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Original Research Article

Comparative evaluation of subarachnoid block with conventional dose Bupivacaine versus low dose Bupivacaine and Fentanyl for Caesarean Section - A RCT study

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Abstract

Background: Subarachnoid block (SAB) is the preferred anesthetic technique for elective caesarean deliveries. Local anaesthesia (LA) dose is the main determinant of its success. Anesthesia textbooks recommend bupivacaine in a dose of 11 to 15 mg; this is associated with incidence of maternal arterial hypotension resulting in maternal and neonatal morbidity. The goal of present study was to compare the intraoperative hemodynamics and vasopressors requirement using a low dose bupivacaine-fentanyl (5mg bupivacaine + 25 mcg fentanyl) in combined spinal–epidural technique (CSE) to a conventional dose of spinal bupivacaine (11mg) for parturient undergoing cesarean section.
Methods: A prospective, randomized controlled trial enrolled sixty patients, who scheduled for elective caesarean sections and were randomized in two equal groups to receive either low dose in CSE (Study group) or conventional dose via SAB (Control group). MAP, pulse rate, requirement of Inj. ephedrine, time of onset of analgesia, highest level of SAB, requirement of additional IV analgesic, APGAR scores, conversion to GA and bromage score were noted.
Results: Demographic variables and baseline parameters were comparable. Incidence of intraoperative hypotension in study and control group was 7 and 25 respectively with P-value < 0.0001. Mean intra-operative ephedrine required for hypotension in study and control group was 7 and 11.14 mg respectively with P-value 0.1331.
Conclusion: Low dose bupivacaine-fentanyl spinal anesthetic in CSE technique had lesser incidence of hypotension and lower requirement of vasopressors compared to conventional dose of spinal bupivacaine. It also had quicker onset of action.
Keywords: Subarachnoid block, Bupivacaine, Fentanyl, Spinal–epidural technique, Ephedrine.

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1. Introduction

Spinal anaesthesia (SA) is the preferred anaesthetic technique for elective caesarean deliveries. The incidence of hypotension during SA for caesarean section is reported to be as high as 80%.[1,2] In anaesthesia practice, prevention and management of hypotension related to SA remains a difficult problem. An approach to decrease incidence of hypotension has been to minimize dose of local anaesthetic used.[3] Anesthesia textbooks recommend bupivacaine in a dose of 11 to 15 mg; this is associated with incidence of maternal arterial hypotension resulting in maternal and neonatal morbidity. This is avoided by use of CSE technique.

2. Materials and Methods

After obtaining Institutional Ethical Committee approval, this hospital based, prospective, randomized control trial was carried out in 60 patients with singleton uncomplicated pregnancy of gestational age >36 weeks, of ASA status I-II, height 150-170 cm and BMI up to 26,

posted for elective caesarean section over a period of 2 years. Patient with severe pre-eclampsia, with coagulation abnormalities or on therapeutic anticoagulants, those having kyphoscoliosis, pre-existing neurological deficit, any infection at site of injection or altered mental status, known allergies to medications used in the study and patients not willing for procedure were excluded from the study. After thorough preoperative evaluation a written informed consent was obtained from the patients. Patients were divided by systematic randomization into two groups: Low Dose i.e. LD (Study group): receiving 5mg bupivacaine + 25 mcg fentanyl as spinal anaesthetic in CSE technique and Conventional Dose i.e. CD (Control group): receiving 11 mg (2.2ml) spinal bupivacaine.

In the operation theater fasting status of patients was confirmed and patients were attached to a multichannel monitor for SpO_2, ECG, $ETCO_2$ and NIBP. 4L/min oxygen was supplied by Hudson's mask. Intravenous line was established with a 20G cannula. Co-loading was done with ringer lactate 500ml and antacid prophylaxis was given with Inj. Ranitidine 1mg/kg IV and inj. Ondansetron 0.1mg/kg IV 30min prior to the procedure. Basal values for BP, pulse rate and SpO_2 were noted. Anaesthesia procedure was done under all aseptic precautions and patient in left lateral position. For LD group, 18G epidural catheter was inserted at L2-L3 or in L1- L2 with 4-5 cm inside epidural space followed by SAB with 23 G Quincke's needle using 1 ml bupivacaine + 25 micrograms fentanyl in a lower space preferably L3-L4. In CD group, only SAB was given using 2.2 ml bupivacaine in L3-L4 space. Patient was made supine, with wedge below right buttock. Head low tilt of 15 degree was given. In both groups onset of block was assessed by pinprick sensation every minute till same reading was observed thrice. Vital parameters like BP, heart rate and SpO_2 were recorded every 2 min for the first 10 min and thereafter every 5 min intraoperatively. Surgery was allowed to start when block reached level of T6. In LD group Test Dose with 3 ml Lignocaine-Adrenalin 2% was planned if level failed to reach T6 and then supplemented with 0.5% Bupivacaine in incremental dose of 2ml for adequate blockade. If the block did not reach T10 level it was considered a failure.

