali Manjula V., Vankaylapatti Sarada Devi, Appagalla Swathi et al. A Prospective Randomised Double Blind Comparative Study of Bolus versus Fractionated Dose Injection in Spinal Anaesthesia for Pregnant Women undergoingelective Caesarean Section. Indian J Anesth Analg. 2018;5(11):184045.
19. Gandhi M, Kabir KK, Arora KK, Tiwari K. Comparative study between fractionated and single bolus dose of local anaesthetic in elective lower segment caeserean section. Indian J Clin Anaesth 2019;6(3):386-90.
20. Harten JM, Boyne I, Hannah P, Varveris D, Brown A. Effects of a height and weight adjusted dose of local anaesthetic for spinal anaesthesia for elective caesarean section. Anaesthesia 2005;60:348-53.
21. McCulloch WJ, Littlewood DG. Influence of obesity on spinal analgesia with isobaric 0.5% bupivacaine. Br J Anaesth 1986;58:610-4.
22. Hocking G, Wildsmith JAW. Intrathecal drug spread. Br J Anaesth 2004;93(4):568-78.

Conflict of Interest: Nil Source of support: Nil