Intravenous analgesics as rescue were to be supplemented as under – In LD group- Increments of 25 mcg Fentanyl IV till maximum dose of 100 micrograms was planned, if patient complained of pain after activation of epidural catheter and achievement of T6 level by CSE. In CD group- If the block failed to reach dermatomal level of T6, a repeat spinal anaesthesia / general anaesthesia would be given and the case would be considered to be a failure of technique. Increments of 25 mcg Fentanyl IV till maximum dose of 100 mcg was planned if pt complained of pain after achievement of T6 level. If analgesia was still inadequate it was planned to convert to General Anaesthesia.

After surgery patient was shifted to PACU and continued to be monitored until effects of SAB had worn off and then in LD group epidural catheter was used for postoperative analgesia. I.V. fluids were given as per anaesthetist discretion. Bradycardia defined as HR<60/min was corrected with Inj. Atropine 0.6mg and hypotension defined as MAP less than 20% of the baseline values was corrected with Inj. Ephedrine 6mg in incremental doses. Time of onset of analgesia, highest peak level of SA, Degree of motor block was assessed every 2 minutes for first 10 minutes and later every 5 minutes till the end of surgery, by Bromage scale.[4]

Intraoperative dose of IV ephedrine, atropine and fentanyl required, APGAR score after 1 and 5 minute after birth, failure of procedure and side-effects such as nausea, vomiting, pruritus and shivering were noted. The demographic characteristics and clinical parameters were compared using Chi-square test and t-test of independent samples respectively. Difference in the means of above parameters between groups was also evaluated for statistical significance at different time points after SAB, using t-test for independent samples. Time to achieve T6 level was compared using t-test. Incidences of hypotension i.e. fall in MAP <60 and difference in its occurrence was evaluated using Pearson's Chi-square test. Frequency distribution for hypotension episodes were studied using Fisher's exact test. Mean Ephedrine dose requirement was obtained using t-test for independent samples. The difference in the number of doses required in two groups was evaluated for significance using Wilcoxon rank sum test. Bromage score between two groups at different time points after surgery was compared for statistical significance using Wilcoxon rank sum test. Entire analysis was performed using R-3.0.0 programming language with prevalidated scripts. The level of significance was fixed at 5% throughout the analysis.

3. Results

The demographic data of the patients and baseline parameters like heart rate, systolic and mean arterial pressure (MAP) and SpO_2 were comparable in two groups as shown in table 1.

Table 1: Demographic data and baseline parameters of two groups

Variables	LD (n = 30)	CD (n = 30)	P value
Age	26.13±3.25	25.93±3.98	0.818(NS)
BMI	22.28±2.31	23.11±1.94	0.380(NS)
MAP	88.83±11.86	90.13±9.71	0.644(NS)
Pulse rate (/min)	92.53±14.07	94±14.88	0.696(NS)

The mean time achieves T6 level in conventional dose group was higher (4:36 min) than low dose group (3:10 min) and difference was statistical significant with p-value 0.004 (Table 2).

Table 2: Descriptive statistics for time to achieve T6 level in two groups

Time to achieve T6 level	LD	CD	P value
Mean ± SD (in min)	3:10±1:20	4:36±2:34	0.004 (S)
Median (in min)	3:00	4:00	
Range (in min)	1:00-6:00	2:00-12:00	

Mean MAP and mean pulse rate (per min) was analyzed between two groups at different time points were insignificant as indicated by P-values greater than 0.05 as shown in figure 1 and 2 respectively.

Figure 1: Line chart showing the mean MAP with time in two study groups

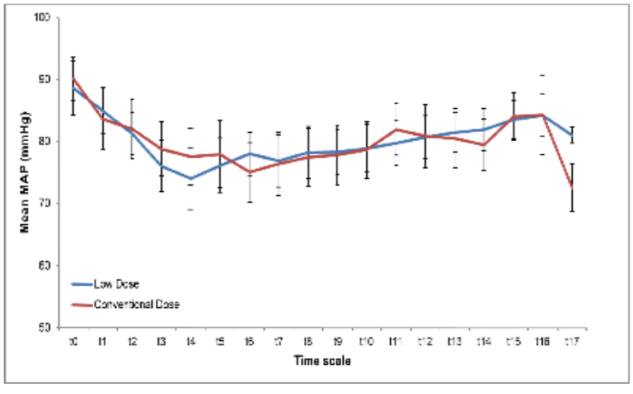
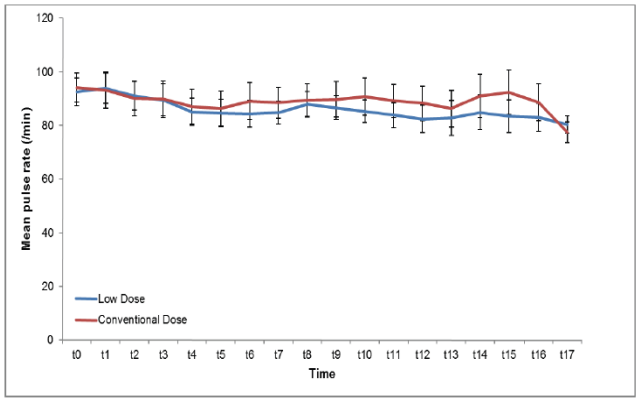


Figure 2: Line chart showing the mean pulse rate with time in two groups



The proportions of patients with incidence of hypotension was maximum i.e. 25 (83.33%) in conventional group as compared to low dose group with only 7 (23.33%) patients. Overall, difference in the incidence of hypotension between groups was statistically significant (P value <0.0001). Table 3 show the frequency distribution for hypotension episodes in two groups.

Table 3: Frequency distribution for hypotension episodes in two groups

Groups	No. of hypotension episodes			Total
	1	2	>3	
Study	5	1	0	6
Control	9	2	3	14
Total	14	3	3	20

P-value: 0.6126 using Fisher's exact test

The difference in mean Ephedrine dose between LD and CD group was 7 mg and 11.14 mg respectively and was evaluated using t-test for independent samples, which was statistically insignificant (P=0.133). Table 4 provides the median value of bromage scores and its comparison at each time point between two groups. Initially, till time point t1, the difference in the bromage score was statistically insignificant as revealed by P-value 0.897. Subsequently, the difference between two scores was statistically significant as indicated by p-values < 0.05. There was no difference in neonatal Apgar scores in both the groups at 1 min and 5 min after birth.

Table 4: Bromage score with time

Time	LD	CD	P value*
t0	4	4	(NS)
t1	3	3	0.897 (NS)
t2	3	3	0.022 (S)
t3	3	3	<0.0001 (S)
t4	3	2	
t5	3	2	
t6	2.5	2	
t7	2	1	
t8	2	1	
t9	2	1	
t10	2	1	
t11	2	1	
t12	2	1	
t13	2	1	
t14	2	1	0.0012 (S)
t15	3	1	0.0019 (S)
t16	2.5	1	0.026 (S)
t17	2	1	0.0357 (S)

Median; *Obtained using Wilcoxon rank sum tests, S: Significant; NS: Non-Significant

4. Discussion

Obstetric anaesthetist faces unique situation of providing anaesthesia for caesarean section and caring for both mother and unborn baby. Numerous factors determine the type of anaesthesia chosen for caesarean section including but not limiting to the urgency, indication of the operation, maternal preference and any coexisting medical problems. Maternal risk increases substantially when general anaesthesia is administered for caesarean section. Most of the deaths occurring during general anaesthesia are airway or aspiration related.[5] This has increased popularity of spinal and epidural anaesthesia in surgical obstetric practice. Spinal anaesthesia is simple to institute, rapid in onset and produces excellent surgical anaesthesia. However, it has various limitations including fixed duration of anaesthesia, lesser control of block height, post-dural puncture headache and hypotension.[6,7]

Hypotension is associated with maternal morbidity including nausea, vomiting, dizziness and influences the neonatal well-being by reducing utero-placental blood flow.[8] Treatment strategies for hypotension include left

uterine displacement, head-down tilt, I.V fluids with comma, ephedrine boluses and lowering the dose of LA agent which improves maternal haemodynamic stability. This has led to attempts at reducing the dose of LA agents. Addition of opioids to local anaesthetics in SAB has synergistic action on the sensory block without increasing sympathetic block for caesarean section.[9] The combination makes it possible to achieve spinal anaesthesia with otherwise inadequate doses of local anaesthetic.[4] Previous studies have shown a more favorable haemodynamic profile in patients when decreased dose of LA was used.[10-12] Thus, by using a low dose of local anaesthetic in combination with fentanyl it may be possible to achieve spinal anaesthesia with less hypotension.

In present study, drug given in LD group was 1 ml 0.5% heavy bupivacaine (5mg bupivacaine in 8% dextrose) mixed with 0.5 ml fentanyl and *no* saline. The final glucose concentration in the drug administered in LD group could be calculated as - 80 ÷ 1.5 = 53.333 mg /cc i.e. 5.33% which was similar to the heavy bupivacaine (Bh) group in study by Gunaydin B *et al*[13] So, the baricity of current study drug can be assumed to be comparable to baricity of group Bh in above study[13] that was 1.0179. Solutions with a baricity of 1.0015 can be expected to reliably behave hyperbaricaly[14] and hence the present study can assume that solution administered intrathecaly in group LD was hyperbaric. Increasing the dose and volume of hyperbaric 0.5% bupivacaine does not increase the block height when doses between 10mg and 20 mg are used. However, dose of hyperbaric 0.5% bupivacaine < 10mg have been shown to result in blocks that are approximately two and one half dermatomes lower than those achieved with doses >10mg. In current study, the dose of bupivacaine was reduced from 11mg to 5mg and inj. fentanyl 25 mcg was added to assess the hemodynamic during caesarean section deliveries.

The onset of sensory block till T6 was significantly quicker in LD group as compared to CD group ($P < 0.004$) and it concurs with study done by Venkata *et al*[15] The incidences of hypotension were significantly more in CD group ($P < 0.0001$) compared to LD group. Also, LD group showed lower incidence of multiple episodes of hypotension and none of the patient had >3 episodes of hypotension in contrast to CD group. Thus, CD group had multiple episode of hypotension persistently. Similar findings were observed by Ben-David *et al* [3] and Seyedhejazi and Madarek.[16]

The mean dose of ephedrine required in the CD group was more as compared to LD group (11.14 mg vs 7 mg). However, this difference did not reach statistical significance. These findings were consistent with the previous studies.[16,17] There were no incidences of bradycardia, nausea and vomiting in either group. None of the patients in either group had an episode of desaturation or dyspnoea. There was no difference in neonatal Apgar scores in both the groups. Duration and intensity of motor blockade was significantly less in group LD than in group CD at time points after 2 min of spinal anaesthesia and at the end of surgery. Surgeon's satisfaction with relaxation was comparable in both groups. None of the patient in LD group required epidural activation and there was no failure. Gurbet *et al*[18] found that intrathecal bupivacaine 2.5 mg and Inj. fentanyl 25 mcg resulted in a block height till T8 in adult non-pregnant patients. In current study, the dose in LD group was more by 0.5 ml and patients were full term. Present study was conducted on ASA physical status I and II patients and hence it may not be extrapolated directly to high risk cases belonging to ASA III and IV or patients with PIH. In LD group 6 of 30 patients did have incidence of hypotension. Studies are needed to find out if the dose of bupivacaine can be further reduced for caesarean sections.

5. Conclusion

From the results of present study, it may be concluded that 5 mg of 0.5 % hyperbaric bupivacaine with 25 mcg fentanyl had better hemodynamic stability as compared to conventional dose with lesser requirement of vasopressors. It is associated with quicker onset, lesser motor blockade and adequate surgical relaxation.

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